RESEARCH IN COMPETENCE-BASED MANAGEMENT
VOLUME 2

A Focused Issue on
MANAGING KNOWLEDGE ASSETS AND ORGANIZATIONAL LEARNING

RON SANCHEZ
AIMÉ HEENE
Editors

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RESEARCH IN COMPETENCE-BASED MANAGEMENT

Series Editors: Ron Sanchez and Aimé Heene

Volume 1: A Focused Issue on the Marketing Process in Organizational Competence
Edited by Ron Sanchez and Jörg Freiling

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EDITED BY

RON SANCHEZ

Professor of Management, Copenhagen Business School, Denmark
and
Lindén Visiting Professor in Industrial Analysis,
Lund University, Sweden

AIMÉ HEENE

Professor, Ghent University, Belgium

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ELSEVIER B.V.
Radarweg 29
P.O. Box 211
1000 AE Amsterdam,
The Netherlands

ELSEVIER Inc.
525 B Street, Suite 1900
San Diego
CA 92101-4495
USA

ELSEVIER Ltd
The Boulevard, Langford
Lane, Kidlington
Oxford OX5 1GB
UK

ELSEVIER Ltd
84 Theobalds Road
London
WC1X 8RR
UK

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LIST OF CONTRIBUTORS

Laurent Bourgeon	ESSEC Business School, France
Marc Buelens	Ghent University, Faculty of Economics and Business Administration, Belgium, Vlerick Leuven Gent Management School, Belgium
Nicoletta Buratti	University of Genoa, Department of Business Studies, Genoa, Italy
Per Davidsson	Brisbane Graduate School of Business, Queensland University of Technology, Australia and Jönköping International Business School, Sweden
Sander M. Heinhuis	Department of Strategy and Business Environment, Rotterdam, School of Management, Erasmus University Rotterdam, The Netherlands
Benson Honig	Wilfrid Laurier School of Business and Economics, Canada, Jönköping International Business School, Sweden
Pekka Huovinen	Helsinki University of Technology, International Construction Business, Finland
Tomas Karlsson	Jönköping International Business School, Sweden
Juhani Kiiras	Helsinki University of Technology, Construction Economics and Management, Finland

Philippe Lorino	Department of Accounting and Control, ESSEC Business School, France, "Gestion et Dynamique des Organisations", Paris-X University
Tammy L. Madsen	Management Department, The Leavey School of Business, Santa Clara University, CA, USA
Marjatta Maula	Institute of Business Information Management, Tampere University of Technology, Tampere, Finland
Bill McKelvey	The Anderson School, University of California, Los Angeles, CA, USA
Tom J.M. Mom	Department of Strategic Management and Business Environment, RSM Erasmus University, The Netherlands
Jonas Ridderstråle	Stockholm School of Economics, Sweden
Johan Stein	Stockholm School of Economics, Sweden
Jean-Claude Tarondeau	ESSEC Business School, France
Frans A.J. Van den Bosch	Department of Strategic Management and Business Environment, RSM Erasmus University, The Netherlands
Raymond van Wijk	Department of Strategy and Business Environment, Rotterdam, School of Management, Erasmus University Rotterdam, The Netherlands
Henk W. Volberda	Department of Strategic Management and Business Environment, RSM Erasmus University, The Netherlands
Annick Willem	Ghent University, Faculty of Economics and Business Administration, Belgium

EDITORS' INTRODUCTION

We are pleased to serve as editors of this volume of the journal *Research in Competence-Based Management* (RCBM). We would like to thank all the authors who have contributed chapters to what we believe will prove to be both a stimulating and enduring volume.

We would also like to take this opportunity to introduce RCBM to readers. This volume is the second issue in a new journal for peer-reviewed research papers contributing to advancement of competence-based management theory. Although published in hard-cover format, RCBM is designed as a peer-reviewed academic journal and is intended initially to appear twice a year. Each volume will contain approximately 10 papers, and successive volumes will address a broad range of management topics being investigated today through the competence perspective. The researchers contributing papers to each volume will typically come from a number of institutions and countries around the world, as our list of contributors in this volume attests.

Like the present volume, each volume in RCBM will be partially or wholly focused on a key aspect of competence theory. The focus in this volume on "Managing Knowledge Assets and Organizational Learning" reflects the fundamental importance of knowledge and organizational learning in competence theory's foundational concepts and theoretical development. The initial volume of RCBM and the planned third volume focus on similarly important aspects of competence theory.

Volume 1 (previously published)
The Marketing Process in Organizational Competence
Ron Sanchez and Jörg Freiling, Editors

Volume 3 (forthcoming)
Understanding Growth: Entrepreneurship, Innovation, and Diversification
Ron Sanchez and Aimé Heene, Editors

Future volumes will feature additional focal themes and editors. Researchers in the competence perspective who would like to organize or act as a coeditor of a future volume are invited to contact Ron Sanchez or Aimé Heene with expressions of interest.

Ron Sanchez
Copenhagen Business School and Lund University

Aimé Heene
Ghent University

INTRODUCTION TO MANAGING KNOWLEDGE ASSETS AND ORGANIZATIONAL LEARNING

Perhaps no aspect of managing organizations has become so prominent in theory, research, and practice – and so quickly – as the set of ideas and issues that we commonly refer to today by the rubrics *knowledge management* and *organizational learning.* The competence perspective early recognized the fundamental importance of an organization's knowledge and its processes for renewing and expanding its knowledge in the building, leveraging, and maintaining of its competences.

In this volume of *Research in Competence-Based Management,* we are pleased to be able to publish a set of stimulating chapters that advance competence theory's understanding and representation of knowledge and knowledge-generating processes in a number of ways. We briefly summarize below the main contributions of each of the chapters in this volume. The chapters have been grouped into three areas of emphasis: learning dynamics and systemics, managing knowledge flows, and learning while developing new products.

PART I. LEARNING DYNAMICS AND SYSTEMICS

In their chapter "Dynamic capabilities and knowledge-driven micro-evolution: Performance effects of intrafirm variation, selection, and retention processes," Tammy Madsen and Bill McKelvey make a significant contribution to the theoretical representation of evolutionary processes of organizations and of the role of organizational learning in those processes. Madsen and McKelvey note that evolutionary theories of organizations (like population ecology) focus on firm-level evolutionary processes in which firms are assumed to suffer from inertia, to be essentially incapable of making internal changes to respond to changes in their environments, and therefore to survive or fail in a population due to the operation of external selection forces at the population level. To overcome this very strong assumption of determinative inertial effects, the authors extend the basic evolutionary concepts of variation, selection, and retention (VSR) to the internal processes of firms. They then argue that *intrafirm evolutionary VSR processes* may enable a firm to adapt to a dynamic environment as internal learning processes generate new knowledge-based variations in its routines, and as more environmentally suited routines are selected internally and retained by being diffused throughout the firm. They then test for the relative impacts of intrafirm VSR processes on firm performance in dynamic environments, and find support for the hypothesized importance of intrafirm level or "micro-evolutionary" VSR processes in maintaining firm performance.

In her chapter on "Organization as a living composition that learns and evolves by producing itself," Marjatta Maula extends our perspective on intrafirm evolutionary processes by applying autopoiesis theory to represent a firm as an entity that may be capable of continuous renewal through processes for continuous self-production. She identifies 10 essential structural components (which she refers to as a "living composition") in any organization that is capable of sustaining learning processes as a *self-producing system.* She also identifies and analyzes two primary knowledge flows in the internal and external environment of a self-producing organization. She then applies her living composition model to analyze the structural composition and knowledge flows of two knowledge-intensive firms.

The chapter "Learning strategies of nascent entrepreneurs" by Benson Honig, Per Davidsson, and Tomas Karlsson uses a longitudinal research methodology over a 24-month period to study the *entrepreneurial learning strategies* of a representative sample of nascent entrepreneurs in Sweden. Sarasvathy's theory of effectuation is invoked to identify and analyze six different learning strategies and their effects on a progression of start-up venture processes. Their results suggest that the progression of identified activities in the start-up process, and in particular a number of "gestation activities" undertaken during each time period, is systematically related to a nascent entrepreneur's (often implicit) learning strategy. Their findings also suggest that some learning strategies of entrepreneurs in the early stages of a start-up can have significant positive effects on the progression of the start-up process. Positive effects from persistent learning strategies in the progression of the start-up process were also found.

How firms might be organized to improve the ability of their competence building and leveraging processes to create sustainable competitive advantages is a central question in competence-based strategic management theory. In their chapter ''A competence-based perspective on organizational design,'' Jonas Ridderstråle and Johan Stein argue that *knowledge systems* should be integral to and prominent in organizational designs that can effectively support the creation of sustainable competitive advantages. The authors argue that knowledge must be actively managed as a critical resource. To test this basic proposition, the authors generate and test several hypotheses exploring relationships between knowledge systems and effective organization designs in high performing companies. Empirical analysis of the annual reports of 25 largest multinational manufacturing companies with headquarters in the Nordic region suggest that there are clear differences in the organization designs of successful business units with ''high-complexity knowledge systems'' and successful business units with ''low-complexity knowledge systems.'' This research thus suggests that there are important choices to be made in deciding the kinds of knowledge systems to be integrated into effective organization designs.

PART II. MANAGING KNOWLEDGE FLOWS

The chapter ''Knowledge reciprocity as a managerial competence: The determinants of reciprocity of knowledge flows in internal network forms of organizing'' by Raymond Van Wijk, Frans Van den Bosch, Henk Volberda, and Sander Heinhuis describes how changes in competitive landscapes are leading many firms to find new ways to build and leverage competences by *internal network*s characterized by strong horizontal knowledge flows. The horizontal knowledge flows in internal networks studied by the authors appear to facilitate knowledge integration and thus may offer advantages in processes for building and leveraging internal capabilities and organizational competences. The authors identify *reciprocity* as an important characteristic of internal networks in which horizontal knowledge flows work well. The authors also describe the attributes of organizational forms that can improve reciprocity. Hypotheses are posed to predict that specialization and the use of formal meetings restrict reciprocity, whereas job rotation, the number of employees with a coordination function, and teams have a positive effect on the level of reciprocity. Tests of the hypotheses confirm the predictions.

In their chapter ''Implanting new cross-disciplinary knowledge into a firm's management-driven competences in the case of building-related firms based in Finland,'' Juhani Kiiras and Pekka Huovinen address the challenge of *transferring and implanting new cross-disciplinary knowledge* into a firm's business management capabilities. They characterize this challenge as consisting of four principal problems, design a new two-part framework to analyze these problems, and apply it to suggest solutions to the problems. To develop their framework, they integrate key theoretical aspects of organizational learning, knowledge management, and competence-based management to clarify the ways in which a firm may be able to embed its business management capabilities in individual managers. They then apply their framework to analyze processes in Finnish construction firms for implanting three kinds of new disciplinary knowledge and local business knowledge into their managers' capabilities. The somewhat unsuccessful initial efforts of the firms and action researchers to solve knowledge implanting problems are reported.

Authors Tom Mom, Frans Van den Bosch, and Henk Volberda study ways in which a firm might try to *change the strategic mix* of its competence building and leveraging processes in their chapter "Managing the tension between competence building and competence leveraging by influencing managerial and organizational determinants of horizontal knowledge exchange." The authors also address the issue of managing conflict between old and new strategic processes during transition periods by developing a conceptual framework for representing exchanges of knowledge across organization units to achieve both goals of competence building and competence leveraging. The framework identifies several managerial and organizational variables that may stimulate competence building processes and competence leveraging processes. Their usefulness of their conceptual framework is illustrated through two case studies.

In their chapter "Knowledge flows between units through different types of inter-unit linkages," Annick Willem and Marc Buelens analyze ways in which knowledge can cross subunit boundaries within larger organizations. They develop an analytical model of the effects of different interunit linkages on processes for *intra-organizational sharing of knowledge*, and then focus on coordination mechanisms between units and members of the units. This study highlights the characteristics of such mechanisms in terms of intensity and complexity of their knowledge and intensity in flows of knowledge sharing. A case study in a British multinational company provides empirical evidence of posited relationships between the identified mechanisms and knowledge-sharing potential. The case suggests the important role of knowledge flows in informal networks and the impact of complexity of knowledge and shared mindset on knowledge sharing.

PART III. LEARNING WHILE DEVELOPING NEW PRODUCTS

The chapter "Organizational learning in project-based organization: The case of new product development projects" by Laurent Bourgeon and Jean-Claude Tarondeau investigates why some organizations learn more (and more efficiently) than others while developing new products, and why some exploit the knowledge that they generate more effectively than others. The authors argue that some organizations not only try harder, but also organize development processes differently in order to succeed in these two efforts. The authors identify a number or *organizational structure and process variables* that impact the abilities of firms to generate and leverage knowledge during product development. An empirical study of R&D units compares the learning and knowledge leveraging performance of project-based organizations to that of functional organizations. The results of the study suggest that horizontal organization structures and processes for product development (such as project teams) have better learning capacities than functional organization-based development processes.

Philippe Lorino's chapter on "Target costing and 'organizational' learning in new product development" applies the theory of activity to management tools to show how managerial approaches such as 'target costing' can have significant impacts on organizational learning. Lorino describes *target costing* as a complex combination of technical artifacts and specific managerial practices linked to the use of those artifacts. An interpretative/semiotic view of management instruments is used to explain how management tools may trigger and support organizational processes and competence building. Lorino then investigates new product development (NPD) as an organizational learning process that is fundamentally based on individual interpretation processes by NPD actors. Lorino characterizes NPD as an example of an 'enquiry' process as defined by Dewey, and shows how Target Costing instruments play a key role in making such situations meaningful for involved actors, and how they open possibilities for new collective learning action by making sense of engineering and planning situations.

In her chapter "New product development as knowledge management in the Italian automobile industry: How many goals have been scored?" Nicoletta Buratti studies the efforts of many firms to *remodel their NPD* processes and management practices on approaches adopted by leading firms worldwide in efforts to develop higher-quality new products more quickly and efficiently. She suggests that the underlying rationale for these new kinds of development processes is the need to balance new knowledge generation, which is a time-consuming process, and timely product development. The author addresses changes in NPD processes in the Italian automobile industry and describes the approaches developed by Fiat Auto during a 10-year period. She identifies specific new patterns of knowledge management followed when implementing the new model of NPD and suggests how they are based on a number of principles emerging now in knowledge-management studies and practice.

Ron Sanchez and Aimé Heene
Editors

PART I:
LEARNING DYNAMICS AND SYSTEMICS

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DYNAMIC CAPABILITIES AND KNOWLEDGE-DRIVEN MICRO-EVOLUTION: PERFORMANCE EFFECTS OF INTRAFIRM VARIATION, SELECTION, AND RETENTION PROCESSES

Tammy L. Madsen and Bill McKelvey

ABSTRACT

This chapter suggests that evolutionary processes of variation, selection, and retention (VSR) operate inside firms to create dynamic capabilities. We argue that differences in the rates of change of VSR activities within firms lead to differential performance among firms. We test how varying levels of VSR activities affect firm performance in a sample of Fortune 500 firms. The findings suggest that higher levels of VSR activities, in combination, lead to better adaptive outcomes as evidenced by above-average firm performance.

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Over the past 30 years, one of the "divides" in the organization science literature concerns adaptive change *versus* "death and replacement." Some scholars claim that organizations adapt, survive, and grow because of their evolving dynamic capabilities. Others hold that industries evolve as a result of the death and replacement of member firms suffering from inertia. The dynamics across this "divide" now appear to be shifting as knowledge-intensive resources become increasingly crucial to firm performance and survival. As environmental change speeds up, for example, the number of industries changing by death and replacement could be expected to grow dramatically, unless firms' dynamic capabilities also speed up substantially.

Theory on the organization of capabilities recognizes that if we view a firm as subject to external selection forces, then we should also consider a firm's internal selection environment where capabilities are developed (Loasby, 1998; Aldrich, 1999; Zollo & Winter, 2002). Building on this view, recent research cites intra-organizational evolutionary learning activities of variation, selection, and retention (VSR) as crucial to the development of dynamic capabilities (e.g. Zollo & Winter, 2002; Helfat & Peteraf, 2003; Zott, 2003). The dynamic capabilities of firms are those that contribute to "...appropriately adapting, integrating, and re-configuring internal and external organizational skills, resources, and functional competences..." in changing environments (Teece, Pisano, & Shuen, 1994, p. 12). Such capabilities govern the rate of change of ordinary (or operational) capabilities (Winter, 2000, 2003) and therefore should play an important part in determining the co-evolutionary success of firms competing against each other in an industry.

Even though empirical research in strategy recognizes that firm evolution is usually explained by both firm factors and industry factors, competing theories of evolution are implicit in these explanations. Lamarckian (adaptation) perspectives focus on the intra-organizational level of analysis and emphasize that the evolution of industry populations reflects changes in the strategy, structure, knowledge, and capabilities of member firms in response to environmental pressures and opportunities (e.g. Cyert & March, 1963; Lawrence & Lorsch, 1967; Thompson, 1967; Child, 1972; Nelson & Winter, 1982; Teece et al., 1994). In this perspective, firms' internal rates of change largely determine firms' fates. Darwinian (selection) views emphasize that structural inertia (e.g. Hannan & Freeman, 1977, 1984) present in firms mitigates against dynamic capabilities, arguing instead that industry evolution primarily occurs via the death and replacement of member firms due to external selection pressures (e.g. Hannan & Freeman, 1977). In this perspective, external selection pressures guide firms' fates.

This chapter helps to integrate these competing explanations. We hypothesize that Darwinian principles of natural selection operate inside firms to create dynamic capabilities. These capabilities, in turn, thwart the effects of inertia, thereby increasing an organization's adaptive ability and its chances for improving performance. Linking internal selection activities to firm performance illuminates one set of mechanisms underlying dynamic capabilities and suggests a form of rapprochement between selection and adaptation perspectives.

What is the relationship between these mechanisms and firm performance? To begin, we argue that variation (knowledge creation), selection (knowledge evaluation), and retention (knowledge preservation and dispersion) – which we collectively refer to as "VSR" activities – each represent a baseline activity that is necessary for the development of a dynamic capability. Together, these activities form an "engine" for new knowledge production and application within firms. Fig. 1 lists some of the general activities underlying each VSR component of this knowledge production engine. In addition, firms may adjust the balance among internal VSR activities to address external selection pressures (Burgelman, 1991; Miner, 1994). Some research suggests that tradeoffs in the amount of resources dedicated to each of these activities influences the development and distribution of knowledge within firms across time (March, 1991).

Building on these observations, we suggest that to maintain performance in a competitive environment, a firm must engage in all three VSR activities simultaneously, but must develop a particular balance among the *rates* of its VSR activities, so that the *amounts* of output of these activities (specific variations, selections, and retentions) can be effectively utilized to achieve successful adaptations. In effect, we suggest that, for example, it does not pay to speed up the variation rate (increasing the amount of variations generated) to match rapidly shifting industry conditions if selection and

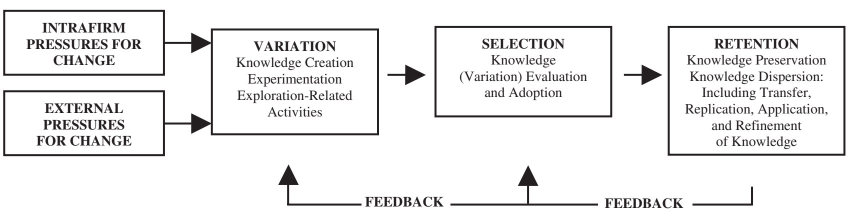

Fig. 1. General Activities Underlying Intrafirm VSR as a Knowledge Production Engine.

retention rates remain stagnant. We refer to an effective balancing of VSR activity rates within a firm as the attaining of "balanced continuity." Consistent with Loasby (1998), our concept of balanced continuity emphasizes that a firm's proficiency in shaping and coordinating the VSR activities underlying its process of trial-and-error learning helps the firm expand its range of possible behaviors for addressing its environment and thereby contributes to its performance. As a first step in exploring these ideas, this chapter tests hypotheses about the relationship between internal VSR activities and firm performance. We then build on our hypotheses to derive broader propositions related to the balanced continuity concept.

The chapter begins by discussing different forms of evolution. We then discuss the role of internal VSR processes in driving intrafirm change and adaptation. The chapter then proceeds to the hypotheses and propositions, presents the research design employed, and discusses the results of our tests. We conclude by suggesting implications of this research for the study of competence development and other areas of research.

EVOLUTION: – TWO PROCESSES OF CHANGE

Organizational evolution holds that performance differences among industry populations and their member firms can be attributed to a continuous process of change (slight or dramatic) over a long period of time (Aldrich, 1979, 1999; McKelvey, 1982; Nelson & Winter, 1982). An industry population is defined as a group of interacting organizations embodying similar combinations of key competencies (McKelvey, 1982; Baum & Singh, 1994a, p. 10). Evolutionary change involves a change in the blueprints (Hannan & Freeman, 1977), competencies (McKelvey, 1982), or routines (Nelson & Winter, 1982) held by a firm's member that ultimately are diffused throughout a population. Routines and competencies reflect a firm's learned, repetitious, or quasi-repetitious patterns of behavior grounded in tacit or semi-explicit knowledge (McKelvey, 1982; Nelson & Winter, 1982; Winter, 2003). In this view, firms have at their disposal at any one time configurations of routines and competencies temporarily embodied in tacit or semi-explicit knowledge held by their employees (Teece et al., 1994).

For the most part, ecological perspectives take a *firm* level of analysis, focusing on the adaptation, or death and replacement, of firms with respect to an exogenous context (e.g. Hannan & Freeman, 1977; see Baum, 1996 for a review). This macro view emphasizes the role of external selection pressures on firm development. More recently, empirical studies have begun applying Darwinian principles to intrafirm *parts* (e.g. Burgelman, 1991, 1994; Baum & Singh, 1994b; Galunic & Eisenhardt, 1996; Usher & Evans, 1996; Madsen & McKelvey, 1996; Madsen, 1997; Madsen, Mosakowski, & Zaheer, 2002, 2003). These "micro-evolutionary" approaches highlight the role of internal selection activities in firm development (we define micro-evolutionary processes formally below).

We next define the Darwinian and Lamarckian views of evolution as they typically apply at the firm level of analysis. We then discuss intrafirm levels of analysis.

Darwinian Evolution: Natural Selection

Most research in organizational evolution adopts the Darwinian view of population dynamics, in which a firm's ability to institute adaptive changes is severely constrained by inertial forces, and change occurs within a population as the result of environmental selection forces rather than internal adaptation (Hannan & Freeman, 1977, 1984). Variations at the population level of member firms only arise by chance as entrepreneurs start up new firms. Failing firms remain locked into obsolete capabilities, while replacement firms survive because they have more advantageous capabilities, given current environmental conditions. External selection forces, in the form of competitors and environmental constraints, provide a context in which some firms thrive and are selected favorably, while others fail and are replaced. Darwinian evolution occurs only when all four principles of natural selection are simultaneously in effect (McKelvey, 1982):

1. *Principle of Variation*: Differences in competencies and fitness occur across organizations.
2. *Principle of Selection*: Environmental forces selectively discriminate against some organizational variations and favor others within a population.
3. *Principle of Retention and Diffusion*: Favored variations are retained and diffuse throughout the population.
4. *The Struggle for Existence*: The competitive context is such that organizations holding a larger proportion of favored competencies will deprive organizations holding fewer favored competencies of required resources, leading to the eventual failure of the latter.

The fourth principle emphasizes the role in organizational evolution of competitive pressures in securing resources (Sanchez & Heene, 2004). In such a competitive context, a firm's performance may be maintained when it holds favored capabilities and resources that are valuable and isolated from imitation and substitution (Barney, 1991).

Lamarckian Evolution: Organizational Adaptation

Lamarck (1809) defined the earliest complete theory of evolution. His view has since been discredited in biology (Mayr, 1982), but it offers a useful alternative to Darwinian theory for understanding organizational evolution. Darwinian theory holds that variations only arise by chance and are "blind" as to their adaptive efficacy and it is environmental constraints that impose selection forces on firms. In applying Lamarckian theory to firms, however, internal adaptive changes are seen to arise purposefully in response to shifting environmental pressures observed by a firm's members, not by chance. Other research stipulates that adaptation is often too perfect to be accounted for simply by chance, and that some changes must arise as the result of managerial responses to environmental pressures (e.g. Penrose, 1952; Goldschmidt, 1976). Lamarckian (adaptation) perspectives suggest that people in organizations purposefully search for alternatives, and firms are thereby able to successfully adapt to shifting environmental conditions to ensure performance and continued survival (Lawrence & Lorsch, 1967; Thompson, 1967; Pfeffer & Salancik, 1978; Andrews, 1980). The extant literature cites several internal factors that may influence organizational change and adaptation, for example:

- Structural Contingency Theory (Burns & Stalker, 1961; Lawrence & Lorsch, 1967; Thompson, 1967)
- Goals, Expectations, Choice, and Control (Cyert & March, 1963)
- Strategic Management Theory (Chandler, 1962; Child, 1972; Miles & Snow, 1978; Andrews, 1980)
- Organizations as Institutions (Zucker, 1983, 1987)
- Resource Dependence Theory (Pfeffer & Salancik, 1978)
- Organizational Learning (Levitt & March, 1988; March 1991)
- Organizational Change (Bennis, Benne, Chin, & Corey, 1976; Goodman & Associates, 1982; Kanter, 1983)
- Organizational Development (French et al., 1994)
- Resource-Based View (Lippman & Rumelt, 1982; Barney, 1989, 1991; Teece et al., 1994).

Selection vs. Adaptation

Weick (1969, 1979) developed the earliest rapprochement between Darwinian and Lamarckian approaches to studying organizations. In Weick's view, purposeful adaptive outcomes are achieved through processes of internal natural selection. Managers, having studied the constraints of their firms' external environments, and understanding the adaptive needs of their firms, "enact" programs of action. These enactments are Weick's equivalent to Darwin's variations – "Enactment is to organizing as variation is to natural selection" (1979, p. 130). Firms adapt to their surroundings by exploring new variations and environments, selecting alternative courses of action, implementing adjustments to environmental changes, and exploiting existing environment and organizational competencies in novel ways.

Other authors suggest that selection and adaptation are interrelated processes of change. For instance, Burgelman (1991) suggests that adaptive processes of internal selection may combine with death and replacement processes to explain change in populations. Levinthal (1991) argues that adaptation and selection are interrelated through processes of learning and inertia. Examining organizational change and mortality, Singh, House, and Tucker (1986) consider whether adaptation arguments are more consistent with the empirical relationships between organizational change and mortality than ecological arguments. Their findings indicate that all changes are not adaptive with respect to survival and that organizational change does not always increase organizational death rates. Usher and Evans (1996) conclude that optimal patterns of behavior may emerge via processes of selection and adaptation. Building on this research, we suggest that empirically examining the relationship between VSR activities and firm performance will move us one step closer to understanding the relationship between selection and adaptation.

RATES OF CHANGE AND INTRAFIRM EVOLUTIONARY LEARNING PROCESSES

> The only thing that gives an organization a competitive edge – the only thing that is sustainable – is what it knows, how it uses what it knows, and how fast it can know something new! (Prusak, 1996, p. 6)

How organizations create, acquire, retain, share, and transfer knowledge continues to attract attention from diverse fields of study, including artificial intelligence (e.g. Hutchins, 1990, 1991; Carley, 1999; Carley & Gasser, 1999), group dynamics (e.g. Ancona & Caldwell, 1998; Argote, 1999; Moreland & Myaskovsky, 2000; Paulus & Yang, 2000), strategic management (e.g. Nelson & Winter, 1982; Henderson & Clark, 1990; Heene & Sanchez, 1997; Hoopes & Postrel, 1999; Argote, McEvily, & Reagans, 2003), and organization theory (e.g. Kogut & Zander, 1992; Darr, Argote, & Epple, 1995; Argote, 1999; Grandori & Kogut, 2002; Zollo & Winter, 2002; Madsen et al., 2003). Much of this work focuses on how firms might increase their amounts of organizational learning. Yet, increasing an organization's *rate* of learning is equally important and could be even more important for firms competing in industries characterized by rapid rates of change (Argote, 1999).

Given this, effective strategy is no longer just about creating or entering the right industry. Instead, it is about positioning a firm to be *continuously* at or near the frontier of its industry's evolution – such that *the firm's knowledge base changes at a rate that enables the firm to create and sustain greater value for its customers and at a cost lower than that of its rivals* (see Hoopes, Madsen, & Walker, 2003). In sum, a firm's ability to speed up or slow down its rates of change – in capabilities and in the inputs to those capabilities like knowledge, learning, resources, and routines (see Winter, 2003) – is increasingly important.

> It's not the BIG that eat the SMALL … It's the FAST that eat the SLOW.
>
> (Jennings & Haughton, 2000: front cover)

Firms vary in their intrafirm rates of change – that is, in their dynamic capabilities which govern the rates of change of ordinary or operational capabilities (Winter, 2000, 2003). One reason for this variance is that firms operate in environments with different rates of macro-environmental change. However, the relative importance of firms' internal rates of change *versus* the rates of change in their industry macro-environments also partly depends on the rate of a firm's internal micro-evolution – which we define here as the interactions of a firm's internal processes of VSR. We also now define the concept of micro-coevolution as the reciprocal interactions of micro-evolving firms within a population of firms (e.g. an industry).

Both micro-evolution and micro-coevolution can occur at different rates and in different directions. One possible form of what we term rapid micro-coevolution could be that two rapidly micro-evolving firms continuously adapt by increasing their knowledge and capabilities, perhaps even setting the pace of competitive evolution in their industry. Another possible outcome of this rapid micro-coevolution scenario, however, might be that the weaker of the two rapidly micro-evolving firms may seek to avoid the Red Queen Paradox (Van Valen, 1992) of simply running faster and faster in place and instead seek to survive in the long run by changing the direction of its micro-evolution towards a niche market in which it does not compete directly with the other, stronger rapidly micro-evolving firm. In both the cases in this scenario, each firm's internal rate of micro-evolution is more important in explaining its evolutionary outcome than the rate of change of their overall industry macro-environment.[1] In other words, adaptation in this scenario is primarily a function of a firm's internal VSR rates and, thereby, the outputs of its VSR processes (e.g. the amounts of knowledge produced by each firm's rate of knowledge production/evolutionary learning).

The "inertia argument," upon which population ecology depends (Hannan & Freeman, 1984), is the opposite of the rapid micro-coevolution scenario we have posed above. Under what we now refer to as slow micro-coevolution, in which a firm's inertia is a strong effect and its ability to micro-evolve internally is a relatively weak effect, industry macro-environmental evolutionary effects will determine which firms survive and thus regulate the size and composition of the population of firms in an industry. Under these conditions, the rates of change of the industry macro-environment will predominantly explain evolutionary outcomes for individual firms.

The distinction between rapid and slow micro-coevolution focuses attention on firms' internal VSR rates relative to the rates of change of their industries and possibly larger environments. It also invites attention to the workings of an evolutionary hierarchy. Firms evolve through cycles of VSR that occur at multiple hierarchical levels – e.g. intrafirm (individual, work groups, department, division), firm, industry population, community (Aldrich, 1979; Baum & Singh, 1994a; Sanchez, 2000). In population ecology, selection is a contextual (or external) property that determines retention of variations. If we think of evolution as a multilevel process that also includes processes *within* firms, however, an obvious question for investigation is how VSR at one level of analysis interacts with the next higher VSR level in this evolutionary hierarchy.

In a minimal hierarchical view, variation and selection processes weed out variations at *two* levels: (1) intrafirm to firm level – firms develop internally a portfolio of variations from which *managers* select preferred models, and (2) population level – *external agents* (or larger macro-environmental forces) select some firms over others based on the variations *retained* by the firms. Two levels of retention may also exist: (1) intrafirm to firm level – variations selected by managers and retained by a firm are dispersed throughout the firm's operations, and (2) population level – variations retained by a firm and favored by external selection agents are dispersed throughout the population, and firms with retained variations that are favored by external selection agents are retained in the population. Two types of experiential learning opportunities can therefore be identified at the firm level: (1) generative learning, in which managers may discover novel knowledge during trial-and-error experimentation, and (2) inferential learning, in which managers may gain knowledge about the efficacy of a retained variation once it is dispersed across the firm. Similar learning processes can occur within work groups, departments, and divisions of a firm. In this way, VSR activities interact inside a firm to form an "engine" for producing knowledge (Madsen et al., 2002; Zollo & Winter, 2002).

Importantly, these learning engines operate at different rates within different firms, depending on each individual firm's rates of VSR. For instance, a firm may have a rapid variation rate, but slow selection and retention rates. Such a firm might generate large amounts of alternatives (variations or trials) continuously over time, but given its slow selection process, previously retained variations may continue to dictate the firm's behavior. Of course, under stable industry conditions, such a mismatch among rates may matter less then in rapidly changing industry conditions. However, we suggest that regardless of industry conditions, a firm that lacks dynamic capability in coordinating rates of VSR activities is likely to be in a weaker position relative to a firm that has developed a capacity to change through balanced VSR rates. Even in stable industries, a firm with a superior capacity to change may be able to introduce organizational innovations that provide it with a competitive edge over the competition. Moreover, a firm with a superior capacity to change will also be better positioned to respond in a timely fashion to rivals' actions and to any industry-level changes that emerge. We expand on this critical balancing of VSR dynamics in the "balanced continuity" section of the chapter (below).

The following subsections present our hypotheses, define internal VSR processes more fully, and identify the mechanisms which facilitate each kind of VSR activity. We also note here that all the hypotheses we put forward below are expected to hold more strongly in environments where the intensity of the competitive struggle for existence is high.

Variation

In our knowledge-based perspective on micro-evolution, variation involves the creation of knowledge that generates novel changes in a firm's ways of operating. Intrafirm variations may occur through (1) intentional or unintentional trials (experiments), (2) focused or unfocused trials, each of which may be supported by (3) direct or indirect incentive systems (Miner, 1994). Whether intentional or unintentional, processes that generate intrafirm variations are mostly ''blind'' (Campbell, 1969; Aldrich, 1979; Weick, 1979), because managers, under conditions of uncertainty and competition, are unlikely to know in advance which variations will lead to successful adaptive outcomes and consequently enhance firm performance. Variations may occur purposefully in response to specific environmental changes, they might be planned but not necessarily responsive to a particular environmental condition, or they might ''just happen'' (Campbell, 1969; McKelvey, 1994). Variations might also arise by combining old and new routines that are not currently recognized as distinct competencies within a firm (Nelson & Winter, 1982; Zollo & Winter, 2002). In this sense, a firm's variation capability is consistent with what Schumpeter (1934) referred to as *entrepreneurship* – that is, the ability to create new ways of operating and new opportunity sets via combinative learning (Zollo & Winter, 2002).

Firms may use a variety of mechanisms to promote variation activity. Some firms believe in the value of unfocused experimentation or ''galumphing'' (Weick, 1979, p. 248) and encourage boundary-spanning activities, the exploration of new environments, the creation of a diversity of ideas, and new competence acquisition (e.g. March, 1991; Kanter, Stein, & Jick, 1992). Firms also often create safe havens for learning such as ''skunkworks,'' which facilitate informal work on new ideas (e.g. Peters & Waterman, 1982). Such contexts may be established by managers to encourage the development of a wide range of ideas and thus are generally characterized by an absence of control mechanisms (Loasby, 1998). Firms may also promote variation activity through focused experimentation activities, such as formalized research and development (Miner, 1994), identifying ''champions of change'' who shape a vision within firms and lead focused experimentation efforts (Nadler & Tushman, 1991; Kanter et al., 1992), and creating parallel projects in which several teams work on the same problem to generate competition in creating potential new product ideas or technology variations (Miner, 1994).

Reward systems that provide direct or indirect incentives to individuals may contribute to increased variation activity (Lawler, 1991; Kanter et al., 1992; Miner, 1994). For instance, incentives that reward useful innovation as part of an employee's standard responsibilities, compensate individuals for patents or innovative work, or allocate limited resources based on a competition between employees may motivate variation activity.

Organizations differ in how they structure their variation activities, in how much they promote focused or unfocused experimentation, and in how they use variation-inducing incentive systems. Research suggests that developing a portfolio of variations (change alternatives) will enable a firm to respond more effectively to environmental change compared to firms that lack identified alternative courses of action and have little or no experience with experimentation (e.g. Nadler & Tushman, 1988; Kanter et al., 1992). Firms that are slow or fail to generate and adopt changes in behavior and that continue to invest in obsolete practices are likely to suffer in their competitive environments. On the other hand, while an openness to wholesale change or ''non-institutionalized innovation'' increases the potential for successful adaptation, it also increases the risk of firm failure (Zucker, 1987). Consequently, firms need to achieve a balance between introducing change and building on past experience to reinforce current practices.

Firms that pursue high rates of variation activity may invest an inordinate amount of resources in experimentation activity and might encounter high costs of experimentation without realizing compensating benefits (March, 1991) and limit potential returns from their past experiences. Under these conditions, a firm may possess a portfolio of new undeveloped ideas but may not become proficient at any one skill or task. In other words, for a number of reasons, excessive rates of variation (if selected and retained internally) may be disruptive and risky to a firm as a whole (Hannan & Freeman, 1984).

In a study of the Finnish newspaper industry, for example, changes in product content and frequency of publication were associated with an increase in the hazard rate of firm failure (Amburgey, Kelly, & Barnett, 1993). Also, the cost of ramping up variation activity in order to generate a large pool of variations may be detrimental to firm performance in the long run and may place a firm at risk of losing market share, because funding creation of large numbers of variations may drain a firm's resources and reduce funds available to pursue new opportunities or to exploit existing capabilities. Moreover, searching for and developing alternative courses of action may simply have lower potential and less certain outcomes than building on existing capabilities. Frequent change also may generate random drift, rather than performance enhancement, when a firm's operations are altered prior to the firm fully understanding its competitive environment (Lounamaa & March, 1987). Nevertheless, even though reducing the frequency of change might provide managers with time to build a better understanding of environmental conditions, a tradeoff exists between realizing the potential benefits of an increase in understanding of one environmental state *versus* the consequences of a decrease in information about possible other states. This dilemma calls attention to a fundamental question in organization science and strategy: What rate of change is most appropriate to sustain a firm's overall (short- and long-term) performance in a dynamic environment?

Thus, even though high rates of internal variation activity may be necessary to develop sufficient requisite variety (McKelvey & Aldrich, 1983), too much variation activity may send a firm into a downward spiral (Hannan & Freeman, 1984; Hambrick & D'Aveni, 1988). In contrast, when a firm's rate of variation activity is too low or variation activity is infrequent, a firm's manager will have a limited amount of variation alternatives to select from. Such a limited pool of alternatives may reduce the firm's chances of selecting and retaining an optimal or even viable solution and thereby put the firm's performance at risk. Such firms may also lack experience with experimentation, one possible implication of which is reduced efficacy in implementing alternatives developed in its variation process.

We therefore hypothesize that, in a competitive environment, inappropriately high or low rates of variation activity may lead to micro-evolutionary dysfunctionalities that adversely affect firm performance.

Hypothesis 1. Firm performance varies non-monotonically (following an inverted U-shape) with rates of internal variation.

Internal Selection

We characterize internal selection as the process by which managers choose variations (Weick, 1979). Firms influence their internal selection processes primarily through administrative and cultural control mechanisms (McKelvey & Aldrich, 1983; Burgelman, 1991; Miner, 1994; Sanchez & Heene, 2004). Administrative control mechanisms include strategic planning, goal setting, and rules governing resource allocation (Weick, 1979; Burgelman, 1991), as well as project evaluation criteria, schedules or basic pre-screening criteria for projects, intrafirm competition for resources or standards, and informal intrafirm competition (Miner, 1994). Cultural control mechanisms include behavioral norms, allegiance to which may influence internal selection processes. For instance, norms against offering suggestions, against experimenting, or against taking initiative may lead managers to select against potentially beneficial variations, thereby contributing to maintaining a status quo. Firms may also promote selection activity by managers by defining goals but not explicitly identifying the actions to be taken to achieve the goals. In this setting, managers may use firm goals to guide their selection of available variations in determining a course of action (Miner, 1994).

In the absence of operative administrative and cultural selection mechanisms, variations are less likely to be selected or retained, and previous firm behavior is likely to drive current behavior and determine firm performance. Consequently, a firm may progressively become less fit with its environment over time as reinforcement of past behavior contributes to inertia and reduces attention to environmental change (Hannan & Freeman, 1984; Meyer & Zucker, 1989). Other factors within a firm, such as political coalitions, may also influence its managers' selection behaviors in the absence of administrative and cultural controls (Meyer, 1994). Moreover, a firm's members may resist adopting a change when the change may place them at risk of losing private gains. In such settings, variations may be selected without regard to whether they benefit the firm as a whole.

By the same token, a high rate of selection driven by rigid administrative control processes may negatively impact firm performance (Weick, 1979; McKelvey & Aldrich, 1983). Overly specified evaluation criteria may slow down the selection process and/or necessitate high levels of managerial effort and other resource allocations to assess the efficacy of the variations developed within a firm. Adherence to behavioral norms may also adversely affect the selection process when potentially successful variations are weeded out as the result of overly strong cultural controls. Managers may also hesitate to evaluate and select particular variations when maintaining a previous course of action simply requires less effort than adopting a change in a behavior or operating routine.

The above arguments lead us to predict that in a competitive environment, inappropriately high or low rates of internal selection activity may lead to micro-evolutionary dysfunctionalities that adversely affect firm performance.

Hypothesis 2. Firm performance varies non-monotonically (following an inverted U) with rates of internal selection.

Retention

Retention is the preservation of variations in behavior adopted by an organization through dispersion of these changes across its operations and subunits. The knowledge content of a variation that is retained by a firm embodies knowledge about both its existing and past behaviors and will be stored in different organizational "retention bins" that form the firm's memory (Walsh & Ungson, 1991). Dispersion involves internally replicating a retained variation across organizational space and time. Through processes of dispersion, a firm leverages its new and past knowledge (Sanchez, 2000).

Firms may facilitate retention (1) through control processes focused on maintaining consistency between selected actions and the actual behaviors of individuals, (2) through leadership that creates commitment to change efforts (Nadler & Tushman, 1991; Kanter et al., 1992), and (3) through organizational designs that facilitate communication and transfer of information across units about the results of previously retained variations (Nadler & Tushman, 1988). Continuous communication and review of change implementation efforts through management information systems, budgets, and schedules may thereby assist in propagating consistent behavior across a firm's operations (e.g. Kanter et al., 1992).

A high rate of retention activity implies repeated exploitation of a firm's current and past knowledge and competencies. With repetition, each retained variation becomes more routine to a firm and thereby increases the chances that it will be used again in the future (e.g. Nelson & Winter, 1982; Levitt & March, 1988). Familiarity with retained activities may create "blind spots" to opportunities that arise from changes in a firm's environment (Andrews, 1980). When environments change, prior firm practices and procedures may no longer be effective (Chakravarthy, 1982), and inappropriately high retention rates may operate as inertial mechanisms that limit a firm's ability to benefit from any internal variation and selection processes a firm may have, and this dysfunctionality may pose obstacles to maintaining a firm's performance.

A low rate of retention activity may also lead to low firm performance. Low firm retention rates may indicate that a firm is not building on its experienced-based knowledge, perhaps because it is not systematically gathering and evaluating feedback on performance outcomes of previously implemented variations, or perhaps because it is not effectively dispersing selected variations across the firm's operations. Levinthal (1991) argues that building on existing knowledge enhances a firm's survival chances. Not utilizing current know-how or experience, however, may expose a firm to the survival risks associated with young firms (Stinchcombe, 1965). Retention also provides a consistent base of experience from which to compare future courses of action. Establishing associations between past actions and subsequent performance is necessary for organizational learning to occur (Fiol & Lyles, 1985). Without feedback from the performance outcomes of previously retained variations, trial-and-error learning breaks down because managers cannot determine which variations resulted in effective or ineffective outcomes, or why they did so (Levinthal & March, 1993).

Lack of dispersion of retained variations throughout a firm also may result from an inability to integrate knowledge across the firm, a lack of effective leadership for change efforts, or a failure to transform experience into routines and embed routines in the firm's memory (Levitt & March, 1988). Adequate processes for distilling knowledge from past experience or for dispersing knowledge-based variations may not exist in the firm. When selected variations are not dispersed, various parts of a firm may continue to base their behaviors on previous experiences which may not address adequately the environmental conditions the firm as a whole currently faces. We hypothesize that, in a competitive environment, inappropriately high or low rates of retention activity will result in micro-evolutionary dysfunctionalities that adversely effect firm performance.

Hypothesis 3. Firm performance varies non-monotonically (following an inverted U) with rates of retention.

Balanced Continuity[2]

We have described how internal natural selection VSR requires a continuous chain of events (Campbell, 1969; Weick, 1979) that allows firms to generate, adopt, and implement changes which satisfy external or internal pressures for change (Burgelman, 1994). We have also argued that each activity in a firm's internal VSR process is necessary for the eventual adoption of variations. The preceding sections argue that inappropriately high or low rates of VSR activities create internal micro-evolutionary dysfunctionalities that constrain a firm's ability to adopt changes and limit the firm's responsiveness to internal and external pressures.

While Campbell (1969) and Weick (1979) emphasize that internal natural selection is a continuous process, they say less about what rates of variation activities or what amounts of variation, selection or retention outputs are necessary for adaptation to occur. As McKelvey and Aldrich (1983, p. 125) state, "Managers should attempt a balanced emphasis on all four principles [of natural selection] as the best way of increasing the chances of the survival of their organization." Tushman and Romanelli (1985) argue that successful organizations are those which develop a balance between change and stability, while March (1991) calls for balancing exploration and exploitation.

The concept of *balanced continuity* that we develop now builds on these arguments.

Firms differ in how they configure and govern internal VSR processes. Depending on this, the rates of each VSR activity and the amounts of variation, selection and retention realized will vary across firms. Such differences give rise to heterogeneous capacities for and actual rates of change across firms, and these variations create the variance in firms' dynamic capabilities. As we have suggested, how effectively a firm manages the rates of its VSR activities influences the firm's ability to learn from past experience, generate new variations (opportunities for change), and control the types of changes adopted. In a competitive environment, a condition of *balanced continuity* exists in a firm when the rates of all three internal VSR activities are brought into a balanced relationship that enables a firm to achieve adaptive outcomes that maintain or enhance its performance.

By finding a more appropriate balance among rates of VSR activities relative to rates of industry-level environmental change, a firm may develop a performance advantage over rivals and prosper in its competitive environment. In the absence of balanced continuity, however, a firm may lack the ability to generate and adopt changes necessary to maintain or improve performance in a timely fashion, and as a result, may become more subject to external selection forces. In effect, under conditions that we have characterized as slow micro-coevolution, a firm's fate is largely driven by selection forces in its environment. In contrast, when a firm achieves balanced continuity by sustaining what we have characterized as rapid micro-evolution, we argue that internal natural selection will lead to adaptation and will dominate over external selection forces.

Hypotheses 1–3 therefore lead to the derivation of two broader propositions that, in effect, summarize the micro-evolutionary theory we develop here and connect the balanced continuity concept to the broader body of evolutionary theory. More specifically, these propositions link selection and adaptation forms of firm evolution and identify the conditions that give rise to the dominance of one form of evolution over the other.

Proposition 1. In a competitive environment, when balanced continuity is achieved within a firm, internal natural selection leads to effective adaptation and dominates over external selection forces.

Proposition 2. In a competitive environment, when balanced continuity is not achieved, external selection forces dominate over internal adaptation in organizational evolution.

RESEARCH DESIGN

Data

Data from a questionnaire on organizational learning, culture change, and competitiveness are used (Ulrich, Von Glinow, Jick, Yeung, & Nason, 1993). Approximately 2,000 surveys were submitted to 382 business units, and 1,359 responses were received from 380 firms worldwide (response rate = 68%). The data were collected following key informant methodology in which respondents are selected based on their ability to provide an informed response about their business (Campbell, 1955; Siedler, 1974; Phillips & Bagozzi, 1986). The respondents are senior managers with an average tenure of 15.8 years and an average age of 45.7 years. Given their tenure, the senior managers are assumed to be familiar with their firms' rates of change. The senior managers span an array of functional areas, including finance, general management, human resources, manufacturing, marketing/sales, and research and development. The firms represent 10 major industry groups (including electronics and computers, chemicals and pharmaceuticals, wholesaling and retailing, finance, services, aircraft, and automobiles) and one miscellaneous manufacturing group. The sample is skewed toward larger, older firms.

We test our hypotheses using data on all the North American firms in the sample ($N = 193$). Following multiple informant methods, data are aggregated by firm for firms having three or more respondents (Siedler, 1974). Cases with high disagreement among respondents in key variables, such as the size or age of the business unit, are treated as missing values. After these adjustments, the average size and age of the sample does not differ significantly from the total sample. The responses of the informants that are members of the same firm have been averaged and treated as an aggregate score for each questionnaire item.

Dependent Variable

Our measure of firm performance is based on a composite measure that is consistent with multi-dimensional performance measures recommended by Venkatraman and Ramanujam (1986) in their review of performance measures for strategy and organizational research. Respondents were asked to (1) rate their firm's financial performance compared to major competitors on a 6-point Likert scale ranging from "much worse" to "much better" (one questionnaire item); (2) similarly rate their firm's performance relative to other competitors in the five functional areas of customer relations, distribution channels, globalization, marketing and sales, and research and development (five questionnaire items); and (3) rate their firm's cycle time for innovation and its reputation as an innovator compared to major competitors (two questionnaire items). We sum these eight questionnaire items by firm to construct each firm's performance measure. Cronbach's alpha for the performance measure is 0.76.

Variables

The main variables of interest, variation, selection, and retention, are empirically developed using orthogonal factor analysis (varimax rotation). The factor analysis consists of 3, 4, and 5 factor rotations; a three-factor solution is extracted. Consistent with Harman's one-factor test (Podsakoff & Organ, 1986), the different stages of factor analysis revealed 3 factors with eigenvalues greater than 1; none of the factors explained more than 20% of the total variance in the data. This finding suggests that common method variance (CMV) does not appear to undermine the validity of our data construction. The discussion section following our analysis offers additional explanations for why CMV does not pose a significant threat to our analysis.

The factor analysis yields measures for variation, selection and retention based on the behaviors underlying firms' rates of VSR. Variations are taken here to include alterations in the state, form, or function of a firm and may occur through focused or unfocused experimentation and under direct or indirect incentive systems. *Variation* reflects the extent to which a firm (1) encourages the acquisition of competencies; (2) continually seeks new ideas; (3) continually seeks new ways to do work; (4) embraces experimentation; (5) strives to be the first to market with a new process or product; and (6) embraces change. The mean score of items 1–6 represents the rate of a firm's variation activity. Cronbach's alpha for the variation scale is 0.84.

Selection, the managerial choice of variations, is assumed to be carried out primarily through administrative and cultural control mechanisms. The following items load high on Factor 1 and reflect the extent to which each firm (1) performs problem analysis prior to implementation of ideas, (2) employs procedures that "make a difference" in the organization, (3) employs behaviors that redress past mistakes, (4) considers the implications of change, and (5) ensures actions are consistent with goals. The mean score of items 1–5 defines the amount of a firm's selection activity. Cronbach's alpha for the selection scale is 0.84.

Retention is the preservation and dispersion of selected variations. Items that load high on retention reflect the extent to which a firm and its managers (1) transfer learning from one site to another, (2) integrate a business change into the firm's overall business process, (3) track progress on business changes, (4) share results widely within the firm, and (5) provide specific and frequent feedback that improves performance. The mean score of items 1–5 defines the amount of a firm's retention activity. Cronbach's alpha for the retention scale is 0.85.

We also include variables to control for firm characteristics and environmental conditions. As for firm characteristics, research suggests that large size reflects a degree of institutional insulation and bureaucratization that might make large firms less responsive to shifting industry conditions (Haveman, 1993). Alternatively, if large size is related to the accumulation of endowments and market power, then large firms may be more able to reposition than small firms. Consistent with this view is the notion that small size limits a firm's ability to adjust to environmental conditions and thereby threatens its performance (Delacroix & Swaminathan, 1991). We control for these effects using firm size, defined as a firm's number of employees. We use the natural log of firm size to reduce the skewness of the distribution. Under this approach, a one-unit change in the size of a small firm will have a larger impact than a one-unit change in the size of a large firm.

Research also suggests that that firm age may differentially affect a firm's performance. Findings on the liability of newness suggest that old firms benefit from accumulated experience (Carroll & Delacroix, 1982; Freeman, Carroll, & Hannan, 1983). The counter argument is that firms become increasingly ossified as they age (Barron, West, & Hannan, 1994) and face increasing difficulty to change in a timely manner. We include a control variable for a firm's age, defined as the number of years since founding. We use the natural log of firm age to reduce the skewness of the distribution.

Environmental conditions, such as the degree of environmental uncertainty and dynamism, may also affect firm behavior and performance. Environmental uncertainty is defined here as the extent to which future changes in an environment are unknown (Lawrence & Lorsch, 1967; Duncan, 1972; Khandwalla, 1977; Romanelli & Tushman, 1994). Using a 6-point Likert scale, respondents rated the extent to which changes in their industry are predictable over the next 3 years; a high score on this variable indicates a very high amount of unpredictability and thus environmental uncertainty. Dynamism is defined as the extent to which changes occur in a firm's business environment (Aldrich, 1979). Building on prior research, we operationalized dynamism by asking respondents to rate the extent to which 14 functions or activities are changing in their business (e.g. customer buying criteria and customer relations, distribution channels, organization structures, research and development, production capability, and sales and marketing) on a 6-point Likert scale, with a high score indicating a very high degree of change. The dynamism index is a summation of the 14 scores for each firm.

Model Specification

We use ordinary least-squares regression to test the relationship between the internal VSR variables and firm performance. The model is specified as follows:

$$\begin{aligned} \textit{Firm Performance} = {} & \beta_0 + \beta_1\ \textit{Variation} + \beta_2\ \textit{Selection} + \beta_3\ \textit{Retention} \\ & + \beta_4\ (\textit{Variation})^2 + \beta_5\ (\textit{Selection})^2 + \beta_6\ (\textit{Retention})^2 \\ & + \boldsymbol{\alpha F} + \boldsymbol{\delta I} + \boldsymbol{\varepsilon}. \end{aligned}$$

where *Firm Performance* is the composite measure of firm performance; $\boldsymbol{\alpha}$ is a vector of coefficients representing the effects associated with $\boldsymbol{F}$, the vector of covariates capturing a firm's characteristics; $\boldsymbol{\delta}$ is a vector of coefficients associated with $\boldsymbol{I}$, the vector of covariates representing the environmental characteristics; and $\boldsymbol{\varepsilon}$ is the error term.

We first test a baseline model for the effects of firm and environmental characteristics on performance. We then add the first-order terms for variation (model 2), selection (model 3), and retention (model 4) followed by the second-order terms for each construct (models 5–7 respectively). These analyses make it possible to determine whether the internal natural selection process explains firm performance after controlling for heterogeneity in the sample due to differences in firm characteristics and environmental characteristics. The combination of first and second order effects of variation, selection, and retention test the hypotheses that firm performance varies non-monotonically (following an inverted U-shape) with each construct.

Descriptive Statistics

Table 1 presents the means, standard deviations, and correlation matrix. The large standard deviation in firm size and dynamism indicates large

Table 1. Means, Standard Deviations and Correlations.

Variable	Mean	S.D.	1	2	3	4	5	6	7	8
1. Performance	23.12	0.53	1.0							
2. Ln(size)	9.27	1.81	−0.17**	1.0						
3. Ln(age)	4.25	0.81	−0.03	0.25**	1.0					
4. Uncertainty	1.94	0.53	0.12*	−0.01	−0.15*	1.0				
5. Dynamism	46.41	4.27	0.03	0.28**	0.11	0.10	1.0			
6. Variation	3.22	0.50	0.50**	−0.01	−0.08	−0.19**	0.27**	1.0		
7. Selection	3.31	0.52	0.45**	−0.26**	−0.22**	−0.05	−0.08	0.33**	1.0	
8. Retention	3.08	0.45	0.38**	0.05	0.03	0.01	0.12*	0.53**	0.51**	1.0

*$p<0.05$.
**$p<0.01$.

differences in the sample of 193 firms. Firm performance is positively correlated with the VSR constructs, as expected, and negatively correlated with firm size and age. Firm size and age also are negatively correlated with variation and selection, but positively correlated with retention. Moderate positive correlations exist among the three main VSR constructs. The positive correlation between variation and retention is consistent with the idea that these activities are reinforcing rather than opposing. Environmental uncertainty and dynamism negatively correlate with selection and retention, but positively correlate with variation. This suggests that under conditions of significant uncertainty and environmental change, firms do pursue more variation activity, but may be more reluctant to commit to the variations they generate. Some variance overlap may exist among the independent variables, given their moderate correlations. Variable inflation factor tests indicate a lack of multicollinearity (VIF < 1.4 in all cases).

RESULTS

Table 2 reports the results of the hierarchical regression analysis. We begin by discussing the linear effects for variation and selection. Model 2 shows a positive and significant relationship between firm performance and variation. This model fits the data significantly better than the baseline model (1) which contains only the control variables: ΔAdjusted $R^2 = 0.26$, $p < 0.01$. The next two models add first-order selection and retention effects, respectively. The coefficient for selection is positive and significant and the coefficient for retention, while positive, is not significant. Model 3 shows that

Table 2. The Effects of Internal VSR on Firm Performance.

Variables	Dependent Variable: Firm Performance						
	Models						
	1	2	3	4	5	6	7
Ln(Size)	−0.032*	−0.26*	−0.16	−0.17	−0.18	−0.23*	−0.22*
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Ln(Age)	0.07	0.23	0.41	0.40	0.40	0.41	0.46*
	(0.27)	(0.24)	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)
Environmental Uncertainty	0.69	0.22	0.48	0.48	0.38	0.44	0.46
	(0.36)	(0.36)	(0.35)	(0.35)	(0.35)	(0.35)	(0.35)
Dynamism	0.05	−0.06	−0.04	−0.04	−0.03	−0.02	−0.02
	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Variation		3.27***	2.52***	2.48***	−5.06	−6.51	−4.94
		(0.41)	(0.41)	(0.42)	(3.39)	(3.45)	(3.66)
Selection			1.79***	1.73***	1.66***	7.61*	8.26*
			(0.43)	(0.44)	(0.43)	(3.15)	(3.19)
Retention				0.09	0.23	0.20	−4.93
				(0.54)	(0.53)	(0.53)	(4.13)
Variation^2					1.16*	1.37***	1.12*
					(0.52)	(0.52)	(0.53)
Selection^2						−0.90	−0.99*
						(0.48)	(0.48)
Retention^2							0.85
							(0.67)
R^2	0.05	0.30	0.38	0.38	0.39	0.41	0.41
Adjusted R^2	0.03	0.29	0.35	0.35	0.37	0.38	0.38
ΔAdjusted R^2		0.26**	0.07***		0.02*	0.01	
F	2.47*	16.74***	18.91***	16.13***	15.05***	13.97***	12.77***

Standard errors are in parentheses.
*$p<0.05$.
**$p<0.01$.
***$p<0.001$.

the selection parameter in the model significantly improves fit to the data over model 2 containing only the control variables and variation: ΔAdjusted $R^2 = 0.07$, $p<0.01$.

The second-order effects of VSR are added in models 5–7, respectively. We discuss the results of the full model, model 7. Hypothesis 1 predicted that firm performance would vary according to an inverted U-shape with the rate, or amount, of variation activity a firm pursues. The results show that, with the inclusion of the second-order term for variation, the first-order effect is negative and not significant but the coefficient for the second-order term is positive and significant. These findings suggest that firm performance may increase at an increasing rate with variation activity.

Hypothesis 2 predicted that firm performance would vary according to an inverted U-shape with internal selection. The findings are consistent with this prediction. The coefficient for the first-order selection parameter is positive and significant and the coefficient for the second-order selection parameter is negative and significant. The inverted-U also reaches its peak within the observed range for the selection variable.

Last, Hypothesis 3 predicted that firm performance would vary according to an inverted U-shape with retention. The findings do not support our prediction. The coefficients for the first- and second-order retention parameters are not significant in model 7. The lack of a change in adjusted R^2 from models 3 to 4 and models 6 to 7 suggests that the addition of the first- and second-order retention terms does not significantly enhance the explanatory power of the models.

Results: Pictures from a Different Angle

In addition to the above analyses, two other hierarchical regression analyses were performed in order to test the hypotheses from a different vantage point – rather like moving a camera in the middle of a forest to alter the effect of obstructing trees. Table 3 presents the results of the second approach, which uses factor scores for the VSR constructs rather than an average of the survey items that mapped to each variable. The coefficients for each VSR activity have a statistically significant association with firm performance. This finding is consistent with one part of the reasoning underlying the concept of balanced continuity – that all three VSR activities matter for firm performance. In addition, model 4 shows a significant improvement in fit to the data over model 3 containing only the control variables and variation and selection: ΔAdjusted $R^2 = 0.04$, $p < 0.01$. Consistent with the first set of analyses, model 7 is consistent with Hypothesis 2. Model 6 also is consistent with Hypothesis 2. Firm performance varies nonmonotonically (following an inverted U-shape) with selection.

A third perspective was taken by revising the order in which the first- and second-order terms for the independent variables are added in the model. Table 4 presents results of the third view. Consistent with the first two sets of

Table 3. The Impact of VSR on Firm Performance (Models Using Factor Scores for VSR Variables).

Variables	Dependent Variable: Firm Performance						
	Models						
	1	2	3	4	5	6	7
Ln(Size)	−0.032*	−0.27*	−0.12	−0.16	−0.18	−0.23	−0.22*
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Ln(Age)	0.07	0.22	0.53*	0.42	0.43	0.43	0.48*
	(0.27)	(0.25)	(0.24)	(0.23)	(0.23)	(0.23)	(0.23)
Environmental Uncertainty	0.69	0.13	0.41	0.45	0.38	0.42	0.45
	(0.36)	(0.39)	(0.36)	(0.36)	(0.36)	(0.35)	(0.35)
Dynamism	0.05	−0.02	−0.004	−0.01	−0.01	−0.01	−0.01
	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Variation		1.30***	1.28***	1.26***	−2.53***	−2.50***	−2.47***
		(0.21)	(0.19)	(0.19)	(0.83)	(0.82)	(0.82)
Selection			1.39***	1.07***	1.05***	2.63***	2.58***
			(0.19)	(0.19)	(0.19)	(0.82)	(0.82)
Retention				0.61***	0.63***	0.57***	−1.57*
				(0.18)	(0.18)	(0.18)	(0.81)
Variation^2					0.21	0.21	0.21
					(0.13)	(0.13)	(0.13)
Selection^2						−0.26*	−0.25*
						(0.13)	(0.13)
Retention^2							0.15
							(0.12)
R^2	0.05	0.20	0.32	0.36	0.37	0.38	0.39
Adjusted R^2	0.03	0.18	0.30	0.34	0.34	0.35	0.36
ΔAdjusted R^2		0.15**	0.12**	0.04**		0.01*	0.01
F	2.47*	9.81***	15.07***	15.17***	13.68***	12.79***	11.71***

Standard errors are in parentheses.
*$p<0.05$.
**$p<0.01$.
***$p<0.001$.

analyses, performance varies non-monotonically with selection, the coefficient for the first order variation parameter is positive and significant until the second-order variation term is included, and the coefficient for the second-order variation parameter is positive and significant. Consistent with the first set of analyses, the coefficients for the retention parameters are not significant.

Table 4. The Impact of Variation, Selection and Retention on Firm Performance (Models with Different Order of Entry for Independent Variables vs. Models in Table 2).

Variables	Dependent Variable: Firm Performance						
	Models						
	1	2	3	4	5	6	7
Ln(Size)	−0.032*	−0.26*	−0.27*	−0.17	−0.22*	−0.23*	−0.22*
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)
Ln(Age)	0.07	0.23	0.25	0.42	0.42	0.41	0.46*
	(0.27)	(0.24)	(0.23)	(0.22)	(0.22)	(0.23)	(0.23)
Environmental Uncertainty	0.69	0.22	0.12	0.39	0.44	0.44	0.46
	(0.36)	(0.36)	(0.36)	(0.35)	(0.35)	(0.35)	(0.35)
Dynamism	0.05	−0.06	−0.05	−0.03	−0.02	−0.02	−0.02
	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Variation		3.27***	−4.28	−4.82	−6.31	−6.51	−4.94
		(0.41)	(3.58)	(3.33)	(3.40)	(3.45)	(3.66)
Variation^2			1.17*	1.14*	1.35*	1.37***	1.12*
			(0.54)	(0.51)	(0.52)	(0.52)	(0.53)
Selection				1.76***	7.72*	7.61*	8.26*
				(0.38)	(3.13)	(3.15)	(3.19)
Selection^2					−0.91*	−0.90*	−0.99*
					(0.47)	(0.48)	(0.48)
Retention						0.20	−4.93*
						(0.53)	(4.13)
Retention^2							0.85
							(0.67)
R^2	0.05	0.30	0.32	0.39	0.40	0.41	0.41
Adjusted R^2	0.03	0.29	0.30	0.37	0.38	0.38	0.38
ΔAdjusted R^2		0.26**	0.01*	0.07**	0.01*		
F	2.47*	16.74***	15.01***	17.25***	15.77***	13.97***	12.77***

Standard errors are in parentheses.
*$p<0.05$.
**$p<0.01$.
***$p<0.001$.

For the most part, the various angles capture the same snapshot with subtle differences. Evidence regarding the relationship between internal VSR activities and firm performance is summarized as follows:

(1) Performance varies in an inverted U-shape with selection.
(2) Performance increases with increases in the amount of a firm's variation activity.

DISCUSSION

Our theory suggests that, in combination, internal VSR activities underlie a firm's dynamic capability. Following Winter (2000, 2003), dynamic capabilities govern the rate of change of ordinary capabilities. Building on this work, we argued that firms must balance the rates and resulting amounts of variation, selection, and retention activities. As a first step in understanding the relationship between VSR activities and firm performance, we relate the behaviors underlying intrafirm variation, selection and retention rates to firm performance. We hypothesized that performance varies non-monotonically (following an inverted U-shape) with a firm's internal variation, selection and retention activities. Our results are partially consistent with the hypotheses. Firm performance varies according to an inverted U-shape pattern with selection. High or low amounts of administrative and cultural control adversely impact performance. The non-monotonic relationship between performance and variation is neither corroborated nor refuted. Instead, results suggest that firm performance increases as variation increases within the range of variable values observed in our study. A lack of support exists for the hypothesis that too much or too little retention is associated with low firm performance, suggesting a possible need to revisit our construct for representing retention, or even to rethink the effects of retention on overall VSR activities.

It is worth noting some of the limitations of this work. For one, the measures for the independent and dependent variables serve as proxy measures of varying quality. In general, constructs and measures of the independent variables seem to align with the theoretical definitions, but may not be as valid as one might prefer. A better alignment between theoretical and operational definitions might be achieved by incorporating more objective measures of VSR rates and amounts and firm performance. As mentioned, this cross-sectional study is only one step towards establishing a link between internal VSR activities and firm performance. However, more dynamic analyses would be desirable. For instance, a systematic longitudinal study that tracks the VSR activities of all the firms competing in an industry and examines how these activities affect the firms' performance over time could further inform the study of evolution across levels of analysis.

Second, a possible common method variance (CMV) problem exists (all data stem from the same questionnaire), though the findings seem to argue against this possibility. The lack of a statistically significant retention effect finding goes against CMV expectations – why would executives not, following conventional wisdom, make connections between change orientation in shifting environments and higher performance? The non-monotonic nature of the selection finding seems unlikely to be CMV-caused, since the potential dysfunctionalities that can result from too much variation and selection (analysis and procedure) may lie outside conventional managerial wisdom. The performance/variation result could indicate CMV, but if this were so, consistency would suggest that respondents would also make connections between variation and environmental uncertainty and dynamism, which they do not appear to do. We conclude that if there is a CMV effect, it is not consistent or obvious, and it should not turn off or on depending on which variable is picked. One might consider substituting "hard" constructs and measures such as ROI or stock returns in place of the "managerial perceptions" used in this study, but there are usually as many issues surrounding use of hard measures as use of perceptual measures. Studies using both kinds of constructs and measures would be useful.

Third, while this research controls for environmental uncertainty, dynamism, firm size, and age, it lacks assessment of other environmental and firm characteristics. Firms in the sample compete in different industries and face different sets of environmental pressures; these differences may affect the relative importance of intrafirm rates of change *versus* external rates of change. For example, a firm in an industry with rapid ongoing change may find that the required VSR balance differs from that required in a firm facing a slower rate of environmental change. Including additional metrics for industry-specific rates of change might further inform our hypothesizing and sharpen our results. Alternatively, future research might focus on a more refined set of industries and collect data on all the firms competing in each industry. Empirical analysis might then examine firm-specific VSR effects in each industry and provide a comparative analysis across industries.

On the firm side, hidden factors such as technological interdependencies, imprinting, or individuals adapting to a firm might influence intrafirm processes (Meyer, 1994; Miner, 1994). While we control for two firm characteristics (size and age) common in studies explaining firm performance, given our sample size we are not able to control for unobserved heterogeneity in the traditional way – by including a dummy variable for each firm. As discussed above, the effects for firm size and age are statistically significant in the full models for each set of specifications.

We now discuss the findings in the context of the foregoing limitations. Our results show that natural selection at the *intrafirm* level of analysis partially explains performance at the *firm* level. Thus, the selection activities that drive Darwinian evolution within an industry may guide or inform VSR activities that drive Lamarckian evolution within a firm in that industry.

The question for future research remains: What balance among VSR activities – as essential components of a dynamic capability – is necessary to enhance performance in a competitive environment? Our results provide some direction for future research. High firm performance is positively associated with high rates of variation. This suggests, in effect, that the greater the amount of variations a firm generates, the higher likelihood that some of the variations it generates may lead to enhanced performance (Aldrich, 1979; Weick, 1979). It is possible that our sample of firms had not reached the dysfunctionalities that can result from inappropriately high rates of variation – many firms have trouble reaching adequate levels of innovation activity, let alone too much. This may be the reason why there is no indication in our study of the right (downward sloping) side of the inverted U effect that we hypothesized. We do find that too much or too little selection tends to adversely affect performance. In combination, these results suggest that a large number of trials (high rates of variation) in conjunction with a moderate amount of selections (moderate rates of selection), may be associated with higher firm performance. The regression analyses using factor scores (Table 3) also suggest that firms with high retention rates (i.e., behaviors reinforcing previous selections) experience higher levels of performance than firms with low retention rates. In other words, the firms in our study appear to be at least somewhat better off if they exploit their past experience than if they do not.

While multicollinearity tests indicate independence among the variables, potential variance overlap may exist between variation and selection, based on the nature of the constructs. For example, the rate at which a firm's managers select variations may influence the rate at which employees generate variations. In effect, selection processes may serve as a signaling device between managers and employees who could become involved in experimentation efforts. Moreover, extensive control mechanisms may constrain experimentation and retention activities – a condition that may be a characteristic of the sample's strong representation of large, old firms (average age = 69 years). Research shows that large, old firms are more prone to bureaucratic rigidity effects (Haveman, 1993). However, the positive association between performance and the second order effect for variation in these firms seems to argue against this simple explanation.

CONCLUSIONS

This chapter attempts to establish links between firm performance and a firm's internal VSR activities. An underlying theoretical goal was to enhance our understanding of the relationship between natural selection and adaptation. The findings provide partial evidence that selection and adaptation are not mutually exclusive, but are linked via internal selection processes. The results suggest that managerial action can influence a firm's internal evolutionary processes and, in turn, the evolutionary context in which the firm is embedded. This contradicts strict environmental determinism views that the nature and distribution of resources in the environment play a larger role in organizational evolution than the internal operation of the organization. Moreover, examining the mechanisms through which internal VSR activities may function helps to draw together previously distinct theoretical perspectives and lines of research.

Our results suggest several avenues for future empirical research, including

(1) Additional testing of the relationship between intrafirm VSR rates and firm performance.
(2) Evaluating the interactions between micro and macro, or internal and external, evolutionary processes when VSR "engines" are present at multiple levels.
(3) Testing potential specific drivers of variation, selection and retention.
(4) Examining different environmental conditions and their performance relationship to VSR rates of firms.
(5) Investigating the implications for firm performance of reinforcing and constraining interdependencies among VSR activities.
(6) Comparing the importance of balanced continuity in VSR processes to other internal processes that might foster dynamic capability.

Such research could refine our basic hypotheses by identifying the conditions that qualify the hypotheses as they apply in various contexts.

In conclusion, the theory and research presented here propose that adaptation and selection are interrelated processes of change and that evolutionary attributes at the *intrafirm* level are partially associated with performance outcomes at the *firm* level of analysis. Our empirical tests of VSR activities relative to firm performance suggests that VSR processes do operate at multiple levels of analysis and that intrafirm VSR activities, in combination, are positively associated with adaptive outcomes that maintain or improve performance.

Clearly, we have not resolved the debate between Lamarckian adaptation and Darwinian selection theorists, but we believe we have shown how an internal Darwinian engine may drive a Lamarckian adaptation process. Adopting an exclusively *firm-level* selection or adaptation view misses insights, which may be gained when these theories of evolution are seen as interrelated *intrafirm* processes of change.

Last, our findings offer some preliminary insight into the nature of the evolutionary principles and change processes underlying the dynamic capabilities concept that is important in both the competence- and the resource-based views in strategic management. By drawing attention to vertical interactions across the evolutionary hierarchy of intrafirm processes, firm, and industries, this chapter highlights potentially rewarding lines of inquiry in the study of organizational evolution, dynamic capabilities, knowledge management, and competence development.

NOTES

1. Though Levins' classic 1968 book is the basis of organizational population ecology studies (Hannan & Freeman, 1977), he also observed that mutation rates driving micro-coevolution should be higher in changing environments (1968, p. 97). Indeed, since the 1930s biologists have debated the principle causes of selection, whether individual, species, population, or geographical. Fisher's (1930) fundamental theorem of natural selection holds that "*the rate of evolution of a character at any time is proportional to its additive genetic variance*…" (Slatkin, 1983, p. 15; our italics). Density- and frequency-dependent effects, that is, population-level effects, moderate this theorem, however. This focuses our attention on the relative rates of *intra*individual variation vs. population, ecological, and geographic variation (Slatkin, 1983). In our study, the "intraindividual" is the intrafirm or intra-organization level of analysis.
2. We think balance may be interpreted in two ways: (1) the traditional "March 1991" way which is "equal portions at the same time;" and (2) a more recent "dynamic rhythm" way (Thomas, Kaminska-Labbé, & McKelvey, forthcoming) in which there is timely and rhythmic oscillation among the three VSR elements.

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REFERENCES

Aldrich, H. (1979). *Organizations and environments*. Englewood Cliffs, NJ: Prentice-Hall.
Aldrich, H. (1999). *Organizations evolving*. Thousand Oaks, CA: Sage.

Amburgey, T. L., Kelly, D., & Barnett, W. P. (1993). Resetting the clock: The dynamics of organizational change and failure. *Administrative Science Quarterly*, *38*, 51–73.

Ancona, D. G., & Caldwell, D. F. (1998). Rethinking team composition from the outside in. In: M. A. Neale, E. A. Mannix & D. H. Gruenfeld (Eds), *Research on managing groups and teams* (Vol. 1, pp. 21–38). Greenwich, CT: JAI Press.

Andrews, K. R. (1980). *The concept of corporate strategy*. Homewood, IL: Richard D. Irwin.

Argote, L. (1999). *Organizational learning: Creating, retaining and transferring knowledge*. Boston, MA: Kluwer.

Argote, L., McEvily, B., & Reagans, R. (2003). Managing knowledge in organizations: An integrative framework and review of emerging themes. *Management Science*, *49*(4), 571–582.

Barney, J. B. (1989). Asset stock accumulation and sustained competitive advantage: A comment. *Management Science*, *35*, 1511–1513.

Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*, 99–120.

Barron, D. N., West, E., & Hannan, M. T. (1994). A time to grow and a time to die: Growth and mortality in credit unions in New York city, 1914–1990. *American Journal of Sociology*, *100*, 381–421.

Baum, J. A. C. (1996). Organizational ecology. In: S. R. Clegg, C. Hardy & W. Nord (Eds), *Handbook of organization studies* (pp. 77–114). London: Sage.

Baum, J. A. C., & Singh, J. V. (1994a). *Evolutionary dynamics of organizations*. NY: Oxford University Press.

Baum, J. A. C., & Singh, J. V. (1994b). Organization–environment coevolution. In: J. A. C. Baum & J. V. Singh (Eds), *Evolutionary dynamics of organizations* (pp. 379–402). NY: Oxford University Press.

Bennis, W. G., Benne, K. D., Chin, R., & Corey, K. E. (1976). *The planning of change*. NY: Holt, Rinehart and Winston.

Burgelman, R. A. (1991). Intraorganizational ecology of strategy-making and organizational adaptation: Theory and field research. *Organization Science*, *2*, 239–262.

Burgelman, R. A. (1994). Fading memories: A process theory of strategic business exit in dynamic environments. *Administrative Science Quarterly*, *39*, 24–56.

Burns, T., & Stalker, G. M. (1961). *The management of innovation*. London: Tavistock.

Campbell, D. T. (1955). The informant in quantitative research. *American Journal of Sociology*, *60*, 339–342.

Campbell, D. T. (1969). Variation and selective retention in socio-cultural evolution. *General Systems*, *16*, 69–85.

Carley, K. M. (1999). Learning within and among organizations. *Advances in Strategic Management*, *16*, 33–53.

Carley, K. M., & Gasser, L. (1999). Computational organization theory. In: G. Weiss (Ed.), *Multiagent systems: A modern approach to distributed artificial intelligence* (pp. 299–330). Cambridge, MA: MIT Press.

Chakravarthy, B. S. (1982). Adaptation: A promising metaphor for strategic management. *Academy of Management Review*, *7*, 35–44.

Chandler, A. D., Jr. (1962). *Strategy and structure: Chapters in the history of the American industrial enterprise*. Cambridge, MA: MIT Press.

Child, J. (1972). Organization structure, environment, and performance: The role of strategic choice. *Sociology*, *6*, 1–22.

Cyert, R. M., & March, J. G. (1963). *A behavioral theory of the firm*. Englewood Cliffs, NJ: Prentice-Hall.

Darr, E. D., Argote, L., & Epple, D. (1995). The acquisition, transfer, and depreciation of knowledge in service organizations: Productivity in franchises. *Management Science*, *41*, 1750–1762.

Delacroix, J., & Swaminathan, A. (1991). Cosmetic, speculative, and adaptive organizational change in the wine industry: A longitudinal study. *Administrative Science Quarterly*, *36*, 631–661.

Duncan, R. (1972). Characteristics of organizational environments and perceived environmental uncertainty. *Administrative Science Quarterly*, *17*, 313–327.

Fiol, C. M., & Lyles, M. A. (1985). Organizational learning. *Academy of Management Review*, *10*, 803–810.

French, W. L., Bell, C. H., Jr., & Zawacki, R. A. (1994). *Organization development* (4th ed.). Burr Ridge, IL: Irwin.

Freeman, J., Carroll, G. R., & Hannan, M. T. (1983). The liability of newness: Age dependence in organizational death rates. *American Sociological Review*, *48*, 692–710.

Galunic, D. C., & Eisenhardt, K. M. (1996). The evolution of intracorporate domains: Divisional charter losses in high technology, multidivisional corporations. *Organization Science*, *7*, 255–282.

Goldschmidt, W. (1976). Biological versus social evolution. *American Psychologist*, *31*, 355–357.

Goodman, P. S., & Associates (1982). *Change in organizations: New perspectives on theory, research and practice*. San Francisco: Jossey-Bass.

Grandori, A., & Kogut, B. (2002). Dialogue on organization and knowledge. *Organization Science*, *13*, 224–231.

Hambrick, D. C., & D'Aveni, R. A. (1988). Large corporate families as downward spirals. *Administrative Science Quarterly*, *33*, 1–23.

Hannan, M., & Freeman, J. (1977). The population ecology of organizations. *American Journal of Sociology*, *83*, 929–984.

Hannan, M., & Freeman, J. (1984). Structural inertia and organizational change. *American Sociological Review*, *49*, 149–164.

Haveman, H. (1993). Organizational size and change: Diversification in the savings and loan industry after deregulation. *Administrative Science Quarterly*, *38*, 20–50.

Heene, A., & Sanchez, R. (1997). *Competence-based strategic management*. Chichester: Wiley.

Helfat, C., & Peteraf, M. (2003). The dynamic resource-based view: Capability lifecycles. *Strategic Management Journal*, *24*, 997–1010.

Henderson, R., & Clark, K. C. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly*, *35*, 9–30.

Hoopes, D. G., Madsen, T. L., & Walker, G. (2003). Why is there a resource-based view? Toward a theory of competitive heterogeneity. *Strategic Management Journal*, *24*, 889–902.

Hoopes, D. G., & Postrel, S. (1999). Shared knowledge, glitches, and product development in a scientific software company. *Strategic Management Journal*, *20*, 837–865.

Hutchins, E. (1990). The technology of team navigation. In: J. Galegher, R. E. Kraut & C. Egido (Eds), *Intellectual teamwork* (pp. 191–220). Hillsdale, NJ: Erlbaum.

Hutchins, E. (1991). The social organization of distributed cognition. In: L. B. Resnick, J. M. Levine & S. D. Teasley (Eds), *Perspectives on socially shared cognition* (pp. 283–307). Washington, DC: American Psychological Association.

Kanter, R. (1983). *The change masters*. NY: Simon & Schuster.

Kanter, R., Stein, B., & Jick, T. (1992). *The challenge of organizational change*. NY: The Free Press.

Khandwalla, P. N. (1977). *The design of organizations*. NY: Harcourt Brace Jovanovich.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, *3*, 383–397.

Lamarck, J. B. (1809). In: H. Elliot, (Trans.), Zoological philosophy. NY: Hafner. Reprinted 1963.

Lawler, E. E., III. (1991). Strategic choices for changing organizations. In: A. M. Mohrman, S. A. Mohrman, G. E. Ledford, T. G. Cummings, E. E. Lawler III & Associates (Eds), *Large scale organizational change*. San Francisco: Jossey Bass.

Lawrence, P. R., & Lorsch, J. W. (1967). *Organization and environment: Managing differentiation and integration*. Cambridge, MA: Graduate School of Business Administration, Harvard University.

Levinthal, D. (1991). Organizational adaptation and environmental selection – interrelated processes of change. *Organization Science*, *2*, 140–145.

Levinthal, D. A., & March, J. (1993). The Myopia of learning. *Strategic Management Journal*, *14*(8), 95–112.

Levitt, B., & March, J. (1988). Organizational learning. *Annual Review of Sociology*, *14*, 319–400.

Lippman, S. A., & Rumelt, R. P. (1982). Uncertain imitability: An analysis of interfirm differences in efficiency under competition. *Bell Journal of Economics*, *13*, 418–438.

Loasby, B. J. (1998). The organisation of capabilities. *Journal of Economic Behavior & Organization*, *35*, 139–160.

Lounamaa, P., & March, J. G. (1987). Adaptive coordination of a learning team. *Management Science*, *33*, 107–123.

Madsen, T. L. (1997). *Integrating organizational evolution and strategy: Intrafirm evolutionary processes and competitive dynamics*. Dissertation, University of California, Los Angeles.

Madsen, T. L., & McKelvey, B. (1996). ''Drawinian dynamic capability: Performance effects of balanced intrafirm selection processes,'' Best papers proceedings, Business policy and strategy division, Academy of management, pp. 26–30.

Madsen, T. L., Mosakowski, E., & Zaheer, S. (2002). The dynamics of knowledge flows: Human capital mobility, knowledge retention and firm change. *Journal of Knowledge Management*, *6*, 164–176.

Madsen, T. L., Mosakowski, E., & Zaheer, S. (2003). Knowledge retention and personnel mobility: The non disruptive effects of inflows of experience. *Organization Science*, *14*, 173–191.

March, J. (1991). Exploration and exploitation in organizational learning. *Organization Science*, *2*, 71–87.

Mayr, E. (1982). *The growth of biological thought*. Cambridge, MA: Belknap/Harvard.

McKelvey, B. (1982). *Organizational systematics: Taxonomy, evolution and classification*. Berkeley, CA: University of California Press.

McKelvey, B. (1994). Evolution and organization science. In: J. A. C. Baum & J. V. Singh (Eds), *Evolutionary dynamics of organizations* (pp. 314–326). NY: Oxford University Press.

McKelvey, B., & Aldrich, H. (1983). Populations, natural selection and applied organizational science. *Administrative Science Quarterly*, *28*, 101–128.

Meyer, M. W. (1994). Turning evolution inside the organization. In: J. A. C. Baum & J. V. Singh (Eds), *Evolutionary dynamics of organizations* (pp. 109–116). NY: Oxford University Press.

Meyer, M. W., & Zucker, L. G. (1989). *Permanently failing organizations*. Newbury Park, CA: Sage.

Miles, R. E., & Snow, C. C. (1978). *Organizational strategy, structure and process*. San Francisco: McGraw-Hill.

Miner, A. S. (1994). Seeking adaptive advantage: Evolutionary theory and managerial action. In: J. A. C. Baum & J. V. Singh (Eds), *Evolutionary dynamics of organizations* (pp. 76–89). NY: Oxford University Press.

Moreland, R. L., & Myaskovsky, L. (2000). Exploring the performance benefits of group training: Transactive memory or improved communication? *Organizational Behavior and Human Decision Processes*, *82*, 117–133.

Nadler, D. A., & Tushman, M. L. (1988). *Strategic organization design: Concepts, tools and process*. IL: Scott, Foresman and Co.

Nadler, D. A., & Tushman, M. L. (1991). Leadership for organizational change. In: A. M. Mohrman Jr., S. A. Mohrman, G. E. Ledford Jr., T. G. Cummings, E. E. Lawler III & Associates (Eds), *Large scale organizational change* (pp. 100–119). San Francisco, CA: Jossey-Bass.

Nelson, R. R., & Winter, S. G. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Belknap/Harvard.

Paulus, P. B., & Yang, H.-C. (2000). Idea generation in groups: A basis for creativity in organizations. *Organizational Behavior and Human Decision Processes*, *82*, 76–87.

Penrose, E. T. (1952). Biological analogies in the theory of the firm. *American Economic Review*, *42*, 804–819.

Peters, T. J., & Waterman, R. H. (1982). *In search of excellence: Lessons from America's best-run companies*. NY: Harper and Row.

Pfeffer, J., & Salancik, G. R. (1978). *The external control of organizations*. NY: Harper & Row.

Phillips, L. W., & Bagozzi, R. P. (1986). On measuring organizational properties of distribution channels: Methodological issues in the use of key informants. *Research in Marketing*, *8*, 313–369.

Podsakoff, P. M., & Organ, D. W. (1986). Self reports in organizational research: Problems and prospects. *Journal of Management*, *124*, 531–544.

Prusak, L. (1996). The knowledge advantage. *Strategy & Leadership*, *24*, 6–8.

Romanelli, E., & Tushman, M. L. (1994). Organizational transformation as punctuated equilibrium: An empirical test. *Academy of Management Journal*, *37*, 1141–1166.

Sanchez, R. (2000). Managing knowledge into competences: The five learning cycles of the competent organization. In: R. Sanchez (Ed.), *Knowledge management and organizational competence* (pp. 1–21). Oxford: Oxford University Press.

Sanchez, R., & Heene, A. (2004). *The new strategic management: Organization, competition, and competence*. NY and Chichester: John Wiley.

Schumpeter, J. A. (1934). *The theory of economic development*. Cambridge, MA: Harvard University Press.

Siedler, J. (1974). On using informants: A technique for collecting quantitative data and controlling measurement error in organization analysis. *American Sociological Review*, *39*, 816–831.

Singh, J. V., House, R. J., & Tucker, D. J. (1986). Organizational change and organizational mortality. *Administrative Science Quarterly*, *31*, 171–193.

Slatkin, M. (1983). Genetic background. In: D. J. Futuyma & M. Slatkin (Eds), *Coevolution* (pp. 14–32). Sunderland, MA: Sinauer.

Stinchcombe, A. L. (1965). Social structure and organizations. In: J. G. March (Ed.), *Handbook of organizations* (pp. 153–193). Chicago: Rand McNally.

Teece, D. J., Pisano, G., & Shuen, A. (1994). Dynamic capabilities and strategic management. CCC Working Paper #94-9, Center for Research in Management, Berkeley, UC.

Thomas, C., Kaminska-Labbé, R., & McKelvey, B. (2005). Managing the MNC and exploitation/exploration dilemma: From static balance to dynamic oscillation. In: G. Szulanski, J. Porac & Y. Doz (Eds), *Advances in strategic management* (Vol. 22).

Thompson, J. D. (1967). *Organizations in action*. NY: McGraw-Hill.

Tushman, M. L., & Romanelli, E. (1985). Organizational evolution: A metamorphosis model of convergence and reorientation. In: L. L. Cummings & B. M. Staw (Eds), *Research in organizational behavior*, *14*, 311–347.

Ulrich, D., Von Glinow, M., Jick, T., Yeung, A., & Nason, S. (1993). Learning organization, culture change, and competitiveness: How managers can build learning capability. Research Prospectus, School of Business Administration, University of Michigan, Ann Arbor, MI.

Usher, J. M., & Evans, M. G. (1996). Life and death along gasoline alley: Darwinian and lamarckian processes in a differentiating population. *Academy of Management Journal*, *39*, 1428–1466.

Van Valen, L. (1992). Ecological species, multispecies, and oaks. In: M. Ereshefsky (Ed.), *The units of evolution: Essays on the nature of species* (pp. 69–77). Cambridge, MA: MIT Press.

Venkatraman, N., & Ramanujam, V. (1986). Measurement of business performance in strategy research: A comparison of approaches. *Organization Science*, *4*, 801–814.

Walsh, J. P., & Ungson, G. R. (1991). Organizational memory. *Academy of Management Review*, *16*, 57–91.

Weick, K. (1979 (1969)). The social psychology of organizing. Reading, MA: Addison-Wesley.

Winter, S. G. (2000). The satisficing principle in capability learning. *Strategic Management Journal*, *21*, 981–996.

Winter, S. G. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, *24*, 991–995.

Zollo, M., & Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, *13*, 339–351.

Zott, C. (2003). Dynamic capabilities and the emergence of intra-industry differential firm performance: Insights from a simulation study. *Strategic Management Journal*, *24*, 97–126.

Zucker, L. G. (1983). Organizations as institutions. In: S. B. Backarack (Ed.), *Research in the sociology of organizations* (pp. 1–47). Greenwich, CT: JAI Press.

Zucker, L. G. (1987). Normal change or risky business: Institutional effects on the hazard of change in hospital organizations, 1959–79. *Journal of Management Studies*, *24*, 671–701.

ORGANIZATION AS A LIVING COMPOSITION THAT LEARNS AND EVOLVES BY PRODUCING ITSELF☆

Marjatta Maula

ABSTRACT

Organizations may be regarded as living systems that learn and evolve by co-evolving with their environmental context within their business eco-system and by continually producing themselves. The processes of learning and renewal that drive continuous co-evolution and self-production can be explained by a living composition® model, an interpretation of autopoiesis theory applied to self-producing, living systems. The living composition model defines ten strategic components and boundary elements that enable learning and renewal of an organization. An organization can be regarded as a living, self-producing system that learns and evolves by producing its strategic components and boundary elements continuously and simultaneously through interacting patterns. The model also distinguishes two major kinds of knowledge flows – sensing and memory – that enable the concurrent functioning and co-evolution of an organization. The model thus helps to understand how an organization can meet the

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requirements for simultaneous creativity and efficiency in organizations. The living composition model is applied to two case studies.

SELF-PRODUCTION AS AN ENABLER FOR ORGANIZATIONAL LEARNING AND RENEWAL

An organization may answer the controversial question of how to maintain simultaneous processes of creativity and efficiency by improving its capability to learn and renew itself. To understand better the phenomena of learning and renewal, there is need for positive theory development and for normative prescriptions that could support the development and implementation of appropriate organizational strategies, structures, and practices for learning and renewal.

Detail Complexity, Dynamic Complexity, and Self-Production

Theories about complexity can be useful for firms and other organizations. While *detail complexity* refers to a large number of details and variables that must be managed and that may overwhelm organizations and render them dysfunctional, *dynamic complexity* may be used as a turbocharger for improving organizational competences. Because both creativity and efficiency are necessary for organizations, the challenge for managers is understanding how to apply the ideas of dynamic complexity in an organizational context so that reasonable balance between freedom and control can be maintained. Dynamic complexity leads to cause and effect relationships that may be subtle and in which the effects of interventions may not be obvious (Senge, 1990). Complex systems are characterized by rich interconnections, iteration, holism, and fluctuations. Complexity arises from high levels of interaction and connectivity. Complex adaptive systems (CAS) are complex systems that have the capacity to create order from chaos and to generate new emergent properties in an accumulative manner (Kauffman, 1993; Holland, 1995, 1999). Examples of such capabilities include self-organizing and decentralized self-structuring processes (Doz & Prahalad, 1993), self-renewal (Nonaka, 1988; Chakravarthy & Doz, 1992), and emergent internal closure (Spender, 1996). Achieving self-organization and emergence in CAS, however, requires reduced control. Although certain basic approaches such as tagging, internal models, and building blocks have been identified to facilitate self-organization (Holland, 1995), they do not fully address the connectedness of viable organizational solutions and their impact on an organization's capability to evolve and to create and utilize knowledge.

The theory of self-production (autopoiesis) is another complexity theory that can help managers to understand alternative approaches to organizing organizational components in a structured way that enhances the potential for self-organization. Self-production is a phenomenon characteristic of all living creatures. In the body that enables the life of an animal or a human being, the continual production and interconnection of its components enable its functioning as a living entity. Organizational components, including non-physical components, may be organized on the same principles.

In general, systems can be classified according to the complexity of the relationships between the components, as shown in Table 1 (Mingers, 1997, based on Boulding, 1956). Each new level of complexity brings new relationships and capabilities into a system, but may also simultaneously involve previous levels. Levels 4–8 in Table 1 include theories that, respectively, explain living (self-producing, autopoietic) systems (such as cells), multicellular systems, organisms with nervous systems, observing systems, and social systems. *Living systems* are complex systems that have been organized to be capable of self-production.[1]

Organizations: Living in their Own Right

According to Varela (1979), as long as the systemic requirements are met, there should be no limitations for extending the ideas of autonomy to the social realm. In fact, the theory of living systems can be applied in several ways to organizations, although attention should be paid to the specific nature of social systems as compared to biological systems.

There are several ways that autopoiesis theory may be applied to organizations. The mode of application is important, because claiming that an organization is truly autopoietic, and not just metaphorically so, raises significant ontological issues (Mingers, 1995). In metaphorical applications, basic characteristics of autopoietic systems such as boundaries, the production of components, organizational closure, autonomy, and structure dependence may be asserted, but do not specify the physical processes of component production. This chapter goes beyond metaphor to propose that an organization can be *a living* (*self-producing, autopoietic*) *system in the true sense of autopoiesis*. This approach regards an organization as an observing system that co-evolves with its complex environment – its *business*

Table 1. The Hierarchy of Complexity.

Level	Description	Characteristic	Type of Relation	Example
1	Structures and frameworks	Static, spatial patterns	*Topology* (where)	Bridge, mountain, table, crystal
2	Single mechanistic systems	Dynamic, pre-determined changes, processes	*Order* (when)	Solar system, clock, tune, computer
3	Control mechanisms, cybernetic systems	Error-controlled feedback, information	*Specification* (what)	Thermostat, body temperature system, auto-catalytic system
4	Living systems	Continuous self-production	*Autopoietic* relations	Cell, amoeba, single-celled bacteria
5	Multicellular systems	Functional differentiation	*Structural coupling* between cells (second-order autopoiesis)	Plants, fungi, moulds, algae
6	Organisms with nervous systems	Interaction with relations	*Symbolic*, *abstract* relations	Most animals (except, e.g., sponges)
7	Observing systems	Language, self-consciousness	Recursive, self-referential relations	Humans
8	Social systems	Rules, meanings, norms, power	*Structural coupling* between organisms (third-order autopoiesis)	Families, organizations
9	Transcendental systems			

Source: Mingers (1997), based on Boulding (1956).

ecosystem. An organization may improve its possibilities for co-evolution by creating and utilizing boundary elements.

Organization as a Living (Self-Producing, Autopoietic) Entity

An organization may be regarded as an autopoietic cognitive entity rather than a collection of individual brains (von Krogh & Vicari, 1993). It may observe, communicate, and understand itself and use knowledge and rules of interpretation that differ from those of any individual. This means that an organization is a system that carries its own knowledge and must be studied as such (von Krogh & Roos, 1995). "The firm is an autopoietic cognitive system and must be regarded as autonomous with respect to knowledge, creation of information, and the application of distinctions and norms. This autonomy stems from the self-referential characteristics of the firm" (von Krogh & Vicari, 1993, p. 399).

Self-production in an organization can be interpreted either in a proactive or passive way. The proactive interpretation emphasizes an organization's possibilities to co-evolve with the environment by utilizing its boundary elements, as well as the capability to learn from interactions and to influence one's own fate. The proactive interpretation may lead to methods, processes, and managerial practices that help to continually improve the organization in the larger context of a business ecosystem. The passive interpretation emphasizes an organization's closure, separating boundaries, isolation, and a limited capability to react to external triggers. It may lead to a pessimistic view of an organization's ability to learn and renew (Table 2).

Table 2. Proactive and Passive Interpretation of Living Organizations.

	Proactive Interpretation	Passive Interpretation
Boundary	Connects an organization to its environment through reciprocal interaction	Separates an organization from its environment
Relationship to the environment	Interactively open toward the environment. An organization learns and renews itself through experimentation, reciprocal interaction, and exposure to triggers from the environment. It selects autonomously whether to change or not.	Closed (isolated) toward the environment. An organization cannot change itself, and the environment cannot directly instruct the organization.
Knowledge and self-referentiality	Enable learning from earlier experience	Limit learning
Internal 'structure' (living composition)	Provides a platform for learning and continuous renewal	Is a source of rigidity

LIVING COMPOSITION AS AN ENABLING STRUCTURE OF AN ORGANIZATION

The living composition®[2] model is a new interpretation of autopoiesis theory that aims to explain the enabling structure and dynamics of organizational learning and renewal. The living composition model holds that organizations satisfy certain specified requirements of an autopoietic system, such as the continual production of an organization's components in co-evolution with the environment. Therefore the model describes an organization's major components and knowledge flows. In the living composition model, organizations produce their own non-physical strategic components and boundary elements in a continuous manner. They learn and renew themselves, thereby improving their chances of survival and success. In a living organization, the components and their relationships constitute a composition that has emerged partly as a result of drift and partly through organizational design.

Defining the Living Composition Model and Its Strategic Components

The living composition model is based on the assumption that an organization evolves by producing its strategic components as simultaneous tracks in an interacting pattern. Ten strategic components have been identified as constituting the living composition of an organization. Preliminary ideas of potential components included generally known key characteristics of autopoietic systems, such as identity, triggers, knowledge (distinctions), and boundaries. These basic entities were supplemented by ideas concerning consistency among a system's components. In addition, the simultaneity of openness and closure in autopoietic systems was interpreted in the organizational context as practical solutions that facilitate 'sensing' (interactive openness) and 'memory' (self-referentiality) of an organization. A preliminary model of living composition was tested in a pilot project at PBS (Danish Payment Systems Ltd.) in Denmark. Feedback from managers suggested that the basic idea and structure of the composition were useful, but that further specification of the components was needed. An improved model was then used as a basis for interviewing managers and consultants in four case companies: Arthur Andersen (Business Consulting), Arthur D. Little (Europe), Ernst & Young (Management Consulting), and The KaosPilots and KaosManagement. The purpose of the case analysis was to test and improve the model. The interviews were taped, and the interview material as well as other company-related data were analyzed by using qualitative analysis software. Because, this analysis revealed new aspects that were relevant for an organization's learning and renewal capability, some components were divided into two and the definitions of the components were further refined.

Strategic Components

If an organization is self-producing, what does it produce? Although the definition of autopoiesis refers to the production of components that constitute the entity, and a boundary that separates the entity from the environment, ''the definition does not specify that these must be physical components, but if they are not, then what precisely is their domain of existence?'' (Mingers, 1995, pp. 120, 124).

One Component Type or Several Ones?

Some earlier interpretations of autopoietic organizations emphasize only one scaled component, such as communication or money (Luhmann, 1983, 1990), value (Vicari, 1991), or conversations (von Krogh & Roos, 1996). However, the richness of organizational solutions and behavior remains unexplained if only one characteristic is viewed as the sole component of autopoietic production. Thus, claiming that a company produces itself as a self-producing entity requires specifying the nature of the components it produces for itself.

Varela (1979) warns against defining autopoietic unities (such as a firm) as mere composites of lower-level autopoietic systems (such as human beings) without defining the relations of production in the resulting unit. Individual persons who act in organizations are not components of the organization's renewal system because they are not produced as a part of that process. Instead, they are connected indirectly to the organizational process through their boundary roles, task definitions, careers, and participation in workflows.

Because organizations are regarded as non-physical autopoietic entities, it is necessary also to define the non-physical components and boundaries of an organization. *Non-physical* autopoietic systems include human organizations, societies, and systems of laws or ideas that belong to abstract systems (Mingers, 1995, 1997). Although the theory itself does not specify what is to be produced in their autopoietic processes, the production of material boundaries and components – such as buildings, products, and human beings – does not belong to the domain of organizational autopoietic production.

The 10 Strategic Components

Drawing on the general characteristics of autopoiesis theory, and secondly on the analysis of case companies, the following 10 strategic components have been identified as constituting the strategic composition of an organization:

1. *Identity* means that the organization (system) maintains the integrity of its 'structure' and can be distinguished from the background and other units (von Krogh & Roos, 1995).
2. *Perception of the environment* means that living organizations create knowledge about their environment according to their own internal rules.
3. *Strategy* helps to operationalize visions and objectives into internal standards and processes. It is based on identity, perception of the environment, and other relevant aspects.
4. *Knowledge (distinctions) facilitates and regulates* the organization's self-production process.
5. *Boundaries (boundary elements)* include various embedded roles and functions that enable reciprocal interaction between the organization and its environment.[3] Boundary elements enable 'sensing' activities (interactive openness), such as experimentation.
6. *Interactive processes (structural and social coupling externally)* include the methods used to communicate reciprocally with the environment, for example with clients, and to influence the co-evolution of each with the other. They also include social coupling that refers to *communication among individuals externally*.
7. *Triggers (exposure to triggers, compensating for perturbations)* are perturbations that may lead to compensations in an organization's 'structure'. Triggers are not inputs to the organization per se. An organization can also be triggered internally.
8. *Experimentation* helps the organization to create new knowledge and learn about its environment through successes and failures. A company can shift from adaptive rational learning to experimental learning in order to facilitate learning and knowledge creation (Vicari, von Krogh, Roos, & Mahnke, 1996; von Krogh & Roos, 1995).
9. *Internal standards, processes, and communication (structural and social coupling internally)* include various elements that influence motivation and capability to learn, such as production processes, career structure, task definitions, and education – all of which occur in firm-specific

'packages'. They also include social coupling that refers to *communication among individuals internally*.

10. *Information and communication systems* may include a variety of more or less structured information systems.

The properties of and relationships among these strategic components determine their interactions and transformations in a dynamic network of interacting processes of autopoietic self-production. Two components, organizational knowledge and boundary elements, will now be discussed in more detail.

Organizational Knowledge as a Strategic Component

Cognitivist, Connectionist, and Autopoietic Viewpoints

Organizational knowledge can be analyzed from cognitivist, connectionist, and autopoietic viewpoints. The cognitivist and connectionist notions share two assumptions. First, an organization is directed to effectively resolve a required or pre-formulated task. In order to adapt successfully in the world, an organization functioning as a cognitive system must be able to identify and represent these tasks. Second, information processing is a basic activity of an organization. Acting analogously to the brain, information is taken in from the environment through the senses and activates various components in the network of components that compose the organization (von Krogh & Roos, 1995).

Connectionist and cognitivist approaches also differ. While cognitivists assume that information processing depends only on stimuli from the environment, connectionists claim that it may also arise within the system itself. The two approaches also assume that organizations acquire representations in different ways. Cognitivists regard learning as a process of creating increasingly accurate representations of the external world. Connectionists understand representation as resulting from global states in a history-dependent system where the learning of rules as well as the history of connections between the components affect present connections (von Krogh & Roos, 1995), so that the network as a whole learns from perceived patterns in its environment (Mingers, 1995).

In the view of autopoiesis, an organization can be regarded as a stream of knowledge in which distinctions are changing, new ones are being created, and old ones are being abandoned (von Krogh, Roos, & Yip, 1996).

Distinctions form the basis for 'knowledge landscapes' in which knowledge is scalable, shared among organizational members, and connected to the organization's history (von Krogh & Roos, 1995; von Krogh *et al*., 1996). The knowledge of a living organization is therefore evolving, temporary, and relative, rather than final and absolute. It is evaluated by its explanatory power, as well as by its capability to enable adequate operating (e.g., by viable procedures).

Table 3 summarizes the cognitivist, connectionist, and autopoietic assumptions about organizational knowledge.

Knowledge in a Living Organization

Knowledge can be defined as a capacity for making distinctions that enable effective or adequate behavior in a given context. New distinctions made, in turn, enable the development of new knowledge (von Krogh & Roos, 1995). In this way, knowledge (the ability to make useful distinctions) facilitates and regulates the autopoietic self-production process.

Table 3. Three Approaches to Knowledge.

Cognitivist View	Connectionist View	Autopoietic View
Knowledge represents the pre-given world (representationism). It enables problem-solving.	Knowledge represents the pre-given world (representationism). It enables problem-solving.	Knowledge is created, it is not just a representation. Knowledge enables problem definition.
Knowledge is universal and objective.	Knowledge is emergent and history-dependent.	Knowledge is emergent, history-dependent, self-referential, and context-sensitive. It is communicated and has meaning.
Knowledge is created through 'information processing' and by using categories (knowledge structures). It resides in individual and organizational memory.	Knowledge emerges by using simple rules and a few representations. It resides in the brains of individuals and in the connections (learning rules) between them.	Knowledge is based on distinction making through observation and experiencing. It is embodied in individuals as well as in the internal 'structure' and distinctions made within an organization.
Knowledge can be transferred.	Knowledge can be transferred.	Knowledge can be communicated through structural and social coupling, but not transferred like a commodity.

Based on Varela, Thompson, and Rosch (1993) and von Krogh and Roos (1995).

Firms as living organizations are autopoietic cognitive systems that are autonomous with respect to knowledge, creation of information, and application of distinctions and norms (Vicari, 1991; von Krogh & Vicari, 1993). Instead of being a mere end result of a knowledge creation process, knowledge is a component of the autopoietic process. It is therefore an essential component in a continuous organization-wide learning and renewal process that aims at survival and evolution. In this sense, an organization can be regarded as a stream of knowledge that drives a continuous re-creation of knowledge (von Krogh *et al*., 1996). Therefore, autopoiesis requires theories of knowing rather than theories of knowledge, and concepts of a system of knowing activity rather than notions of applications of abstract knowledge (Blackler, 1995; Spender & Grant, 1996).

Knowledge is created in response to stimulation or disturbance from the environment or by endogenous structural change. It is embodied in an organization's internal 'structure' in the form of improved distinctions, in changes in its 10 strategic components, and in their relationships. Organizational knowledge depends largely on the experiences of individual people (von Krogh & Roos, 1995), and exposure and sensitivity to the environment, boundary elements, and work processes influence the availability of new experiences for individuals. Knowledge flows commonly extend beyond geographic, temporal, hierarchical, functional, and organizational boundaries. Networking among employees at all levels of the organization is more relevant for the global accumulation and sharing of knowledge than conventional formal communication, such as vertical and horizontal knowledge flows among subsidiaries and headquarters. In the organizations studied as cases here, knowledge flows between employees, teams, and global knowledge bases rather than between organizational units.

Boundary Elements: Roles and Functions

A living (autopoietic) system is a unity contained within and producing identifiable boundaries consisting of non-physical *boundary elements* that connect the organization with the environment and enable interaction with it. They enable and maintain the reciprocal interaction and co-evolution between the organization and its environment.[4] They act as 'senses' of the organization and enable 'sensing' of the environment (interactive openness).

Boundary elements are defined by various *roles and functions*. They can be embedded in employees and other individual persons, groups, units, or information and communication systems. They may also consist of other kinds of advanced socio-technical solutions embodied in *roles*. For example, a project manager role can be 'embedded' in various persons within the organization. Project managers interact with clients, acquire experiences, and accumulate new knowledge about projects. Such roles are continually produced by the self-producing, autopoietic organization.

To be considered as a living system requires that an organization has identifiable boundaries, and that it is capable of continually producing a boundary, but does not require explicit definition of the boundary or require specific boundary elements. For example, Mingers (1995) simply suggests that the components involved must create a boundary defining the entity as a unity – that is, a whole interacting with its environment. Luhmann (1990) defines social systems as recursively closed systems with respect to communications, and boundaries are identified by the limits of interactions between people. Boundary can also be defined as the fundamental distinction between the system and its environment, although the nature of the distinction can vary with time and location. For example, in organizations as systems, "the boundary is created by individuals' knowledge pertaining to the organization-environment criterion. Each individual will form his or her own boundaries of the organization and recreate these dynamically as a part of their individual knowledge base" (von Krogh & Roos, 1995, p. 57). In this sense, the autopoietic notion of boundary differs fundamentally from various atomistic notions of boundaries in theories of firm.

An organization's learning and renewal is enabled by boundary elements that include various roles and functions. An organization can be connected to its environment in various ways, and the term 'boundary element' includes many ways to constitute boundaries. For example, roles and functions can be permanent or temporary, and they can be embedded in various ways. In contrast, 'boundary spanner', a familiar concept in organizational theory, has an established meaning that is not directly related to self-production (e.g., Scott, 1992), because a boundary spanner may be associated primarily with individuals and not with roles, functions, or information systems.

'Boundary' therefore does not refer here to the separation of the organization and its resources from its environment. Instead the living composition model emphasizes the active interaction of boundary elements – roles and functions – with the environment, leading to the organization's capability to absorb and create new knowledge. Boundary elements act like connecting absorption surfaces between an organization and its environment (Sivula, van den Bosch, & Elfring, 1997; Maula, 2000a).

'SENSING' AND 'MEMORY' IN A LIVING ORGANIZATION: TWO MAJOR-KNOWLEDGE FLOWS

Maintaining a living organization requires processes of *sensing* and *memory*, each of which constitutes a major knowledge flow. Sensing and memory are likely to be simultaneous and interconnected phenomena. Sensing helps to coordinate the functioning of an organization within its environment, while memory maintains an organization's capacity for autopoietic functioning and facilitates efficiency.

'Sensing' (Interactive Openness)

In order to survive, adapt, learn, and renew itself, a living organization needs to co-evolve reciprocally with its environment. Boundary elements influence an organization's learning and renewal capability by enabling three kinds of sensing activities:

1. Exposure or awareness of the organization to *triggers* – perturbations in the environment that elicit compensating reactions.
2. Interactive processes and communication with clients, suppliers, and other entities.
3. Experimentation through new forms of exposure to and interactions with its environment.

These activities enable an organization to maintain openness. In this way, autopoietic boundary elements function as connecting and absorbing elements, rather than as separating elements.

Sensing – the condition of *interactive openness* – thus refers to the way an organization interacts with its environment by being aware of and compensating for perturbations, by improving its knowledge (distinctions), and by changing internally. As an organization is exposed to its environment, its boundary elements and components are engaged in a process of mutual co-evolution (structural coupling) with the environment. An organization conducts experiments, interacts reciprocally with its environment, and compensates for triggers by making specific compensations in its living composition (internal structure). Some degree of interactive openness is thus necessary in creating and accumulating new knowledge that helps an organization sense and respond to its evolving environment.

'Memory' (Self-Referentiality)

von Krogh and Roos (1995) describe *organizational closure* as the condition that exists when environmental perturbations only trigger compensations in an organization in the form of internal reorganization and restructuring, rather than leading to changes in an organization's outputs and forms of feedback. Organizational closure may, however, improve an organization's self-referential capability to 'understand itself, to get access to own knowledge, and to utilize it'.

In this sense, living organizations have the property of being organizationally closed. They construct their reality in relation to their past and future. This self-referential capability gives an organization *memory*, without which an organization would depend only on external impulses without an ability to steer its own functioning. *Self-referentiality* therefore implies that an organization has a capacity for organizational closure.

While sensing helps organizations to navigate the turbulence in their environments and to co-evolve with them, memory maintains an organization's capacity for daily functioning by providing access to earlier knowledge and experiences. *Organizational memory* thus does not refer here only to accumulated data, but to the fundamental capability to access and interpret experiences that are stored in an organization's whole internal structure, in all its strategic components, and in its living composition.

Memory means that an organization's accumulated knowledge affects its functioning and learning. In the case examples to follow, the availability of globally accumulated knowledge enables firms' daily functioning and facilitates their learning and evolution. Having memory also means that an organization's functioning affects its acquisition and creation of new knowledge because its ways of interpreting and the methods it uses to accumulate knowledge influence its acquisition of new knowledge. In the case studies below, companies have developed screening mechanisms to identify new knowledge for their knowledge base. Fig. 1 presents graphically the knowledge flows that result from these relationships between sensing (interactive openness), memory (self-referentiality), and an organization's boundary elements.

DEFINITION OF LIVING COMPOSITION

A living organization can now be defined as an organization that produces its own strategic components and boundary elements and renews itself in

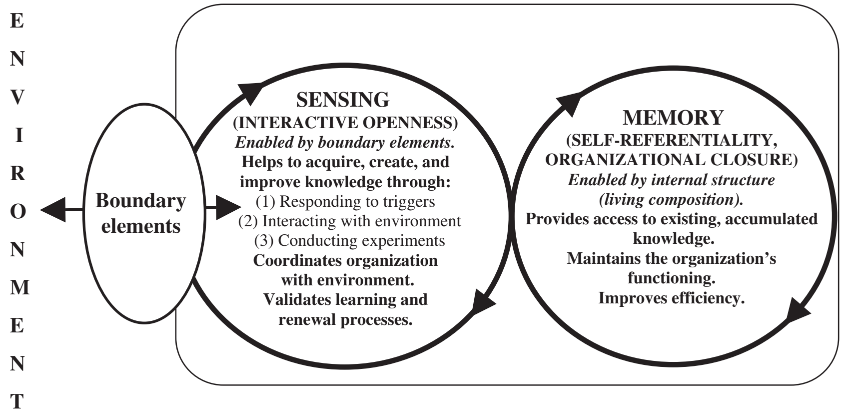

Fig. 1. Sensing and Memory: The Two Major Knowledge Flows of a Living Organization.

ways that allow the continuous maintenance of its identity. The components and their content are illustrated in Fig. 2.

The living composition model of a living organization can now be defined in the following way:

> A *living composition model* specifies the essential characteristics of living organizations. A living organization is a self-producing, autopoietic system that is composed of ten different strategic components, including boundary elements. Living composition describes the 'structure' of a living organization in which strategic components and their composition (interrelationships) determine an organization's evolutionary capability. An organization evolves by continually producing its strategic components as simultaneous tracks within a pattern of interactions. The production and interaction of the components and their interrelationships facilitate sensing (interactive openness) and memory (organizational closure) in an organization. These in turn enable both an organization's current efficiency and its capability to learn, to renew itself, and to co-evolve with its changing environment within its larger business ecosystem.

EXAMPLES OF LIVING ORGANIZATIONS

The following two case studies summarized below, Ernst & Young (Management Consulting) and The KaosPilots & KaosManagement, illustrate how the living composition model helps to analyze the components and dynamics of a living organization in a structured way.[5]

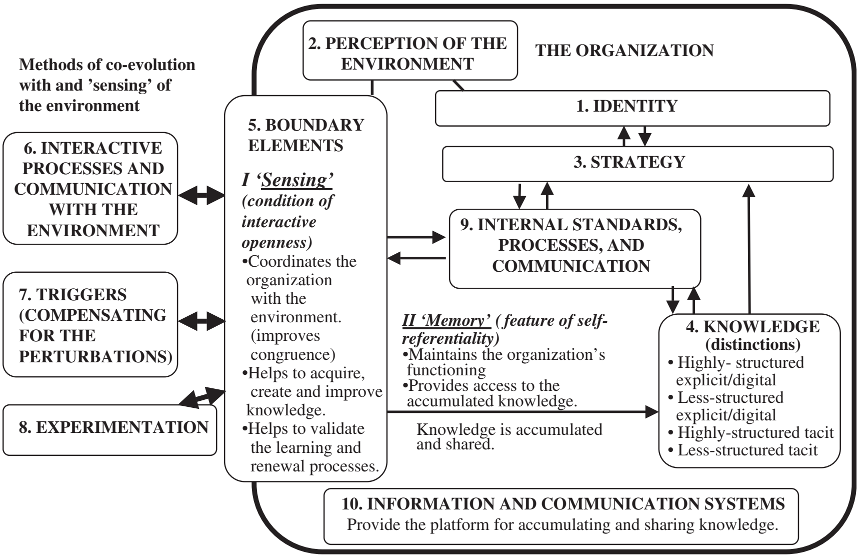

Fig. 2. Living Composition: 10 Strategic Components and Two Knowledge Flows.

Ernst & Young (Management Consulting)

Ernst & Young Management Consulting (now merged into Cap Gemini Ernst & Young) represents a large multinational consulting company composed of many local member companies. Rapid growth followed a merger between Ernst & Whinney and Arthur Young in 1989. Ernst & Young was one of the largest accounting and consulting companies in the world, operating globally in more than 130 countries and employing 84,000 professionals (in 2002). In 1997, before the merger with Cap Gemini, the revenues of the Management Consulting practice were US$2.7 billion, growing 29% that year. The company was classified as a strongly methodology-oriented company (Reimus, 1996, 1997) and as an information technology-oriented consulting firm (Consultants News, 1997). Fig. 3 shows the result of applying the living composition model to represent the strategic components and internal dynamics within Ernst & Young Management Consulting.

Ernst & Young's processes for learning and renewal have been consciously designed to support achievement of the firm's strategic objectives, and are aligned to maintain the firm's identity and ongoing perception of its environment. The firm's identity as a rapidly growing culture motivates the

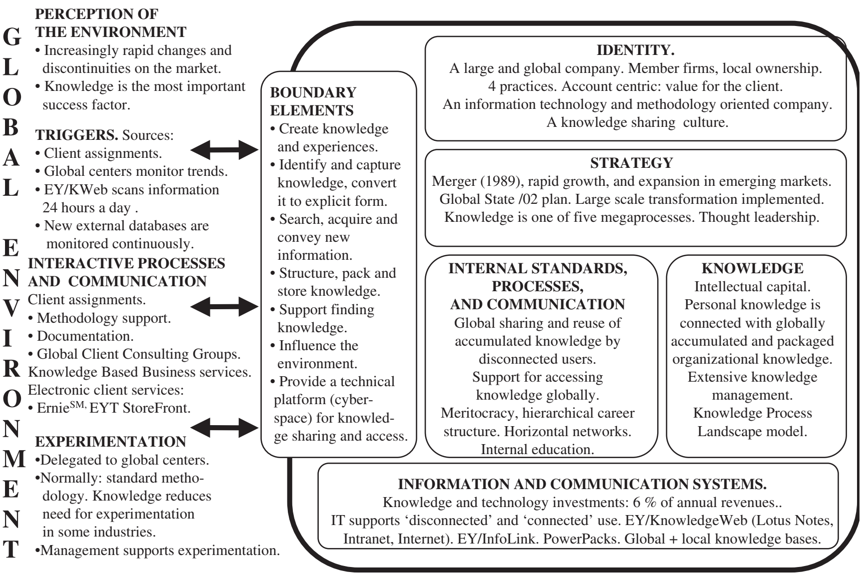

Fig. 3. The Strategic Components of Ernst & Young (Management Consulting).

firm to learn from its environment (sensing) and from its earlier experiences through processes for global knowledge sharing (memory). Ernst & Young perceives the environment as one of increasingly rapid changes and frequent discontinuities in its knowledge-based market. This perception and its strategy of 'thought leadership' have motivated the firm to develop communication and knowledge flows that facilitate openness and access to its knowledge. The firm supports these flows through an extensive knowledge management process and a global information and communication system. Ernst & Young supports connectivity internally and with the environment in a number of ways – for example, through a customized 'EY/Kweb' (Ernst & Young Knowledge Web) tool, and Ernie^{SM}, an 'artificial consultant' tool.

Through use of such tools, Ernst & Young improves its ability to co-evolve in a multinational environment through interactions with clients in assignments, by identifying triggers from external sources through EY/Kweb, and by conducting research and experiments in its global knowledge centers. Boundary elements, such as local partner roles, employee roles, and global center roles, support ongoing interactions with the environment. Information technologies facilitate communication with clients, and help to capture information and create knowledge from these relationships.

New knowledge is systematically structured and accumulated globally for knowledge-sharing purposes. Internal standards and processes (such as work processes and methodologies) are aligned with the firm's identity and strategy. Individual and organizational learning are linked together through standardized development curricula and education that are increasingly supplemented by 'chaotic' networks and communication. Extensive knowledge management processes help the company to collect, package, and store information and knowledge in 'PowerPacks' (CD-ROMs) and global knowledge bases. This structured knowledge accumulation process is supplemented by 'chaotic'[6] networks, such as Subject Matter Expert Networks that help to create and collect new knowledge about specific topics into PowerPacks. Access to the globally accumulated knowledge (an example of self-referentiality) in client assignments provides new knowledge for consultants. Efficient processes for global knowledge sharing increase the value of the globally accumulated knowledge capital.

Ernst & Young's learning and renewal system contributes to the firm's objectives to achieve consistency among local offices, reuse problem-solving experience, take advantage of its size and market dominance, accelerate the delivery of valuable knowledge to the marketplace, and broadly leverage its intellectual capital. In addition, interactive openness helps Ernst & Young to learn from its environment, to improve its knowledge about and congruence with the environment, and to validate its learning and renewal system. Improved knowledge developed through interactive openness has helped Ernst & Young to obtain strategic objectives of growth and thought leadership. Such mega-processes founded on extensive knowledge management systems have increased the firm's performance dramatically by contributing to both current performance and continuous learning and renewal.

The KaosPilots & KaosManagement

The KaosPilots is a management educational institution, and KaosManagement a management-consulting firm. The KaosPilots and KaosManagement constitute a small, action-oriented, experimental value-chain composed of 13 young persons and various networks of freelancers and other connected people.

Fig. 4 illustrates the strategic components of The KaosPilots and KaosManagement.

The identity of The KaosPilots and KaosManagement as 'navigators in chaos' drives their learning and renewal capacity. While the way in which

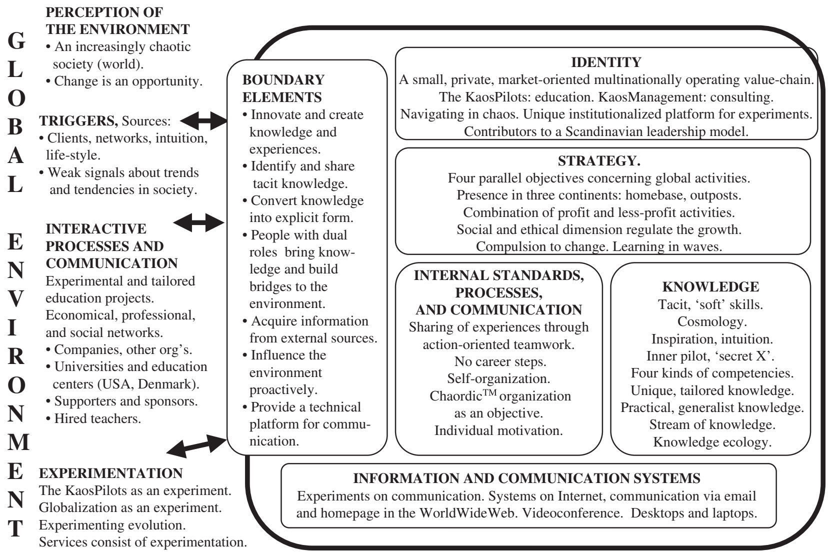

Fig. 4. The Strategic Components of The KaosPilots and KaosManagement.

the firms function has undergone several transformations, their common identity and basic values have remained the same.

Learning from the environment (sensing) is encouraged by the perception of the environment as a chaotic world where change is an opportunity. The objective of The KaosPilots and KaosManagement is not to achieve static congruence with an existing environment. Instead, they focus on future change and explore trends and opportunities proactively to be prepared to meet the future and to influence society.

In order to explore new geographic and business areas, The KaosPilots and KaosManagement improve knowledge through reciprocal interaction with their client organizations and wide contact networks. The KaosPilots and KaosManagement have leveraged their limited resources by creating attractive boundary element roles and by operating within networks in which 'external' persons, such as freelance consultants and Business Network members, who have boundary roles in the two organizations.

The identity of The KaosPilots and KaosManagement is centered around being curious, exploiting their experiences, improving knowledge, and quickly abandoning outdated knowledge. They explore and, where possible, seek to change the conditions of future congruence with the environment and to create new ways of functioning. They do not try to accumulate explicit knowledge bases because their organization is small, and knowledge in their areas of activity quickly becomes outdated and is difficult to transform into an explicit form. Instead, they compensate for perturbations by improving tacit knowledge and by changing themselves quickly through action-oriented 'experimenting evolution'. Knowledge is accumulated as tacit personal knowledge and skills and as process-based organizational knowledge, such as groupwork skills. Part of its organizational knowledge, however, such as the curriculum offered by The KaosPilots, is explicit and forms the backbone for its functioning. Accumulated experience is accessed via communication and sharing within teams, scientific evaluations, and increasingly via the information system that supports communication within teams (memory). Communication is used to actively create meanings rather than merely transfer facts. The KaosPilots and KaosManagement's learning and renewal processes are based largely on interactive openness that is sustained by their capability to learn from experiences.

People at The KaosPilots and KaosManagement are encouraged and trained to create, share, and exploit new knowledge in teams, projects, and self-organizing communities of learners, and through personal communication. Motivation to learn is based on curiosity and individual willingness to grow, not on incentives or hierarchical career paths. Continuously improved knowledge helps The KaosPilots and KaosManagement to develop new strategic objectives. Their strategy has evolved in waves, through action-oriented learning and rapid implementation of new knowledge. Successful organizational evolution through periods of environmental turbulence has reinforced their identity as 'navigators in chaos' and promoted their role as a unique institutionalized platform for experiments.

The capacity of The KaosPilots and KaosManagement for learning and renewal enable them to be continually and proactively exposed to surprises and 'impossible' tasks, to learn how to handle such challenges, to stimulate creativity, and to implement necessary changes very quickly. They multiply their resources and improve knowledge by attracting external people and organizations to boundary roles. They also validate the learning and renewal system via exposure to surprises and new territories, and via external evaluations.

Summary of the Cases

Ernst & Young and The KaosPilots & KaosManagement both interact with their environments and change themselves proactively, yet in very different ways. Both facilitate changes in their client organizations and business environments. Both improve the prospects for their future success by continuously evolving their current service offerings, research, and public visibility. However, The KaosPilots and KaosManagement choose not to focus on achieving congruence with today's environment, because paradoxically their clients expect them to be 'against the market'. Instead, they focus on exploring the conditions for achieving congruence with future environments.

Both firms change themselves proactively. They continuously improve their learning and evolution capabilities, intentionally seek to increase their exposure to triggers, develop new boundary elements, and thereby improve their capacity to absorb knowledge. They also evaluate and measure their capability to learn and evolve – for example, by evaluating employees' contributions to knowledge sharing.

These observations support earlier findings that organizations have to build systematic practices in order to manage self-transformation (Drucker, 1992, 1993) and that there must be increasing focus on processes of collective learning and proactive experimentation to create new competences (Grant, 1991; Boisot, 1995). They also support the view that a proactive stance toward the environment can 'excite' the organization as a system, and that the system can increase its own 'excitability' by increasing its cognitive complexity, thereby better preparing itself to observe deviations in its environment and thereby to notice and process more information.

SUMMARY

Living Organizations, Creativity, and Efficiency

The need for simultaneous creativity and efficiency in organizations increases the pressure to achieve learning and renewal. However, the sources of organizational learning and renewal are often diverse and difficult to understand.

The living composition model has been developed to help understand the phenomena of organizational learning and renewal. The model is an interpretation and application of complexity theory that emphasizes the crucial role of organizational structure in evolutionary capability. In the living composition model, the composition of ten strategic components and boundary elements has been characterized as the central feature of this enabling structure of a living organization. The components and their relationships facilitate the sensing and memory in an organization that generate flows of both new and prior knowledge.

The main propositions implicit in the living composition model are:

1. The evolutionary capability of a living organization is derived from the functioning of its living composition.
2. A successful organization is likely to have found ways to utilize the complexity phenomena of self-organization and emergence through its living composition.
3. A living organization improves its chances for co-evolving with its complex environment within its business ecosystem by creating and utilizing boundary elements.

While CAS theories include concepts of self-organization and the capability create 'order from chaos' in general, the living composition model provides a more detailed specification of internal organizational structure and the relationships that enable an organization to mediate between 'chaos' and order, freedom and control. The model also helps to reconcile the controversy between creativity and efficiency. First, the living organization acquires and creates new knowledge by exploring its 'chaotic' environment and by co-evolving with it. Second, the living organization creates order and new knowledge through the continuous maintenance of its internal structure, the living composition. Third, the living organization facilitates internal self-organization – for example, a controlled and 'productive chaos' achieved in internal communities, networks, and less-structured knowledge processes.

Managerial Implications

The living composition model provides a number of benefits to managers. It is a useful tool for analyzing and communicating the complex characteristics and dynamics of adaptive organizations that is consistent with common ways of thinking in management. It describes and explains learning and evolution from an internal perspective and thereby helps managers to identify and develop strategic components that can be coordinated to better support sustainable learning and evolution. Moreover, by providing a comprehensive framework, the living composition model can help managers to coordinate various development projects that concern organizational learning, knowledge management, competence development, business process improvement, and other aspects of continuous adaptation.

The model also provides the perspective that organizations can in general be regarded as living, thus freeing the managers from the sense that they must start generating the 'life' for an organization. However, managers may apply the model to help identify inconsistencies in an organization's living composition to compose a well-functioning 'package' and to improve its renewal capability.

An organization's competitiveness and capability to survive and succeed depend on open co-evolution with the environment. When organizing change processes, managers should recognize that a living organization cannot be changed from the outside. Rather it can only be triggered to change internally by outside stimuli. Managers can increase interactive openness by improving sensitivity to triggers and supporting greater interaction and experimentation (sensing), as well as by defining and resourcing the roles (boundary elements) and practices that enable interaction.

NOTES

1. Autopoiesis theory was originally developed by Maturana and Varela (1980, 1987) to explain the lives of biological organisms and their physical reproduction. Today, it has the status of a general systems theory (von Krogh & Roos, 1995). The term 'autopoiesis' originates from the Greek words 'auto' (self) and 'poiesis'/'poein' (production). Autopoiesis theory explains the nature of living entities. Autopoietic systems are a subset of autonomous systems.

2. Living composition® is a registered trademark of CKC, Creative Knowledge Consulting Ltd. To be consistent with academic norms of discourse, the trademark has been deleted from subsequent use of the term in this chapter. However, all uses of the term "living composition" in this chapter are included in and protected by the trademark designation noted here.

3. Boundary elements are included as components because they are continually reproduced in the autopoietic process.

4. Boundary elements are regarded as special kinds of components because they are continually reproduced in the autopoietic process.

5. These cases are based on interviews made in 1997–1998. Because of evolution in the management consulting industry, the firms have undergone many changes, including mergers and acquisitions, since then. Therefore the cases discussed below do not necessarily depict the current situations of these organizations.

6. 'Chaos' and 'chaotic' are used here in a metaphorical sense.

REFERENCES

Blackler, F. (1995). Knowledge, knowledge work and organizations: An overview and interpretation. *Organization Studies*, *16*(6), 1021–1046.

Boisot, M. H. (1995). Is your firm a creative destroyer? competitive learning and knowledge flows in the technological strategies of firms. *Research Policy*, *24*, 489–506.

Boulding, K. (1956). General systems theory: The skeleton of science. *Management Science*, *2*(3), 197–208.

Chakravarthy, B. S., & Doz, Y. (1992). Strategy process research: Focusing on corporate self-renewal. *Strategic Management Journal*, *13*(Special Issue), 5–14.

Consultants News (1997). (March), 1–7.

Doz, Y. L., & Prahalad, C. K. (1993). Managing DMNCs: A search for a new paradigm. In: S. Ghoshal & E. D. Westney (Eds), *Organization theory and the multinational corporation* (pp. 24–50). New York: St. Martin's Press.

Drucker, P. F. (1992). The new society of organizations. *Harvard Business Review*, September–October, 95–104.

Drucker, P. F. (1993). *Post-capitalist society*. Oxford: Butterworth-Heinemann.

Grant, R. M. (1991). Porter's advantage of nations: An assessment. *Strategic Management Journal*, *12*, 535–548.

Holland, J. H. (1995). *Hidden order. How adaptation builds complexity*. Cambridge: Perseus Books.

Holland, J. H. (1999). *Emergence. From chaos to order*. Cambridge: Perseus Books.

Kauffman, S. A. (1993). *The origins of order: Self-organization and selection in evolution*. Oxford: Oxford University Press.

Luhmann, N. (1983). Retssystemets enhed. In: J. C. Jacobsen (Ed.), *Autopoiesis II. Udvalgte tekster af Niklas Luhmann (1995)* (pp. 134–164). Copenhagen: Forlaget politisk revy.

Luhmann, N. (1990). *Essays on self-reference*. New York: Columbia University Press.

Maturana, H. R., & Varela, F. J. (1980). *Autopoiesis and cognition. The realization of the living*. London: D. Reidel Publishing Company.

Maturana, H. R., & Varela, F. J. (1987). *The tree of knowledge*. London: New Science Library Shambhala.

Maula, M. (1999). *Multinational companies as learning and evolving systems. A multiple-case study of knowledge-intensive service companies. An Application of Autopoiesis Theory*. Doctoral dissertation. Helsinki School of Economics and Business Administration, A-154, Helsinki.

Maula, M. (2000a). The senses and memory of a firm – implications of autopoiesis theory for knowledge management. *Journal of Knowledge Management*, *4*(2), 157–161.

Maula, M. (2000b). Three parallel knowledge processes. *Knowledge and Process Management*, *7*(1), 55–59.

Mingers, J. (1995). *Self-producing systems. Implications and applications of autopoiesis*. London: Plenum Press.

Mingers, J. (1997). Systems typologies in the light of autopoiesis: A reconceptualization of boulding's hierarchy, and a typology of self-referential systems. *A research paper. Systems Research and Behavioral Science*, *14*, 303–313.

Nonaka, I. (1988). Creating organizational order out of chaos. *California Management Review*, Spring, 57–73.

Reimus, B. (1996). Does knowledge sharing reflect a firm's identity? Consultants News, March 1 and 7; May 8.

Reimus, B. (1997). *Knowledge sharing within management consulting firms. Executive summary*. Fitzwillian, NH: Kennedy Publications.

Scott, W. R. (1992). *Organizations: Rational, natural and open systems* (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Senge, P. M. (1990). *Fifth discipline*. London: Doubleday.
Sivula, P., van den Bosch, F. A. J., & Elfring, T. (1997). Competence building by incorporating clients into the development of a business service firm's knowledge base. In: R. Sanchez & A. Heene (Eds), *Strategic learning and knowledge management* (pp. 121–137). Chichester: Wiley.
Spender, J.-C. (1996). Making knowledge the basis of a dynamic theory of a firm. *Strategic Management Journal*, *17*(December, Special Issue), 45–62.
Spender, J.-C., & Grant, R. M. (1996). Knowledge and the firm: Overview. *Strategic Management Journal*, *17*(December, Special Issue), 5–10.
Varela, F. (1979). *Principles of biological autonomy*. The North Holland Series in General Systems Research (Vol. 2). New York: North-Holland.
Varela, F., Thompson, E., & Rosch, E. (1993). *The embodied mind. Cognitive science and human experience*. London: The MIT Press.
Vicari, S. (1991). *L'impresa vivente. Itinerario in una diversa concezione*. Milano: Etas libri.
Vicari, S., von Krogh, G., Roos, J., & Mahnke, V. (1996). Knowledge creation through co-operative experimentation. In: G. von Krogh & J. Roos (Eds), *Managing knowledge. Perspectives on cooperation and competition* (pp. 184–202). London: Sage.
von Krogh, G., & Vicari, S. (1993). An autopoiesis approach to experimental strategic learning. In: P. Lorange, B. Chakravarthy, J. Roos & A. Van de Ven (Eds), *Implementing strategic processes: Change, learning and co-operation* (pp. 394–410). London: Basil Blackwell.
von Krogh, G., & Roos, J. (1995). *Organizational epistemology*. London: MacMillan Press Ltd.
von Krogh, G., & Roos, J. (1996). Conversation management for knowledge development. In: G. von Krogh & J. Roos (Eds), *Managing knowledge. Perspectives on cooperation and competition* (pp. 218–225). London: Sage.
von Krogh, G., Roos, J., & Yip, G. (1996). A note on the epistemology of globalizing firms. In: G. von Krogh & J. Roos (Eds), *Managing knowledge. Perspectives on cooperation and competition* (pp. 203–217). London: Sage.

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LEARNING STRATEGIES OF NASCENT ENTREPRENEURS

Benson Honig, Per Davidsson and Tomas Karlsson

ABSTRACT

This research utilizes a longitudinal methodology to study the entrepreneurial learning strategies of a representative sample (n = 173) of nascent entrepreneurs in Sweden. We examine Sarasvathy's theory of effectuation with respect to six different learning strategies and their effect on the progression of start-up processes. The results show that the progression of the start-up process, as represented by the number of gestation activities undertaken during each time period, is systematically related to the nascent entrepreneur's learning strategy. The analysis covers 24 months, and findings indicate that learning strategies associated with effectuation processes have positive effects on the progression of the start-up process. We also found positive effects from persistent learning strategies in the progression of the start-up process.

INTRODUCTION

Despite considerable research regarding the characteristics of new entrepreneurs in small and medium-sized enterprises (SMEs), we know little about the process in the early stages of organizational design (Gartner,

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1985, 1988; Ripsas, 1998). Nascent activities are arguably one of the most crucial and understudied aspects of the study of organizational development, as they determine the critical point at which certain individuals succeed or fail at creating new organizations. Our current knowledge regarding existing organizations tells us little about what might be done to support, nurture, or in any way promote the development and activities of nascent entrepreneurs – those individuals at various stages in the process who are attempting to develop new businesses (Katz & Gartner, 1988). A noted exception to this dearth of knowledge is the American Panel Study of Entrepreneurship Dynamics (PSED; formerly referred to as the "ERC study") and its sister projects in various countries (Alsos & Kolvereid, 1998; Carter, Gartner, & Reynolds, 1996; Delmar & Davidsson, 2000). The present study is based on the Swedish derivative of PSED.

Reynolds defined nascent entrepreneurship according to a range of specific behaviors that include planning, obtaining resources, networking, registration, and similar activities related to organizational emergence (Carter et al., 1996; Reynolds, 1997). While some of these activities define the critical point by which certain individuals succeed or fail in creating new organizations, others represent intermediary steps of limited consequence, depending upon the exact nature of the business organization emerging. Studying this nascent activity allows for the examination of resource requirements which are likely to be quite different from more mature organizations, those that form the bulk of our current theoretical reference points.

New firms establish themselves by introducing new goods, new methods of production, new markets, new sources of supply, or new ways of organizing (Carland, Hoy, Boulton, & Carland, 1984; Gartner, 1985). The rapid pace of economic and social changes that enable such activity continues to fuel considerable interest in dynamic models of organizational learning, particularly from a strategic perspective. Nascent entrepreneurs, who by definition are in the early stages of their learning curves, are particularly susceptible to these considerable forces, and must repeatedly anticipate and react to new events.

Nascent Activity and Organizational Learning

Although there appears to be a relationship between the frequency of gestation activities and the start of a business, research regarding the sequential importance of gestation activities has not been conclusive (Carter et al., 1996). Because only a few percent of all individuals undertake nascent activities during a given time period, with an even smaller number going on to actually start businesses, our information regarding strategic approaches to learning has been quite limited (Reynolds, 1997). Aldrich argues that while many nascent enterprises are simply reproducing organizations, innovative activities can be quite different and ground breaking in their approach. He points out that organizations employing new types of knowledge are able to put older organizations at a distinct disadvantage (Aldrich, 1999).

Just as environmental characteristics constrain various activities, resulting in the creation of different organizations, so the process by which they are developed eventually affects outcomes. Firms created in a rapidly changing environment have more opportunities to incorporate innovative approaches. Firms created by individuals with a penchant for scanning and learning new approaches will also be more likely to incorporate innovation. The learning process, which eventually determines the strategic direction of the organization, occurs from the very outset of organizational development, and is particularly relevant to nascent activities. It is during early formulation and emergence that the business opportunity is located, resources are accumulated, products conceptualized, markets identified, and the fundamental building blocks of the organization formed. This learning process allows the nascent entrepreneur to integrate environmental, organizational, and individual processes into something that resembles strategic value (Gartner, 1985).

Traditionally, learning theories have emphasized a causal approach to organizational learning. Organizations are said to establish goals within the organization, and then find the means to fulfill that goal (Drucker, 1976; Wildavsky, 1979). In reaching such a goal, the organization is expected to engage in extensive market, competitor, supplier and product research (Kotler, 1991). Entire management systems, such as "management by objective" have been designed to take advantage of this process (Drucker, 1976). Under this paradigm, the learning process is designed to find the appropriate means to achieve an aspired set of goals.

There are many reasons to suspect that causal learning is a rare activity, bounded by rules, convention, communication constraints, and turnover (Simon, 1991; Meyer & Rowan, 1977). In one alternative paradigm, learning is conducted through experimentation, evaluation, and assessment (March & Olsen, 1975). Sarasvathy, focusing primarily on entrepreneurial decision-making, proposes another alternative learning theory, "effectuation". Using an effectuation approach may be seen in opposition to the causal approach to learning. The effectual process starts with a set of given means, and attempts to combine those means into a coherent and winning strategy.

Means include current knowledge, traits, abilities, and social resources. Thus, while a chef engaged in a causal process develops a menu first, and obtains the necessary ingredients and resources to execute a set of predetermined goals, the effectual chef looks in the cupboard, sees what is available, and produces a menu based on available resources. For the effectual strategy, the learning process is aimed at finding the appropriate effects of the given means (Sarasvathy, 2001). In real life, actors can go back and forth between causal reasoning and effectual reasoning or in fact engage in both activities almost simultaneously.

We agree with Sarasvathy that a useful definition of learning must incorporate both adaptive elements and causal learning. In order to evaluate organizational learning, it is first necessary to identify the learning strategy of the organization under study. This study aims to compare two categories of nascent strategy, those flexible and adaptive (effectual), versus those that are more systematic and formalized (causal). In educational terms, the latter strategy is comparable to formal institutional education, such as that obtained in High Schools and Universities, representing systems that focus on what has been known to be relevant but which are typically slower to respond to environmental changes. This contrasts with an adaptive strategy comparable to informal education, or learning by experience, where freedom from institutional constraints allows for more rapid adaptation and environmental relevance, but where the risk of haphazard or too high/low attention to idiosyncratic issues is also greater.

Shrivastava (1983) argues that learning systems can be classified according to the process by which they come to exist in the organization. Learning systems may develop without a conscious effort to design or contrive the learning mechanisms that emerge in the organization. Such learning systems are called evolutionary. Contrasting the evolutionary learning systems are the designed learning systems, which are purposely designed to fulfill the needs for learning in the organization. Shrivastava introduced a typology of six learning systems related to adaptive as well as institutional demands of mature organizations (Shrivastava, 1983). The six are as follows: (1) one man institution strategy, (2) information seeking culture, (3) participative learning system, (4) formal management systems, (5) bureaucratic strategy, and (6) mythological learning systems. While this categorization provides good insight into the range of potential learning strategies, they are somewhat generic and fail to provide insight into the specific conditions necessary for learning in nascent organizations.

New organizations, in particular, are frequently required to improvise under situations of resource and time constraints (Moorman & Miner, 1998;

Weick, 1993). The environments where new firms are most likely to emerge are characterized by rapid change, high uncertainty, and under-defined norms and competitive rules (Brews & Hunt, 1999). Such environments may preclude systematic rational planning and learning, depending instead upon different strategies, such as flexible and incremental planning. For example, Brews and Hunt (1999), found that in unstable environments, achieving specific organizational goals are associated with flexible planning. They noted the importance of revising and adjusting plans on a frequent basis.

Sarasvathy (2001) implies that pre-firms or very early stage firms created through a process of effectuation will perform better than those created through a process of causation. They will be able to experiment with more ideas at lower costs, they are more likely to enter a new industry successfully and they are more likely to engage in "seat of the pants" marketing/selling activities and alliances. Effectuation processes are characterized by constantly searching for new opportunities (effects), given the organizations current operations (Sarasvathy, 2001). Thus, in terms of learning, entrepreneurial organizations that continuously adjust their organizational learning strategy are an indication of alignment with Sarasvathy's effectuation process.

Hypothesis 1. A continual adjustment learning strategy will have a positive effect on the number of gestation activities undertaken in subsequent periods.

Effectuation processes according to Sarasvathy (2001) are based on affordable loss or acceptable risk, rather than maximizing expected returns. We examine this aspect of learning strategy by identifying whether the entrepreneur has a preference for testing the ground in small steps rather than big, one-time decisions. Thus an incremental strategy is an indication of alignment with Sarasvathy's effectuation process and should thus perform better.

Hypothesis 2. An incremental learning strategy will have a positive effect on the number of gestation activities undertaken in subsequent periods.

Effectuation is contrasted with causation in Sarasvathy's theory. Causation is a process characterized by prediction and is hypothesized to be of uncertain benefit to the new organization. Sarasvathy (2001) characterizes causation processes as heavily based on analysis and research. Learning of this kind is based on analysis and research of known aspects rather than continuous tests on the market. Thus, focusing heavily on research and development is an indication of an emphasis on causation processes, and we argue that new organizations do not necessarily benefit from using strategies that involve extensive planning and predictions for the future.

Hypothesis 3. An R&D-based learning strategy will have either no effect or a negative effect on the number of gestation activities undertaken in subsequent periods.

The main difference between the causation and effectuation paradigms can be found in their focus. While effectuation processes focus on given means and the possible effects that can be created with them, causation processes focus on a given effect and the selection of what means should be used to accomplish that effect. Thus if the organization focuses on a systematic search directed at finding solutions to a specific known end, it is seen as an indication of a causation process.

Hypothesis 4. A systematic search strategy will have either no effect or a negative effect on the number of gestation activities undertaken in subsequent periods.

We also examine two learning strategies whose main characteristics do not fall naturally within the causation vs. effectuation continuum, namely the persistent learning strategy and the random learning strategy. The main characteristic of a *persistent strategy* is the tendency not to give up. Persistence in the learning strategy is equally possible for adaptive and systematic approaches. We contend that persistence is helpful in making progress during the start-up process, whether applied with systematic or adaptive learning.

Hypothesis 5. A persistent learning strategy will have a positive effect on the number of gestation activities undertaken in subsequent periods.

A *Random strategy,* is akin to Shrivastava's (1983) "mythological learning systems" as well as to what March refers to as "superstitious learning" (Choen & March, 1974; March & Olsen, 1975). This strategy is obviously not systematic, but due to its stated lack of direction and focus it may not be very adaptive, either. We hold that a random learning strategy is not likely to be helpful for making progress in the start-up process. This leads us to the following hypothesis:

Hypothesis 6. A random learning strategy will have no effect or a negative effect on the number of gestation activities undertaken in subsequent periods.

METHOD

Introduction

In order to fully assess learning practices, it is necessary to follow a trajectory that includes studying one parameter of organizational ignorance, identifying targeted learning activities, and reassessing organizational competence in that particular sphere after the learning activity has occurred. In this way, the entire dynamic process of planning, analysis, forecasting, and deciding is examined. Essentially, this entails observing different responses to the same stimulus. Even with a controlled experiment, however, it is quite difficult to ascertain that different responses are the result of learning. Changes in responses might also be the outcome of stochastic processes, or reflect a much more active organization (Weick, 1991). In practical terms, understanding organizational learning suggests a qualitative case study approach, with the resulting conclusions subject to assertions of non-generalizability.

This study is based on longitudinal survey data. What we *are* able to measure through survey research are stated learning strategies – the cognizant goals of specific members (the lead entrepreneur) of an organization regarding their strategic direction and educational goals. Further, while we might be able to correlate these strategic goals to various organizational outcomes, we should be careful not to infer organizational learning as the sole cause of any particular outcome. Rather, it is sufficient to note relationships between strategic learning styles and organizational behaviors, even if these behaviors are not rationally based artifacts (Meyer & Rowan, 1977).

Sample

The study was designed to provide population estimates for business start-up efforts and to follow a random sample of nascent activities leading to the possible start of new businesses. Data are based on two samples of randomly selected individuals living in Sweden. The first sample consists of individuals aged between 16 and 70 years and the second sample consists of individuals aged between 25 and 44 years. The purpose of the first sample was to get a representative sample of the adult population in Sweden, while the second sample was to increase the yield of nascent entrepreneurs. Previous research indicated that this age group has the highest rate of business founders (Reynolds, 1997).

Because nascent entrepreneurs constitute a relatively small group in society, every respondent went through a screening interview with the objective of selecting out the nascent entrepreneurs. All respondents were asked "Are you, along or with others, now trying to start a new independent firm?" The individuals who responded affirmatively were then asked if they were willing to participate in a longer telephone interview. The interviews were conducted during the period of May–September 1998, with follow-up interviews at 6, 12, 18, and 24 months.

Swedish individuals (35,971) were randomly contacted by telephone, and 30,427 (84.6%) agreed to participate (see Appendix Table A1). Of these, 3.2%, or 961, were identified as engaged in one or more nascent gestation activities, and 623 of these nascent entrepreneurs or intrapreneurs agreed to participate in the study. These respondents participated in the initial longer phone interview and were sent mail questionnaires for supplementary items. Over the course of the following 24 months, 168 cases left the study due to termination of efforts or refusal to continue to participate, 244 failed to complete a mail questionnaire that was the basis for four of our six learning strategy questions, and 38 were disqualified as nascent intrapreneurs developing new ventures for established firms. The remaining 173 nascent entrepreneurs were evaluated at the initial screening period, at 6, 12, 18, and 24 months by telephone survey.

A case was considered qualified for the panel if at the first interview at least one gestation activity was completed. Gestation activities were determined as any of 46 different sequences accounting for 20 different behaviors that were considered demonstrative of actively beginning the business creation process (see Appendix Table A2). The 20 nascent gestation behaviors are identical or nearly identical to those used in other studies (Alsos & Kolvereid, 1998; Carter et al., 1996; Davidsson & Honig, 2003; Reynolds, 1997). Note that while the nascent entrepreneur is always "nascent" with regard to the current start-up effort, he or she may previously and/or concurrently (have) run other businesses. That is, not all nascent entrepreneurs are novices.

Measures

The dependent variable utilized in this study is the total number of 46 steps or sequences toward 20 gestation activities counted at the time of initial screening, and over the course of the subsequent 24 months. When appropriate, each phase of behavioral sequencing was coded by a dummy variable for completion. For example, preparing a business plan, however informal, was coded "1", a written informal plan coded again as "1", and a formal written plan for external use was also identified. Thus, each nascent might receive anywhere from 0 to 3 sequences under the business plan gestation behavior, with similar multiple sequence operations accounting for most of the gestation behaviors. Variables which otherwise might have been considered a gestation sequence behavior, such as organizing a team or having customer contacts before starting, were omitted from the dependent variable.

Independent Variables

As regards explanatory variables we use the following measures of learning strategies:

Research and Development strategy: Those who indicated "spending on research and development will be a major priority for this new business."

Systematic Search strategy: Those who completely or generally agreed to the following: "I have engaged in a deliberate, systematic search for an idea for a new business."

Continual Adjustment strategy: Those who completely or generally agreed to the following: "I spend considerable time making the organizations I belong to function better."

Incremental strategy: Those who completely or generally agreed to the following "For me, identifying business opportunities has involved several learning steps over time, rather than a one-time thing."

Persistent strategy: Those who completely or generally agreed to the following "If this business idea is not successful, I am willing to try up to 10 other business ideas before I go to work for someone else."

Random strategy: Those who completely or generally agreed to the following: "The best business ideas just come, without a need to search for them."

Note that logically these are not mutually exclusive. Accordingly, it is possible for our nascent entrepreneurs to represent more than one of the strategies. However, the overlaps are not very big. The frequency of various learning strategies varied considerably. Fifty-seven percent utilized an incremental strategy, followed by 53% that made use of a random strategy, 43% a continual adjustment approach, 31% an R&D strategy, and only 15% a persistent strategy. The pairwise correlations between learning strategies are moderate (see Table 1).

Table 1. Means, Standard Deviations, and Correlation Coefficients for Nascent Entrepreneurs.

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 R&D	0.312	0.465																
2 Systematic search	0.214	0.411	0.105															
3 Continual adjustment	0.434	0.497	−0.036	0.084														
4 Incremental	0.578	0.495	0.070	0.103	0.039													
5 Persistent	0.156	0.364	−0.049	0.164*	0.106	0.109												
6 Random	0.538	0.500	−0.051	−0.082	−0.031	0.076	−0.048											
7 Team	0.532	0.500	0.007	−0.019	0.003	0.019	−0.011	0.082										
8 Networks	0.370	0.484	0.104	0.009	0.030	0.291**	−0.033	0.086	−0.049									
9 Customer social capital	0.445	0.498	−0.051	−0.070	0.061	0.035	0.064	−0.032	0.001	0.109								
10 Encouragement	0.798	0.403	−0.033	−0.053	0.034	−0.168*	0.137	−0.178*	0.133	−0.240	0.075							
11 Years education	12.746	2.528	0.063	−0.087	0.121	0.062	−0.020	−0.034	0.016	0.096	0.104	0.052						
12 Years experience	15.419	1.664	0.028	0.111	0.072	0.065	0.110	−0.103	−0.009	0.010	−0.019	0.021	−0.228*					
13 Age	39.277	1.199	−0.005	0.086	0.163*	0.098	0.063	−0.119	−0.028	0.023	0.032	−0.037	0.010	0.844**				
14 Gender	0.335	0.473	−0.056	−0.102	0.169*	−0.013	−0.069	−0.029	−0.217**	0.090	0.029	−0.100	0.057	−0.092	0.060			
15 Married	0.746	0.437	−0.094	−0.084	0.002	0.065	−0.005	0.071	0.090	0.173*	0.149*	−0.030	0.083	0.106	0.082	0.049		
16 Sum gestations at start	5.040	3.619	0.100	0.029	0.103	0.133	0.132	−0.134	0.097	0.207**	0.125	0.002	−0.005	0.228**	0.206**	0.050	0.168*	
17 Gestations total	22.012	16.730	0.012	−0.143	0.208	0.011	−0.069	0.044	0.131	0.337**	0.217	0.007	0.088	−0.011	−0.033	0.111	0.198	0.355**

*$p < 0.05$.
**$p < 0.01$.

Control Variables

In a related paper (Davidsson & Honig, 2003) we have examined in some detail the effects of human and social capital in the firm gestation process. We therefore refrain from repeating the theoretical arguments here. Instead, we include a number of indicators of social and human capital as control variables. Doing so is important, as our previous analysis showed that in particular social capital variables have strong and systematic effects. If these variables were excluded from our current analyses the estimated effects of learning strategies might get exaggerated or distorted.

Much activity and research in the field of entrepreneurship (e.g., Bennett & Robson, 1999; Wood, 1994; Honig, 1998) is based on assumptions regarding human capital theory, which views education as an investment that yields higher wage compensation in return for individual variations of skills, training, and experience (Schultz, 1959; Becker, 1964; Mincer, 1974).

Human capital of the nascent firm owners was determined by two methods. Owners were asked to indicate the highest level of education they had completed, coded into number of years. Respondents were also asked their total years of full-time paid work experience in any field, to provide the work experience variable.

Social capital theory maintains that social networks provided by extended family, community-based, or organizational relationships enhance the effects of education, experience, and financial capital (Bourdieu, 1983; Loury, 1987; Coleman, 1988, 1990). Organizational research holds that social networks play an important role in the emergence of organizations (Van De Ven, 1993). They bring both diversity of ideas and resources, as well as strong relationships that serve to endure and provide critical trust (Aldrich, 1999; Granovetter, 1985, 1993).

Social capital was determined utilizing a number of variables representing an external network, an internal network, and a customer oriented network. Start-ups that were owned by more than one person were identified as team start-ups. One question asked nascent entrepreneurs if they were involved in any formal business networks for the specific purpose of helping this start-up. Another question concerned encouragement from family and friends for going into entrepreneurship. Finally, nascent owners were asked if they knew their customers before starting up, or if any of their customers had helped in financing the new start-up. A "customer contact" dummy variable was created for those individuals who indicated they had either of these previous customer contacts.

Other control variables. The age of the nascent entrepreneur was used as a control, as this was found to be a factor in other studies (Reynolds, Hay, & Camp, 1999; Reynolds, Wolters, & Zevenbergen, 2000). A gender dummy was also included. Finally, nascent entrepreneurs who indicated they were married or living with a partner were coded 1 on a dummy variable.

Data Analysis

The analysis of learning strategy on gestation activity utilized ordinary multiple linear regression, with the total number of gestation sequences as a dependent variable. The analysis is repeated for the total number of gestation sequences at 0, 6, 12, 18, and 24 months, respectively. With two exceptions, the explanatory variables were assessed during the first interview (0 months). The exceptions are customer contact, which was not asked about until the 6-month interview, and the network variable for which the most current data during months 6–24 was used. This means that except for the 0-month regression the time order of variables is correct for causal analysis. Projects that were abandoned, or where the respondents failed to continue with the survey, were dropped from the analysis, in order to minimize any biases resulting from reduced activity resulting from early termination or insufficient data.

RESULTS

Table 1 presents the correlation matrix for the entire data set, including means and standard deviations.

The average nascent entrepreneur was 39 years old, married, and had 12.7 years of education. One-third of the interviewed nascent entrepreneurs were female. About half of the start-ups were team-based projects, reporting, at the start of the interview series, an average of 5 gestation sequences. The number of sequences increased considerably over the course of the study, to an average of 22 for the entire group. Approximately 44% of the nascent entrepreneurs reported having relationships with potential customers before starting their businesses. Thirty-six percent of the nascent entrepreneurs were members of a business network.

In general, the variables studied were not highly intercorrelated. The highest inter-variable correlation in learning strategy was between the persistent and systematic strategies, and it was only at the 0.16 level. All other correlations were found to be negligible and not statistically significant.

Table 2 displays the results for five regression analyses using number of gestation activities as the dependent variable.

There is a time sequence such that the farther to the right, the "longer term" is the estimated effect. The following observations can be made. The regression functions are significant and yield non-negligible R^2 values. The explanatory power increases over time. This is a logical pattern if the explanatory variables have real and lasting effects. The strongest effects are ascribed to some social capital indicators – networking in particular – while little effect is found for human capital or other control variables. These results are consistent with previous analyses with slightly different model specifications (Davidsson & Honig, 2003). Hypothesis 1 states that a continual adjustment learning strategy will have a positive effect on the number of gestation activities undertaken in subsequent periods. Continual adjustment strategy is assigned positive effects in all six regressions, and the coefficients are positive and significant or marginally significant in two Equations. Thus we consider Hypothesis 1 supported, albeit weakly.

Hypothesis 2 states that an incremental learning strategy will have a positive effect on the number of gestation activities undertaken in subsequent periods. Positive and significant effects of incremental learning strategy are found in the last two regressions, and only one analysis (6 months) has negative (and non-significant) results. Thus we consider Hypothesis 2 supported.

Taken together we can conclude from the first two tests that effectuation based learning strategies have a positive effect on the progression of the start-up process.

Hypothesis 3 holds that R&D based learning strategies will have neutral or negative effects on the number of gestation activities undertaken in subsequent periods. The effect actually estimated is positive in all regression but marginally significant only in one of them. Hypothesis 3 is neither clearly supported not clearly disproved.

Hypothesis 4 states that a systematic search strategy will have a neutral or negative effect on the number of gestation activities undertaken in subsequent periods. In the last three regressions (12, 18, and 24 months) the systematic strategy shows statistically significant negative results. Hence, we regard Hypothesis 4 as supported.

According to Hypothesis 5, a persistent learning strategy will have a positive effect on the number of gestation activities undertaken in subsequent periods. A positive and significant effect is estimated in the last of the five regressions. This is backed up by marginally significant positive effects in the 12 and 18 months regressions. We regard this as support for the

Table 2. Regression Analysis for Sum of Gestation Activities of Nascent Entrepreneurs During 0–24 Months.

	Unstandardized Regression Coefficients				
	Initial Interview	6-month Follow-up	12-month Follow-up	18-month Follow-up	24-month Follow-up
Learning strategies					
R&D strategy	0.75	0.54	0.82	1.13†	0.68
	(0.58)	(0.59)	(0.73)	(0.69)	(0.63)
Systematic search strategy	−0.20	0.21	−1.24†	−1.40*	−1.22*
	(0.67)	(0.69)	(0.84)	(0.80)	(0.73)
Continual adjustment strategy	0.42	1.09*	1.01†	0.264	0.039
	(0.55)	(0.56)	(0.69)	(0.659)	(0.60)
Incremental strategy	0.38	−0.48	0.73	1.70**	1.06*
	(0.57)	(0.58)	(0.71)	(0.67)	(0.62)
Persistent strategy	1.02	0.009	1.41†	1.24†	1.70*
	(0.76)	(0.58)	(0.96)	(0.91)	(0.83)
Random strategy	−0.98*	−0.14	−0.70	−0.41	−1.18*
	(0.54)	(0.56)	(0.68)	(0.65)	(0.59)
Control variables					
Team start-up	0.86	0.98	0.90	0.66	0.77
	(0.55)	(0.56)	(0.69)	(0.65)	(0.60)
Networking	1.25*	1.99***	2.61***	2.38***	2.87***
	(0.60)	(0.61)	(0.75)	(0.71)	(0.65)
Customer contact	0.60	1.03†	0.77	0.38	−0.13
	(0.54)	(0.56)	(0.68)	(0.65)	(0.59)
Encouragement	−0.04	0.91	0.74	1.45†	0.76
	(0.71)	(0.73)	(0.89)	(0.84)	(0.77)
Education	−0.03	0.02	0.13	−0.002	0.11
	(0.12)	(0.12)	(0.15)	(0.14)	(0.13)
Work experience	0.06	0.08	0.11	0.005	0.005
	(0.05)	(0.05)	(0.06)	(0.06)	(0.05)
Age	−0.004	−0.07	−0.006	0.05	−0.01
	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)
Gender (0 = m; 1 = f)	0.50	−0.56	0.02	−0.59	−0.003
	(0.61)	(0.62)	(0.76)	(0.72)	(0.66)
Married (0 = single)	0.93	1.01	0.53	0.347	0.24
	(0.64)	(0.65)	(0.80)	(0.761)	(0.69)
Constant	2.32	3.09	0.448	−2.0	−1.11
	(1.96)	(2.01)	(2.46)	(2.33)	(2.12)
F	2.20**	2.47**	2.69***	2.93***	3.41***
R^2	0.18	0.19	0.21	0.22	0.25
Adj. R^2	0.10	0.11	0.13	0.14	0.18
N	173	173	173	173	173

Reported significance levels are single-tailed for learning strategies and double-tailed for control variables.

$^{\dagger}p<0.10$.

$^{*}p<0.05$.

$^{**}p<0.01$.

$^{***}p<0.001$.

hypothesis, especially as the estimated effect tends to increase with time. Thus, Hypothesis 5 is supported.

Hypothesis 6, finally, holds that a random learning strategy will have no or negative effects on the number of gestation activities undertaken in subsequent periods. The estimated effect is negative in all six regressions and statistically significant in both the initial and 24 month periods. Hypothesis 6 is supported.

In summary, five of the six hypotheses are supported at least to some extent. However, the estimated effects and their explanatory power are modest.

DISCUSSION

Organizational learning is both a complex and exceedingly difficult activity to research. Even a hypothetical "pure" simulation is difficult to administer, as the researcher must examine behaviors that may be related to artifacts that exist outside the knowledge-learning dynamic. Further, as organizations are composed of multiple individual intelligences, the task of identifying any collective behavior becomes more complicated by magnitudes.

By examining organizational activity in its earliest stages, we were able to observe results from the primary actor (nascent entrepreneur) before dilution in a more complex organizational structure, thus avoiding some of the aforementioned complexities. Inspired by a typology of organizational learning systems, we operationalized and examined Sarasvathy's theory of effectuation and related these to the number of gestation activities undertaken in subsequent periods.

From the limited analysis conducted in this study, it appears that learning strategy *does* matter, and that it is possible to identify efficient strategies for nascent or emergent organizations. Our results point out learning strategies based on effectuation processes characterized by continual adjustment and – in particular – incrementalism as effective tools for making the start-up process move forward. By contrast, causation-based learning strategies had no reliable positive effects in our analysis. Importantly, the fact that effectuation-based strategies are adaptive should not lead one to confuse them with a random approach. We examined random learning strategy separately and found – as predicted – that learning strategy to be ineffective. Apart from support for adaptive strategies we also found some support that persistence is helpful. In summary, our results are in line with the view that nascent entrepreneurs should have a strong commitment to successful completion of their entrepreneurial efforts, but be prepared to use flexible means in order to reach that goal.

While statistically significant in many cases our estimated effects of learning strategies are relatively weak for the most part. This may be because many other factors determine the progression of venture start-up processes. It must be noted, however, that the measures of learning strategies employed in this study utilize only a single independent variable – the stated style or strategy of the nascent entrepreneur, coded as dichotomous variables. Using a single item for each strategy may result in producing comparatively weak effects in the model. It is therefore likely that with improved measurement the estimated effects of learning strategies would be greater.

Of course, only additional longitudinal analysis will determine if the relationships disclosed in this study are persistent and indicative of financial success. Further, it is entirely possible that a particular strategy is more suitable for emergence, while another is more suitable for subsequent organizational evolution (Venkataraman & Sarasvathy, 2002). The findings in this study suggest that the speed with which gestation takes place is dependent upon the favored learning strategy of the entrepreneur. Carter et al. (1996) demonstrated a relationship between the number of gestation activities and the actual start of a new business, further noting that the frequency of activities diminished rapidly over time for those who failed to launch their business. Identifying a learning strategy that provides more consistent gestation activity may be a critical factor in predicting eventual success. From a public or managerial policy perspective, this research suggests that it may be advantageous to provide nascent entrepreneurs, and potential nascent entrepreneurs, with learning models that promote such gestation activity. Doing so represents a deviation from common institutional practices in the education and promotion of small businesses, which tend to favor the production of business plans, marketing, and financial analysis. Our results suggest that adaptive learning strategies should be more emphasized.

Our results show an interesting development over time for the effects of different learning strategies. While it cannot be ruled out that this apparent pattern is due to stochastic variation, it is interesting to note that it is only when the analysis period is 12 months or longer that the superiority of adaptive strategies, and the positive effect of persistence, begin to stand out. This has implications for practitioners and for researchers. For the practitioner it means that it may take some time before an adaptive learning strategy starts to pay off. For researchers it points out the necessity of covering as much of the process as possible. Had this been a cross-sectional study or a study with just one follow-up, the results and their interpretation would have been very different from what we have been able to report.

In conclusion, this research supports Sarasvathy's theory of effectuation. Effectuation processes are beneficial in creating new organizations, while causation processes were found to be largely uncorrelated with progress in the creation of the new organization. It demonstrates the importance of adaptive and persistent learning strategy as well as social capital to nascent entrepreneurs. Of particular interest is that we know of few programs that attempt to intentionally foster these characteristics. Given the apparent contribution of learning strategy on gestation sequence activity, this research suggests that incubation and entrepreneurial promotion programs would be advised to consider providing lessons in strategic learning to their clientele and effectuation process reasoning. Additional research regarding the longitudinal outcomes of both social capital and strategic learning, particularly utilizing multi-method approaches, will help immeasurably with the design and implementation of appropriate programs.

REFERENCES

Aldrich, H. (1999). *Organizations evolving*. London: Sage Publications Ltd.

Alsos, G. A., & Kolvereid, L. (1998). The gestation process of novice, serial and parallel business founders. *Entrepreneurship Theory and Practice*, *22*, 101–114.

Becker, G. S. (1964). *Human capital*. Chicago: The University of Chicago Press.

Bennett, R., & Robson, P. (1999). The use of external business advice by SME's in Britain. *Entrepreneurship and Regional Development*, *11*, 155–180.

Bourdieu, P. (1983). Forms of capital. In: J. Richardson (Ed.), *Handbook of theory and research for the sociology of education* (pp. 241–258). New York: Greenwood Press.

Brews, P., & Hunt, M. (1999). Learning to plan and planning to learn: Resolving the planning school/learning school debate. *Strategic Management Journal*, *20*, 889–913.

Carland, J., Hoy, F., Boulton, W., & Carland, J. A. (1984). Differentiating entrepreneurs from small business owners: A conceptualization. *Academy of Management Review*, *9*(2), 354–359.

Carter, N., Gartner, W., & Reynolds, P. (1996). Exploring start-up event sequences. *Journal of Business Venturing*, *11*, 151–166.

Choen, M., & March, J. (1974). *Leadership and ambiguity*. New York: McGraw-Hill.

Coleman, J. (1988). Social capital in the creation of human capital. *American Journal of Sociology*, *94*(S), S95–S120.

Coleman, J. (1990). *Foundations of social theory*. Cambridge: Belknap Press.

Davidsson, P., & Honig, B. (2003). The role of social and human capital among nascent entrepreneurs. *Journal of Business Venturing*, *18*(3), 301–331.

Delmar, F., & Davidsson, P. (2000). Where do they come from? Prevalence and characteristics of nascent entrepreneurs. *Entrepreneurship and Regional Development*, *12*(1), 1–23.

Drucker, P. (1976). What results should you expect? A user's guide to MBO. *Public Administration Review*, *36*, 1–45.

Gartner, W. (1985). A conceptual framework for describing the phenomenon of new venture creation. *Academy of Management Review*, *10*(4), 696–706.

Gartner, W. (1988). "Who is an entrepreneur?" Is the wrong question. *American Journal of Small Business*, *12*, 11–32.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, *91*(3), 481–510.

Granovetter, M. (1993). The nature of economic relationships. In: R. Swedgerg (Ed.), *Explorations in economic sociology* (pp. 3–41). New York: Sage Press.

Honig, B. (1998). Who gets the goodies? An examination of microenterprise credit in Jamaica. *Entrepreneurship and Regional Development*, *10*, 313–334.

Katz, J., & Gartner, W. (1988). Properties of emerging organizations. *Academy of Management Review*, *13*(3), 429–441.

Kotler, P. (1991). *Marketing management*. Englewood Cliffs, NJ: Prentice-Hall.

Loury, G. (1987). Why should we care about group inequality? *Social Philosophy and Policy*, *5*, 249–271.

March, J., & Olsen, J. (1975). The uncertainty of the past: Organizational learning under ambiguity. *European Journal of Political Research*, *3*, 147–171.

Meyer, J., & Rowan, B. (1977). Institutionalized organizations: Formal structure as myth and ceremony. *American Journal of Sociology*, *83*, 340–363.

Mincer, J. (1974). *Schooling, experience and earnings*. New York: Columbia University Press.

Moorman, C., & Miner, A. (1998). Organizational improvisation and organizational memory. *Academy of Management Review*, *23*(4), 698–723.

Reynolds, P. (1997). Who starts firms? Preliminary explorations of firms in gestation. *Small Business Economics*, *9*(5), 449–462.

Reynolds, P., Hay, M., & Camp, M. (1999). *Global entrepreneurship monitor* (Global Entrepreneurship Monitor). Kauffman Center for Entrepreneurial Leadership.

Reynolds, P., Wolters, T., & Zevenbergen, P. (2000). *Opportunities and threats to nascent entrepreneurship*. Den Haag, Netherlands: EIM Small Business Research and Consultancy. Entrepreneurship in the Netherlands.

Ripsas, S. (1998). Towards an interdisciplinary theory of entrepreneurship. *Small Business Economics*, *10*, 103–115.

Sarasvathy, S. D. (2001). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of Management Review*, *26*(2), 243–263.

Schultz, T. (1959). Investment in man: An economist's view. *The Social Service Review*, *33*(2), 69–75.

Shrivastava, P. (1983). A typology of organizational learning systems. *Journal of Management Studies*, *20*(1), 7–28.

Simon, H. (1991). Bounded rationality and organizational learning. *Organization Science*, *2*(1), 125–139.

Van De Ven, A. (1993). The development of an infrastructure for entrepreneurship. *Journal of Business Venturing*, *8*, 211–230.

Venkataraman, S., & Sarasvathy, S. D. (2002). Strategy and entrepreneurship: Outlines of an untold story. In: M. Hitt, E. Freeman & J. Harrison (Eds), *The Blackwell handbook of strategic management* (pp. 650–653). Oxford, UK: Blackwell Publisher Ltd.

Weick, K. (1991). The nontraditional quality of organizational learning. *Organization Science*, *2*(1), 116–124.

Weick, K. (1993). The collapse of sensemaking in organizations: The Mann Gulch disaster. *Administrative Science Quarterly*, *38*, 628–652.

Wildavsky, A. (1979). *Speaking truth to power: The art and craft of policy analysis*. Boston, MA: Little Brown.

Wood, W. (1994). Primary benefits, secondary benefits, and the evaluation of small business assistance programs. *Journal of Small Business Management*, *32*(July), 65–75.

APPENDIX

Table A1. Sample and Response Rates.

Category	Total
Individuals randomly sampled with identifiable phone number	35,971
Individuals screened	30,427
Percentage	84.6%
Percentage Yes to NE, NI item	3.2%
No. of 'Yes' answer to nascent entrepreneur or nascent intrapreneur item	961
Refused to volunteer, could not or did not complete interview	−338
No. who accepted invitation to volunteer and completed long interview	623
Removed from analysis due to early termination	−168
Failed to complete mail questionnaire or missing data	−244
Nascent intrapraneurs	−38
Nascent entrepreneurs analyzed	173

Table A2. Twenty Gestation Behaviors and 46 Gestation Sequence Questions.

Gestation Activity	Question
1 Business Plan	Have you prepared a business plan?
1 Business Plan	Is your plan written, (includes informally for internal use)?
1 Business Plan	Is your plan written formally for external use?
2 Development of product/service	At what stage of development is the product or service that will be provided to the customers?
3 Development of product/service	Ready for sale or delivery
3 Development of product/service	Tested on customers
3 Development of product/service	Initial development
3 Development of product/service	Idea or concept
4 Marketing	Have you started any marketing or promotional efforts?
4 Patent/ copyright	Have you applied for a patent, copyright, or trademark?
4 Patent/ copyright	Has the patent, copyright, or trademark been granted?
5 Raw material	Have you purchased any raw materials, inventory, supplies, or components?
6 Equipment	Have you purchased, leased, or rented any major items like equipment, facilities or property?
7 Gathering information	Have you gathered any information to estimate potential sales or revenues, such as sales forecasts or information on competition, customers, and pricing?
7 Gathering information	Have you discussed the company's product or service with any potential customers yet?
8 Finance	Have you asked others or financial institutions for funds?
8 Finance	Has this activity been completed (successfully or not)?
8 Finance	Have you developed projected financial statements such as income and cash flow statements, break-even analysis?

Table A2. *Continued.*

Gestation Activity	Question
9 Saved money	Have you saved money in order to start this business?
10 Credit with supplier	Have you established credit with a supplier?
11 Household help	Have you arranged childcare or household help to allow yourself time to work on the business?
12 Workforce	Are you presently devoting full time to the business, 35 or more hours per week?
12 Workforce	Do you have any part time employees working for the new company?
12 Workforce	How many employees are working full time for the new company? One?
12 Workforce	How many employees are working full time for the new company? Two?
12 Workforce	How many employees are working full time for the new company? Three or more?
13 Non-owners hired	Have you hired any employees or managers for pay, those that would not share ownership?
14 Education	Have you taken any classes or workshops on starting a business?
14 Education	How many classes or workshops have you taken part in? One only
14 Education	How many classes or workshops have you taken part in? Two only
14 Education	How many classes or workshops have you taken part in? Three or more
15 Contact information	Does the company have its own phone number?
15 Contact information	Does the company have its own mail address?
15 Contact information	Does anyone in the team have a mobile mainly used for the bus?
15 Contact information	Does the company have its own visiting address?
15 Contact information	Does the company have its own fax number?

Table A2. *Continued.*

Gestation Activity	Question
15 Contact information	Is there an e-mail or internet address for this new business?
15 Contact information	Has a web page or homepage been established for this business?
16 Gestation Marketing	Have you started any marketing or promotional efforts?
17 Gestation income	Do the monthly expenses include owner/manager salary in the computation of monthly expenses?
18 Obtained licenses	Has the new business obtained any business licenses or operating permits from any local, county, or state government agencies?
19 Legal form	Has the new business paid any federal social security taxes?
19 Legal form	Has the company received a company tax certificate?
20 National specific	Have you applied for start-up benefits? (Cf. U.K. 'enterprise allowance scheme')
20 National specific	Has the application (the answer) regarding start up benefits been completed?
20 National specific	Has the new business received a company tax certificate?

A COMPETENCE-BASED PERSPECTIVE ON ORGANIZATIONAL DESIGN

Jonas Ridderstråle and Johan Stein

ABSTRACT

The strategic actions of a firm result in a knowledge system with particular complexity characteristics in terms of its extensity and intensity implying different managerial challenges. The chapter shows that there are clear differences between how successful units with high- and low-complexity knowledge systems, respectively, are organized.

INTRODUCTION

During the last century, perhaps one question more than any other has intrigued and bewildered practicing managers and academics alike; how should we organize business firms in order to build sustainable competitive advantages? We argue that research has neglected the importance of knowledge systems when trying to answer this question. Hence, the purpose of this chapter is to generate and test hypotheses on the relationship between knowledge systems and organizational design. Our results suggest that there

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are clear differences between how successful units with high- and low-complexity knowledge systems, respectively, are organized.

ORGANIZATIONAL DESIGN AND KNOWLEDGE SYSTEMS

What once started out as a search for the one best organizational form a' la Weber's (1947) bureaucracy and Fayol's (1919, 1949 trans.) principles of organizing eventually forced scholars to look for conditions that influence the efficiency and effectiveness of various configurations. A plethora of different contingency variables have been suggested. The classical models cover variations in firm size (Pugh, Hickson, Hinings, & Turner, 1969; Child, 1973), technology (Woodward, 1965; Perrow, 1967), and the organizational environment (Burns & Stalker, 1961; Lawrence & Lorsch, 1967). Meanwhile, scholars such as Chandler (1962), Ansoff (1965), and Andrews (1971) developed theories on strategy that emphasized the fit between internal resources (including competences) and the industrial environments.

Given the common interest between contingency and strategy scholars to consider the fit between internal and external conditions, surprisingly few attempts have been made to bridge these lines of thought. Notably, some recent contributions in the field of strategy discuss aspects of organizational design and competitiveness, but many contingency variables are neglected (see Leonard-Barton, 1992). However, with the introduction of the resource-based view of the firm, the strategy field has contributed to the organizational design discussion by considering the importance and complexity of knowledge (Birkinshaw, Nobel, & Ridderstråle, 2002).

It is our belief that so far research has been overly focused on the structural design of organizations in order to explain the fit between internal and external conditions. Given this observation, the purpose of this chapter is to generate and test hypotheses on the relationship between knowledge systems and organizational design. More specifically, we want to build on the theory of competence-based competition (Hamel & Heene, 1994; Sanchez, Heene, & Thomas, 1996; Heene & Sanchez, 1997) with its focus on the dynamics of competence building and leveraging on both the firm and the industry level, and its holistic and systemic view on organizations.

The underlying idea in this chapter is that the strategy of the firm is visible in retrospect as "a pattern within a stream of actions" (Mintzberg & Waters, 1985). These acts of strategy in turn have a strong impact on the knowledge system that a company subsequently utilizes in the pursuit of building sustained competitiveness, i.e., strategy influences the nature of a firm's knowledge system. By knowledge system, we refer to the entire stock of knowledge that a particular company can access. The simplicity/complexity dimension is captured by its level of extensity across space and scope as well as its degree of intensity in terms of depth and economic durability. Such knowledge may exist at the individual and/or supra-individual levels, i.e., group, organizational, and in the inter-organizational domain in the form of routines (see Hedlund & Nonaka, 1993 for a similar definition).

We will claim that four contemporary aspects of strategy appear critical to consider, in that they all shape the nature of the organization's knowledge system. First, a strategy focused on geographical expansion will result in a more dispersed system (Bartlett & Ghoshal, 1989). Second, a strategy centered on combining many different types of capabilities in the development of new customer offerings, will require access to a more diverse knowledge system (Kogut & Zander, 1992). Third, a competence-based strategy, e.g., employing skilled people that are kept on the knowledge frontier by continuously being exposed to training and education, produces a system marked by depth (Heene & Sanchez, 1997). Finally, competing on time makes the system less durable and strategic innovation becomes a continuous act of creative destruction (Schumpeter, 1942).

The resource-based view of strategy (Wernerfelt, 1984; Dierickx & Cool, 1989; Barney, 1991) has for a long time recognized that the knowledge set of an organization functions as a source of distinctiveness between firms. The general prescription for improved performance is to enhance the protection of unique aspects of knowledge, possibly through combining them into inimitable capabilities, and to develop new knowledge (Kogut & Zander, 1992; Grant, 1996; Teece, Pisano, & Shuen, 1997). Our principal argument, however, is that the most efficient mode of organizing these activities will vary depending on the specific characteristics of the knowledge system of the firm.

In short, we will show that the strategies pursued by the firm affect the nature of its knowledge system in the four dimensions referred to rendering it a particular extensity/intensity position. In turn, this position will influence which organizational arrangements are most fit to maximize the potential for exploiting current and creating new advantages. We will focus on four classical dimensions of organizational design that are often used to capture the distinction between mechanistic and more organic organizational solutions (Burns & Stalker, 1961); flatness of hierarchy, flexibility of organizational arrangements, organizational awareness of knowledge, and degree of normative integration.

BACKGROUND

To secure long-term survival, all organizations need to uphold a fruitful balance between exploiting their current resources while simultaneously creating new ones (March, 1991; Levinthal & March, 1993; Hedlund & Rolander, 1990).

Today, most scholars seem to agree that knowledge constitutes the most critical resource of the firm. The access to and entrepreneurial use of unique skills have always been important in the pursuit of competitive advantages (Wren, 1994), as noted already by a French Economist Jean Baptiste Say close to 200 years ago. Yet, our previous research suggests that the competitive landscape is changing in at least four crucial and partly inter-related dimensions (Ridderstråle, 1996), which will be discussed in more detail below. In turn, this transformation forces many organizations to alter both their own knowledge systems and the administrative structures in place to manage them. The shift is not automatic, but rather in many cases caused by firms that proactively act as change agents within their respective industries. These strategic movers introduce new rules and recipes within their respective industries.

Globalization Increases Knowledge Dispersion

The recent wave of deregulation, internationalization, and global integration already affects most companies. During the last 40 years, international trade has increased by some 1,500 percent. This is perhaps not surprising as average tariffs have simultaneously dropped from approximately 50 percent to less than five percent (Knoke, 1996). In many industries, competition has become truly global, and according to the Economist, the 300 largest multinational companies control 25% of all productive assets on earth. Accordingly, it seems fair to assume that knowledge is more evenly spread across the globe. Reich (1991) provides a telling example of how already almost 15 decades ago GM's Pontiac LeMans was made from components from more than five countries. Some companies, and particularly those combining knowledge from many different fields of expertise, are also realizing that sophisticated demand and supply are not always colocated (Ridderstråle, 1996). For instance, a majority of the most advanced trendsetters in the world do not live near Helsinki. This is at least potentially a problem for Nokia, the Finnish mobile phone company. Consequently, this firm has to send its people to Kings Road in London and Venice Beach in

LA to pick up the latest signals. Thus, we suggest that in many industries, the knowledge system required to develop a competitive customer offering is increasing in geographical dispersion.

Combination Increases Knowledge Diversity

Creation of novelty often requires that capabilities be combined in new ways (Schumpeter, 1942; Kogut & Zander, 1992). Knowledge must be integrated (Grant, 1996). From this perspective, many modern customer offerings are becoming more complex. First, it appears increasingly difficult to separate products from services. Some people even claim that it is better to talk about "provices" and "serducts" (Toffler, 1970). In the automotive industry, developing, producing, and launching a competitive customer offering requires mixing mechanics with electronics, design, manufacturing, PR, and finance skills. A single firm may of course not have to control all these capabilities, but the process still needs to be coordinated. Second, we also see more "products" being turned into purely multi-technology offerings (Baba & Imai, 1991; Granstrand & Schölander, 1989). Ericsson's P900 mobile phone/PDA/Camera/MP3 player is just one recent example. As a result, we see many traditional industrial boundaries becoming increasingly blurred. Third, the use of a simple process of either technology push or market pull is being challenged by genuinely cross-functional efforts in which technological and market knowledge is combined. Stories of parallel "rugby" development projects and concurrent engineering, especially in Japan, are widely spread (Nonaka & Takeuchi, 1995; Clark & Fujimoto, 1991). Finally, the increased need for combination is not limited to atoms and bits, technologies, and the call for cross-functional collaboration, but also encompasses the people possessing these skills. In the Silicon Valley companies, for instance, traditional "minority groups" such as women, immigrants, and people below 35 are dramatically over-represented as compared to the traditional US firm. Accordingly, we suggest that in many industries, the knowledge system required to develop a competitive customer offering is increasing in diversity.

Education Increases Knowledge Depth

Knowledge develops cumulatively. Bearing this in mind, we can conclude that never before has so much knowledge existed. The last few decades mark a veritable explosion in competence development. Since the early 1960s, the number of MBAs graduated in the USA has increased by 1,500% (Micklewait & Woolridge, 1996). When the US Army fought the Vietnam War, only 15% of the men had a college degree. During the Desert Storm campaign, approximately 99.3% of the soldiers were college graduates (Stewart, 1997). In addition, spending on executive education is skyrocketing. For instance, Motorola employees get 40 days of training per year (Dearlove & Crainer, 1999). Companies such as Apple and Intel have instituted sabbaticals for some of their top-people. To keep up, firms are forced to change their definition of learning into something that is life-long and personal (Davies & Botkin, 1994). Often, the internal distribution of competence is no longer as concentrated to a few people at the top. Currently, knowledge workers may be found on every level of the firm. At FedEx, for instance, front-line employees and second-level managers must attend 10–11 weeks of mandatory training in the first year. Therefore, we suggest that in many industries the knowledge system required to develop a competitive customer offering is increasing in depth, thereby forcing firms to stay even closer to the competence frontier.

Innovation Decreases Knowledge Durability

Today, continuous innovation, revolutionary, and evolutionary, is a necessity, possibly an evil one but even so a fact of life in most industries. Research indicates that the time it takes competitors to imitate has steadily shortened over the last 100 years (Baumol, 2002). Companies are forced to cut development time and increase the frequency of new product introductions. At Hewlett-Packard, a majority of revenues stem from products that did not exist a year before (Tapscott, 1996). A car launched in 1990 had generally taken some 6 years to develop. Currently, most auto companies do the same thing in less than 2 years. In Tokyo, you can even order a customized Toyota on Monday and be driving it on Friday (Davies & Meyer, 1998). In a Fortune Magazine interview, Disney CEO Michael Eisner even claimed that his firm introduces a new product offering, a CD, video, T-shirt, or whatever, every 5 min. Not only product life cycles are becoming shorter. The pressure to continuously develop new routines, systems, and procedures, allowing firms to move faster into the future, is also reaching boiling point. Learning and unlearning capabilities (Hedberg, 1979; Senge, 1992) are of utmost importance to any firm in the new economic landscape evolving in front of our eyes. Accordingly, we suggest that in many industries the knowledge system required to develop a competitive customer offering is decreasing in durability.

The Resulting Complexity of Knowledge Systems

Let loose, for those firms affected the impact of the four forces referred to may necessitate a simultaneous expansion in geographical space, breadth of technological scope, and intensity of skills – internally or in cooperation with others. Either way, the result is clearly spelt increased complexity. To create new customer offerings, knowledge must, at least hypothetically, be combined and re-combined across geographical, organizational, technological, industrial, and possibly also across institutional borders, e.g., in the form of joint-ventures or strategic alliances. While this development constitutes a true challenge as such, the fact that the time available to accomplish all this is simultaneously decreasing further complicates the task of organizing these activities.

COMPETENCE-BASED STRATEGIES

To cope with the new requirements, or indeed to shape the new business environment, companies launch strategies aimed at improving the knowledge systems on which they base their competitiveness. Given our purpose of linking strategic actions to the resulting web of capabilities, we believe it is useful to connect the distinction introduced by Hedlund (1999) who talks about the intensity and extensity of knowledge systems to our initial discussion of dispersion, diversity, depth, and durability. Intensity, as defined by Hedlund, refers to the need for advanced and recent knowledge in the activities performed by the firm. By extensity, the author describes the dispersion of knowledge within the organization in terms of geographical and cultural distances as well as diversity in terms of technologies and people. The dimensions proposed by Hedlund also partly overlap with the framework present in Nass (1994), where the author talks about the depth and breadth of knowledge. Cohen and Levinthal (1990), in discussing absorbtive capacity elaborate on the impact of knowledge diversity and commonality, which could be regarded as elements of extensity.

It is apparent that strategic actions increase or decrease the intensity and/or extensity of a firm's knowledge system. The changes in geographical dispersion and diversity that we have mentioned clearly affect the extensity of an organization's knowledge system. In turn, both the depth and durability dimensions of our framework used to describe the complexity of knowledge systems overlap with the term intensity used by Hedlund. Thus, strategies focused on internationalization or combination of new capabilities increase extensity. Actions centered on increasing the depth of the knowledge system, either by hiring more educated people or exposing the present employees to more training, as well as measures taken to influence the durability of knowledge by shortening the life cycle of products, services, and changing routines in general lead to higher intensity.

Combining our framework for operationalizing the complexity of knowledge systems with the typology implied by Hedlund's framework results in the two by two matrix below. A system of low intensity and extensity is defined as one marked by knowledge simplicity, whereas a company with high extensity and intensity would face the organizational and managerial challenges associated with a complex knowledge system (Fig. 1).

ORGANIZATIONAL RESPONSES

In line with Chandler's (1962) original argument, we claim that successful companies must achieve a fit between their strategy and the structures in place. We suggest that the underlying reason behind the criticality of achieving this fit is related to the fact that the strategy of the firm shapes its knowledge system. To secure the simultaneous exploitation of current advantages and creation of new ones, the administrative structures need to be adapted to the demands posed by the specific knowledge system. Thus, in

		Extensity	
		Low	High
Intensity	High	Internationalization: Low Combination: Low Education: High Rate of innovation: High	Internationalization: High Combination: High Education: High Rate of innovation: High
	Low	Internationalization: Low Combination: Low Education: Low Rate of innovation: Low	Internationalization: High Combination: High Education: Low Rate of innovation: Low

Fig. 1. Four Archetypal Competence-Based Strategic Positions.

line with contingency theory, we hypothesize that there is no one best way in which to organize firms.

Within the field of contingency theory, however, there has been a widespread debate on which circumstances are most important to take into account when designing an organization. The most common approaches mean that organizational size, employed technology, or environmental conditions have an impact on the effectiveness of a certain design (Morgan, 1986). Often, the alternative organizational structures proposed lie in a continuum between what has become known as the mechanistic firm and the organic firm (Burns & Stalker, 1961).

The Size Imperative

Proponents of the size imperative recognize that not only structural differences exist between large and small organizations, but also that these differences are systematic. Growth in organizational size generally leads to increased specialization of tasks, widened spans of control and additional hierarchical levels of authority (Blau, 1970; Child, 1973). Pugh, Hickson, Hinings, and Turner (1969) found that out of seven potentially influential variables, size was the most powerful predictor of structural solution. Large size is also often coupled with spatial dispersion of sub-units and formalized communication and control (Hickson, Pugh, & Pheysey, 1969; Blau & Schoenherr, 1971; Khandwalla, 1974).

The Technology Imperative

Researchers within the technology imperative stress that the technology at use in the organization decides the tasks to be performed, and should thus also influence the organizational design. Through a categorization of manufacturing technology processes into three groups, Woodward (1965) could explain variations in organizational design. The categories proposed, unit and small batch, large batch and mass production, and finally continuous process production imply an increasing interdependence between subprocesses, increasing capital investments, and a greater need for stability of the process. The more complex the production technology, the more managerial levels in the organizational hierarchy and the more managers per worker. Firms using mass production processes had wider spans of control, more formalized rules and procedures and relied more on written communication than the other two technology types.

Hickson et al. (1969) followed up Woodward's study with a different sample and a scale measuring technological complexity instead of dividing them into discrete types. They arrived at the conclusion that technological differences could explain variation in organizational design in smaller firms, but not in large companies where most employees are not in direct contact with the production workflow, but rather in administrative or other types of processes. Child and Mansfield (1972) draw similar conclusions.

While the view of technology in these studies is fairly narrow, including only the technology used in the production function of manufacturing organizations, Perrow (1967) understood technology instead as the actions performed by all organizational members. Technology was then categorized depending on the amount of exceptions to established routines encountered and how solutions were found to these irregularities, e.g., if the search mechanism was intuitive or logical. Thompson (1967) also introduced a more inclusive approach, providing a typology consisting of long-linked, mediating and intensive technologies. More importantly, he presented a categorization of types of interdependencies between tasks, describing them as pooled, sequential, and reciprocal. Depending on the type of interdependency, rational ways of grouping tasks were proposed. Van de Ven, Delbecq and Koenig (1976), further developed the concepts of Perrow and Thompson and tested them empirically. They found that the effective mode of coordination differed with the type of interdependency between tasks in a unit.

The Environment Imperative

Expanding on research emanating from complexity and systems theory in biology (Von Bertalanffy, 1950, 1968), it has been argued that organizations can be seen as components within a larger system, the environment. The size and technology imperatives of organization theory may be seen as internally oriented, in the sense that the factors affecting the effectiveness of a certain organizational design are internal and possible to control. According to the environment imperative, the effectiveness of an organization also depends on the fit with factors that do not exist inside the boundaries of the firm. Certain environmental elements, be they social/cultural, economic, and physical or technological influence and put constraints on the range of possible effective actions of firms.

In the framework of Emery and Trist (1965), the primary focus is on the interaction between environmental elements. If different parts of the organization perceive the rules governing interaction between elements in different ways, the environment is heterogeneous and should promote multi-unit organizations, with each unit learning about their specific conditions. Interaction between elements can be either stable or changing in a predictable or unpredictable fashion. With change taking place, it becomes necessary to expand capacity for planning and quick execution through decreasing unit size and decentralizing decision-making. As environmental change becomes turbulent and chaotic, prime concern is to keep the decentralized, multi-unit organization aligned through a common value base, rather than only management authority.

Burns and Stalker (1961) describe the environment distinctly different by defining it as the market context of a firm. Naturally, attention is then directed at the output of the firm and the demands of the buyers, while omitting several other environmental elements. The focus is on the volatility of market conditions, a term including both rate of change and uncertainty about the direction of change. With more volatility in the marketplace, an effective firm will need to have a high capacity to adapt to changes, i.e., develop new products, processes, and markets. This is more readily performed with an organic management system.

Lawrence and Lorsch (1967) argue that the environment can be divided into three distinct segments, the scientific, the market, and the techno-economic. Usually, the characteristics differ so much between these segments that most firms use different (functional) sub-units to interact with them. Variations in uncertainty level (clarity of information, uncertainty of causal relationships and time span of definitive feedback) introduce a need for differentiation. Superior performance is derived from allowing sub-units within the firm to differentiate according to their specific environments, and provide sufficient amounts of integrative measures.

Modern Approaches to Contingency Theory

The controversy sparked around the contingency variables presented have lessened the belief that size, technology, or environmental conditions in themselves suffice to explain variations in organizational design among firms (Morgan, 1986). There have been at least two approaches to amend this problem; either by combining several variables to form a more complex model, or by trying to identify underlying variables, the reasons for which size, technology, and environment seem to cause structural differences.

Already Thompson (1967) used both environment and technology as variables influencing organizational design, providing a more multifaceted description of the reality confronting most firms. The core technology of a unit decides the amount of buffering and smoothing of environmental changes to be performed in order to gain efficiency, whereas environmental conditions influence growth patterns of the organization and the grouping of units. Most of the models presented, though, include an even wider range of variables. One aim of such research is to identify viable combinations of these variables. Miles and Snow (1978) and Mintzberg (1979), based on theoretical reasoning, present typological descriptions of organizations, archetypal firms where configurations are coherent in environmental setting, structure, and strategy. If the firms deviate from the ideal configurations it is proposed that there will be losses in performance. Miller and Friesen (1984) continue in the same vein, and propose that it is possible to use advanced statistical methods to find relevant groupings of variables in quantitative data and develop taxonomies of organizational configurations.

Proponents of the information-processing approach (e.g., Galbraith, 1973, 1977; Tushman & Nadler, 1978; Daft & Macintosh, 1981) instead claim that the underlying variable deciding the efficiency of an organizational design is task uncertainty, a function of relevant experience possessed by the organization, output diversity, workforce diversity, and time constraints. Uncertain situations require more communication than certain, as the exception to established decision-making rules call for counseling with and authorization from a manager to take action. This becomes a problem in strictly hierarchical structures, because of the limited number of paths for communication. The information-processing capacity becomes overloaded, resulting in distortions and delays. To remedy the situation, organizations either reduce the uncertainty level (through various methods of decentralizing decision-making) or increase information-processing capacity (through introducing vertical information systems or enhancing lateral relationships).

A Knowledge-Based Imperative

While the information-processing perspective implies a focus on uncertainty and what the firm does not know, we believe that variations in organizational design can also be explained by the characteristics of what the firm does know, i.e., the nature of the knowledge system it employs in transforming input to output. The dominant hierarchical paradigm as summarized in Simon's (1962) seminal article rests upon a number of underlying assumptions. Firms operate in a predictable environment with no changes in input, output, and processes, and the combination of knowledge that competitive advantages are based on is given, eternal and kept internally at one permanent location. Therefore the role of the organizational design is to ensure the efficient exploitation of this combination of knowledge. No requirements for stimulating also the creation on new sources of competitive advantage have to be taken into account.

For firms with more complex knowledge systems, few, if any, of these assumptions hold true, however. To these organizations, elements of surprise, change, and external dependence have become business as usual. Therefore, we posit that under conditions of knowledge complexity a different organizational form, departing from the principles suggested by the hierarchical logic is required. In more detail, there are four areas of organizational design where we expect successful organizations to respond differently.

Flatness

In the bureaucratic organization, complexity is countered with increased division of labor and specialization, which leads to a higher hierarchy (Mintzberg, 1979). However, in a firm with a complex knowledge system, we would expect the opposite to occur. Quick decisions need to be taken closely to where critical, in-depth knowledge resides, geographically as well as organizationally. This would imply a more decentralized and flatter positional structure. Other measures than centralized planning are necessary to cope with the challenges raised by increased intensity and extensity. From this perspective, increased systems complexity is handled with structural simplicity rather than complexity. Thus, the hypothesis can be formulated as follows:

H1. For high-performers, the organizational design of companies with complex knowledge systems will be flatter than those with less complex knowledge systems.

Flexibility

The bureaucratic organization derives its competitive strength from being an efficient solver of repetitive tasks. Through control, planning, and reiterations, processes are rationalized and routinized. Complex knowledge systems imply that there is less potential for planning and rationalization as new business opportunities may demand novel combinations of knowledge, possibly in ways crossing the borders of a traditional organization chart (Grant, 1996; Nohria & Ghoshal, 1997; Nonaka & Takeuchi, 1995; Zander & Kogut, 1995). Indeed, there are strong reasons to believe that new ideas are born in the spontaneous interaction between problems and solutions (March & Olsen, 1976). Thus, we would expect boundary-spanning projects, which function as horizontal processes utilizing knowledge from different parts of the firm and the inter-organizational domain, to be the main vehicle for action. These projects would also have considerably more power than is generally the case in the typical bureaucracy, where much decision-making responsibility still rests with "the boxes and arrows." To facilitate this new way of operating; people would have less permanent homes in the positional hierarchy, in that they would continuously be transferred across organizational borders such as functions and countries. Through intense socialization, people would develop a common frame of reference or culture (Hedlund & Nonaka, 1993; Nonaka & Takeuchi, 1995), and combination and recomposition of knowledge also in day-to-day activities would be promoted. Accordingly, the hypothesis can be formulated as follows:

H2. For high-performers, the organizational design of companies with complex knowledge systems will be marked by more flexibility than those with less complex knowledge systems.

Awareness

In the bureaucracy, the general manager or chief executive officer is supposed to know who knows who, who knows what, who knows how, and who knows where. The firm with a complex knowledge system needs a more holographic design, where the whole is reflected in all parts (Morgan, 1986). Consequently, if the knowledge system describes the availability of resources, intelligence covers the organizational awareness of these. Without shared knowledge about what the unit knows, exploitation of the current stock of knowledge and creation of new knowledge risks becoming stifled (Nonaka & Takeuchi, 1995). Expansion, particularly in space, also increases the probability that problems and solutions may be permanently decoupled (Weick, 1979). With raising extensity and intensity, it becomes more difficult to keep track of and update the map of organizational knowledge. The reasoning is valid also as for the awareness of resources located outside the legal boundaries of the firm, i.e., knowledge controlled by customers and suppliers. Thus, due to the increased complexity, these processes of increasing knowledge awareness must be more actively managed. Therefore, the hypothesis can be formulated as follows:

H3. For high performers, the organizational design of companies with complex knowledge systems will be marked by higher degrees of competence awareness than those with less complex knowledge systems.

Integration

Control and coordination in the bureaucratic organization is based on legal authority and formalization. In a firm with a complex knowledge system, integration cannot be handled in such a manner. The conditions change so fast that formalized procedures become too rigid and static. Knowledge may be located in the periphery where little formal authority resides, but still rapid organizational action is required. Experts in various fields need to know about the general direction from those in charge of the positional structure, but often they will control the skills necessary to come up with the answers required to initiate the proper actions. As noted above, socialization, rather than formalization or standardization, becomes the preferred mode of coordination. Thus, as the system increases in complexity, a shared vision and values will constitute the least common denominator needed to secure organizational action to utilize the knowledge available, e.g., normative integration (Etzioni, 1975). Ideally, minimum critical specification in the form of these few, mutual principles secure coordination while still allowing for flexibility, thus enabling for increased self-organization (Morgan, 1986). Consequently, the hypothesis can be formulated as follows:

H4. For high performers, the organizational design of companies with complex knowledge systems will utilize normative integration to a larger extent than those with less complex knowledge systems.

METHOD

There are strong reasons to believe that knowledge systems are organization dependent and, in part, also industry dependent. The relevant level of analysis is therefore the business unit, rather than the corporate group, which is often active in several industries. Based on information in the corporate annual reports of 25 of the largest multinational manufacturing companies with headquarters in the Nordic region, a total of 155 divisions were identified.

In June 1998, a survey was mailed to the managing director of each division, with instructions for him (in a few cases, her), or the manager he deemed most knowledgeable about the issues, about the questions to be answered. After two written reminders (mailed in early August and late September) and a round of telephone calls to the non-respondents in October, we received 58 responses from 21 companies in total. This corresponds to a response rate of 37 percent. The responses from the two rounds were then compared, but none of the variables included in the study were significantly different at $p<0.05$.

Of the 97 units not answering, one company with 5 units claimed they were unable to answer our questions as they were currently conducting a company-wide reorganization and 7 units claimed they did not have the type of activities so as to be able to answer. The absolute majority, though, referred to policies of not answering surveys, personal time constraints, corporate policies of not answering research questionnaires and that the information we were asking for was of a confidential nature. Yet, since no systematic pattern could be found in this sample we believe that the non-respondents do not bias our results. A brief descriptive overview of the respondents can be found in Table 1.

Admittedly, there are limitations to the sampling strategy used. In each organization, we have only one informant. Adding more informants would possibly give a higher degree of reliability. However, sending multiple surveys to each company was believed to further decrease the response rate. Since detailed information on the business area level is not reported in publicly available sources, the possibilities of complementing the survey with secondary data were also deemed as limited.

In terms of generalizability, it is worth noting that all companies in our study originate from small, open economies. Accordingly, compared to the typical US or Japanese multinational firms, most of the units are more

Table 1. Characteristics of the Units Included in the Sample.

	N	Minimum	Maximum	Mean	Standard Deviation
Number of employees (1997)	58	90	37800	4966	6796
Total sales (1997, billion SEK)	55	0.8	167.7	10.43	23.30
Number of units outside home country (1997)	57	0	200	21.68	30.01
Number of countries in which strategic centers exist (1997)	54	1	35	4.85	5.71

international in terms of sales, employees, experience, etc. On the other hand, this particular fact is also a major strength of the study in that the impact of geographical dispersion is at its peak. Most units are parts of traditional manufacturing companies with a long history, often dating back to the turn of the century or beyond. Generally, they do business in what is considered as fairly mature industries, e.g., pulp and paper, steel, automotive. This is a drawback to the extent that we lack companies with high scores in knowledge intensity, and also variation in this dimension is much lower than in the case of extensity (see Table 5). Accordingly, our results may not be as applicable when it comes to units that are young, growing rapidly, and active in high-tech industries.

Performance

The question of how performance should be measured is open to a perennial debate. Several respondents were reluctant to answer questions relating to financial results (return on sales and return on assets). Had the units in the sample corresponded to legal entities, it would have been possible to observe their financial performance through annual reports, but in dealing with divisions this is not always the case. Moreover, as the average level of financial performance may vary from industry to industry, the performance measure should take this possibility into account. The interesting question is thus performance in relation to competitors in the same industry, rather than performance per se.

The second aspect concerns what dimensions of performance that are crucial to capture. Financial measures do not necessarily capture the richness of performance, since they focus solely on the past. In discussing organizational learning, performance can be described as the organizations' ability to conduct activities of exploration and exploitation (March, 1991). Exploitation is focused on the effective use of the current resources, whereas exploration refers to the development of new resources. Proficiency in one aspect does not necessarily lead to success in the other. Instead, they may even be mutually exclusive in that they compete for scarce resources. Not only March, but also many other scholars have described the same difference between incremental improvement and wider change, e.g., Argyris and Schön (1978), Nonaka (1994), and Hedlund and Rolander (1990), albeit using a somewhat different terminology.

Ansoff (1965) introduces a model for growth strategies of the firm. Based on markets and products, this model captures the continuum between exploration and exploitation in four categories. In this vein, we asked the respondents to assess their "…capabilities compared to those of your competitors" in each of Ansoff's four categories on a seven point Likert scale (see Table 2). As argued in March (1991), an organization should strive for a balance between its activities of exploration and activities of exploitation. To reflect these considerations, we devised a scale with equal weightings of the four categories of performance.

Regrettably, the alpha value for this construct is low. There may of course be genuine weaknesses associated with our way of measuring performance, but the fact that we are trying to capture aspects of both exploitation and creation in one construct could also account for the low score. As these two sides of performance could be mutually exclusive, the diversity reflected in the alpha value is perhaps not surprising. Despite the weaknesses in statistical terms, we still believe it essential to capture the built-in multi-dimensionality of performance, in order to accurately describe the dual demands posed on contemporary organizations. Therefore, rather than using two separate measures, we decided to keep the combined one.

Knowledge System

Knowledge system characteristics were operationalized through a questionnaire, which consisted of 27 statements where the respondents were asked to state the percentage of, e.g., employees outside the home country, innovation projects involving collaboration across functions or employees with a university degree. Percentage was marked on a scale from 1 to 10 (in 10 percent increments, or in three cases, 1 percent increments). When constructing the questionnaire, we had a theoretically based a priori conception about which items should be included in the respective dimensions. In the primary analysis of the material, though, certain items were excluded due to low inter-item correlation.

Table 2. Operationalization of Performance.

Construct: Performance	Number of Items: 4	Alpha: 0.52

Items included in scale:
On a scale of 1 (much worse) to 7 (much better), how would you describe your capabilities compared to those of your competitors in:
Creating new products for new customers?
Creating new products for existing customers?
Bringing existing products to existing customers?
Bringing existing products to new customers?

The extensity dimension assesses geographical dispersion as the amount of activities taking place abroad. The scale for extensity further includes items describing the amount of activities spanning national and organizational borders, both internal and external (Table 3). Thus, due top missing data, the diversity aspects of the extensity measure are restricted to the organizational level, e.g., the extent to which units with diverse skills work together, and do not capture the product-offering, technology, and people dimensions. Within the intensity dimension, the depth statements related to the formal education and experience of the personnel, the amount of training they receive and the durability aspects were captured by rate of updating of product range, systems, and procedures (Table 3).

Organization Design

The score for the organizations was estimated through constructing multi-item scales from the questionnaire's 35 questions covering organizational

Table 3. Operationalization of Knowledge System Variables.

Dimension: Extensity	Number of Items: 9	Alpha: 0.87
Items included in scale:		
Percentage of employees outside the home country		
Percentage of research and development outside the home country		
Percentage of production outside the home country		
Percentage of suppliers outside the home country		
Percentage of sales outside the home country		
Percentage of innovation projects involving collaboration across functions		
Percentage of innovation projects involving collaboration across business areas		
Percentage of innovation projects involving collaboration across nations		
Percentage of innovation projects involving collaboration with external partners		
Dimension: Intensity	Number of Items: 9	Alpha: 0.68
Items included in scale:		
Percentage of employees with Ph.D. degree (1 percent increments)		
Percentage of sales spent on training and education (1 percent increments)		
Percentage of sales spent on research and development (1 percent increments)		
Percentage of employees receiving yearly training and education		
Percentage of employees who need to upgrade their skills every year to stay competitive		
Percentage of existing administrative systems and procedures introduced in the last 2 years		
Percentage of existing administrative systems and procedures introduced in the last 5 years		
Percentage of sales from products introduced in the last 2 years		
Percentage of sales from products introduced in the last 5 years		

design. For each question, the respondent was asked to mark his agreement or disagreement on a seven point Likert scale. The order of the questions did not correspond to the dimensions that we were measuring, and certain statements were worded as negations.

In the study, flatness of the firm is indicated by three items measuring the perceived flatness and de-layering of the organization, and the number of middle managers. Flexibility relates to the ability of the organization to quickly recompose its structure. In the study, we estimate this from the rotation of people across countries, business areas and functions, and the amount of and importance of work taking place in projects. The awareness dimension measures the ability of the organization to keep track of its various knowledge resources and how these are diffused. We assess this from the existence of systems for knowledge management and the transfer of knowledge between countries and functions. We also asked whether they were aware of their key capabilities, and to cover also the inter-organizational domain we inquired about the sophistication of their suppliers and customers. Integration reflects the extent to which the employees are part of an organizational culture. The statements used to assess this related to the importance of shared values in the business area, and whether a shared vision existed (Table 4).

An overview describing the distribution of scores of in the dimensions we employ in the study is found in Table 5.

ANALYSIS

To test the hypotheses, we used the intensity and extensity dimensions to split the sample into the four groups implied by Fig. 1. The units in each group were then classified as either high or low performers. The distribution of units can be found in the table below. Scores for each organizational dimension and sub-group were then computed (see Table 6).

The scores for high-performing low-complexity units were then compared to those for high-performing high-complexity units by running a t-test for equality of means. The results are displayed in Table 7.

Evident from Table 7 is that we find support for hypotheses one through three. Accordingly, high-performing units which are subject to complex knowledge systems utilize an organizational design that is flatter, more flexible, and marked by higher degrees of awareness than high-performing units with less complex knowledge systems. We could, however, find no statistically significant support for the former units also relying more on

Table 4. Operationalization of Organization Design Variables.

Dimension: Flatness	Number of Items: 3	Alpha: 0.63
Items included in scale: On a scale of 1 (disagree) to 7 (agree) please rate:	We have a flat organization We have few middle managers We have a de-layered organization	
Dimension: Flexibility	Number of Items:	Alpha: 0.70
Items included in scale: On a scale of 1 (disagree) to 7 (agree) please rate:	Project leaders have much power We rotate people across countries We rotate people across functions We rotate people across business areas Most people work in projects We work in horizontal processes	
Dimension: Awareness	Number of Items: 7	Alpha: 0.62
Items included in scale: On a scale of 1 (disagree) to 7 (agree) please rate:	We manage internal knowledge transfer between countries We manage internal knowledge transfer between functions We are a learning organization We have a system for knowledge management We know who our most sophisticated suppliers are We know who our most sophisticated customers are We know which our core competences are	
Dimension: Integration	Number of Items: 2	Alpha: 0.73
Items included in scale: On a scale of 1 (disagree) to 7 (agree) please rate:	We have a shared vision at the business area level Shared values are critical in keeping the business area together	

Table 5. Distribution of Scores for Variables Operationalized.

	N	Minimum	Maximum	Mean	Standard Deviation
Performance	57	3.75	7	4.96	0.63
Extensity	58	1	8.89	5.05	2.03
Intensity	58	1.22	6.44	3.55	1.15
Flatness	58	2.60	6.67	4.80	0.93
Flexibility	58	2.86	6.43	4.81	0.79
Awareness	58	3.57	6.71	5.17	0.72
Integration	58	2	7	5.90	0.86

Table 6. Organizational Scores for Units with Different Types of Knowledge Systems.

Intensity	Extensity			
	Low		High	
High	High performers: 2 Flatness: 5.1 Flexibility: 5.2 Awareness: 4.7 Integration: 5.9	Low performers: 9 Flatness: 4.6 Flexibility: 4.7 Awareness: 4.8 Integration: 5.9	*High performers: 14* *Flatness: 5.3* *Flexibility: 5.3* *Awareness: 5.8* *Integration: 6.2*	Low performers: 4 Flatness: 4.3 Flexibility: 5.2 Awareness: 4.9 Integration: 5.5
Low	*High performers: 8* *Flatness: 4.4* *Flexibility: 4.3* *Awareness: 4.9* *Integration: 5.4*	Low performers: 9 Flatness: 4.5 Flexibility: 4.7 Awareness: 5.3 Integration: 6.2	High performers: 6 Flatness: 5.2 Flexibility: 4.3 Awareness: 5.0 Integration: 5.8	Low performers: 6 Flatness: 4.7 Flexibility: 4.7 Awareness: 4.9 Integration: 5.8

normative integration in the form of shared visions and values than the latter group.

DISCUSSION

In our minds, the analysis conducted indicates that in order to maximize performance, companies with different knowledge systems must be organized in various ways. The traditional hallmark of the large and complex firm of the 20th century is the hierarchical design logic. The concept of hierarchy as such, however, is much older. A Greek scholastic called Dionysius the Areopagite introduced the word hierarchy some 1,500 years ago. Dionysius

Table 7. Comparison of Means for High-Performing Units with Different Knowledge Systems.

Organizational Dimension	Sig. (2-tailed)	95% Confidence Interval of the Difference	
		Lower	Higher
Flatness	0.014	0.1997	1.5763
Flexibility	0.004	0.4041	1.7188
Awareness	0.014	0.2286	1.6283
Integration	0.203	−0.5117	2.0653

argued that heaven and hell are hierarchically organized. This celestial structure in turn composes three separate systems of being, knowledge, and action, respectively (Hedlund, 1993). Furthermore, the original argument states that these structures overlap. Accordingly, the position in the hierarchy is assumed to accurately describe and reflect what people know and do.

As we see it, our results are easier to understand by differentiating the organization into these three distinct systems, based on position, knowledge, and action, respectively (Hedlund, 1993). In much research, the correspondence between these systems has largely been taken for granted. Still, we know from previous work that left to dominate, each of these three systems will result in a specific, archetypal design. Letting the positional system dominate will result in a bureaucracy (Weber, 1947). If knowledge is the only organizing principle, we are left with a meritocracy. Finally, if action drives the entire system, the design resembles an adhocracy (Bennis & Slater, 1968; Toffler, 1970; Mintzberg, 1979).

For firms with less complex knowledge systems, it seems as if the three systems overlap in a way that makes the positional system a reasonable proxy of the others. In this case, the headquarters unit in charge of the others does control all critical skills and relationships with external actors, and is thus apt to be in charge of all relevant organizational actions, while the subsidiaries can be relegated to minor, implementing roles. In Weber's ideal bureaucracy, position was granted on the basis of technical competence and tasks were performed with increasing skill, and interrelationships were primarily based on authority and subordinance. Scott (1987) points out that in Weber's time, the position and knowledge were indeed highly correlated. Today, however, this is no longer always the case.

When the knowledge system of a firm increases in extensity and/or intensity, strong forces appear to tear the three systems apart. A higher position does not necessarily imply more or more advanced knowledge.

Actions are more erratic and often placed outside the organization as such. Relying solely on the positional system would produce an organization that is far too static and rigid to create new competitive advantages. Our interpretation of the organizational responses of the successful units with complex knowledge systems is that rather than designing purely organic adhocracies or meritocracies, however, they try to manage all three systems simultaneously. The action system captures the new modus of operandi. Resources are transferred from units in the positional system to temporary and boundary spanning projects with increased organizational clout. The knowledge system is actively managed in that great efforts are made to inform and get the parts to inform themselves about the whole. Increasing knowledge awareness throughout the firm appears critically important.

CONCLUDING REMARKS

Knowledge is a critical resource that must be actively managed. There are, however, many different ways in which to do it – no methods or organizational solutions are necessarily always better than the others. In this chapter, we have tried to point out that the strategic actions of a firm result in a knowledge system with particular traits. If the nature of these systems is not reflected in the organizational design in place to manage this most principal asset of the modern company, performance will deteriorate. We have shown that there are clear differences between how successful units with high- and low-complexity knowledge systems, respectively, are organized. In the former case, solutions with ahierarchical elements appear to work better, while in the latter case more traditional arrangements still seem appropriate. A hammer should be used for nails and a screw-driver for screws – not the reverse. We see few signs of a Swiss-army-knife type of organizational design that is fit to handle any type of knowledge system.

REFERENCES

Andrews, K. R. (1971). *The concept of core strategy*. Homewood, IL: Irwin.

Ansoff, H. I. (1965). *Corporate strategy*. New York: McGraw-Hill.

Argyris, C., & Schön, D. (1978). *Organizational learning: A theory of action perspective*. Reading, MA: Addison-Wesley.

Baba, Y., & Imai, K. (1991). Globalization and cross-border networks of Japanese firms. Paper presented at the conference Japan in a Global Economy – A European Perspective, Stockholm, Sept. 5.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*, 99–120.

Bartlett, C. A., & Ghoshal, S. (1989). *Managing across borders: The transnational solution*. London: Hutchinson Business Books.

Baumol, W. J. (2002). *The free-market innovation machine: Analyzing the growth miracle of capitalism*. Princeton, NJ: Princeton University Press.

Bennis, W., & Slater, P. (1968). *The temporary society: What is happening to business and family life in America under the impact of accelerating change*. New York: Jossey Bass.

Birkinshaw, J., Nobel, R., & Ridderstråle, J. (2002). Knowledge as a contingency variable: Do the characteristics of knowledge predict organization structure? *Organization Science*, *13*(3), 274–289.

Blau, P. (1970). A formal theory of differentiation in organization. *American Sociological Review*, *35*, 201–208.

Blau, P., & Schoenherr, R. (1971). *The structure of organizations*. New York: Basic Books.

Burns, T., & Stalker, G. M. (1961). *The management of innovation*. London: Tavistock Publications.

Chandler, A. (1962). *Strategy and structure: Chapters in the history of the American industrial enterprise*. Cambridge, Mass: MIT Press.

Child, J. (1973). Predicting and understanding organization structure. *Administrative Science Quarterly*, *18*, 168–185.

Child, J., & Mansfield, R. (1972). Technology, size and organization structure. *Technology*, *6*, 369–393.

Clark, K. B., & Fujimoto, T. (1991). *Product development performance: Strategy, organization and management in the world auto industry*. Boston, MA: Harvard Business School Press.

Cohen, W. M., & Levinthal, D. A. (1990). Absorbtive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*, 128–152.

Daft, R. L., & Macintosh, N. B. (1981). A tentative exploration into the amount and equivocality of information processing in organizational work units. *Administrative Science Quarterly*, *26*, 207–224.

Davies, S., & Botkin, J. (1994). *The monsters under the bed: How business is mastering the opportunity of knowledge for profit*. New York: Simon & Schuster.

Davies, S., & Meyer, C. (1998). *Blur: The speed of change in the connected economy*. London: Capstone.

Dearlove, D., & Crainer, S. (1999). *Gravy training*. San Francisco, CA: Jossey-Bass.

Dierickx, I., & Cool, K. (1989). Asset stock accumulation and sustainability of competitive advantage. *Management Science*, *35*, 1504–1511.

Emery, F. E., & Trist, E. L. (1965). The causal texture of organizational environment. *Human Relations*, *18*, 21–32.

Etzioni, A. (1975). *A comparative analysis of complex organizations*. New York, NY: Free Press of Glencoe.

Fayol, H. (1919) (1949 trans.). *General and industrial management*. London, Pitman.

Galbraith, J. R. (1973). *Designing complex organizations*. Reading, MA: Addison-Wesley.

Galbraith, J. R. (1977). *Organization design*. Reading, MA: Addison-Wesley.

Granstrand, O., & Schölander, S. (1989). Managing innovation in multi-technology corporations. *Research Policy*, *18*, 35–60.

Grant, R. M. (1996). Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. *Organization Science*, *7*, 375–387.

Hamel, G., & Heene, A. (1994). *Competence-based competition*. New York: Wiley.

Hedberg, B. (1979). How organizations learn and unlearn. In: P. Nyström & W. Starbuck (Eds), *Handbook of organizational design* (pp. 3–27). Oxford: Oxford University Press.

Hedlund, G. (1993). Assumptions of hierarchy and heterarchy, with applications to the management of the multinational corporation. In: S. Ghoshal & E. Westney (Eds), *Organization theory and the multinational corporation* (pp. 211–236). New York: St. Martin's Press.

Hedlund, G. (1999). The intensity and extensity of knowledge and the multinational corporation as a nearly recomposable system. *Management International Review*, *19*, 5–44.

Hedlund, G., & Nonaka, I. (1993). Models of knowledge management in the West and Japan. In: P. Lorange, B. G. Chakravarthy & A. H. Van de Ven (Eds), *Implementing strategic processes, change, learning and cooperation* (pp. 117–144).

Hedlund, G., & Rolander, D. (1990). Action in heterarchies – New approaches to managing the MNC. In: C. A. Bartlett, Y. L. Doz & G. Hedlund (Eds), *Managing the global firm* (pp. 15–46). London: Routledge.

Heene, A., & Sanchez, R. (Eds) (1997). *Competence-based strategic management*. Chichester: Wiley.

Hickson, D. J., Pugh, D. S., & Pheysey, D. (1969). Operations technology and organization structure: An empirical reappraisal. *Administrative Science Quarterly*, *14*, 378–397.

Knoke, W. (1996). *Bold new world: The essential road map to the 21st century*. Kodansha International.

Kogut, B., & Zander, U. (1992). Knowledge of the firm: Combinative capabilities and the replication of technology. *Organization Science*, *3*, 383–397.

Lawrence, P. R., & Lorsch, J. W. (1967). *Organization and environment: Managing differentiation and integration*. Boston, MA: Harvard University Press.

Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. *Strategic Management Journal*, *13*, 111–125.

Levinthaland, D. A., & March, J. G. (1993). The myopia of learning. *Strategic Management Journal*, *14*, 95–112.

March, J. (1991). Exploration and exploitation in organizational learning. *Organization Science*, *2*, 71–87.

March, J. G., & Olsen, J. P. (1976). *Ambiguity and choice in organizations*. Bergen: Universitetsforlag.

Micklewait, J., & Woolridge, A. (1996). *The witch doctors: Making sense of the management gurus*. New York: Random House.

Miles, R. E., & Snow, C. C. (1978). *Organizational strategy, structure and process*. New York: McGraw-Hill.

Miller, D., & Friesen, P. H. (1984). *Organizations: A quantum view*. Englewood Cliffs: Prentice-Hall.

Mintzberg, H. (1979). *The structuring of organizations*. Englewood Cliffs, NJ: Prentice-Hall.

Mintzberg, H., & Waters, J. (1985). Of strategies, deliberate and emergent. *Strategic Management Journal*, *6*, 257–272.

Morgan, G. (1986). *Images of organizations*. London: Sage.

Nass, C. (1994). Knowledge and skills: Which do administrators learn from experience? *Organization Science*, *5*, 38–50.

Nohria, N., & Ghoshal, S. (1997). *The differentiated network: Organizing multinational corporations for value creation*. San Fransisco, CA: Jossey Bass.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, *5*, 14–37.
Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company*. Oxford: Oxford University Press.
Perrow, C. (1967). A framework for the comparative analysis of organizations. *American Sociological Review*, *32*, 194–208.
Pugh, D. S., Hickson, D. J., Hinings, C. R., & Turner, C. (1969). The context of organization structures. *Administrative Science Quarterly*, *14*, 91–114.
Reich, R. (1991). *The work of nations: Preparing our selves for 21st century capitalism*. New York: Simon & Schuster.
Ridderstråle, J. (1996). *Global innovation: Managing international innovation projects at ABB and electrolux*. Stockholm: Institute of International Business, The Stockholm School of Economics.
Sanchez, R., Heene, A., & Thomas, H. (Eds) (1996). *Dynamics of competence-based competition: Theory and practice in the new strategic management*. Oxford: Elsevier Press.
Schumpeter, J. (1942). *Capitalism, socialism and democracy*. New York: Harper & Brothers.
Senge, P. (1992). *The fifth discipline*. London, Great Britain: Century Business.
Simon, H. A. (1962). The architecture of complexity. *Proceedings of the American Philosophical Society*, *106*, 467–482.
Stewart, T. (1997). *Intellectual capital: The new wealth of organizations*. London: Doubleday.
Tapscott, D. (1996). *The digital economy*. New York: McGraw-Hill.
Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*, 509–533.
Thompson, J. (1967). *Organizations in action: Social science bases of administrative theory*. New York: McGraw-Hill.
Toffler, A. (1970). *The third wave*. London: Collins.
Tushman, M. L., & Nadler, D. A. (1978). Information processing as an integrating concept in organizational design. *Academy of Management Review*, *3*, 613–624.
Van de Ven, A. H., Delbecq, A. L., & Koenig, R. (1976). Determinants of coordination modes within organizations. *American Sociological Review*, *41*, 322–338.
Von Bertalanffy, L. (1950). The theory of open systems in physics and biology. *Science*, *3*, 23–29.
Von Bertalanffy, L. (1968). *General systems theory: Foundations, development, applications*. New York: Braziller.
Weber, M. (1947). *The theory of social and economic organization*. Oxford: Oxford University Press.
Weick, K. (1979). *The social psychology of organizing*. Belmont: Addison-Wesley.
Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*, 171–180.
Woodward, J. (1965). *Industrial organization: Theory and practice*. London: Oxford University Press.
Wren, D. A. (1994). *The evolution of management thought*. New York: Wiley.
Zander, U., & Kogut, B. (1995). Knowledge and the speed of transfer and imitation of organizational capabilities: An empirical test. *Organization Science*, *6*, 76–92.

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PART II:
MANAGING KNOWLEDGE FLOWS

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KNOWLEDGE RECIPROCITY AS A MANAGERIAL COMPETENCE: THE DETERMINANTS OF RECIPROCITY OF KNOWLEDGE FLOWS IN INTERNAL NETWORK FORMS OF ORGANIZING

Raymond van Wijk, Frans A. J. Van den Bosch, Henk W. Volberda and Sander M. Heinhuis

ABSTRACT

Fundamental changes in the competitive landscape triggered many firms to leverage and build competences by focusing on transition processes toward internal network forms of organizing. These forms ameliorate exploration through knowledge creation and transfer. Internal networks are characterized by horizontal knowledge flows that supplement and supplant the vertical knowledge flows that characterize other organization forms like the functional and multidivisional forms. As these horizontal knowledge flows facilitate knowledge integration, internal networks have an advantage over other organization forms in leveraging and building competences. One characteristic that makes these horizontal knowledge

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flows work is the reciprocity ensuing them. Reciprocity relates to the interdependence and coordination modes that characterize internal networks. As reciprocity is influenced by managerial coordination, by the intention to deploy knowledge, and by goal attainment, creating and maintaining reciprocity of knowledge flows can be considered as a managerial competence.

In this chapter, the attributes of organization form that impact the reciprocity in a firm are explored from structural, managerial and knowledge perspectives. Hypotheses are developed which suggest that specialization and the use of formal meetings restrict reciprocity, whereas job rotation, the number of employees with a coordination function, and teams have a positive effect on the level of reciprocity. These hypotheses are tested by means of a questionnaire administered in a business unit of a multinational financial services firm. Reciprocity of knowledge flows was found to be dependent on the characteristics mentioned above in a predicted way. Since none of the hypotheses needed to be rejected, the evidence suggests that reciprocity is a fundamental feature of internal networks and the horizontal knowledge flows that characterize them. This suggests reciprocity to be an important managerial competence.

INTRODUCTION

In the past decade, the competitive landscape has changed drastically. Corporate and business environments have been changing progressively and competitive interactions have intensified. To enable flexible adaptations, firms have focused on exploration and innovation rather than exclusively on exploitation (Volberda, 1996, 1998). Knowledge as a competitive resource received considerable attention (Boisot, 1998; Easterby-Smith & Lyles, 2003; Grant, 1996; Kogut & Zander, 1992; Nonaka & Takeuchi, 1995). Firms increasingly focused on the ability to create and integrate new knowledge as a crucial competence of firms as well (Sanchez, Heene, & Thomas, 1996).

Strategies aimed at increased knowledge creation have led many knowledge-intensive firms to initiate transition processes towards internal network forms of organizing (Van Wijk, 2003). While organization forms such as the functional and multidivisional organizations have been found to be less appropriate for the creation of knowledge (Hedlund, 1994), internal network forms of organizing provide an important context that enables knowledge creation (Pettigrew & Fenton, 2000; Pettigrew et al., 2003; Van Wijk et al., 2003). Since 'knowledge is fundamental to organizational competence' (Sanchez & Heene, 1997, p. 5), internal networks are likely to be important sources of competences (Van Wijk & Van den Bosch, 2000). Organizational knowledge creation involves knowledge transfer among employees and organizational units (Grant, 1996; Nonaka, 1994).

A key attribute that characterizes internal network forms of organizing is the configuration of knowledge flows that emphasizes horizontal knowledge flows guiding knowledge transfer rather than vertical ones (Hedlund, 1994; Van Wijk & Van den Bosch, 1998). Employees, knowledge workers and organizational units in internal network forms of organizing communicate and interact directly without adhering to the chain of command. These horizontal knowledge flows are therefore multidirectional instead of unidirectional as vertical knowledge flows normally are. Moreover, reciprocity facilitates connecting existing stocks of knowledge, that is leveraging, and by doing so creating new knowledge, that is building. This suggests that reciprocity underlies the knowledge flows between employees and between organizational units. Furthermore, reciprocity is likely to be crucial to the proper functioning of internal networks, and to the leveraging and building of competences (Sanchez et al., 1996).

Except for a study of joint ventures by Kogut (1989), who found that knowledge creation and transfer could be attributed to the presence of reciprocity, *reciprocity from a knowledge perspective* has been a sparsely developed construct. Reciprocity has been mainly the focus of game theorists in studies of prisoner's dilemma and dictator games (e.g., Axelrod, 1984); of management theorists in negotiation studies (e.g., Brett, Shapiro, & Lytle, 1998) and studies of international cooperation and contracting (e.g., Kashlak, Chandran, & Di Benedetto, 1998); and of economic theorists in studies of transaction costs, economic anthropology and principal–agent relationships (e.g., Guth, Klose, Konigstein, & Schwalbach, 1998). Within the management field, also a considerable amount of studies have examined interdependence and coordination (e.g., Thompson, 1967; Van de Ven et al., 1976), which are constructs that closely relate to reciprocity.

The purpose of this chapter is to examine the role of reciprocity in knowledge creation and transfer both theoretically and empirically. Organizational attributes are discerned from structural, managerial and knowledge perspectives, and their effects on reciprocity are subsequently investigated. That is, based on the contributions of Thompson (1967) and Van de Ven et al. (1976) it is argued that specialization, job rotation, number of employees with coordinating functions, teams and formal meetings can be considered as organizational attributes that influence reciprocity. On the basis of a questionnaire administered in a business unit of a multinational financial services firm, the impact of these attributes are investigated empirically in the context of an internal network form of organizing.

The agenda of this chapter is as follows. In the second section, the role of reciprocity in knowledge creation and transfer, and consequently in internal network forms of organizing is examined. The third section theorizes on the effects of the organizational attributes specialization, job rotation, the number of employees with coordinating roles, teams and formal meetings on reciprocity. Then, in the fourth section, the research design of the study reported in this chapter is elaborated on. The fifth section reports the results of the current study. Finally, in the sixth section, the findings are discussed and conclusions are drawn.

KNOWLEDGE, INTERNAL NETWORKS AND RECIPROCITY

Internal networks can be distinguished from other organization forms by their configuration of knowledge flows that underlies the knowledge creation and transfer process in a firm. In internal network forms of organizing, the vertical knowledge flows that characterize more orthodox organization forms such as the functional and multidivisional form have been supplanted and supplemented by horizontal knowledge flows (Hedlund, 1994). As such, internal networks are important sources of competences (Van Wijk & Van den Bosch, 2000).

Besides a different knowledge flow configuration, the directionality of knowledge flows is also distinguishing internal networks from other organization forms. For example, in organization forms like the functional form knowledge flows are primarily vertical, either bottom-up in the shape of proposals to top management, or top-down in the shape of decisions to be executed by frontline management (see, e.g., Nonaka, 1988, 1994). In contrast, in internal networks, these unidirectional vertical knowledge flows have been supplanted or supplemented by multidirectional horizontal knowledge flows (Hedlund, 1994; Nohria & Ghoshal, 1997; Van Wijk & Van den Bosch, 1998). Such a configuration of knowledge flows enables sharing knowledge and circumventing the hierarchical chain of command. The result of this shift is that swifter responses to competitive dynamics are possible (Hedlund, 1994). As Nohria and Ghoshal (1997, p. 208) stress, the key advantage of an internal network 'arises from its ability to create new value through the accumulation, transfer, and integration of different kinds of knowledge…across its dispersed organizational units' (p. 208).

Crucial to proper functioning of horizontal knowledge flows is that some degree of reciprocity between the interacting actors is present. In terms of knowledge flows this means that the amount of knowledge flowing into an actor roughly equals the amount of knowledge flowing out of that actor (cf. Gupta & Govindarajan, 1991). In the context of this chapter, these actors are *organizational units*, but by the same token, these actors can be employees, teams, entire organizations (Boisot, 1998), or strategic alliances (Kogut, 1989). In the absence of reciprocity, some actors receive more knowledge than they transmit, which may be detrimental to the knowledge creation processes pursued by a firm. For example, on the basis of a 'knowledge is power' argument, the presence of *asymmetrical knowledge flows* might result in units gaining more *power*. In turn, this fosters units' awareness of the potential benefits that may accrue from pursuing any political strategies in a firm (cf. Pfeffer, 1992), while a balanced power structure is one of the characteristics that makes internal networks efficacious in knowledge creation (Handy, 1992). Reciprocal interaction may therefore prevent an unbalanced power structure from developing.

A characteristic that underlies reciprocity is *interdependence*. Thompson (1967) discerns three types of interdependence: pooled, sequential and reciprocal interdependence. One can speak of pooled interdependence when actors perform separate tasks, but are only dependent to the extent that all tasks are to be completed, not to jeopardize the firm from achieving its goals. Sequential interdependence denotes an activity where the output of actor A is the input for actor B. An activity that is reciprocally interdependent is one where the output of actor A is the input of actor B, whose output is the input of actor A again. Van de Ven et al. (1976) have expanded on Thompson's classification by incorporating team interdependence as a fourth type of interdependence. Team interdependence is manifested in a situation where activities come into the unit and the employees diagnose, problem-solve and collaborate as a group at the same time to deal with the activities (Van de Ven et al., 1976). It goes without saying that reciprocity in knowledge flows most closely relates to reciprocal and team interdependence, and not to either pooled or sequential interdependence. Also, given that pooled and sequential interdependence constitute more impersonal coordination modes, while reciprocal and team interdependence constitute more personal and group coordination modes (Van de Ven et al., 1976), reciprocity is more important to the creation and transfer of tacit knowledge than explicit knowledge. This is illustrated by, for example, Grant (1996) and Nonaka and Takeuchi (1995) who argue that tacit knowledge can be transferred by involving employees in activities, on the basis of which these employees can observe and repeat the crafts that are involved in these activities.

That internal network forms are important organization forms for knowledge creation and transfer is also reflected in their structure, which is characterized by a high degree of interdependence (Van Wijk et al., 2003). As Baker (1992, pp. 424–425) points out, internal networks are '*integrated* across formal groups created by vertical, horizontal and spatial differentiation for any type of relation'. Strong interpersonal networks and high levels of interunit communication exist, which result in higher levels of social capital (Nohria & Ghoshal, 1997). Furthermore, owing to increased decentralization, in internal networks the role of top management has diminished to the extent that middle managers are responsible for creating and maintaining the linkages across organizational units (Bartlett & Ghoshal, 1993; Ghoshal & Bartlett, 1997; Van den Bosch & Van Wijk, 2000). These linkages are largely effectuated through teams in which new experiments and explorations are performed by 'varying constellations of actors' (Hedlund, 1994, p. 83). These characteristics, which manifest themselves from structural, managerial and knowledge viewpoints, underscore the importance of reciprocity in order to leverage and build competences.

DETERMINANTS OF RECIPROCITY IN INTERNAL NETWORKS

Although internal networks seem to require and benefit from reciprocity, the question remains as to which organizational attributes influence the level of reciprocity. In their influential paper, Van de Ven et al. (1976) tested the effects of task uncertainty, task interdependence and unit size on three different coordination modes used in firms: impersonal mode, personal mode and coordination mode. Their findings confirmed the additive effect of the different types of interdependence that was hypothesized by Thompson (1967): at the aggregate level all types of coordination modes are increasingly used when moving from pooled to team interdependence. However, use of rules, plans and vertical channels was less for team interdependence than for pooled interdependence, while horizontal channels and meetings were used more frequently in the former. Moreover, they found that as 'tasks increase in uncertainty, mutual work adjustments through horizontal communication channels and group meetings are used in lieu of coordination through hierarchy and impersonal programming' (Van de Ven et al., 1976, p. 332). Finally, they found that coordination modes get impersonalized as the organizational unit increases.

Stimulated by the above-discussed literature and taking into account three conditions that have to be met by a competence – coordination, intention and goal attainment (Sanchez et al., 1996) – in this chapter the effects of *five organizational attributes* on the level of reciprocity are examined: (1) specialization, (2) job rotation, (3) number of employees with coordination roles, (4) teams and (5) the use of formal meetings. In terms of Van de Ven et al. (1976), specialization and job rotation are impersonal coordination modes, the number of employees with coordination roles constitutes a personal coordination mode, while the use of teams and formal meetings are group coordination modes. The first refers to programmed coordination, whereas the last four refer to coordination by feedback.

Specialization

With its close relationship to departmentalization and differentiation (March & Simon, 1958; Scott, 1996), specialization is an important coordination mechanism, which not only has implications for the interdependence among the units of a firm but for the reciprocity in a firm. When specialization in a unit is high, interdependence among units tends to be pooled or sequential, whereas in cases where specialization in a unit is low, interdependence among units tends to be reciprocal or team-based (cf. Thompson, 1967; Van de Ven et al., 1976). Note that specialization at one level impacts interdependence at a higher level. For example, interdependence *within* a specialized unit may still be reciprocal or team-based, because employees are better able to collaborate since they share common activities.

This argument can be explained from a knowledge-based perspective. It goes without saying that when specialization in a unit is high, employees in that unit perform similar activities. Conversely, when specialization in a unit is low, employees perform different activities. Consequently, the knowledge employees deploy is specialized or deep in the former case, whereas it is generalized or broad in the latter. Leonard-Barton (1995) refers to a person positioned in the middle as having T-shaped knowledge, where the stem constitutes the depth of knowledge and the bar the breadth of knowledge.

In case an actor transfers or shares knowledge, it must have absorptive capacity, which is the ability to evaluate, absorb and utilize new knowledge (Cohen & Levinthal, 1990; Van den Bosch, Van Wijk, & Volberda, 2003). Since absorptive capacity is largely a function of the level of prior related knowledge, the degree of specialization has an impact on knowledge transfer, and the reciprocity surrounding knowledge transfers. Cohen and Levinthal (1990) argue that specialization influences absorptive capacity to the extent that deep knowledge fosters knowledge absorption in a certain knowledge or activity domain, while broad knowledge fosters knowledge absorption in a variety of domains. It follows then that when units' knowledge is broad – that is their absorptive capacity is broad in scope – more opportunities to transfer knowledge are present, and thus reciprocity is more likely to develop than when units' knowledge is deep. This leads to the following hypothesis:

Hypothesis 1. As the degree of specialization increases, reciprocity will decrease.

Job Rotation

Another determinant that influences the reciprocity of knowledge flows in a firm is job rotation. Job rotation involves policies and procedures regarding the movement of employees from job to job. Employees perform a greater variety of tasks allowing them to increase their experience and knowledge of those tasks. At the same time, employees can transfer knowledge they have learned on previous jobs and occasions on to their colleagues. Job rotation as a control and coordination mechanism (cf. Edström & Galbraith, 1977) facilitates reciprocity. From another point of view, job rotation increases employees' breadth of knowledge, and with that increases the scope at which new knowledge may be absorbed (Van den Bosch, Volberda, & De Boer, 1999). In that vein, the overlap of the knowledge domains of various employees and the units they are working for enhances. This overlap facilitates the transfer of knowledge in and out of the unit. In other words, job rotation facilitates reciprocity of knowledge flows to develop. Summarizing,

Hypothesis 2. As the degree of job rotation increases, reciprocity will increase.

Coordinating Employees

The roles and activities managers perform to coordinate is another organizational attribute that enables knowledge transfer across organizational units. Especially in internal network-based forms this coordination mechanism is important. In their case study at Asea Brown Boveri, Bartlett and Ghoshal (1993) found that in internal network-based forms the roles and activities performed by managers at various organizational levels has changed fundamentally when compared to managerial roles in other organization forms. As a result of higher degrees of decentralization in internal network-based forms, managerial discretion has moved to lower level managers. In internal network-based forms, the roles of 'entrepreneurial initiative', and of leveraging this initiative 'by linking dispersed resources and expertise and transferring best practices across units' (Ghoshal & Bartlett, 1997, p. 216) are with frontline and middle management respectively, not with top management, as they are in, for example, a multidivisional corporation (see also Hedlund, 1994).

Based on Bartlett and Ghoshal's (1993) findings, it can be argued that the number of employees who have discretion to coordinate activities within and across units increase knowledge transfer and reciprocity. Managerial roles aimed at coordinating and linking knowledge exist by the virtue of facilitating knowledge transfer. Since these coordination roles and activities pertain more to reciprocal and team interdependence than to pooled and sequential interdependence, reciprocity is increased as well. This suggests the following hypothesis:

Hypothesis 3. As the number of employees with discretion to coordinate increases at the same organizational level, reciprocity will increase.

Teams

Another coordination mechanism that has been implemented in internal networks in particular is the use of teams (Hedlund, 1994; Nonaka & Takeuchi, 1995). In teams various people from various organizational units and functions are grouped together to perform activities aimed at a specific goal. Teams enable the integration, combination and socialization of knowledge and expertise (Grant, 1996; Nonaka & Takeuchi, 1995), so as to explore new opportunities. Van de Ven et al. (1976) refer to teams as a personal or group coordination mechanisms based on mutual adjustment.

This mutual adjustment indicates that in teams employees give and take, and with that operate on a reciprocal basis. Teams are implemented so as to enable employees from one unit to make their knowledge available to other employees from other units, to learn new things and gain knowledge from others, and to integrate that knowledge collectively to achieve the goal of the team. This leads to the following hypothesis:

Hypothesis 4. As the degree to which teams are used increases, reciprocity will increase.

Formal Meetings

A final mechanism through which activities in a firm are coordinated that is of interest here is the use of formal meetings. Formal meetings bring together various managers and employees to discuss the operations of a firm. In contrast to informal meetings, which emerge as a result of personal relationships between and social capital of employees, formal meetings exist as a consequence of rules and procedures that guide behavior in a firm (cf. Grant, 1996; Scott, 1996). Although formal meetings are an example of coordination by feedback, a group coordination mode in particular (Van de Ven et al., 1976) from a knowledge perspective tends to relate to the transfer of explicit knowledge (Sanchez, 1997). Informal meetings and gatherings, on the other hand, relate to the transfer of tacit knowledge. In contrast to tacit knowledge, which is best transferred in internal network-based forms (Hedlund, 1994), explicit knowledge is best coordinated in hierarchical forms (cf. Burns & Stalker, 1961). This is reflected in that formal meetings are more unidirectional, top-down means of coordinating and integrating knowledge. This is also stressed by Van de Ven et al. (1976), who argue that scheduled group meetings are in place 'to plan and coordinate the work within the unit' (p. 327). Due to this character, formal meetings relate more to pooled and sequential interdependence than to reciprocal and team interdependence. This suggests the following hypothesis:

Hypothesis 5. As the degree to which formal meetings are used increases, reciprocity will decrease.

All hypotheses are illustrated in Fig. 1, which will guide the empirical investigation in the sections to follow.

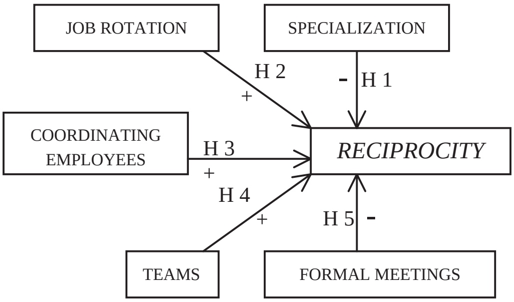

Fig. 1. The Determinants of Reciprocity in Knowledge Flows.

METHOD

To test the hypotheses developed above, a questionnaire was administered in a business unit of Rabobank, a Dutch multinational financial services firm. The bank is the only commercial bank in the Netherlands accredited the top AAA-rating for credit reliability. Rabobank ranks among the top 30 on the Fortune Global 500 in terms of total revenue in the banking industry. In 1992, the business unit Spectrum was created as an internal network to create new knowledge to be used throughout Rabobank, in particular to explore new and emerging opportunities (Van Wijk & Van den Bosch, 2000; Van Wijk, 2003).

Data Collection and Sample

In order to gear the items in the questionnaire to the specific context of Spectrum as an internal network organization, a qualitative inquiry was conducted. First, 15 extensive semi-structured interviews lasting 1–2 h were held in 1998 with members of Spectrum's management team, coordinating managers and other employees. Alongside, internal documents were studied to provide a qualitative account of Spectrum's development and evolution over the period 1992–1998 (see also Van Wijk & Van den Bosch, 1999; Van Wijk, 2003). Using the insights created, a questionnaire (see Van Wijk, 2003) was developed. After initial testing, the questionnaire was sent to all 260 employees of Spectrum. To increase the response rate the survey was issued twice with a three-week interval followed by a round of telephone reminders.

On each occasion it was communicated to the respondents that the questionnaire would be treated confidentially. In the beginning of 1999, a total of 100 usable responses was obtained, reflecting an effective response rate of 38.5 percent.

Variables and Measures

To construct the indicators 15 items of the questionnaire were used. All questions needed to be ticked on a 5-point scale ranging from "a small extent" to "a large extent". One question to substantiate the coordinating employees construct consisted of a simple count of perceived managers in the unit employees worked for. The 15 items were used to develop nine indicators. Four indicators were modeled as reciprocity variables and thus constituted the dependent variables of the current study: K_IK_T, $K_{HI}K_{HT}$, *DEPEND* and *INDEPEND*. K_IK_T relates the perceived intensity of knowledge inflow to the perceived intensity of total knowledge flows between units. The $K_{HI}K_{HT}$ indicator was also included in the analysis as a reciprocity measure. The $K_{HI}K_{HT}$ measure differed from K_IK_T measure in that it only covered horizontal knowledge transfer between units.

DEPEND was specified as the third reciprocity measure. It was entered into the analysis as a control variable to the first two reciprocity measures. Whereas K_IK_T and $K_{HI}K_{HT}$ dealt with reciprocity in knowledge flows, *DEPEND* measured reciprocity more generally. Following Van de Ven et al. (1976), the measure describes to which degree employees perceive the activities performed in their units to be an example of team interdependence. This kind of interdependence specifies a situation in which employees collaborate as a group at the same time to execute a unit's work and activities, and is closely associated with reciprocity. In summary, each of the first three variables, K_IK_T, $K_{HI}K_{HT}$ and *DEPEND* were specified as reciprocity measures.

The fourth variable (*INDEPEND*) was modeled as the opposite of a reciprocity measure. This measure described the degree to which employees perceived the activities of their units as lacking reciprocity, i.e., people perceive unit activities to be an example of pooled interdependence. This kind of interdependence describes actors performing separate tasks, which are only dependent on each other to the extent that all tasks are to be completed (Van de Ven et al., 1976). Explaining *INDEPEND*, the corresponding model was specified as an additional model that controlled the other reciprocity models in order to seek for additional empirical evidence to the hypotheses

Table 1. Description of the Variables.

Variable	Description
K_IK_T	Knowledge inflows as percentage of total knowledge flows (inflows and outflows)
$K_{HI}K_{HT}$	Horizontal knowledge inflows as percentage of total horizontal knowledge flows (inflows and outflows)
DEPEND	The degree to which tasks are being executed by a team of mutually interdependent employees
INDEPEND	The degree to which tasks are being executed separately by independent employees
SPECIAL	The degree of specialization
JOB	The extent to which job rotation is used
dMGT1	The presence of just a few employees with a coordinating role
dMGT2	The presence of moderate number employees with a coordinating role
dMGT3	The presence of many employees with a coordinating role
TEAM	The extent to which teams are used
MEET	The extent to which formal meetings are used

developed. Using this dependent variable we expected the model estimates to be opposite to the effects predicted by the hypothesis.

The remaining five indicators constitute the explanatory variables: *SPECIAL*, *JOB*, *MGT*, *TEAM* and *MEET*. *SPECIAL* was included in the analysis to describe the extent to which employees are specialized in tasks and activities in a unit (Pugh et al., 1968). The degree to which job rotation was used as a coordination mechanism was captured by the *JOB* variable. The *MGT* variable describes the presence of coordinating employees. Due to the fact that Spectrum consisted of multiple units having different numbers of employees the *MGT* variable had to be corrected for differences in unit size. This resulted in the construction of an ordinal three-point scale variable, which was transformed into three separate dummy variables. To prevent visible multicollinearity, one dummy variable was omitted from the analysis. The *TEAM* and *MEET* variables describe the extent to which use is being made of cross-functional teams and planned meetings in a unit respectively. The descriptions of the nine variables used in this study are reported in Table 1.

Reciprocity Models

To analyze the variability in the coefficient estimations for different reciprocity measures we specified three different models including the same explanatory variables but with different dependent variables. The population regression-model is specified as

$$\begin{aligned} Y_{ij} = \alpha + \beta_1\ SPECIAL_i + \beta_2\ JOB_i + \beta_{3.1}\ dMGT2_i \\ + \beta_{3.2}\ dMGT3_i + \beta_4\ TEAM_i \\ + \beta_5\ MEET_i + \varepsilon_i \end{aligned}$$

The subscript *j* under the dependent variable *Y* represents the three alternate reciprocity measures. In total four reciprocity models were estimated. The first two models with $K_I K_T$ and $K_{HI} K_{HT}$ as the dependent variables explained reciprocity in knowledge flows. The third model with *DEPEND* as the dependent variable explained the presence of reciprocity in general, and was denoted *control model* (A). Finally, the fourth model with *INDEPEND* as the dependent variable was specified as control model (B), and measures the absence of reciprocity. Clearly, *control model* (B) was expected to portray results opposite to the first three models.

QUESTIONNAIRE RESULTS

Fig. 2 illustrates the variety in individual perceptions concerning the relation between knowledge absorption and diffusion.[1] Fig. 2a illustrates the proportion of total knowledge inflows to total knowledge flows, whereas Fig. 2b illustrates the proportion of horizontal knowledge inflows to total horizontal knowledge flows only. Although on average respondents

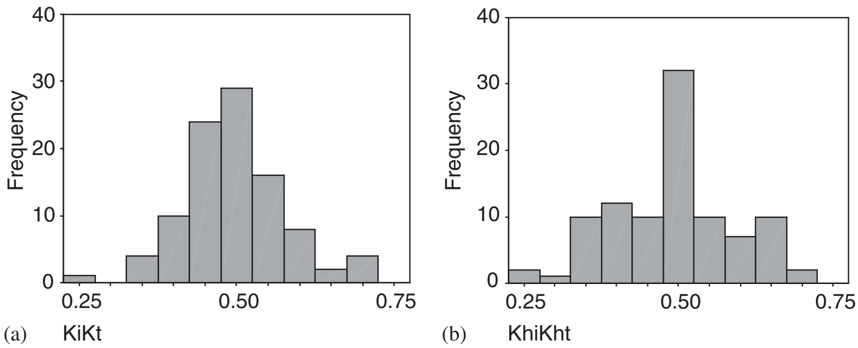

Fig. 2. Knowledge Absorption in Relation to Knowledge Diffusion as a Reciprocity Measure: Total Effects (a) and Horizontal Effects (b).

perceived that they diffuse as much knowledge as they absorb, there is variation in this individual perception. Furthermore, close similarity of the relation between knowledge absorption and knowledge diffusion regarding horizontal knowledge flows and total knowledge flows is present.

Trying to explain the two above-presented variables, Table 3 shows, among other things, the estimated models 1 and 2. Both models explain the variation in the perceived relation between knowledge absorption and diffusion by the attributes of organization form outlined above. The descriptive statistics on which the estimation was based are given in Table 2. As explicated in the previous section we opted for estimating different models with different reciprocity measures. Table 3 presents the three estimated models that followed from the hypotheses developed.

The results of model 1 in Table 3 suggest that 22 percent of the variation in the reciprocity measure can be explained by the explanatory variables. The *SPECIAL* measure is negatively related to the dependent variable at a 5 percent significance level, and therefore supported Hypothesis 1. Hypothesis 2 had somewhat weaker statistical evidence at a 10 percent significance level. Also, the *MGT* measures showed the hypothesized relation to the reciprocity measure. Both measures show that a moderate presence of coordinating employees significantly increases the reciprocity measure compared to the presence of just a few coordinating employees at a 10 percent significance level. The presence of many coordinating employees, being significant at a 1 percent level, had even a stronger positive relation, providing support for Hypothesis 3. The *TEAM* and *MEET* measures were found not to be significant. Therefore, the model lacked support for both Hypotheses 4 and 5.

The second model differs from the first in that its reciprocity measure was restricted to horizontal knowledge flows. This model exhibits a slight increase in the overall explanatory power of the model relative to the former one, in that 27 percent of the variation was explained. Empirical evidence was found for the same hypotheses the first model supported, except for some differences in significance levels. Stronger evidence was found for both the positive relation of job rotation and the presence of coordinating employees on reciprocity. In comparison to model 1, the effect of specialization was diminished to a 10 percent significance level, but still provided evidence for Hypothesis 1.

The third model was specified as control model (A), which controlled the first two models. Whereas the first two models explained reciprocity of knowledge flows, this model was constructed to explain reciprocity in general – that is to say, reciprocal interdependence in, for instance, activities or outcomes. The overall explanatory power amounted to 35 percent of the

Table 2. Descriptive Statistics: Means, Standard Deviations, and Correlations.

		Mean	St. dev.	Correlations										
				(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	$K_I K_T$	0.50	7.61E−02	1.00										
(2)	$K_{HI} K_{HT}$	0.48	0.11	0.85^{***}	1.00									
(3)	*DEPEND*	2.59	1.19	0.09	0.15	1.00								
(4)	*INDEPEND*	3.54	1.04	−0.17	−0.16	-0.294^{*}	1.00							
(5)	*DIVISION*	3.28	0.97	-0.264^{*}	$-0.233^{\dagger}$	0.03	−0.18	1.00						
(6)	*JOB*	2.31	1.12	$0.22^{\dagger}$	0.24^{*}	0.15	0.05	−0.03	1.00					
(7)	*DMGT1*	0.32	0.47	$-0.20^{\dagger}$	−0.17	-0.35^{**}	0.08	0.11	0.19	1.00				
(8)	*DMGT2*	0.41	0.50	−0.02	−0.11	0.07	0.10	0.05	−0.16	-0.58^{***}	1.00			
(9)	*DMGT3*	0.27	0.45	$0.23^{\dagger}$	0.31^{**}	0.29^{*}	−0.19	−0.18	−0.03	-0.42^{***}	-0.50^{***}	1.00		
(10)	*TEAM*	2.48	0.95	0.07	0.14	0.24^{*}	$-0.23^{\dagger}$	0.13	0.26^{*}	0.06	−0.03	−0.04	1.00	
(11)	*MEET*	3.27	0.89	0.09	0.13	−0.03	-0.25^{*}	0.09	0.05	−0.01	−0.09	0.11	0.15	1.00

$^{*}p<0.050$;
$^{**}p<0.010$;
$^{***}p<0.001$;
$^{\dagger}p<0.100$.

Table 3. Testing the Hypotheses across Different Reciprocity Models.

Reciprocity Measures		Model 1	Model 2	Control Model A
		$K_I K_T$	$K_{HI} K_{HT}$	*DEPEND*
Explanatory variables				
	Intercept	0.50	0.37	0.94
1	*SPECIAL*	−2.59E−02**	−2.32E−02†	0.13
		(0.01)	(0.01)	(0.12)
2	*JOB*	1.40E−02†	2.65*	0.18
		(0.01)	(0.01)	(0.11)
3	*dMGT2*	3.52E−02†	4.17E−02	0.56**
		(0.02)	(0.03)	(0.28)
	dMGT3	5.22E−02*	9.64E−02**	1.08***
		(0.02)	(0.03)	(0.31)
4	*TEAM*	4.70E−03	1.47E−02	0.54***
		(0.01)	(0.01)	(0.13)
5	*MEET*	4.07E−03	1.25E−02	−0.33**
		(0.01)	(0.01)	(0.14)
R^2		0.22	0.27	0.35
Durbin–Watson		1.80	1.94	2.12
N		75	73	71

*$p<0.050$;
**$p<0.010$;
***$p<0.001$;
†$p<0.100$.

variation in the reciprocity measure. Support for hypotheses 1 and 2 was absent since none of the corresponding coefficients was found to be statistically significant. The estimates regarding hypotheses 3–5, on the other hand, confirmed our expectations. The two dummy variables estimating the effect of the presence of moderate and many managers were significant at 1 and 0.1 percent, respectively. The *TEAM* variable related positively to the reciprocity measure at a 0.1 percent significance level providing empirical evidence for Hypothesis 4. The statistically significant negative coefficient of *MEET* at a 1 percent significance level supported Hypothesis 5.

Control model (B) presented in Table 4 was specified as a second control model, and explained a dependent variable *INDEPEND*, essentially measuring the *absence* of reciprocity. Therefore, opposite effects of the explanatory variables were expected. *SPEC* and *JOB* still showed the initially assumed impact on reciprocity, although only the former was significant

Table 4. Control Model B: A Control Model to the Reciprocity Models.

	Intercept	*SPECIAL*	*JOB*	*dMGT2*	*DMGT3*	*TEAM*	*MEET*
INDEPEND	5.17	$-0.22^{\dagger}$ (0.12)	6.11E−02 (0.11)	6.68E−02 (0.28)	$-0.60^{\dagger}$ (0.33)	-0.25^{*} (0.13)	−9.49E−02 (0.13)
$R^2 = 0.17$	Durbin–Watson = 1.84	$n = 74$					

$^{*}p < 0.050$;
$^{\dagger}p < 0.100$.

Table 5. Support for Hypotheses across Different Reciprocity Models.

Model	1	2	Control Model A	All Models
Reciprocity Measure	$K_I K_T$	$K_{HI} K_{HT}$	*DEPEND*	
Hypothesis	Support	Support	Support	Total number of times supported
1 *SPECIAL*	Yes	Yes	No	2
2 *JOB*	Yes	Yes	No	2
3 *MGT*	Yes	Yes	Yes	3
4 *TEAM*	No	No	Yes	1
5 *MEET*	No	No	Yes	1

at a 10 percent level, while the effect was insignificant for the latter. The effect of the presence of a moderate number of coordinating employees as compared to the presence of just a few coordinating employees appeared insignificant, whereas the effect of many coordinating employees as compared to the influence of just a few coordinating employees was negatively significant at a 10 percent significance level. The estimated effect of *TEAM* matched our expectations by regressing negatively on the dependent variable at a 5 percent significance level. *MEET* related only weekly to the dependent variable.

Table 5 summarizes the statistical evidence across the different reciprocity models. Both *SPEC* and *JOB* significantly related to the $K_I K_T$ and $K_{HI} K_{HT}$ measures, providing support for Hypothesis 1 which decreed the restraining effect of specialization on reciprocity, and Hypothesis 2 which hypothesized the stimulating effect of job rotation on reciprocity of knowledge flows. Due to the contra-intuitive significant effect to Hypothesis 1 in control model (B), the results of the first and second model needed to be interpreted with necessary caution. Albeit varying in degree, Hypothesis 3 was supported in all models. The presence of coordinating employees appeared to be of significant importance to reciprocity in knowledge flows as well as to reciprocity in general. Contrary to the first and second model, the third model confirms Hypotheses 4 and 5, which stated that the use of cross-functional teams positively influences reciprocity of knowledge flows and that formal meetings negatively impact reciprocity of knowledge flows.

DISCUSSION AND CONCLUSIONS

This chapter provides evidence about the importance of knowledge reciprocity to competence leveraging and building in a unit operating as an internal network. Most of the hypotheses postulated were confirmed by the empirical analysis. Support was found for Hypothesis 1, which stated that specialization negatively affects the reciprocity ensuing knowledge flows. This evidence confirms theoretical arguments made by, for example, Cohen and Levinthal (1990) and Leonard-Barton (1995), who argue that increases in specialization decreases the ability to absorb new knowledge. Because this capacity is diminished, the knowledge flows that ensue knowledge transfer are more likely to be unidirectional rather than multidirectional or reciprocal. Job rotation was found to have a positive effect on reciprocity of knowledge flows. This led to the adoption of Hypothesis 2. Rotating employees across various functions and organizational units through which they gain experience appeared to increase the reciprocity of knowledge transfer. This effect upheld for horizontal knowledge transfers in particular, which can be explained by the fact that job rotation is foremost a horizontal coordination technique. This expands Edström and Galbraith's (1977) finding that transferring managers across organizational units is an important coordination and control strategy to socialize managers and enhance managers' verbal social communication networks. Since communication is increased, this enables multidirectional knowledge flows as well, tacit knowledge flows in particular. The control model, however, did not reveal any significant effect. Apparently, job rotation does not increase or decrease interdependence in general. This finding is also as hypothesized since job rotation is primarily a coordination technique to increase the experience and knowledge of employees and managers in a variety of different tasks.

The number of employees with coordination roles and tasks was found to have a positive effect on both reciprocity of knowledge flows and reciprocity in general, confirming Hypothesis 3. Increases in the number of employees not only enhance reciprocity ensuing knowledge transfers, but reciprocity in general. This suggests that the managerial function in internal networks is of fundamental importance to proper functioning of an internal network, confirming the findings of, for example, Bartlett and Ghoshal (1993), Ghoshal and Bartlett (1997), Nonaka (1988, 1994) and Van den Bosch and Van Wijk (2001), who state that middle managers are the true knowledge engineers.

Contrary to the third model, in the first and second model the use of teams and of formal meetings did not confirm our hypotheses. The question whether this finding is due to the particular context of an internal network is addressed below. For the use of teams, no significant effect was found on the reciprocity of knowledge flows, while a positive effect was found on reciprocity in general. This contradicts earlier theoretical arguments (e.g., Nonaka & Takeuchi, 1995) that teams increase knowledge transfer across employees and organizational units. While knowledge flows between team members may still sustain in a team, they apparently do not increase reciprocity. On the other the use of teams does increase reciprocity in general, suggesting that, for example, the activities within and the outcomes of teams are reciprocally interdependent. For the use of formal meetings, no significant evidence was found other than a negative effect on reciprocal interdependence in general as indicated by the control model.

Although the findings reported in this chapter provide overall support for the importance of knowledge in internal networks, several limitations have to be addressed in future research. First, the current study was conducted in a single business unit of a multinational financial services firm located in the Netherlands. Future research should focus on other levels of analysis and contexts like entire firms that are located in different industries and different countries. The effects of the independent variables used in this study on reciprocity may differ across industries and countries as a result of industry-specific effects and cultural effects. This could be of importance to understanding knowledge flows and their reciprocity in multinational firms as well (cf. Bartlett & Ghoshal, 1989).

Second, similar studies should be conducted in firms with organization forms other than an internal network. In this way, the effects of specialization, job rotation, number of employees with coordination roles, teams and formal meetings on reciprocity can be validated or not, and eventually generalized. It may be the case, for example, that the effect of teams on reciprocity of knowledge flows in a functional or multidivisional form is significant, whereas in internal networks teams are used differently or knowledge flows are enabled through other mechanisms like trust, and thus exhibit no significant dependency with reciprocity in knowledge transfer. In the present study, contradictory evidence was found as to the role of teams in achieving reciprocity. Studies in other organization forms can shed additional light on this matter.

Third, in this chapter reciprocity was examined at a specific point in time. However, reciprocity may also be considered as a dynamic construct comparing knowledge inflows and outflows over a certain period of time. Clearly, in such a study reciprocity is to be related to learning and the transfer of knowledge over time. To that end, time lags between knowledge inflows and outflows can be examined, which will provide a more comprehensive analysis of the reciprocity construct and its importance. Finally, an assessment of the performance effects of reciprocity is needed.

In conclusion, while most studies have examined reciprocity from a dependency perspective, this chapter has highlighted the importance of knowledge and competence perspectives on reciprocity. Entering a period in which coping with the present and future knowledge environment will be of great strategic importance, we believe the knowledge reciprocity construct is likely to become of crucial strategic importance for the leveraging and building of competences enabling the transfer, creation and utilization of knowledge. Therefore, creating and maintaining a firm's reciprocity of knowledge flows has to be considered a crucial managerial competence.

NOTES

1. All models were analyzed for possible non-linearity by testing for positive autocorrelation. Using six explanatory variables and approximately 75 observations at a 5 percent confidence level, the critical Durbin–Watson values to test for positive autocorrelation indicated a lower bound of d_l 1.46 and an upper bound of d_u of 1.80. Since the estimates displayed a lowest value of 1.80 in model 2, it was concluded that no positive autocorrelation was present. The presence of visible multicollinearity was tested for by regressing each explanatory variable to all other independent variables. The lowest tolerance across the various models presented a value of 0.71. Even in this case 29 percent of the corresponding explanatory variable could be explained by the other explanatory variables. This indicates that the parameter estimates were not influenced by visible multicollinearity. In addition, the models were examined for multivariate outliers by analyzing the studentized deleted residuals. Observations presenting a studentized deleted residual with an absolute value above 2.6 were identified as possible outliers, resulting in exclusion from the model. Eventual elimination was based on disproportional influence on the model estimates.

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REFERENCES

Axelrod, R. (1984). New York: Basic Books.

Baker, W. E. (1992). The network organization in theory and practice. In: N. Nohria & R. G. Eccles (Eds), *Networks and organizations: Structure, forms, and action* (pp. 397–429). Boston, MA: Harvard Business School Press.

Bartlett, C. A., & Ghoshal, S. (1989). *Managing across borders*. Boston, MA: Harvard Business School Press.

Bartlett, C. A., & Ghoshal, S. (1993). Beyond the M-form: Toward a managerial theory of the firm. *Strategic Management Journal*, *14*(Winter Special Issue), 23–46.

Boisot, M. (1998). *Knowledge assets*. Oxford: Oxford University Press.

Brett, J. M., Shapiro, D. L., & Lytle, A. L. (1998). Breaking the bonds of reciprocity in negotiations. *Academy of Management Journal*, *41*(4), 410–424.

Burns, T., & Stalker, G. (1961). *The management of innovation*. London: Tavistock.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1), 128–152.

Easterby-Smith, M., & Lyles, M. A. (Eds) (2003). *Handbook of organizational learning and knowledge management*. Oxford: Blackwell.

Edström, A., & Galbraith, J. R. (1977). Transfer of managers as a coordination and control strategy in multinational organizations. *Administrative Science Quarterly*, *22*(2), 248–263.

Ghoshal, S., & Bartlett, C. A. (1997). *The individualized corporation: A fundamentally new approach to management*. New York: HarperBusiness.

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, *17*(Winter Special Issue), 109–122.

Gupta, A., & Govindarajan, V. (1991). Knowledge flows and the structure of control within multinational corporations. *Academy of Management Review*, *16*(4), 768–792.

Guth, W., Klose, W., Konigstein, M., & Schwalbach, J. (1998). An experimental study of a dynamic principal–agent relationship. *Managerial and Decision Economics*, *19*(4/5), 327–341.

Handy, C. (1992). Balancing corporate power: A new federalist paper. *Harvard Business Review*, *71*(6), 59–72.

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

Kashlak, R. J., Chandran, R., & Di Benedetto, C. A. (1998). Reciprocity in international business: A study of telecommunications alliances and contracts. *International Business Review*, *29*(2), 281–304.

Kogut, B. (1989). The stability of joint ventures reciprocity and competitive rivalry. *The Journal of Industrial Economics*, *38*(2), 183–198.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, *3*(3), 383–397.

Leonard-Barton, D. L. (1995). *Wellsprings of knowledge*. Boston, MA: Harvard Business School Press.

March, J. G., & Simon, H. A. (1958). *Organizations*. New York: Wiley.

Nohria, N., & Ghoshal, S. (1997). *The differentiated network: Organizing multinational corporations for value creation*. San Francisco, CA: Jossey-Bass.

Nonaka, I. (1988). Toward middle-up-down management: Accelerating information creation. *Sloan Management Review*, *29*(3), 9–18.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, *5*(1), 14–37.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. Oxford: Oxford University Press.

Pettigrew, A. M., & Fenton, E. M. (Eds) (2000). *The innovating organization*. London: Sage Publications.

Pettigrew, A. M., Whittington, R., Melin, L., Sánchez-Runde, C., Van den Bosch, F. A. J., Ruigrok, R., & Numagami, T. (Eds) (2003). *Innovative forms of organizing: International perspectives*. London: Sage Publications.

Pfeffer, J. (1992). *Managing with power: Politics and influence in organizations*. Boston, MA: Harvard Business School Press.

Pugh, D. S., Hickson, D. J., Hinings, C. R., & Turner, C. (1968). Dimensions of organization structure. *Administrative Science Quarterly*, *13*(1), 65–105.

Sanchez, R. (1997). Managing articulated knowledge in competence-based competition. In: R. Sanchez & A. Heene (Eds), *Strategic learning and knowledge management* (pp. 163–187). Chicester: Wiley.

Sanchez, R., & Heene, A. (1997). A competence perspective on strategic learning and knowledge management. In: R. Sanchez & A. Heene (Eds), *Strategic Learning and Knowledge Management* (pp. 3–15). Chicester: Wiley.

Sanchez, R., Heene, A., & Thomas, H. (1996). Introduction. In: R. Sanchez, A. Heene & H. Thomas (Eds), *Dynamics of competence-based competition* (pp. 1–35). Oxford: Pergamon.

Scott, W. R. (1996). *Organizations: Rational, natural and open systems* (4th ed). New York: Prentice Hall.

Thompson, J. D. (1967). *Organizations in action*. New York: McGraw-Hill.

Van den Bosch, F. A. J., & Van Wijk, R. A. (1999). Transition processes towards the n-form corporation: Strategic implications for knowledge flows. In: M. A. Hitt, P. Clifford, R. D. Nixon & K. P. Coyne (Eds), *Dynamic strategic resources: Development, diffusion, and integration* (pp. 223–244). New York: Wiley.

Van den Bosch, F. A. J., & Van Wijk, R. (2000). Creation of managerial capabilities through managerial knowledge integration: A competence-based perspective. In: R. Sanchez & A. Heene (Eds), *Knowledge management and organizational competence* (pp. 159–176). New York.

Van den Bosch, F. A. J., & Van Wijk, R. A. (2001). Creation of managerial capabilities through managerial knowledge integration: A competence-based perspective. In: R. Sanchez (Ed.), *Knowledge management and organizational competence* (pp. 159–176). New York: Oxford University Press.

Van den Bosch, F. A. J., Volberda, H. W., & De Boer, M. (1999). Coevolution of firm absorptive capacity and knowledge environment: Organizational forms and combinative capabilities. *Organization Science*, *10*(5), 551–568.

Van den Bosch, F. A. J., Van Wijk, R., & Volberda, H. W. (2003). Absorptive capacity: Antecedents, models, and outcomes. In: M. Easterby-Smith & M. A. Lyles (Eds), *Handbook of organizational learning and knowledge management* (pp. 278–301). Oxford: Blackwell.

Van de Ven, A. H., Delbecq, A. L., & Koenig, R., Jr. (1976). Determinants of coordination modes within organizations. *American Sociological Review*, *41*(2), 322–338.

Van Wijk, R. (2003). *Organizing knowledge in internal networks: A multilevel study.* ERIM Ph.D. Series research in management, 21, Rotterdam School of Management, Rotterdam.

Van Wijk, R., & Van den Bosch, F. A. J. (1998). Knowledge characteristics of internal network-based forms of organizing. In: S. Havlovic (Ed.), *Academy of management best paper proceedings*, BPS: B1–B7, San Diego.

Van Wijk, R., & Van den Bosch, F. A. J. (2000). Creating the N-form as a managerial competence. In: R. Sanchez & A. Heene (Eds), *Advances in applied business strategy, part B* (pp. 199–214). Greenwich, CT: JAI Press.

Van Wijk, R., Van den Bosch, F. A. J., & Volberda, H. W. (2003). Knowledge and networks. In: M. Easterby-Smith & M. A. Lyles (Eds), *Handbook of organizational learning and knowledge management* (pp. 428–453). Oxford: Blackwell.

Van Wijk, R., & Van den Bosch, F. A. J. (2000). The emergence and development of internal networks and their impact on knowledge flows: The case of Rabobank group. In: A. M. Pettigrew & E. M. Fenton (Eds), *The innovating organization* (pp. 144–177). London: Sage.

Volberda, H. W. (1996). Towards the flexible form: How to remain vital in hypercompetitive environments. *Organization Science*, *7*(4), 359–374.

Volberda, H. W. (1998). *Building the flexible firm: How to remain competitive*. Oxford: Oxford University Press.

IMPLANTING NEW CROSS-DISCIPLINARY KNOWLEDGE INTO A FIRM'S MANAGEMENT-DRIVEN BUSINESS COMPETENCES IN THE CASE OF BUILDING-RELATED FIRMS BASED IN FINLAND

Juhani Kiiras and Pekka Huovinen

ABSTRACT

The research problem of transferring and implanting new cross-disciplinary knowledge into a firm's management-driven business competences is herein approached in terms of addressing the four principal problems, designing a new two-part framework, and applying it to solving initially these problems. The generic part is based on integrating the key theoretical bases in organizational learning, knowledge, and competence-based management for defining the embeddedness of a firm's management-driven business competences. The contextual part deals with the implanting of the three kinds of new disciplinary knowledge into the competences of a building-related firm. In addition, the management of local business knowledge is

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incorporated into the framework. The initial evidence on solving the knowledge implanting problems (un)successfully in the four Finland-based cases is reported on as the outcomes of the action research. Finally, the validity of our action research is discussed, some ways to solve knowledge implanting problems are suggested, and more related competence-based management research is envisioned.

INTRODUCTION

Herein, the generic problem of *transferring and implanting new cross-disciplinary knowledge* into a focal firm's organization is approached. As a rule, exchanging and transferring both the explicit and tacit knowledge takes place smoothly between key persons with the same disciplinary background, e.g. between architects, engineers, or lawyers. They discuss and act in cohesive ways and turn in the same directions like "a school of fish." However, we have observed during several action research assignments that *severe problems* are likely to arise when new cross-disciplinary knowledge from two or more disciplines is being transferred to and implanted in a firm's existing competences. On the other hand, when a firm is acquiring and establishing a new competence, similar problems may be either aggravated or avoided.

The purpose is (a) to design a two-part framework for managing the implanting of new cross-disciplinary and local knowledge into a firm's management-driven business competences, (b) justify our approach in terms of defining the four principal knowledge implanting problems in the context of building design and contracting firms, (c) report on the four action research studies and their findings with regard to solving initially the major knowledge implanting problems in the Finnish context, and (d) validate our action research study briefly and suggest some promising ways to advance the management of implanting cross-disciplinary knowledge into a firm's competences.

Our context is that of distinct businesses based on and firms operating in *building construction markets* across the globe. On the demand side, locally, nationally, regionally, or globally operating investors (clients) invest in the utilization of various office, industrial, commercial, public, and apartment building concerns. On the supply side, leading foreign and local design and contracting firms aim at participating in the design, implementation, and/or life cycle stages of building investments in targeted competitive arenas. Competitive participation with regard to the targeted value-adding building processes means that firms must compete and cooperate in (a) offering markets and (b) integrated competence, knowledge, and other resource markets.

DEFINING EMBEDDEDNESS OF A FIRM'S MANAGEMENT-DRIVEN BUSINESS COMPETENCES: A GENERIC PART

Herein, a generic part of the suggested framework is designed as follows. Within management research, the transfer and implanting of new disciplinary knowledge is perceived to belong to a broad area of *organizational learning* (*OL*). We align with Pawlowsky (2001) who has organized the key contributions to OL into the five clusters of theories or traditions: (a) the organizational decision-making and adaptation view, (b) the systems-theory view, (c) the cognitive and knowledge views, (d) the cultural view, and (e) the action-learning view. Different views are not mutually exclusive. Indeed, Berthoin Antal, Dierkes, Child, and Nonaka (2001a, p. 6) posit that it would be misleading and sterile to treat the aspects of OL as though they could best be understood as neat packages. Instead, this "OL bazaar" is alive with *multiple voices competing for attention*.

Nevertheless, we have adopted *some key elements from several OL views*. Senge's (1990) five disciplines of a learning organization are relied upon (the systems-theory view). Members of organizations are seen as interpreters of reality according to the specificities of their cognitive system (the cognitive view). However, any individual's cognitive process is treated as "a black box," i.e. our focus is only on its inputs and outputs. Thus, such theoretical clusters as representationism and corporate epistemology (von Krogh & Roos, 1996) are excluded. Instead, the implanting of new knowledge is defined as one of the key means for modifying the organizational knowledge system, which, in turn, enables to improve understanding and evaluation of a firm's internal and external environments (e.g. Fiol & Lyles, 1985). In particular, we apply those approaches to OL that center around Hamel and Prahalad's (1994) core competencies, Leonard-Barton's (1995) core capabilities as wellsprings, and Nonaka and Takeuchi's (1995) knowledge creation and development processes (the knowledge view). We focus on managing cross-cultural issues (the cultural view) (e.g. Terpstra & David, 1991). The primary author of this chapter has realized literally the idea of "learning occurs through acting" (Argyris & Schön, 1978) where the learning and problem-solving process is supported by the introduction of relevant external knowledge, and the process is managed by a facilitator (the action-learning view).

Next, these selected OL elements are integrated both with each other and a set of competence-based management concepts. Ex ante, we decided that when facing two or more converging or overlapping definitions, the competence-based option(s) be adopted. These tradeoffs seem to be justified in light of many (too) diverging views of "OL bazaar" vis-à-vis high internal coherence between the recent competence-based concepts and terms (e.g. Sanchez, Heene, & Thomas, 1996a; Sanchez, 2001a).

Knowledge and competence management is seen as a means to achieve the business goals. We align with Sanchez (2001b, pp. 5–8), who argues that to achieve its goals, a firm must be able to integrate its knowledge-related activities into processes for competence building, leveraging, and maintenance. Knowledge is "some variant on a belief that A causes B," which implies actually knowing how to do things or to cause things to happen. This concept is rooted also in the action-oriented world of business managers. Knowledge ultimately resides in the minds of individuals. Thus, *disciplinary knowledge* exists when individuals in the same discipline share sets of beliefs about causal relationships that enable them to understand each other and even to work together in doing something. In particular, *cross-disciplinary knowledge* refers to sets of beliefs about causal relationships where the factors involved originate from different disciplines. The most important characteristic of new cross-disciplinary knowledge for our main purpose of implanting the same in a firm's business-specific management competences is whether this knowledge (i) exists only in the mind of an individual manager, (ii) is shared among members of a management team, or (iii) is recognized and used at the level of the business unit(s) in question.

Sanchez' (2001b, p. 6) notion of *sensemaking* is adopted for linking disciplinary knowledge, information, and data as follows. Sensemaking is a process of perceiving events, comparing current and past events, and forming expectations about the significance of current events. Sensemaking is a process of gathering and interpreting disciplinary *data* (i.e. representations of the events that people notice) to create disciplinary *information* (i.e. meaning that is imputed to some data by evaluating this in an interpretive framework) which is then used to formulate a set of disciplinary beliefs about important (causal) relationships in the business world and an organization.

In addition, the four interrelated competence-based notions are defined by applying Sanchez (2001b, pp. 6–8, 19, 30) and Sanchez, Heene, and

Thomas (1996b, pp. 7–11). *Management-driven business competences* are the abilities of a firm to sustain coordinated deployments of assets and capabilities in ways that help the firm achieve its business-specific goals. Each competence includes an ability to orientate toward and, when logical, to connect a firm with targeted markets. Each competence includes the knowledge (accumulated and new; articulated and tacit; Polanyi, 1966), preparedness (organizational, managerial, and process), systems (management, information, and operational), skills (team-specific and individual), and resources (human, physical, and financial) that enable a firm to perform successfully also in an emerging management situation. Management-driven business competences are the properties of a firm that depend on the choices and actions of management teams and individual managers at various levels as well as on the effectiveness of a firm's management systems and processes. Knowledge is an inherent part of these three elements (Fig. 1).

(i) *Capabilities residing in management teams* are repeatable patterns of action that are used to get things done. Capabilities use or operate on other kinds of assets (like production systems and skills) in the process of performing effectively. Joint capabilities are based on team-specific knowledge. Members of a management team represent managerial, functional, and technical areas. Teams are used at several levels (e.g. business, marketing, product design, and production teams). Some knowledge possessed by each team member may be applied to the performance of her or his assigned task, but much individual knowledge must be shared with other members before that knowledge can become the basis for taking joint and coordinated actions.

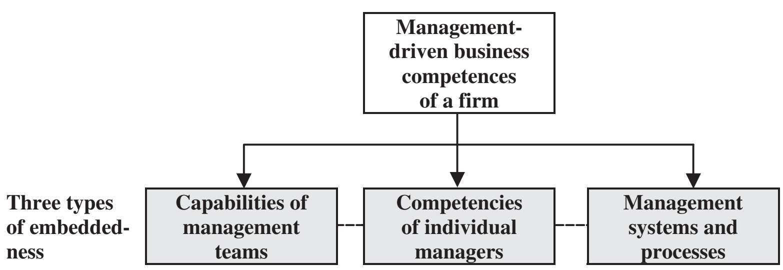

Fig. 1. Defining a Firm's Management-driven Business Competences Embedded in Management Teams, Individual Managers, and Management Systems and Processes. (Applying the Terms Defined by Sanchez, 2001b; Sanchez, Heene, & Thomas, 1996).

(ii) *Competencies of individual managers*, as used in our discussion, refers to the knowledge, skills, and values of individuals that enable them to perform specific kinds of management tasks. Relevant managerial knowledge in this context includes knowing how a firm can succeed in its business through and with people. This requires developing know-how, know-why, know-what, know-who, know-where, and know-when forms of knowledge (van den Bosch & van Wijk, 2001). These six forms of managerial knowledge are the building blocks of knowledge domains related to disciplinary, managerial, functional, technical, internal, and external matters.

(iii) *Management systems and processes* are central in managing knowledge into the elements of a firm's business-specific competences, i.e. both to implant new cross-disciplinary knowledge into the internal knowledge base (e.g. databases, business information, and knowledge embedded in capabilities and competencies) effectively and to support efficient application of this renewed knowledge base as a whole.

DRAWING KNOWLEDGE FROM THREE DISCIPLINES FOR MANAGING A BUILDING DESIGN AND CONTRACTING BUSINESS: A CONTEXTUAL PART

Herein, a contextual part of the suggested framework is designed as follows. According to Project Management Institute (2000, p. 4), an organization's operations and projects differ primarily in that operations are ongoing and repetitive while projects are temporary and unique. *A building design and contracting project* is a temporary endeavor undertaken to create a new unique building(s). Temporary means that every project has a definite beginning and a definite end. Unique means that the building is different in some distinguishing way from all other buildings.

The term "project-oriented business" is frequently used to refer to businesses based on implementing various capital investments, supplying information systems, and delivering packaged sets of industrial goods. *Building design and contracting business* is defined as having the following generic features (applying Huovinen, 2002):

- Fluctuations of building construction markets are associated with short-term business cycles and public sector developments. Recession inevitably occurs in any given market.

- Building contracting firms typically take responsibility for the engineering, design, and implementation of buildings up to their total values. Customers include versatile investors and developers that act as owners of buildings. Building contracting business can be differentiated by building types as follows: industrial, commercial, residential, official, and leisure-time building contracting businesses as well as the ones related to natural resources utilization, power generation, telecommunications networks, and infrastructure.
- Procurement methods (in the U.K./EU context), contracting modes or delivery methods (in the U.S. context) determine the number, contractual roles, and responsibilities between investors (owners), building design and contracting firms, financiers, and suppliers, as well as the nature of such competition by project. Each investor applies a specific procurement method to achieve the best possible results in terms of functionality, buildability, quality, money, time, and other investment criteria. Contracting firms assume various roles as design-to-build, general, main, speciality, construction management (CM), and sub-contractors.
- Locations of new buildings are found across the globe. In each location or market, project stakeholders may be nationals and/or foreigners. Competing firms (or alliances of firms) submit bids, and the investor will choose one or several of them to carry out his building(s).
- Operations are typically joint ventures and consortiums, subcontracting, technology transfer, licensing, management contracts, and various services contracts. So far, longer-term partnerships and networking among project stakeholders have increased only gradually.
- Financing propositions often play a decisive role. Investors may require that contractors arrange the financing of their buildings (e.g. as a minor shareholder for a limited period of say 3–10 years). Today, private initiatives are launched to pre-finance public investments.

Initially, we argue that a design and contracting firm must be capable of drawing knowledge from *the three management disciplines* as well as integrating and implanting this cross-disciplinary knowledge into its management-driven business competences in order to succeed in targeted building markets. These overlapping management disciplines are introduced as follows.

Applying Project Management Institute's PMBOK Guide (2000, pp. 6, 9), much of the knowledge needed to design and construct new buildings is unique to (1) Project business and management (PBM) discipline, e.g. building contracting logic and work breakdown structures. In many OECD countries, project management and project business management are considered as own disciplines. The PBM knowledge and practice are elaborated in the previously defined characteristics of building design and contracting business(es). Project management (PM) is the application of knowledge, skills, tools, and techniques to project activities to meet building project requirements. PM is accomplished through the use of the iterative processes throughout the project life cycle such as: initiating, planning, executing, controlling, and closing. Nine PM knowledge areas (and related processes) include integration, scope, time, cost, quality, human resource, communications, risk, and procurement management. The challenge lies in managing big transactions, location dependence, project uniqueness, design competence, technical capabilities, and fast-track schedules. Success requires that most project-specific decisions turn out to be the right ones and that the negative consequences of the wrong ones can be avoided.

(2) General business management (GBM) discipline encompasses planning, organizing, staffing, executing, and controlling the operations of an ongoing firm. GBM also includes supporting disciplines such as law, strategic planning, logistics, financing, and human resources management. GBM is applied to managing a firm's project business(es) and projects in many areas such as mastering leadership and organizational behavior and adopting effective tools for managing quality, risks, procurement, and schedules (e.g. Chinowsky & Meredith, 2000, p. 46).

(3) Building engineering and construction management (BECM) discipline includes foundation, structural, mechanical, and electrical engineering, various areas of materials-based engineering, and those of construction production (works) engineering. Basic knowledge is drawn from mathematics and engineering sciences. From the other PBM discipline's view, all functional and technical (management) disciplines are application areas defined as functional departments and supporting disciplines (e.g. production management, logistics), technical elements (e.g. software development), management specializations (e.g. government contracting, housing area development), or industry groups (e.g. pulp and paper, telecommunications).

In addition, we take into account the needs of building design and contracting firms to master (4) local business knowledge and practices, which are considered in part (i) originating from local business culture, practices, and regulations, and in part (ii) being drawn from the three generic management disciplines (knowledge bases) and then applied to local conditions in each targeted market (country). Terpstra and David (1991, p. 164) remind us that managers engaged in building abroad are faced with the problem of how much to adapt their firm to local business practices; or to what extent a foreign investor should refuse to conform to local norms and practices, and follow their own way of constructing buildings? We argue that degrees of adaptation of foreign firms are (extremely) high in (some) building design and contracting businesses across the globe. For example, local authorities do exercise their power. Foreign firms are adapting to serve attractive local clients also. Tens of local suppliers and subcontractors are involved in each project.

ADDRESSING FOUR KNOWLEDGE IMPLANTING PROBLEMS IN BUILDING-RELATED FIRMS: A NEW FRAMEWORK AS A WHOLE

Herein, we combine the two parts of *a framework* for managing disciplinary and local knowledge bases into a firm's management-driven business competences embedded in management teams, individual managers, and management systems and processes (Fig. 2). The three sets of management disciplines, i.e. general business management, project business and project management, and engineering and construction management differ

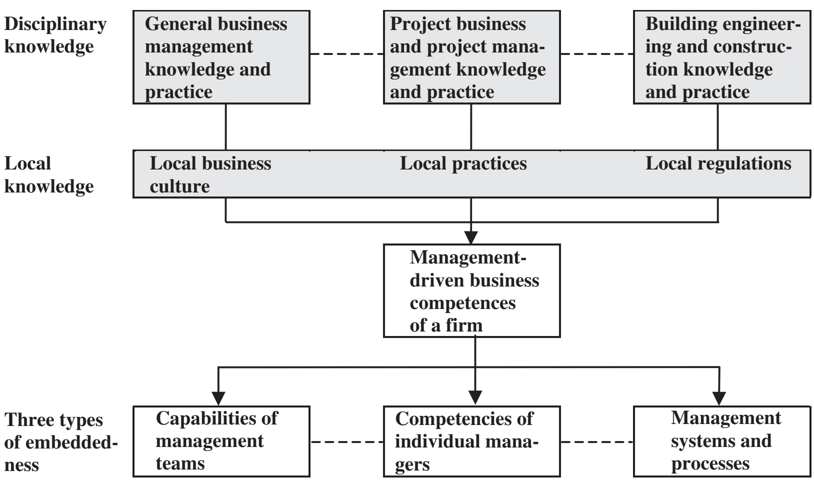

Fig. 2. A Framework for Managing Disciplinary and Local Knowledge Bases into a Firm's Management-Driven Business Competences Embedded in Teams, Managers, Systems, and Processes in the Context of Building Design and Contracting Firms.

markedly in terms of respective knowledge and practices. In addition, local culture, practices, and regulations play such important roles in each national or ethnic market that the relevant local knowledge must also be integrated with cross-disciplinary knowledge into competences. In turn, management-driven business competences are embedded in business units, i.e. management teams, individual managers, systems, and processes.

We address *the four principal types of knowledge-implanting problems* that arise when new cross-disciplinary knowledge is needed for rebuilding business-specific competences, capabilities, and individual competencies within building design and contracting firms. We exclude architects due to major differences (and contradicting attitudes) between the two educational programs of architecture and building engineering. Within the suggested new framework, the four problems are defined, elaborated, and principally solved as follows.

(1) How should one implant *new project business and management* (*PBM*) *knowledge* into the capabilities and competencies inherent in building design managers and construction managers? Newly appointed project managers gradually learn by doing the crucial elements of their CPM competencies during a series of actual building projects. Education of technical or functional managers rarely contains knowledge in PBM, which makes it more difficult for them to absorb managerial knowledge later on, i.e. starting 5–10 years after graduating. Technical and functional managers must learn to master sophisticated PM methods and tools as well as to lead a PM team. In the Finnish context, even transferring new technical knowledge across engineering disciplines has been difficult. It seems that only an engineer who has passed one or more management courses as part of the master's degree wants to learn new managerial knowledge later. Typically, one business manager wanted to improve the team's schedule management capabilities. Immediately, a trade manager contradicted the two objectives of "schedule versus quality."

(2) How should one implant *new building-engineering and construction management* (*BECM*) *knowledge* into capabilities and competencies inherent in professional project managers? In general, a project manager has also studied one technical or functional area. A fresh project manager will specialize in a building sector (e.g. offices). Many sooner or later are assigned to manage projects across a new sector. Thus, the need to learn new BECM knowledge arises by analysis. A real test occurs when a project manager should be competent to lead a PM team in conjunction with a new building type and whose members represent engineering areas where (s)he lacks any prior experience. In the Finnish context, implanting new BECM

knowledge into the competencies of senior project managers has turned out to be effective. They have first understood by theoretical analysis the new engineering fundamentals, solutions, and techniques, and then incorporated this knowledge into their PM competencies via learning by doing.

(3) How should one implant *new general business management* (*GBM*) *knowledge* into the capabilities and competencies of project managers? A project manager's performance is critical for achieving project objectives. In many cases, the share of one multi-billion euro project is 20–50% of the firm's total turnover and profits for that 2-year period. This implies that new members of the middle and top management teams are chosen from among that firm's most competent project managers. Their excellent PM competencies have been established through years of narrowly defined project-level experience. One option is to recruit new business managers outside a building-related business. The success implies overcoming mental barriers between a newcomer and that firm's senior managers. The latter seem to accept easily only the promotion of one of their peers.

GBM knowledge provides much of the foundation for developing PM competences. A project manager needs to master softer competencies in leading, communicating, negotiating, problem solving, and influencing. However, the education in PM disciplines contains only some basic courses in general or project business management, which makes it difficult for many individuals to absorb new general and business management knowledge. In the U.S. context, Chinowsky and Meredith (2000, pp. 38–39) posit that knowledge gaps appear when newly appointed business managers continue to rely on project knowledge to make business-level decisions. Understanding and bridging this gap must be a priority. In the Finnish context, some leading firms recruited new top managers from outside building-related businesses. All these recruitments have failed by now. It seems that these newcomers did not succeed in understanding new kinds of building business logics. Typically, a senior building project manager commented on this by using the phrase "*men design and construct, firms finance*." Similarly, an expert in generic total quality management (TQM) came to the conclusion that "*constructing high-quality buildings implies no competitive advantage*."

(4) How should one implant *new local knowledge* into the capabilities and competencies of various building-related managers? The transfer of local tacit and explicit knowledge is difficult for culture-related reasons. Learning local knowledge by analysis and/or by doing the first project involves major risks that materialize in real projects. At a minimum, all viable ways of entering a new country and managing the first projects include the

recruitment of "middlemen or interpreters." They assist teams and individuals, who are foreigners, to learn by doing the local building culture, practices, and regulations. Senior business and project managers also seem to make erroneous judgments easily when dealing with new building markets and cultures.

REPORTING ON ACTION RESEARCH-BASED EVIDENCE: IMPLANTING OF NEW DISCIPLINARY KNOWLEDGE INTO COMPETENCES IN FOUR CASES

The initial empirical evidence is presented in a form of *the four case descriptions* (Fig. 3). The four principal problems were addressed during a set of *action research projects* carried out in the unit of Construction Economics and Management at the Helsinki University of Technology. The primary author assumed the various roles of the trusted action researcher (the CPM expert). The second author acted as the supporting researcher (the PBM expert). In the four cases, the knowledge implanting problems were solved during the years 1997–2001. Today, all Finland-based firms involved can leverage (and rebuild) the targeted business competences, i.e. they rely

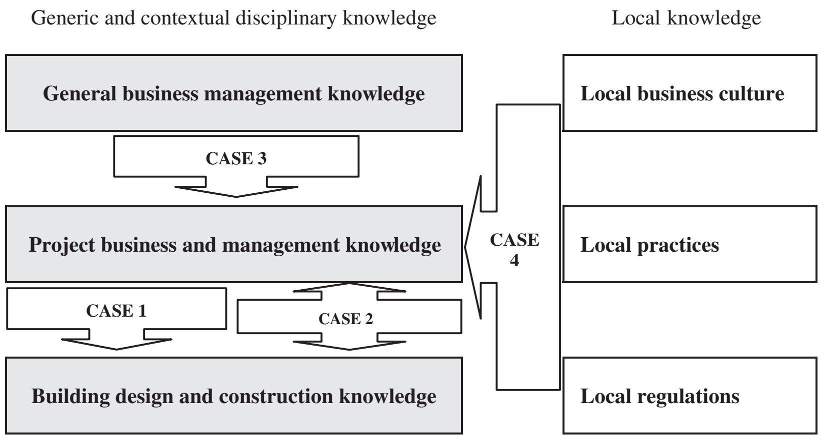

Fig. 3. Four Kinds of Cross-Disciplinary Knowledge Needs and Related Implanting Problems Targeted in the Four Finland-Based Cases (Action Research).

on the team capabilities and individual competencies extended or created in the previous years.

We focus on reporting *the crucial observations* on the case firms and the behavior of the focal manager when he became aware of the need to acquire new disciplinary knowledge, create new managerial capabilities and competencies, or implant the acquired knowledge into the existing capabilities and competencies embedded in key managers. From the cognitive point of view, individuals have been treated as "black boxes," i.e. only the most important team-specific or individual inputs, actions, and outcomes are presented.

The four cases have been selected as *the factual representations* of dealing with the four principal knowledge implanting problems (un)successfully. With regard to *Cases 1 and 3*, we report on the tackling of the difficulties that arise due to differences between new disciplinary knowledge needed vis-à-vis the receiver's own disciplinary background. In *Case 2*, a senior project manager succeeded in implanting new knowledge into his multi-disciplinary team despite the fact that the application area was new to himself. In *Cases 1–3*, we deal with domestic building markets in Finland. Some participating firms are foreign-owned, but all the individuals involved are Finns. Thus, we can assume that most individuals have gained in-depth local knowledge of the targeted building sectors in Finland, and no major differences along this local business dimension were involved. However, we want to inform the reader about the Finnish cultural orientation and business practices with a short description, which is comparable with the 59 other countries:

> Finns feel that they have obtained what they need, and therefore they do not seek or accept information or help from others. Finnish higher education is becoming more conceptual, and information is being processed from an analytical perspective, rather than a subjective, associative one. Finns follow universalistic laws and rules of behavior rather than considering each situation as a unique problem. Finns tend to use objective facts rather than subjective feelings in making their case. One's ability is more important than one's station in life. Finns are highly nationalistic, with a liberal philosophy of tolerance for dissent and deviation. The population is homogeneous (Morrison, Conaway, & Borden, 1994, pp. 115–120).

In *Case 4*, we describe how the reliance of a "middleman" proved to be an effective way to adopt local business knowledge and learn local practices. Case 4 deals with managing a building design and contracting project in Russia. The primary project stakeholders originated from the U.S., Finland, and Russia. Many western and Russian subcontractors took part in the case project. Thus, we deal later with major differences between Russian and western stakeholders in ways of doing business and projects.

Implanting New PM Knowledge into Competencies of a Contractor's Site Managers (Case 1)

This building contractor is among the 10 largest construction contractors in Finland. Its turnover was over EUR 200 million in the year 2001.

In the late 1990s, the top manager and the focal business manager decided to develop the site works scheduling and controlling capabilities of the firm's site management teams and the related competencies of the individual site managers at a markedly higher level. The old way of one scheduling team (at headquarters) planning schedules for all projects turned out to be ineffective. The action researcher suggested *a new decentralized way of project scheduling* where each site manager started to make schedules for his project independently. The implantation of new knowledge of schedules – together with dependent knowledge of methods and resources – into site managers was done first through learning by analysis (as a group), followed immediately by learning by doing, i.e. each site manager made his first schedule for his next project (in the years 1997–1998). Initially, most site managers could comprehend systematic scheduling logic quite easily based on their competencies and experience in managing the site works on a daily basis (Fig. 4).

The managing director himself and the action researcher attended the meetings of the business management team, which guided each site manager, reviewed all his schedule drafts, approved his final schedule with targeted high performance before he started the works at site, followed monthly (or bi-weekly) the progress of the site works, and finally approved (or decided upon) the corrective actions when needed. The business

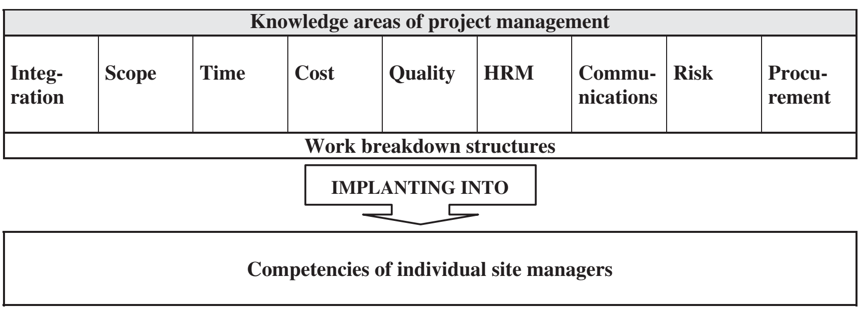

Fig. 4. Implanting New Project Management Knowledge into the Competencies of a Finnish Building Contractor's Site Managers in the Late 1990s.

management team felt confident and for several years continued to focus their attention on guiding proactively this new way of scheduling at their monthly meetings, project by project, and on nurturing systematically the scheduling capabilities and competencies of site managers. By the year 1999, this frontline PM had been established as a part of "*our PM way*." Today, site management plans are effective and targeted costs are attained. Senior site managers are motivated to re-plan the schedules swiftly, when any major change occurs. Both real-time scheduling and cost control have become a part of "*our PM values*." However, the high performance is endangered every time a new site manager is appointed unless the business management team (and his boss) continues this guiding work.

Integrating the CPM Consultant's Own Capabilities and New Railway Engineering and Track Construction Capabilities within One Project Management Team (Case 2)

This construction project management (CPM) consultant is among the three leading CPM firms in industrial, commercial, office, and public building businesses in Finland. Its invoicing was over EUR 5 million in the year 2001. *The case project* involves the construction of two new tracks and the rebuilding of six stations on the Helsinki–Espoo Urban Line in the years 1997–2001. The costs were approximately EUR 135 million. Until the year 1995, only two firms possessed the core competences for railway engineering and track construction in Finland. The Finnish State Railways had a monopoly of managing railway projects. Its subsidiary, VR-Track Oy, planned and carried out the works according to the funds allocated annually by the Government of Finland, without any comprehensive project-specific plan. In addition, Electric Rails Oy had the competence for fixed installations of railway electrification.

The Finnish Rail Administration (FRA) was responsible for implementing the new tracks. The cities of Helsinki and Espoo were responsible for reconstructing the stations. Based on the first ever open tendering related to railway projects in Finland, the FRA appointed *this CPM consultant* to manage the track construction. The CPM contract included the division of the design, construction works, and supplies into app. 150 packages, awarding the related contracts in open competition, and managing their fulfillment. Traditional railway constructors criticized the choice of the CPM consultant with no prior experience in railway construction, breaking the works down, and the inclusion of tens of sub-contractors at the same

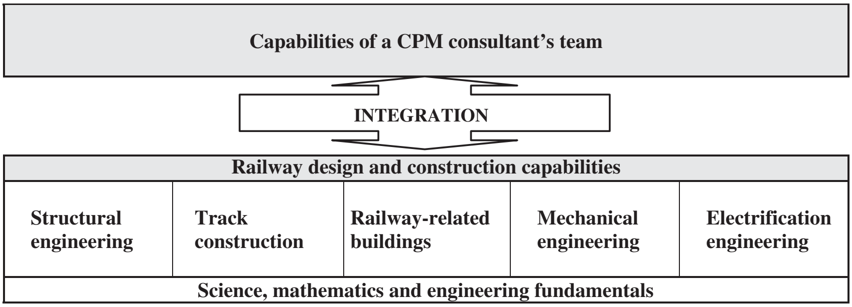

Fig. 5. Integrating the CPM Consultant's Own Capabilities with New Railway Engineering and Construction Capabilities within One PM Team in the Late 1990s.

sites along the existing tracks where trains continued to commute on a regular basis.

The CPM consultant negotiated the new decision-making and communication system, managed the PM plan, and managed the work packages well. The crucial choice involved recruiting the site supervisors and integrating the CPM and electrified track construction capabilities (Fig. 5). The project manager succeeded in motivating his new cross-disciplinary team. The high PM performance resulted in holding to the project schedule and realizing the final costs below the target budget without any traffic accidents. This description is based on the study of Laitinen (2002, pp. 81, 84, 90, 97) where he assessed in particular that the level of the CPM consultant's project risk management was high.

Misplacing New Management Tools into Capabilities of a Housing Producer's Team (Case 3)

This housing producer is among the leading operators in the housing market in Finland with the turnover of over EUR 200 million in the year 2001. It is the owner of 27,000 apartments with 52,000 dwellers. The finished production numbers app. 1500 new apartments annually.

In the year 2000, the housing producer decided to productize the prefabricated family houses, i.e. create a set of high-quality designs that could be produced profitably anywhere in Finland, both as family house areas and single houses. The producer established a new productization team and chose its members, i.e. the leading Finland-based design firms and trade

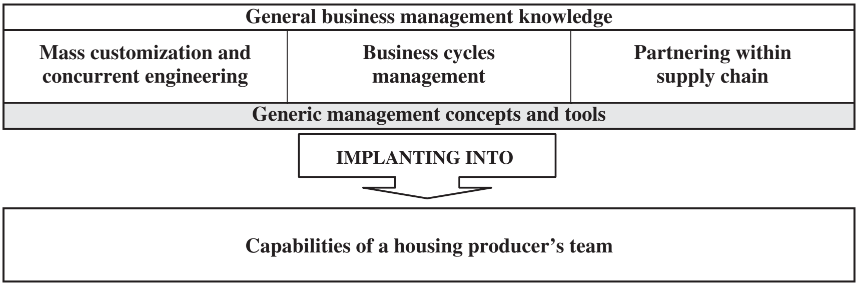

Fig. 6. Implanting the Three New Business Management Tools into the Capabilities of a Finnish Housing Producer's Team in the Year 2000.

contractors, *on a partnering basis*. The action researcher was asked to join the team and guide the process. He suggested that the team would apply the two management tools of *mass customization* and business cycles management (Fig. 6). According to *the business cycles theory*, the family house configuration and delivery process must be planned in ways that enable the producer to fulfill the buying criteria of the house buyers in terms of the shortest delivery time. The family house configuration was divided into the three elements to match the business cycles: (i) housing area planning and legislation with a cycle of 2–3 years, (ii) area works and house-specific foundations and frames with a one-year cycle, and (iii) house-specific infill works based on the buyers' choices (of partitioning, surfaces, and fittings) with a cycle of 2–3 months.

At the beginning, *the productization team* made only little progress, wrong functional and technical issues were discussed, team members were not dedicated, and engineers drafted their solutions as usual. Only the architect and the action researcher tried to guide the team toward applying the two tools. Later, the final family house designs and related housing area plans turned out to be the results of compromises. The team failed due to the members having very little prior experience in product or business development. The housing producer terminated the team after having learned that each member (i.e. potential partners in future housing business) were pricing their house parts and services too high, implying the non-profitability of the targeted family house (see Kiiras, 2001). One of the prerequisites for implanting new management tools into the team's capabilities is to appoint a team leader who has a clear vision and who can motivate the team. A new tool seems to become effective only after several pilot projects.

Contracting the Localized Capabilities of a Finland-Based Contractor for Managing a Western Investor's Building Project in Russia (Case 4)

The 10 largest construction contractors based in Finland have accumulated profitable experience (with some major losses, too) in managing building projects in Russia. They have learnt to deal with local risks. *This case contractor* ranks among the three largest contractors in Finland with a turnover of over EUR 1 billion in the year 2001. The share of its foreign turnover was app. 20%.

As a rule, western firms meet obstacles that may prevent them from doing profitable business in Russia. Many obstacles are related to differences in national, business, building, and corporate cultures (e.g. Alsakini, 2001). Generic differences are inherent in national and business values, attitudes, education systems, business and building practices, design and construction processes, project roles of stakeholders, stereotype careers of engineers, and technical regulations. In practice, firms meet difficulties in getting the tens of permits. Morrison et al. (1994, pp. 314–321) describe that Russians are not open to outside information. They process information subjectively and associatively. Many look to faith or feelings. Negotiations involve temper tantrums, dire threats, and walkouts. [Only] the more educated managers let objective facts dictate the truth. Many managers delegate decision-making authority to a team or specialists. However, Russians have patience and endurance, which may put impatient North Americans at a disadvantage.

The case project involves a western manufacturing firm investing in a factory in the St. Petersburg during the years 1998–2000. This firm used the familiar CPM contract with the U.S. architectural design. The Finland-based case contractor won the main contract for construction works. In addition, the contractor entered into *a CPM services contract*, which turned out to be critical. Its CPM team advised the owner to apply the Finnish general conditions of building contracts and to assign key Finnish designers for making designs in co-operation with Russian designers. The latter supplied the owner's PM team with the local information and finalized the drawings to meet the local requirements. The factory was built on time and within the budget. The start-up of production took place successfully (Kiiras, 2002). Thus, the implanting of knowledge of foreign cultures into the capabilities of a western investor can be based on *a middleman* who knows the cultures behind each stakeholder (Fig. 7). A middleman may originate from the home country of one of the stakeholders (e.g. Russia or the U.S.A.) or a third country (Finland).

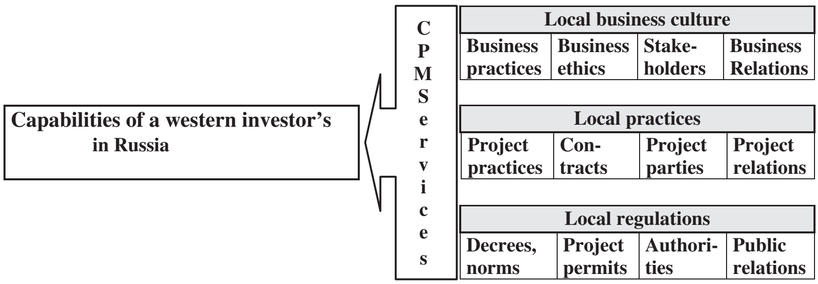

Fig. 7. Transferring the Local Knowledge and Complementing the Capabilities of a Western Investor's PM Team for Building a Factory in Russia in the Late 1990s.

DISCUSSION

Herein, we discuss first the validity of our action research approach. On the one hand, we posit that a researcher will meet *severe method-related limitations* when (s)he aims at investigating and solving those four principal problems inherent in the transfer and implanting of cross-disciplinary knowledge only at an arm's length. This is so because a researcher will not be capable of determining even the starting points, i.e. the degrees to which focal informants themselves understand the nature of a knowledge implanting problem. A quantitative statistical method does not allow an in-depth inquiry. Both qualitative mail surveys and interviews fall short as well. No (laboratory-like) pre-planned experiments qualify. An inquiry based on the case study research (e.g. Yin, 1994) may produce only a series of cross-sectional snapshots.

On the other hand, we are validating *our action research approach* as follows (aligning with e.g. Argyris, 1999, Gummesson, 2000). An action researcher does not have the privilege to choose the eligible cases based on a random or theoretical sampling. When the in-depth, longitudinal inquiry is targeted, this researcher must be allowed to enter the focal firm on a continuous basis in order to perceive a continuous series of real events and obtain authentic information. Ex ante, the crucial decision is to determine the action researcher's role and ways of observing the events as well as participating and influencing them at the spot. Ex post, our experience points out to one of the pre-conditions, i.e. the focal firm's decision makers will let active participation to take place only when they trust the action researcher. In turn, trust will develop only over a longer period of collaboration between parties. The fulfillment of this pre-condition is evident in each of the four reported cases (Table 1). Many causal roots had been

Table 1. Summary of the Four Knowledge-implanting Cases between the Years 1997–2001.

Case No.	Knowledge to be Implanted	From	To	Outcome
1	Basic project management (PM) knowledge	Consultant (action researcher)	A contractor's site managers	Successful adoption took place (after several years)
2	Advanced construction project management (CPM) knowledge and railway engineering knowledge	CPM consultant Railway engineers	A CPM consultant's railway project team	Successful integration within the project team during the multi-year contract
3	Three management tools	Action researcher	Business concept development team	Members of the development team neither understood, nor adopted the tools
4	Local knowledge of Russia	A Finnish contractor ("middle-man" or "interpreter")	A Western investor (industrial company)	Local culture and practices were transferred successfully through "the middle-man"

planted mutually already in the late 1980s. The primary author has assumed the various roles in these and other similar cases during the 1990s, i.e. mostly as a consultant (cf. Case 1), many times as a member of a development team (cf. 3), and repeatedly as an observer inside a firm (cf. Cases 2 and 4). However, the case descriptions are biased in the sense that they do not contain detailed information of how the managers and teams dealt with and solved actual problems at the end of the day. Due to the repeated denials by the focal informants, we could not scrutinize their interpretive frameworks, learning, and sensemaking processes (we did not start to guess at those either).

Next, we suggest some promising actions to be adopted both among competence-based scholars and practitioners in order to manage new cross-disciplinary knowledge and have it assimilated into management competences in effective ways also within several business contexts as follows. The primary context for applying the suggested framework is *building design and contracting businesses across the globe*. The four cases provide readers with the initial evidence on a set of viable ways to solve the four knowledge implanting problems: (i) Implanting *new PM knowledge* into capabilities and competencies of building design and construction managers is effective by learning by combined analysis and doing, coaching, and setting targets high (in the beginning), and involving committed top and business managers. No "academic" lectures and guidebooks alone are effective (cf. Case 1).

(ii) Implanting *new technical or functional knowledge* into capabilities and competencies of professional project managers is effective, for example, by recruiting technical or functional managers to become new members of the PM team and by cross-training newcomers and project managers. Hands-on coaching is more needed for embedding PM knowledge into newcomers.

One partial solution is to enter into a service contract for acquiring the crucial missing capabilities or competencies, project by project (cf. Case 2).

(iii) Implanting *new management frameworks and tools* into capabilities and competencies of project, engineering, or construction managers is effective by assigning a visionary manager who sets the clear targets and then leads the adoption and the first applications of the framework/tool in question in trial, pilot, and actual projects in a dedicated, determined manner. Hands-on coaching is needed in particular in the case of technical and functional managers (cf. Case 3).

(iv) Implanting *new local knowledge* into capabilities and competencies of building business managers, project managers, design managers, and construction managers can be effective in such ways as by entering into a service contract with a middleman or an interpreter who knows the cultures behind each stakeholder involved at the time, entering into a partnership with the local(ized) stakeholders, or recruiting individual experts (cf. Case 4).

From the competence-based view, we acknowledge that managing cross-disciplinary knowledge is only one of competence-based management's concerns. Nevertheless, we argue that more competence-based, hands-on studies on effective new uses of cross-disciplinary knowledge are worthy endeavors not only among project business, project management, and engineering scholars but also among competence-based management scholars across the globe. It is envisioned that researching concurrently both (a) management of discipline-specific versus cross-disciplinary knowledge and (b) tacit versus explicit knowledge into a firm's business competences will likely enhance our understanding of the internal causal chains that explain a firm's (non-)success in managing its dynamic businesses at large.

Finally, it is concluded that future enhancement of knowledge-based and competence-based business management could take place along Berthoin Antal, Dierkes, Child, and Nonaka, (2001b) and Sanchez and Heene's (2004) line of envisioning, i.e. learning, knowledge, and competences will increase their importance. *Learning as a competence* and *knowledge as a resource* will turn out to be(come) key factors not only for economic competitiveness but also for access to participating in the four dimensions of dynamic, systemic, cognitive, and holistic societies as a whole. Change will remain a dominant feature requiring both incremental adjustment and radical innovation. New business logics, ways of competing, and organizational forms will emerge to replace or complement the existing ones. Thus, we assume that the need to create and use new cross-disciplinary knowledge will grow, too.

REFERENCES

Alsakini, W. (2001). *Managing cross-cultural business relations with Russian stakeholders*. Unpublished data. Special Assignment. Helsinki University of Technology, International Construction Business. Espoo.

Argyris, C. (1999). *On organizational learning* (2nd ed.). Oxford: Blackwell.

Argyris, C., & Schön, D. A. (1978). *Organizational learning: A theory of action perspective*. Reading, MA: Addison-Wesley.

Berthoin Antal, A., Dierkes, M., Child, J., & Nonaka, I. (2001a). Introduction: Finding paths through the handbook. In: M. Dierkes, A. B. Antal, J. Child & I. Nonaka (Eds), *Handbook of organizational learning and knowledge* (pp. 1–13). Oxford: Oxford University Press.

Berthoin Antal, A., Dierkes, M., Child, J., & Nonaka, I. (2001b). Organizational learning and knowledge: Reflections on the dynamics of the field and challenges for the future. In: M. Dierkes, A. B. Antal, J. Child & I. Nonaka (Eds), *Handbook of organizational learning and knowledge* (pp. 921–939). Oxford: Oxford University Press.

Chinowsky, P. S., & Meredith, J. E. (2000). *Strategic corporate management for engineering*. New York: Oxford University Press.

Fiol, C. M., & Lyles, M. A. (1985). Organizational learning. *Academy of Management Review*, *10*, 803–813.

Gummesson, E. (2000). *Qualitative methods in management research* (2nd ed.). Thousand Oaks, CA: Sage.

Hamel, G., & Prahalad, C. K. (1994). *Competition for the future*. Boston, MA: Harvard Business School Press.

Huovinen, P. (2002). Competitiveness of Finland-based firm groups in international capital investment markets. In: J. Larimo (Ed.), *Current European research in international business.*

The proceedings of the 6th Workshop in International Business, No. 86 (pp. 99–124). Vaasa: University of Vaasa.

Kiiras, J. (2001). Productization of family house areas. HUT construction economics and management. Publication no. 200. Espoo: Helsinki University of Technology (in Finnish).

Kiiras, J. (2002). *Multi-cultural construction in Russia, co-operation with Finns*. CD-Rom. Helsinki University of Technology, Construction Economics and Management.

Laitinen, H. (2002). *Identification of major accident hazards (IMAH)*. Licentiate thesis. Helsinki University of Technology, Construction Economics and Management (Unpublished).

Leonard-Barton, D. (1995). *Wellsprings of knowledge: Building and sustaining the sources of innovation*. Boston, MA: Harvard Business School Press.

Morrison, T., Conaway, W. A., & Borden, G. A. (1994). *Kiss, bow, or shake hands. How to do business in sixty countries*. Holbrook: Adams Media Corporation.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. New York: Oxford University Press.

Pawlowsky, P. (2001). The treatment of organizational learning in management science. In: M. Dierkes, A. B. Antal, J. Child & I. Nonaka (Eds), *Handbook of organizational learning and knowledge* (pp. 61–88). Oxford: Oxford University Press.

Polanyi, M. (1966). *The tacit dimension*. London: Routledge & Kegan Paul.

Project Management Institute (2000). *A guide to the project management body of knowledge* (PMBOK Guide). 2000 ed. Pennsylvania: PMI.

Sanchez, R. (Ed.) (2001a). *Knowledge management and organizational competence*. Oxford: Oxford University Press.

Sanchez, R. (2001b). Managing knowledge into competence: The five learning cycles of the competent organization. In: R. Sanchez (Ed.), *Knowledge management and organizational competence* (pp. 3–37). Oxford: Oxford University Press.

Sanchez, R., & Heene, A. (2004). *The new strategic management. Organization, competition, and competence*. New York: Wiley.

Sanchez, R., Heene, A., & Thomas, H. (Eds) (1996a). *Dynamics of competence-based competition*. Oxford: Pergamon/Elsevier.

Sanchez, R., Heene, A., & Thomas, H. (1996b). Introduction: Towards the theory and practice of competence-based competition. In: R. Sanchez, A. Heene & H. Thomas (Eds), *Dynamics of Competence-based competition* (pp. 1–35). Oxford: Pergamon/Elsevier.

Senge, P. M. (1990). *The fifth discipline. The art and practice of the learning organization*. New York: Bantam Doubleday.

Terpstra, V., & David, K. (1991). *The cultural environment of international business*. South-Western Publishing.

van den Bosch, F. A. J., & van Wijk, R. (2001). Creation of managerial capabilities through managerial knowledge integration: A competence-based perspective. In: R. Sanchez (Ed.), *Knowledge management and organizational competence* (pp. 159–176). Oxford: Oxford University Press.

von Krogh, G., & Roos, J. (Eds) (1996). *Managing knowledge: Perspectives on cooperation and competition*. London: Sage.

Yin, R. K. (1994). *Case study research. Design and methods* (2nd ed.). Thousand Oaks, CA: Sage.

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MANAGING THE TENSION BETWEEN COMPETENCE BUILDING AND COMPETENCE LEVERAGING BY INFLUENCING MANAGERIAL AND ORGANIZATIONAL DETERMINANTS OF HORIZONTAL KNOWLEDGE EXCHANGE

Tom J. M. Mom, Frans A. J. Van den Bosch and Henk W. Volberda

ABSTRACT

Both in theory as in practice insight is limited about how firms in dynamic environments could organize to manage concurrently both the strategic processes of competence building and competence leveraging. To contribute to this issue, a conceptual framework is developed which considers the ability to exchange knowledge across organization units as a prerequisite for firms to achieve both the goals of competence building and

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leveraging. The framework shows how several important managerial and organizational determinants, associated with cross-unit knowledge exchange, may stimulate competence-building processes and how they may stimulate competence-leveraging processes.

The conceptual framework will be illustrated by two case studies of Novartis, one of the leading European life-science companies. The cases analyze how the horizontal knowledge exchange determinants of the framework – awareness and interest toward knowledge exchange, transfer mechanisms, prior knowledge, and the organization form – influence competence building and leveraging processes within the firm. The first case is about knowledge exchange between Novartis' divisions in the actual organization context. The second case is about an experiment of Novartis' top management to stimulate horizontal knowledge exchange via the company's intranet. These two contexts of 'organization-enabled' and 'web-enabled' knowledge exchange appear to be complementary. While, in the first case, mainly competence building is stimulated by exchanging tacit knowledge, the second case is more conducive to leveraging existing competences by exchanging explicit knowledge.

As such, the conceptual framework and cases might give insight into (1) possibilities about how firms could organize to deal with the tension between competence building and leveraging processes, and (2) how managing the determinants of horizontal knowledge exchange can contribute to changing a firm's actual mixture of competence building/leveraging processes into a more desired strategic mixture.

INTRODUCTION

The most fundamental question in strategy, both from a researcher and practitioner point of view, is probably why and how firms are successful over time. The competence-based view argues that whether a firm will gain and maintain competitive advantage is to a large extent determined by its ability to manage concurrently *both* the processes of competence building and competence leveraging (Sanchez & Thomas, 1996). We associate competence building with qualitative changes in the firm's existing stock of competences, and with changing the status quo by creating new strategic options for future action (cf. Sanchez, Heene, & Thomas, 1996, p. 8). Competence leveraging will be related to using or quantitatively changing existing competences, and to exercising existing options for actions (cf. Sanchez et al., 1996, p. 8).

The need to both build and leverage competences is most apparent in dynamic industries, for example, the life sciences (Mom, 2001), the multi media industry (De Boer, Van den Bosch, & Volberda, 1999; Roos & Von Krogh, 1996) and the financial services sector (Flier et al., 2001; Flier, Van den Bosch, & Volberda, 2003). Firms in such industries continuously need to renew themselves to ensure profits for tomorrow by building new competences. At the same time these firms are confronted with competitive forces that compel them to make profits today by leveraging existing competences.

However, managing concurrently the processes of competence building and leveraging appears both in theory – especially from the organizational learning literature (e.g. March, 1991; Levinthal & March, 1993) – and in practice to be difficult for firms. Apparently, there is a tendency for firms to fall into a 'competence trap' (Leonard-Barton, 1992), or into a 'failure trap' (Levinthal & March, 1993). This is among others due to the fact that revenues from building new competences are more distant in time and less certain as compared to revenues from leveraging activities. More theoretical and practical insight is needed into how firms could deal with these paradoxical or even conflicting strategic issues (Hamel & Heene, 1994; Volberda, 1998). Or as Sanchez et al. (1996, p. 4) express it: insight is needed into 'how firms competing in environments that demand both competences simultaneously might organize to reconcile the conflicts that such seemingly opposing competences might create within the firm.'

As knowledge has emerged as the most strategically significant resource of the firm (Grant, 1996b; Sanchez & Heene, 1997), this chapter argues along with other authors that knowledge processes, and especially *horizontal knowledge exchange* within a firm (Hedlund, 1994; Nohria & Goshal, 1997; Van Wijk & Van den Bosch, 2000), plays an important role for managing the above-described competence building/leveraging problem. Horizontal knowledge exchange takes place between divisions, between business units and between operating units. Vertical knowledge exchange is being associated with the vertical lines of hierarchy and follows a top-down or bottom-up direction (Van den Bosch & Van Wijk, 1999).

Horizontal knowledge exchange may contribute both to competence building and leveraging processes within the firm. New strategic options and qualitative changes in a firm's existing stock of assets and capabilities may be created through cross-fertilization of knowledge across an organization's units and new knowledge combinations based on existing knowledge (Grant, 1996a; Kogut & Zander, 1992). The argument for leveraging may, for instance, be illustrated by the study of Szulanski (1996) about the internal transfer of best practices. Szulanski argues that firms engage in the cross-unit transfer of best practices to improve knowledge utilization within the firm, to avoid the duplication of effort and 'in this sense, transfers of best practice could be conceived as replications of organizational routines' (1996, p. 28). Utilization, duplication, and replication of knowledge assets lead to quantitative changes in stocks of like-kind assets within the organization and as such can be associated with leveraging competences at organizational level (Sanchez et al., 1996).

The *goal* of this chapter is to create an insight into how a firm could change its actual mixture of strategic competence building/leveraging processes into a more desired mixture, and how firms might organize to deal with the associated conflicts between these processes. The focus will be on the role of horizontal knowledge exchange, by addressing as a *research question*: 'How and why do key managerial and organizational determinants of horizontal knowledge exchange contribute to both competence building and competence leveraging processes?'.

To address this research question we have developed an integrated conceptual framework. The framework is based on the literature and will in particular focus on the *process dimension* of horizontal knowledge exchange. Subsequently, several key managerial and organizational determinants of the various phases of the knowledge exchange process are analyzed. We will develop propositions relating these determinants to the knowledge exchange process in terms of competence building and competence leveraging. The empirical and managerial applicability of the conceptual framework will be illustrated by two related case studies of horizontal knowledge exchange efforts of a European life-science multinational. In the first case, we will focus on competence building by investigating the organizational and managerial determinants of inter-division knowledge exchange. The second case deals with competence leveraging. Based on the suggested process framework we will investigate the role of information and communication technology (ICT) in this respect. Finally, we will discuss the findings.

THE PROCESS OF HORIZONTAL KNOWLEDGE EXCHANGE: PHASES AND DETERMINANTS

The horizontal exchange of knowledge between organization units can be considered as an unfolding process with different phases. To identify these phases and the particular characteristics of each of them, we integrate three previously developed models of intra-corporate knowledge and exchange: Von Krogh and Köhne (1998), Boone (1997), and Szulanski (1996). Identifying the managerial and organizational determinants of the various phases of the integrated framework will be the next step of the conceptual analysis.

The Three Phases in the Process of Horizontal Knowledge Exchange

Knowledge exchange between persons, groups, departments, units, and divisions of the same organization can be considered and analyzed as a process consisting of three phases: the initiation phase, the flow phase, and the integration phase (Initiierungsphase, Wissenflussphase, Integrationsphase) Von Krogh and Köhne (1998). The initiation phase is characterized by the wish, will, and goal of people, groups or organization units to transfer knowledge. According to Von Krogh and Köhne (1998), the most important challenge in this phase is finding and identifying the appropriate knowledge and involving those who own the knowledge into the transfer of the knowledge. During the flow phase, the explicit and tacit knowledge flows between those involved by interaction and communication. The integration phase starts when the recipient receives the knowledge and puts it into use. Von Krogh and Köhne (1998) point out that the recipient first assorts the transferred knowledge into his environment based on his experiences and own knowledge base and then applies the knowledge and assimilates it.

Boone (1997) develops a two-phase process model of internal cross-unit knowledge exchange. The model contains a decision and an execution phase. The decision phase is about the willingness and decision process of the potential knowledge donor and acceptor about sharing knowledge: 'besides the donor being willing to share his or her knowledge, potential recipients have to make up their mind with respect to their eagerness to adopt, apply, and integrate a particular knowledge item' (Boone, 1997, p. 47). During the execution phase the knowledge is being transferred. These two phases correspond closely with the 'Initiierungsphase' and 'Wissenflussphase' of Von Krogh and Köhne (1998). Boone does not focus explicitly on the application of the transferred knowledge by the recipient.

The literature about the transfer of best practices also provides clues for our framework. For example, Szulanski (1996, p. 28) conducted an interesting quantitative empirical research in that field with the goal 'to investigate the origins of internal stickiness of knowledge transfer'. He uses a four-stage process model to characterize the internal transfer of knowledge.

The stages of this model (initiation, implementation, ramp-up, and integration) correspond closely with the phases of the model of Von Krogh and Köhne (1998) and the model of Boone (1997). His initiation stage is about deciding to start the transfer, like the initiation phase of Von Krogh and Köhne and the decision phase of Boone. During the implementation stage of Szulanski, the knowledge flows between the recipient and the source like the flow phase and execution phase of the previous authors. In the ramp-up stage the best practice is put into use and in the integration stage the knowledge becomes routinized; this is what happens in the integration phase of Von Krogh and Köhne.

By integrating the models of the above-mentioned authors, it can be concluded that the exchange of knowledge within an organization between persons, groups, and organization units can be described as a process comprising three phases. First, a *Decision Phase* which comprises all activities that enable the potential donor and recipient to decide to start exchanging knowledge. Second, a *Transfer Phase* in which resources are being allocated to actually transfer the knowledge and finally an *Absorption Phase* where the recipients assimilated the newly received knowledge and starts using it. Fig. 1 depicts our conceptual framework.

Managerial and Organizational Determinants of Horizontal Knowledge Exchange

Besides the three identified phases of the process of horizontal knowledge exchange, Fig. 1 shows the managerial and organizational determinants that are assumed to influence these phases. The upper panel of Fig. 1 indicates how the determinants may stimulate the process of horizontal knowledge exchange conducive to competence building, and the lower panel with respect to competence leveraging.

All authors as mentioned above give an overview of factors or determinants, which may influence the phases of the horizontal knowledge exchange process within an organization. Boone (1997, pp. 55–118) provides the most extensive overview of the potential stimulating and inhibiting factors concerning the Decision and Transfer Phases. The factors that Von Krogh and Köhne (1998, pp. 242–248) and Szulanski (1996, pp. 32–33) briefly describe are all extensively dealt with by Boone (1997) as well.

Boone (1997) argues that for the *Decision Phase* both awareness- and interest-related factors play a role. He identifies several awareness- and interest-specific barriers that need to be reduced and eliminated by the use of

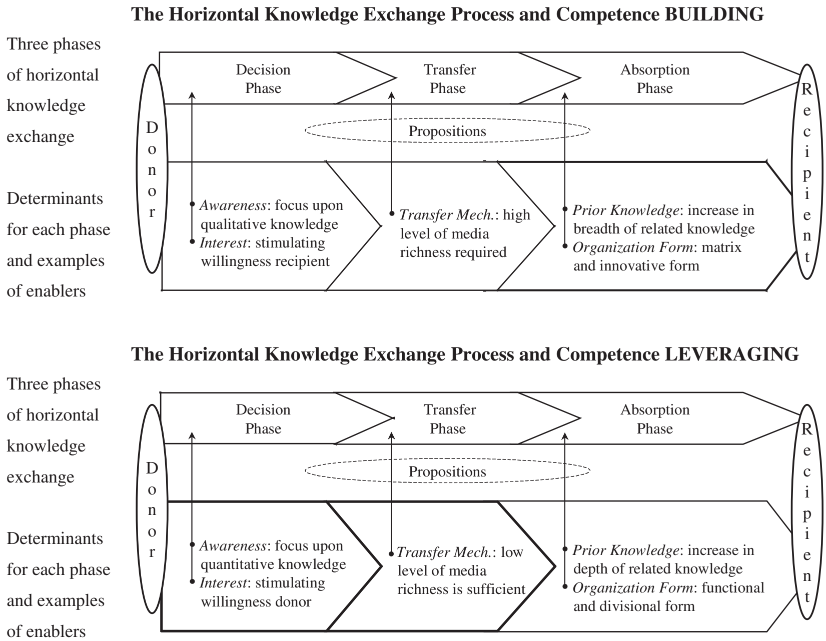

Fig. 1. An Integrative Framework of Organizational and Managerial Determinants of the Horizontal Knowledge Exchange Process: Competence Building and Competence Leveraging. *Source*: Von Krogh and Köhne (1998), Boone (1997), Szulanski (1996), Cohen and Levinthal (1990), Van den Bosch et al. (1999).

management systems and tools. Awareness-related factors hinder or stimulate a potential knowledge recipient to become aware of where the knowledge resides that could be used to solve problems or to explore new opportunities. Likewise, 'donors looking for application opportunities of their knowledge need to be aware where their knowledge is needed' (Boone, 1997, p. 48). 'Tacitness of knowledge' is an example of an awareness-related barrier. Tacit knowledge remains in many cases difficult to abstract and hence extremely hard to locate and exploit (Nonaka, 1994). A way to tackle this barrier could be to codify, register, and store such knowledge according to Boone. Interest-related determinants are about the 'willingness to participate in the transfer of a knowledge item' (Boone, 1997, p. 71). An example of a barrier is 'efficiency rationales' (p. 72); if the exchange of knowledge is assumed to have a negative trade-off between costs and benefits for either the donor or recipient, one of them might withdraw to engage in the transfer. Boone (1997, p. 79) suggests tackling this barrier by financial measures and rewards systems.

In the *Transfer Phase*, transfer mechanisms play an important role. Boone (1997, p. 51) indicates that 'one needs to study the complexity of the particular situation and decide upon the most suitable transfer mechanism to be used for the effectuation of the knowledge transfer. (…) There needs to be a fit between the nature of the knowledge item and the richness of the transfer medium'. What further matters during this phase according to Boone is the extent of trust between the parties involved, the amount of resources allocated to the knowledge exchange activities, and the skills of the firm's employees to deal with transfer mechanisms.

During the *Absorption Phase*, the recipient assimilates the knowledge and starts using it. Cohen and Levinthal (1990) call the ability of a firm to assimilate and apply new knowledge 'absorptive capacity'. By shifting the unit of analysis from the organizational to the intra-organizational level it can be argued that the success of the final phase of the knowledge exchange process is determined by the 'absorptive capacity' of the recipient. Cohen and Levinthal (1990, p. 128) consider the level of prior related knowledge as the determinant of absorptive capacity: 'At the most elemental level, this prior knowledge includes basic skills or even a shared language but may also include knowledge of the most recent scientific or technological developments in a given field'. Based on this, Van den Bosch, Volberda, and De Boer (1999) and Van den Bosch, Van Wijk, and Volberda (2003) suggest two specific organizational determinants of absorptive capacity: 'organization forms' and 'combinative capabilities'. An organization form is viewed here 'as a type of infrastructure, which in a specific way enables the process of integrating knowledge' (1999, p. 554). We will leave out combinative capabilities in this chapter because the previously discussed determinants contain various aspects of combinative capabilities.

PROPOSITIONS ABOUT THE IMPACT OF KNOWLEDGE EXCHANGE DETERMINANTS ON COMPETENCE LEVERAGING AND BUILDING

In the Decision Phase of the knowledge exchange process, *Awareness*-related factors hinder or stimulate a potential knowledge donor or recipient to become aware of where in the organization knowledge is needed or resides. We argue that awareness facilitators conducive to competence building are 'qualitatively more advanced' as compared to those conducive to competence leveraging: in the case of competence building, the awareness facilitators should be able to reduce the cognitive limits managers face when they search for qualitatively unrelated knowledge and the associated causal ambiguities when deciding about the potential value of integrating such knowledge into the existing organization-unit's knowledge base. In the case of competence leveraging, the knowledge being exchanged is often less ambiguous and better quantifiable (Sanchez & Heene, 1996); it is associated with quantitative changes in the unit's existing competences. While knowledge codification, registration, and storage and internal standardized benchmark procedures seem more suited to detect related knowledge (Boone, 1997; Von Krogh & Köhne, 1998), for identifying and interpreting qualitative unrelated knowledge qualitatively more advanced awareness facilitators are needed like, for example, cross-unit personal networks, job rotation, and meetings. These considerations give rise to the following proposition:

Proposition 1. In the Decision Phase of the horizontal knowledge exchange process, awareness facilitators conducive to competence building are 'qualitatively more advanced' as compared to those conducive to competence leveraging.

The second determinant of the Decision Phase, *Interest*, is about the willingness of the units to participate in knowledge exchange activities. At first sight, it seems that the donor unit only could lack interest because of such reasons as a possible negative trade-off between costs and benefits, an assumed loss in power base or fear for inter-unit competition (Boone, 1997). It seems, however, that stimulating the interest of the recipient unit becomes important as well in the case of knowledge exchange aimed at competence building. The underlying reason being that the benefits related to competence building are less certain and more distant in time for the knowledge recipient, as compared to benefits coming from competence leveraging. These considerations give rise to the following proposition:

Proposition 2. In the Decision Phase of the horizontal knowledge exchange process, stimulating the interest of the recipient unit is more important for competence building, whereas stimulating the interest of the donor unit is more important for competence leveraging.

During the transfer phase, *transfer mechanism* related factors play a role. Competence building is associated with higher uncertainty and higher complexity than competence leveraging because desired and possible outcomes are unclear. Therefore, we argue that knowledge exchange aimed at competence building requires more 'media richness' than competence leveraging. Media richness can be defined as 'the communication medium's capacity to exchange mental representations within a specific time interval. It has two underlying dimensions – the variety of cues that the medium can convey and the rapidity of feedback that the medium can provide' (Huber, 1991, p. 103). The argument is also based on the assumption that the 'qualitative changes in the existing stocks of assets' (competence building, cf. Sanchez et al., 1996, p. 8) are related to the exchange of tacit knowledge whereas the 'quantitative changes in stocks of like-kind assets' (competence leveraging, cf. Sanchez et al., 1996, p. 8) are related to the exchange of explicit knowledge. The transfer of tacit knowledge requires mechanisms which allow for more intense, frequent, open, and dense communication and personal interactions as compared to the transfer of explicit knowledge (Boone, 1997; Gupta & Govindarajan, 1991, 2000). These considerations lead to the following proposition:

Proposition 3. In the Transfer Phase of the horizontal knowledge exchange process, the transfer-mechanisms contain more 'media richness' in the case of competence building as compared to competence leveraging.

The first determinant of the Absorption Phase is considered to be the level of *prior related knowledge* of an organization unit (Cohen & Levinthal, 1990). Cohen and Levinthal (1990) associate a higher level of prior-related knowledge with a higher level of absorptive capacity. It seems useful, however, to distinguish between the level of depth and breadth of the knowledge base (Van Wijk, Van den Bosch, & Volberda, 2001) for understanding how an organization's knowledge base could offer potential for the exchange of knowledge conducive to competence leveraging versus building. Cohen and Levinthal (1990, p. 150) point out that, for an organization unit to be able to absorb knowledge from unrelated domains, the unit needs first to acquire the requisite breadth of knowledge. As such, an increase in the breadth of an organization unit's knowledge base can be assumed to increase the potential of that unit to build new competences. An increase in depth of the knowledge base offers an increased potential to leverage-related competences. These considerations lead to the following proposition:

Proposition 4. In the Absorption Phase of the horizontal knowledge exchange process, an increase in the breadth of the knowledge base of an organization unit increases the potential for that unit to build competences, whereas an increase in the depth of the knowledge base increases the potential for that unit to leverage competences.

The last determinant of the Absorption Phase is the *Organization Form*. De Boer et al. (1999) and Van den Bosch et al. (1999, 2003) provide a rational for the impact of several basic organization forms on the ability of the organization to absorb knowledge. They assume that organization forms like the matrix-form offer potential to absorb knowledge conducive to the exploration of the organization's competence base, while organization forms like the functional-form offer potential for exploiting existing competences. These considerations lead to the following proposition:

Proposition 5. In the Absorption Phase of the horizontal knowledge exchange process, a matrix or innovative organization form offer most potential to build competences, whereas a functional or divisional organization form offer most potential to leverage competences.

CASE COMPANY AND RESEARCH METHODOLOGY

To illustrate the empirical applicability of the framework, case research has been performed within *Novartis*. Founded in 1996 as the result of a merger of Ciba and Sandoz, Novartis nowadays is active in the life-sciences industry in over 140 countries. With sales of US$ 25 billion, US$ 5 billion net income, and US$ 3.8 billion R&D expenses over 2003, Novartis is the second largest pharmaceuticals companies in Europe (cf. Forbes, 2003). Regarding the selection of this industry, several challenges in the life-science industry provide an interesting context to investigate abilities to build and leverage competences for firms who want to survive and succeed in the industry. Increased competition, changing legislation, and fast technological developments force the incumbents to strategic renewal (Volberda, Baden-Fuller, & Van den Bosch, 2001). The average life cycle (from launch to catch up by competitor) of a life-science product becomes constantly shorter (Chiesa, 1996; Stühn, 1999) from 10 to 6 years in the 1970s to 2 to 1 years in the 1990s. Increasing competition and more diverse and faster technological development are major forces driving this trend. A new challenge in the industry is posed by the fact that the various domains and technologies of the life sciences like, for example, pharmacology, botany, and zoology become more and more overlapping and innovations increasingly take place by cross-fertilization between different domains. However, in the large multi-unit firms, these domains are grouped in separate divisions or units.

Other pressures, like shareholder value creation, force the firms to focus on short-term costs and profits and demand an efficient deployment of their current competences. While there is an increased pressure on prices and margins on life-science products (Stühn, 1999), research and development expenses are very substantial and are increasing year after year. R&D expenses of, for example, Novartis increased from 10 percent of total revenues in 1990 to 13 percent in 2001.

Methodology

Two case studies were conducted in 2000. The first study is mainly about how the determinants of the conceptual framework of this chapter influence knowledge exchange across Novartis' divisions aimed at competence building. The second case study shows how the identified determinants influenced an initiative of corporate knowledge management to stimulate, in particular, competence leveraging throughout Novartis with the help of the company's intranet.

The first case study is mainly based on interviews with top and middle managers in the areas of research, development, and knowledge management. This choice is made because of the central role of top and especially of middle management with respect to inter-unit knowledge exchange (Nonaka & Takeuchi, 1995; Van den Bosch & Van Wijk, 1999) and the importance of research and development in the life-science industry. The interviews were conducted in the period of April to June 2000. The analysis focuses on two of the – at that time seven – divisions of Novartis, namely Pharma and Animal Health. The Pharma division is the most important division of Novartis in terms of sales (60 percent of total sales), profits (80 percent of total profits) and R&D expenses (69 percent of total R&D). The Animal Health division is the youngest and fastest growing division (4 percent of total sales, 3 percent of total profits and 2 percent of total R&D). These numbers apply to the year 2000.

A sample of 11 respondents was composed with the help of Corporate Knowledge Management on the basis of their knowledge concerning the topic addressed in this chapter. Eight of them are division managers in the areas of research, development, and knowledge management. The remaining three are corporate managers. Semi-structured interviews were conducted and recorded by notepad and pencil. When further clarification was needed, follow-up interviews were conducted. Other empirical data of Novartis for this case has been gained during inter- and intra-divisional meetings concerning knowledge management, internal lectures, and presentations concerning the topic of this research, the Novartis Intranet and internal company documents.

The second case study concerns an experiment of Corporate Knowledge Management to stimulate the corporate-wide leveraging of existing competences by an intranet-based knowledge-sharing conference. The event took place at the same time as the interviews for the first study were held. The framework as developed in this chapter and shown in Fig. 1 was used to guide the preparation, conduct, and evaluation of this conference.

CASE 1: DETERMINANTS OF HORIZONTAL KNOWLEDGE EXCHANGE AIMED AT COMPETENCE BUILDING

The need to exchange knowledge across units is recognized by senior management, as the following quote from an interview emphasizes: 'Sharing knowledge across divisions becomes increasingly important for us. Take for example the functional foods in the industry; they actually are the result of cross-fertilization between pharmaceutical and 'normal food'-knowledge'.

Impact of the Determinants during the Decision Phase

It appeared from the interviews that both the potential knowledge donor and the recipient consider it very difficult to find out where potential knowledge exchange possibilities are situated within the organization. All interviewed division managers said that personal contacts between people of various divisions are very limited and that this lack of personal contact seriously hinders the awareness of cross-division knowledge exchange opportunities (see Box 1, quote 1).

It further turned out that awareness might be hindered because of employees who might be unwilling to give insight of their knowledge when it is being considered as a personal property or as a power base (see Box 1, quote 2). Another reason for a lack of awareness concerning cross-division competence-building possibilities might be related to the high level of tacit knowledge in use at the divisions (see Box 1, quote 3). Tacit knowledge is hard to detect, formulate, and communicate (Nonaka, 1994).

Box 1. Excerpt Interview Quotes Concerning Decision Phase of the Cross-Division Knowledge Exchange Process.

1. As a manager of the Animal Health division pointed out: '*It is difficult to know what knowledge is where. There clearly is a lack of who knows what. I think a major reason that knowledge sharing initiatives are not started is that people don't know each other across divisions; there are too less interpersonal relationships between divisions for really knowing who knows what'.* (Interview, May 2000.)
2. As a manager of the Pharma division puts it: *'Knowledge is considered too much as a personal property. Scientists do not want others to look in their notebooks and are reluctant to put their knowledge into databases'.* (Interview, May 2000.)
3. As a knowledge management manager of one of the divisions states: '*The most valuable knowledge for innovation is often tacit. Well, this knowledge is often difficult to understand for people who come from other areas. The problem is to make the tacit knowledge explicit in a useful manner for the recipient. For this, one has to know the processes of the donor and potential recipient very well'.* (Interview, June 2000.)
4. As a Development manager of one of the divisions states: '*We have to be able to run our business independently of other divisions. If we borrow too much knowledge from others, we might loose that capability'.* (Interview, June 2000.)

Source: Interviews conducted at Novartis, May–June 2000.

In 1996, Corporate Knowledge Management took an initiative to increase the awareness about cross-division knowledge exchange possibilities; the YellowPages. The YellowPages is an electronic database containing summaries of knowledge and expertise of individual associates of Novartis. Although there is a lack of 'awareness', all division managers but one, indicated that the YellowPages are not really being used. People have entered their knowledge into the YellowPages, but do not contact each other and ask for explanations, experiences, knowledge, etc. When asked why the YellowPages are not really used, the interviewees indicated that the personal contact is missing when using the YellowPages.

Other reasons for the lack of cross-division knowledge exchange initiatives within Novartis seem to be related to the interest determinant. Six of the eight division managers indicated that cooperation with respect to knowledge sharing is received well by their division or other divisions, but is not actively searched. Three reasons were found during the interviews. The most important reason for not being willing to engage in a knowledge exchange activity is that acting as a donor is assumed to take time that cannot be spent for profitable activities. This is an example of an efficiency rationale in terms of Boone (1997). Opposition by the donor because of personal reasons (no reward, knowledge considered as a power base or a personal property) and opposition by the receiving division because of fear to lose independence also play a role. The underlying reason for both the efficiency rational of the donor-divisions and the fear of the recipient-division could be the need for every division to run its business independently of others and the responsibility to make its own profit (see Box 1, quote 4).

Corporate Knowledge Management tries to increase the interest for cross-division knowledge exchange among the divisions and their associates. They mainly do this by demonstrating their commitment regarding such knowledge exchange activities to the division managers and scientists. Posters and brochures can for instance be found throughout the company showing slogans of the CEO, encouraging scientists and managers to have an open attitude toward each other and to share knowledge with each other, for example, 'our success in building a high performance organization will also be based on the capability of sharing and exploiting or professional knowledge better and faster than our competitors' (company brochure, Novartis, 1998).

Impact of the Determinants during the Transfer Phase

Regarding the Transfer Phase, two units within Novartis aim at stimulating the transfer of knowledge between divisions. These units are the Research Advisory Board and the Technology Advisory Board. Top managers in the field of research, development, and other disciplines of all the divisions have a seat in these boards. The goal of both boards is to launch, finance, and monitor long-term, explorative, cross-division projects. About 10 projects were initiated in 1999. All interviewees recognized these roles of the boards (see Box 2, quotes 1 and 2).

The interpersonal relations stimulated by the Boards and the exploratory nature of the projects funded and coordinated by them, matches with the

Box 2. Excerpt Interview Quotes Concerning Transfer Phase of the Cross-Division Knowledge Exchange Process.

1. A manager of Pharma for instance comments: '*The Research and Technology Advisory Boards are very useful for maintaining a long-term, innovative and inter-division view because their projects are explorative and long-term focused. The most valuable of the RAB and TAB are the people from other divisions we get to know who work on related problems as we do*'. (Interview, May 2000.)
2. An Animal Health manager pointed out: '*The Technology Advisory Board opened some doors for our division to other divisions. We met people who helped us solving problems we had*'. (Interview, May 2000.)

Source: Interviews conducted at Novartis, May–June 2000.

high need for tacit knowledge of the divisions and their focus on exploring knowledge. There seems to be a fit between the nature of knowledge in use (tacit) and the goal of the knowledge transfer activity (new competence building) on one hand and the richness of the transfer mechanism on the other hand. It should be remarked, however, that the Boards do not directly bring the divisions' operational managers and scientists together; only top management of the divisions are involved in these activities. Since 1996, Corporate Knowledge Management experiments with the possibilities the Novartis' intranet offers to transfer knowledge between 'people at the front', the scientists. One of these possibilities may be offered through the organization of web-based conferences. This is what the second case study will be about.

Impact of the Determinants during the Absorption Phase

During the final phase of the model, the transferred knowledge is being absorbed and put into use by the recipient. A difference between the Pharma and Animal Health division appeared in this phase. The interviewed managers of Pharma indicated that they actually hardly absorb knowledge from other divisions (see Box 3, quote 1). If their division engaged in

Box 3. Excerpt Interview Quotes Concerning Absorption Phase of the Cross-Division Knowledge Exchange Process.

1. As an interviewee of the Pharma division comments: 'When we join cross-division projects, we spend most of the time in providing other's with knowledge while we do not learn that much'. (Interview, May 2000.)
2. As a manager of the Animal Health division states: 'Our division tries to use as much as possible knowledge from others; that is the way we have grown'. (Interview, June 2000.)

Source: Interviews conducted at Novartis, May–June 2000.

cross-division knowledge exchange, they almost always acted as a donor and not as a recipient. The managers of the Animal Health division indicated that their division acts mostly as a knowledge recipient (see Box 3, quote 2). This corresponds with the assumption of the Senior Officer Corporate Knowledge Management that 'Animal Health is assumed to use more than the other divisions knowledge from other divisions'.

During the case study research, we were able to substantiate this observation by developing an indicator of the breadth of knowledge in a particular division. The analysis of all the product and therapeutic areas of all the divisions of Novartis shows that about 67 different scientific and technological disciplines such as Gene Technology, Microbiology, Chromatography, etc. lay at the basis of the life-science products. Some divisions use most of these disciplines as, for example, the Pharma division (about 52 of the 67), while other divisions use a limited number of these disciplines as, for example, the Animal Health (about 19). If the number of scientific and technological disciplines within a certain division are considered to be an indicator of the breadth of the knowledge base of that division, then it could be plainly stated that '67' is the maximum breadth of knowledge a division could reach through cross-division knowledge exchange activities. In that sense, Animal Health has more potential to increase its breadth of knowledge base by absorbing knowledge from other divisions than Pharma has. Fig. 2 shows graphically the number of scientific and technological disciplines in use at Pharma and Animal Health as a part of the total number of disciplines in use at Novartis.

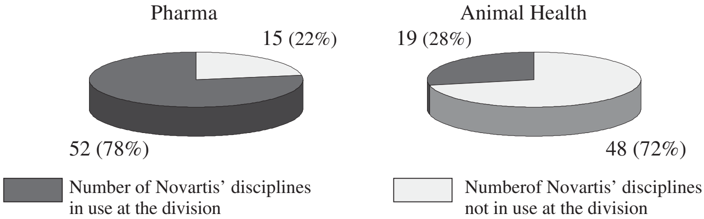

Fig. 2. Tentative Visualization of Actual and Potential Breadth of Divisions' Knowledge Base. *Source*: Novartis' intranet life-science network.

The Pharma division used in the period investigated a functional organization form. Such an organization form enables economies of scale, but the potential for scope and flexibility of knowledge exchange is rather low because of communication difficulties between the functions (Volberda, 1998, p. 138; De Boer et al., 1999). The organization form of the Animal Health division relates to the 'innovative form' (Volberda, 1998, p. 140). This organization form possesses a high potential for both exploring and exploiting knowledge. As De Boer et al. (1999, p. 384) pointed out: 'the underlying principle of the innovative form is, (…), to gather currently profitable, established product markets into a current business group and to place the development of new product-market positions into a team based innovation group. Thus the innovation group focuses on increasing the scope and flexibility of knowledge integration, while the current business exploits its efficiency of knowledge integration'.

CASE 2: DETERMINANTS OF HORIZONTAL KNOWLEDGE INTEGRATION AIMED AT COMPETENCE LEVERAGING

Introduction

Being aware of how difficult inter-division knowledge exchange takes place in the organizational setting as described in the first case, Corporate Knowledge Management experiments with possibilities to stimulate knowledge exchange throughout the company with the help of the Novartis intranet. The 'virtual forum' is an electronic platform at the intranet where group discussions and conferences take place about specific themes, problems, and products between

Box 4. Data of the Web-Enabled Conference.

- Duration: launch May 22, end June 9, 2000
- 140 participants, 33 nationalities
- 225 posted documents (comments, data, drawings, etc.)
- On average 5 visits per participant and 118 documents read per participant

scientists of Novartis from various divisions, countries, functions, and background. During the period of the research, an electronic conference was organized and moderated by Corporate Knowledge Management, the first author of this chapter and the head of a unit in the Pharma Division. This unit delivers analysis tools, databases, and information sources to the scientists of the Pharma division and is located at Basel, Switzerland. Some general information about this conference can be found in Box 4.

For two reasons it can be argued that the main aim of this knowledge-sharing event was the leveraging of existing competences. First, because the goal of the conference was, for the organization unit, to gain information and ideas coming from the Pharma scientists from all over the world to improve their products and to find new opportunities for applications of their existing products. Second, because mainly explicit knowledge was being exchanged in the form of written documents, data, drawings, tables, etc. This inspires us to contrast this case with the previous one, which was mainly about intra-corporate competence building. To facilitate this comparison, it was decided to organize the conference with the help of and along the theoretical framework as developed in this chapter. What specific managerial and organizational determinants for the phases of the knowledge exchange process were identified is shown in the following sections. The Decision and Transfer Phases are emphasized because these two phases could be finished within the limited time period of the research (from April to June 2000).

Impact of the Determinants during the Decision Phase

The level of awareness and interest determine the success of the Decision phase according to the framework in Fig. 1. Thiesse and Bach (1999) mention as the most important factor why people are reluctant or unwilling to participate in ICT-related knowledge sharing tools such as an electronic conference, a lack of trust because people don't know each other and/or the tool. To increase trust, a physical conference setting was replicated to make the conference more familiar; there was a 'bulletin board', a 'plenum room' and various 'break out rooms'. A kind of community feeling was created among the participants – who indeed did not know each other – by sending announcements and newsletters only to a selected limited number of (about 180) people, all who were familiar with the products of the group. Finally, a short video-clip where the head of the product-group presents him and the conference provided the conference with a 'friendly face'. According to Jansen and Bach (1999), a certain critical mass of participants is *continuously* needed during a web-based conference. This means that potential participants have to be made continuously aware of and interested in the conference. To achieve this, before and during the conference, several informative and motivating newsletters, signed by Pharma middle managers, were sent to the potential participants to raise their awareness and interest about the conference to motivate them to visit the conference several times and to stimulate those people who had not come yet, still to visit. Fig. 3 shows the impact of these newsletters. All substantial increases in visits and readings took place within 24 h after a newsletter had been sent.

Impact of the Determinants during the Transfer Phase

Transfer mechanisms-related factors determine the success of the second phase of the framework. Farag (1998, p. 46) mentions a *limited ability to communicate* with each other as a typical barrier for a transfer mechanism as an electronic conference. People can face difficulties in transferring knowledge via the medium because there is a limited ability to interact; they do not see and hear each other and the discussions are asynchronous. For this reason, about ten middle managers of the Pharma division were asked to act as 'challengers' during the Transfer Phase of the conference. Their task was to post some 'challenging' documents in the conference's rooms that provoke discussion and interaction among the participants. Finally, a potential lack of transfer skills to handle the medium among the participants was tackled by providing them with instructions and guidelines about how to subscribe, how to read, post, and comment on documents in the electronic conference.

Fig. 3 can also be seen as a visualization of the knowledge being transferred during the conference. The exchange of knowledge took place by

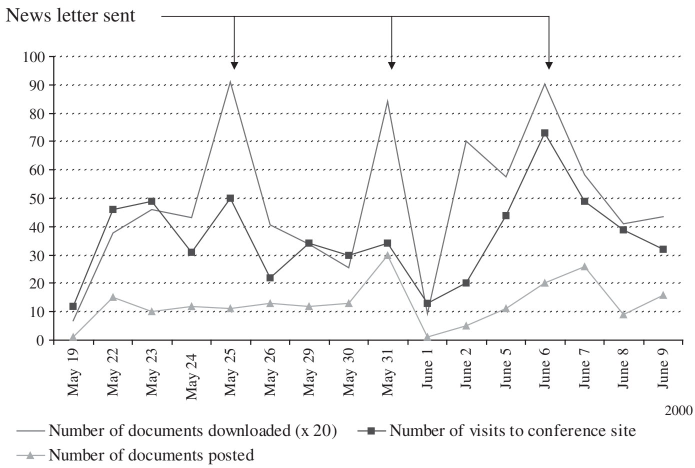

Fig. 3. Transfer of Knowledge and Impact of Newsletters during the Conference. *Source*: Corporate Knowledge Management, Novartis.

posting and subsequently downloading explicit knowledge in the form of research data, documents, and pictures. Novartis' Corporate Knowledge Management considers the conference as successful in terms of participation, interaction, and knowledge exchanged. It is decided to continue to organize and moderate web-based knowledge exchanging. Electronic conferences seem to be a very effective tool for bringing Novartis' scientists together and make them exchange and use existing knowledge.

DISCUSSION AND CONCLUSION

The goal of this chapter is to increase our insight into how a firm could change its actual mixture of competence building/leveraging processes into a more desired mixture. Furthermore, we are interested in how firms might organize to deal with the associated conflicts between these two strategic processes. To contribute to these issues, a conceptual framework is developed which considers the ability to exchange knowledge across organization units as a prerequisite for firms to achieve both goals of competence building and leveraging. The framework conceptualizes the horizontal exchange of knowledge as a process containing three phases: Decision, Transfer, and Absorption phases. It also indicates how awareness and interest toward knowledge exchange, transfer mechanisms, level of prior related knowledge, and the organization form might influence cross-unit knowledge exchange in terms of competence building and competence leveraging. Several propositions are developed to illustrate the framework. The implicit assumption in this chapter is that a firm could change its actual combination of competence building/leveraging into another, more desired mixture, by changing the identified managerial and organizational determinants of knowledge exchange in the direction as indicated by the propositions.

Two case studies are conducted: the first case is mainly about building competences by recombining knowledge from different divisions. The second case has as a main consequence the leveraging of existing competences by exchanging knowledge across divisions. We will now contrast the two cases and analyze how and to what extent they might illustrate the conceptual framework. We organized this analysis along the five propositions. It is however not our intention to actually test these propositions, as for this future – quantitative – research will be needed.

The first proposition postulates that in the Decision Phase, for competence building, qualitatively more advanced awareness facilitators are required than for competence leveraging. The only awareness facilitator present in the first case is 'The YellowPages', an intranet-based electronic database, meant to increase the ability of people to identify knowledge throughout the company. The managers argued, however, that this facilitator is not sufficient for identifying valuable knowledge across divisions when competence building is desired. Personal networks would be the preferred awareness facilitator in that case according to the interviewees. The second case, which is about competence leveraging by exchanging explicit knowledge, shows that the creation of awareness via the intranet did work sufficiently.

The second proposition advances that in the Decision Phase, stimulating the interest of the recipient unit is more important for competence building, whereas stimulating the interest of the donor unit is more important for competence leveraging. The interview results of the first case indicate that serious barriers exist with respect to the willingness of the recipient units to receive knowledge from other divisions. One of the reasons is that the recipient unit fears to lose part of its independence when receiving knowledge from other divisions. In the second case, stimulating only the donor's interest to participate in the knowledge exchange event appeared to be sufficient for the event's success.

The third proposition postulates that in the Transfer Phase, the media richness of the transfer mechanisms should be higher in the case of competence building as compared to competence leveraging. In both cases, the transfer mechanisms in use were found to be adequate. The mechanisms in the competence building case (the meetings and projects facilitated by the Research and Technology Advisory Boards) allow for more 'media richness' than the mechanism in the leveraging case (the electronic platform that allows only asynchronous interaction and the exchange of explicit knowledge).

The fourth proposition advances that in the Absorption Phase, an increase in the breadth of the knowledge base of an organization unit increases the potential for that unit to absorb knowledge from other units conducive to competence building, whereas an increase in depth is associated with competence leveraging. Management indicated that the Animal Health division is more active in absorbing knowledge from other divisions conducive to competence building than the Pharma division. This can be related to the fact that Animal Health has more opportunities to increase the breadth of its knowledge base by receiving knowledge from other divisions: only 28 percent of all scientific and technological disciplines of Novartis are in use at Animal Health, while 78 percent at Pharma.

The fifth proposition postulates that in the Absorption Phase, a matrix or innovative organization form will be most suited to absorb knowledge aimed at competence building, while the functional and divisional form are most conducive to competence leveraging. It is illustrative in the first case that Animal Health, which absorbs more knowledge than Pharma, has an innovative organization form, while Pharma has a functional form.

Complementary of Organization- and Web-Enabled Knowledge Exchange: Organizing for both Competence Building and Leveraging

At this point we did not yet address explicitly the issue of how firms might organize to deal with the associated conflicts between competence building and leveraging. With respect to this issue, the chapter at first sight seems to favor the conclusion that these processes cannot be synthesized but should rather be separated in place and/or time. This conclusion can be illustrated with the help of the identified determinants of horizontal knowledge exchange, whose attributes seem to be mutually exclusive for competence building versus leveraging (Fig. 1). Spatial separation is, for instance, illustrated in the literature on internal corporate venturing where a firm develops competence building modes and competence leveraging modes in different portions of the organization (Volberda, 1998). However, there are problems involved as well, for instance, re-assimilating or exploiting the newly created competences into the parent organization (Burgelman, 1983). In the oscillating organization, for example, separation of time takes place by alternating periods of stability with periods of renewal. However, in an environment of frequent change, the oscillating firm has the risk of becoming extremely chaotic or rigid (Volberda, 1998).

Comparing and contrasting the two case studies again might give some interesting preliminary insights into how firms could organize to deal with the tension between competence building and leveraging processes. The serious barriers to cross-division knowledge exchange as found in case 1 stimulated Corporate Knowledge Management to experiment with novel ways to facilitate the corporate-wide use of Novartis' knowledge. The web-enabled knowledge exchange event of case 2 is an example of such an experiment. In the usual organizational setting of Novartis, the awareness and interest concerning cross-division knowledge exchange opportunities is rather low among the scientists and division managers. Case 2 showed, with respect to the stimulation of awareness and interest, the importance of Novartis' division management. In their role of 'challenger', middle management linked the scientists with each other during the electronic conference and created, in that way, awareness among them with respect to opportunities to exchange knowledge with other scientists. Middle management also continuously created interest and stimulated the employees to exchange knowledge.

Within the organizational setting of Novartis, the Research and Technology Advisory Boards are the 'mechanisms' to transfer knowledge between organization divisions. The interviewees positively valued the boards, especially because tacit knowledge is being exchanged by them and they respond to the high need in the divisions to renew; to build competences. A shortcoming of these boards is that they only bring top managers of the divisions together and only increase their awareness and interest in cross-unit knowledge exchange. Case 2 shows that by the web-enabled knowledge exchange event, the employees (the scientific knowledge workers) as well become aware of and interested in knowledge exchange opportunities, and that they get the tools to exchange knowledge directly with each other.

In conclusion, it seems that 'organization-enabled' knowledge exchange (case 1) and 'web-enabled' knowledge exchange (case 2) provide two complementary contexts for horizontal knowledge exchange. While the focus of the first case is on competence building, the main consequence of the second case is the leveraging of existing competences. Furthermore, tacit knowledge was being transferred/absorbed at unit or division level in the first case, while mainly explicit knowledge was being transferred and absorbed at individual level in the second case. As such, the cases might give some preliminary insights into how firms could organize to deal with the tension between competence building and leveraging processes. Therefore, managing the determinants of horizontal knowledge exchange can contribute to a firm's strategic renewal by changing the actual mixture of competence building/leveraging processes into a more desired strategic mixture aimed at gaining and maintaining a competitive advantage in turbulent environments.

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REFERENCES

Boone, P. F. (1997). *Managing intracorporate knowledge sharing*. Ph.D. thesis of the Strategy Department of the Rotterdam School of Management, Eburon, Delft.

Burgelman, R. A. (1983). A process model of internal corporate venturing in the diversified major firm. *Administrative Science Quarterly*, *28*(2), 223–244.

Chiesa, V. (1996). Separating research from development: Evidence from the pharmaceutical industry. *European Management Journal*, *14*(6), 638–647.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*, 128–152.

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

Farag, Z. (1998). *Managerial aspects of corporate conferences in virtual space*. MBA project, University of Geneva.

Flier, B., Van den Bosch, F. A. J., & Volberda, H. W. (2003). Coevolution in the strategic renewal behaviour of British, Dutch and French financial incumbents: Interaction of environmental selection, institutional effects and managerial intentionality. *Journal of Management Studies*, *40*(8), 2163–2187.

Flier, B., Van den Bosch, F. A. J., Volberda, H. W., Carnevale, C. A., Tomkin, N., Melin, L., Quélin, B. V., & Kriger, M. P. (2001). The changing landscape of the European financial services sector. *Long Range Planning*, *34*, 179–207.

Forbes (2003). http://www.forbes.com/lists/.

Grant, R. M. (1996a). Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. *Organization Science*, *7*(4), 375–387.
Grant, R. M. (1996b). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, *17*(Winter Special Issue), 109–122.
Gupta, A. K., & Govindarajan, V. (1991). Knowledge flows and the structure of control within multinational corporations. *Academy of Management Review*, *16*(4), 768–792.
Gupta, A. K., & Govindarajan, V. (2000). Knowledge flows within multinational corporations. *Strategic Management Journal*, *21*, 473–496.
Hamel, G., & Heene, A. (1994). Introduction: Competing paradigms in strategic management. In: G. Hamel & A. Heene (Eds), *Competence-based competition* (pp. 1–10). Chichester: Wiley.
Hedlund, G. (1994). A model of knowledge management and the N-form corporation. *Strategic Management Journal*, *15*(Summer Special Issue), 73–90.
Huber, G. P. (1991). Organizational learning: The contributing processes and literatures. *Organization Science*, *2*, 88–115.
Jansen, C., & Bach, V. (1999). Smartnet als Kernstück des Intranets der Credit Suisse. In: V. Bach, P. Vogler & H. Österle (Eds), *Business knowledge management: Praxiserfahrungen mit Intranet-basierten Lösungen* (pp. 161–178). Berlin: Springer.
Kogut, B., & Zander, U. (1992). Knowledge on the firm, integration capabilities, and the replication of technology. *Organizational Science*, *3*, 383–397.
Leonard-Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. *Strategic Management Journal*, *13*, 111–125.
Levinthal, D. A., & March, J. G. (1993). The myopia of learning. *Strategic Management Journal*, *14*, 95–112.
March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, *2*(1), 71–87.
Mom, T. J. M. (2001). *Towards a framework of the determinants of horizontal intra-corporate knowledge flows*. Unpublished Master's Thesis, Erasmus University Rotterdam.
Nohria, N., & Goshal, S. (1997). *The differentiated network: Organizing multinational corporations for value creation*. San Francisco, CA: Jossey-Bass.
Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, *5*(1), 14–37.
Nonaka, I., & Takeuchi, H. (1995). *The knowledge creating company*. Oxford: Oxford University Press.
Roos, J., & Von Krogh, G. (1996). *Managing strategy processes in emergent industries: The case of media firms*. Houndsmill and London: MacMillan Press.
Sanchez, R., & Heene, A. (1996). A systems view of the firm in competence-based competition. In: R. Sanchez, A. Heene & H. Thomas (Eds), *Dynamics of competence-based competition: Theory and practice in the new strategic management* (pp. 39–62). Oxford: Elsevier Pergamon.
Sanchez, R., & Heene, A. (1997). A competence perspective on strategic learning and knowledge management. In: R. Sanchez & A. Heene (Eds), *Strategic learning and knowledge management*. Chichester: Wiley.
Sanchez, R., Heene, A., & Thomas, H. (1996). Towards the theory and practice of competence-based competition. In: R. Sanchez, A. Heene & H. Thomas (Eds), *Dynamics of competence-based competition: Theory and practice in the new strategic management* (pp. 1–38). Oxford: Elsevier Pergamon.

Sanchez, R., & Thomas, H. (1996). Strategic goals. In: R. Sanchez, A. Heene & H. Thomas (Eds), *Dynamics of competence-based competition: Theory and practice in the new strategic management* (pp. 63–84). Oxford: Elsevier Pergamon.

Stühn, C. (1999). *Der strategische Einfluss von Customization auf die Pharmazeutische Industrie*. Diplomarbeit HSG, St. Gallen.

Szulanski, G. (1996). Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal*, *17*(Winter Special Issue), 27–43.

Thiesse, F., & Bach, V. (1999). Tools und Architekturen für Business Knowledge Management. In: V. Bach, P. Vogler & H. Österle (Eds), *Business knowledge management: Praxiserfahrungen mit Intranet-basierten Lösungen* (pp. 85–115). Berlin: Springer.

Van den Bosch, F. A. J., & Van Wijk, R. A. (1999). Transition processes towards the n-form corporation: Strategic implications for knowledge flows. In: M. A. Hitt, P. G. Clifford, R. D. Nixon & K. P. Coyne (Eds), *Dynamic strategic resources*. Chichester: Wiley.

Van den Bosch, F. A. J., Van Wijk, R., & Volberda, H. W. (2003). Absorptive capacity: Antecedents, models, and outcomes. In: M. Easterby-Smith & M. A. Lyles (Eds), *Handbook of organizational learning and knowledge management* (pp. 278–301). Oxford: Blackwell.

Van den Bosch, F. A. J., Volberda, H. W., & De Boer, M. (1999). Coevolution of firm absorptive capacity and knowledge environment: Organizational forms and combinative capabilities. *Organization Science*, *10*(5), 551–568.

Van Wijk, R. A., & Van den Bosch, F. A. J. (2000). Creating the N-form corporation as a managerial competence. In: R. Sanchez & A. Heene (Eds), *Implementing competence-based strategy, advances in applied business strategy*, (Vol. 6B, pp. 199–214). Greenwich, CT: JAI Press.

Van Wijk, R. A., Van den Bosch, F. A. J., & Volberda, H. W. (2001). The impact of the depth and breadth of knowledge absorbed on levels of exploration and exploitation. Paper presented at the Academy of Management Conference, August 3–8.

Volberda, H. W. (1998). *Building the flexible firm: How to remain competitive*. Oxford: Oxford University Press.

Volberda, H. W., Baden-Fuller, C., & Van den Bosch, F. A. J. (2001). Mastering strategic renewal mobilizing renewal, journeys in multi-unit firms. *Long Range Planning*, *34*, 159–178.

Von Krogh, G., & Köhne, M. (1998). Der Wissentransfer in Unternehmen: Phasen des Wissentransfers und wichtige Einflussfactoren. *Die Unternehmung*, *52*, 235–252.

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KNOWLEDGE FLOWS BETWEEN UNITS THROUGH DIFFERENT TYPES OF INTER-UNIT LINKAGES

Annick Willem and Marc Buelens

ABSTRACT

In the strategic literature, the value of knowledge has long been discussed. It goes without saying that knowledge can be the source of competitive advantages because of its unique and sticky characteristics (Conner & Prahalad, 1996; Teece, Pisano, & Shuen, 1997). However, that advantage can be limited to a certain business unit, department or project-team (Argote & Ingram, 2000; Gupta & Govindarajan, 2000; Szulanski, 1996). To build organization-wide capabilities and competences, knowledge needs to be transferred within the organisation but this is a highly complex process (Argote & Ingram, 2000; Szulanski, 2000).

We draw on a review of the existing literature to analyse how knowledge can cross unit boundaries within larger organisations. This is to develop an analytical model of the effects of different inter-unit linkages on the sharing of knowledge. We describe the linkages between units and members of the units in terms of coordination mechanisms. Our study highlights the characteristics of each of these linkages in terms of intensity and complexity of knowledge and intensity in knowledge sharing. In addition, the role of trust is discussed. We observe that different types are associated with distinctive constraints for particular kinds of knowledge

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needs; for example, informal networks are able to deal with the need for sharing complex knowledge but do not allow enough flexibility in the knowledge-sharing possibilities.

A case study in a British multinational company in the production and retail sector seeks for empirical evidence of our assumed relationships between linkages and knowledge-sharing possibilities. The case reveals the role of informal networks, the impact of the complexity of knowledge and shared mindset. Strategic directions turned out to have a major effect on the possibilities to share knowledge. Initial initiatives in building a common language and developing a more global strategy were a leverage to knowledge sharing and the development of knowledge-integrating mechanisms.

INTRODUCTION

Undoubtedly, intangible assets, such as knowledge, have become increasingly important for companies to gain advantages on the markets (Lank, 1997; Teece, 1998). They are often considered as the only assets that can give a sustainable advantage in the market for many Western companies (De Geus, 1997; Drucker, 1993; Nonaka & Takeuchi, 1995; Quinn, 1992). Those assets are created during daily work processes and are dispersed in the organisation. We need insight into how intangible assets can be spread, copied and exploited within the organisation. Teece (1998) emphasises that knowledge by itself does not give a competitive advantage but the deployment and use of individual-created knowledge by means of physical, social and resource allocation structures to reshape this knowledge into competences on the organisational level. Furthermore, the competences need to be sustainable and dynamic to give a real competitive advantage (Fiol, 2001; Mahoney, 2001; Teece, Pisano, & Shuen, 1997; Wright, Dunford, & Snell, 2001).

The well-known definition of 'knowledge' by Nonaka and Takeuchi (1995) is often referred to in the field: ''Knowledge is a dynamic human process of justifying personal belief towards the truth (Nonaka & Takeuchi, 1995, p. 85)''. A similar definition can be found in the work of Sanchez, Heene, and Thomas (1996): ''Knowledge is the set of beliefs held by an individual about causal relationships among phenomena (p. 6)''. Other authors follow this cognitive approach (e.g. Cabrera & Allen, 1999; Davenport & Prusak, 1989; Grant, 1996a; Szulanski, 1996; Von Krogh, Roos, &

Slocum, 1994). 'Competencies' have been defined as bundles of work-related knowledge and abilities held by individuals (Wright et al., 2001) – a property of individuals that is termed *skills* in the competence vocabulary (Sanchez et al., 1996). When the term 'competencies' is used on the organisational level to a bundle of skills, resources and capabilities able to build a product or service that delivers value to the customer (Hamel & Prahalad, 1994), this ability is termed as *competence* in the competence vocabulary (Sanchez et al., 1996). Sanchez (2001) puts the stress on organisations' goal achievement in order to have a real organisational competence. A competence can then be defined as "the ability of an organisation to sustain coordinated deployments of assets and capabilities in ways that help an organisation to achieve its goals (Sanchez, 2001, p. 8)". Knowledge is thus necessary to develop competences. Sanchez and Heene (1997, p. 6) explain that "capabilities are repeatable patterns of action in the use of assets to create, produce and/or offer products to a market". Furthermore, "Assets are anything tangible or intangible used by firms to perform actions and to produce goods or services and offer these to the market (Sanchez & Mahoney, 1996, p. 7)". Knowledge is clearly an asset (Boisot, 1998; Sanchez et al., 1996; Teece, 1998). Other assets are machines, land, other fixed assets, financial means, intellectual property rights, etc. Hence, knowledge is part of assets and both are used, built and leveraged by skills, capabilities and competences.

Different scholars have focussed on one of the concepts. Wright et al. (2001) explain the relationship between strategic human resources management and several strategic literature streams, such as resource-based view on the firm, core competence, dynamic capabilities and the knowledge-based view on the firm. Their overview reveals the inter-relatedness of these disciplines and concepts. In particular, they explain that those fields need to be integrated to understand strategic capability on both the individual and organisational levels and on the level of resources and changing organisational processes.

The importance of knowledge, skills, capabilities, etc. are thoroughly discussed in the literature (Sanchez & Heene, 1997; Teece, 1998) as well as the fact that those assets need to be leveraged on the organisational level (Argote & Ingram, 2000; Szulanski, 1996; Wright et al., 2001). In addition, the interplay between structure and inter-unit communication, knowledge and information sharing has been identified in the strategy literature; among others by Ghoshal, Korine, and Szulanski (1994), Gupta and Govindarajan (2000) and Cohendet, Kern, Mehmanpazir, and Munier (1999). However, there is still a lack of understanding of human interactions as source of knowledge transfers and, hence, of building company-wide competitive advantages (Argote & Ingram, 2000; Wright et al., 2001). Moreover, the existing literature only provides a partial view on the different kinds of inter-unit coordination and linkages. For example, Gupta and Govindarajan (2000) studied the effect of formal coordination mechanisms. Ghoshal et al. (1994) also analysed the effect of formal coordination mechanisms on inter-unit information sharing. Furthermore, the work of Szulanski (2000) is interesting because it identifies a broad range of factors influencing the transfer of best practices but again only limited attention is paid to coordination mechanisms. Other partial insights can be found in the work of Hansen (1999). We intend to contribute by exploring the role of inter-unit linkages to spread knowledge throughout the organisation, taking into account the particular need for flexibility and complexity. It is our objective to study the coordination mechanisms more in depth and rely on a broad literature base covering the full range of different mechanisms from procedures to social capital. Our approach thus reflects different epistemological assumptions and disciplinary perspectives on structure and knowledge sharing; namely organisation design (Grant, 1996b; Van Den Bosch, Volberda, & De Boer, 1999), organizational network (Hansen, 1999; Nohria & Eccles, 1992), social capital (Adler & Kwon, 2002; Leana & Van Buren, 1999; Nahapiet & Ghoshal, 1998) and community of practice (Brown & Duguid, 1991; Lave & Wenger, 1991; Liedtka, 1999) perspectives. These different perspectives identify a wide range of linkages and effects on knowledge sharing, including the impact of complexity of knowledge, the distribution of inter-personal networks and the importance of shared mental models in knowledge-sharing processes. In particular, an answer to the following question is pursued: "Which kind of linkages between sub-units are best suited to spread knowledge to fit the organisation's knowledge-sharing needs?" To begin with, a classification of inter-unit linkages and coordination mechanisms follow. Then the assumed sharing and leveraging potential of those linkages are discussed. Next, a case study will provide further empirical insight. The case study is confirmatory and exploratory in nature. First, it allows us to provide evidence rejecting or supporting the effect of inter-unit linkages on knowledge sharing, which are based on the insights from the literature review. Second, it allows to reveal new insights and potential relationships between the studied concepts, advancing our understanding of the knowledge-sharing process in a multinational context. Before developing our theoretical framework, we draw the attention towards the importance of knowledge as an asset.

KNOWLEDGE AS COMPETITIVE ADVANTAGE

Although assets include a portfolio of resources, knowledge takes a special place. Knowledge is, due to its characteristics and uniqueness, a resource well fit to build 'sustainable' advantages. There are several reasons why knowledge is unique in organisations. First, every organisation possesses unique knowledge because every organisation has a unique combination of resources and people, each with their own experiences, information and personal knowledge (Tsoukas, 1996; Wathne, Roos, & Von Krogh, 1996). Furthermore, building knowledge stocks takes time and therefore cannot be copied fast enough by competitors (Dierickx & Cool, 1989). A third reason is that causal ambiguity makes it unclear which part of the knowledge stock can give an advantage (Barney, 1991). Other firms lack also the context to understand and apply these capabilities based on unique knowledge (Argote & Ingram, 2000). Consequently, knowledge is firm specific and hard to copy by other firms which makes knowledge a source for sustainable advantages (Aadne, Von Krogh, & Roos, 1996; Brown & Duguid, 1998; Gupta & Govindarajan, 2000). Moreover, protecting this knowledge to build sustainable advantages in firms is indicated as the reason of existence for firms (Gupta & Govindarajan, 2000; Liebeskind, 1996). Besides, knowledge can be more easily shared within organisations and organisations allow the use of knowledge held by others (Conner & Prahalad, 1996; Gupta & Govindarajan, 2000; Jensen & Meckling, 1992; Kogut & Zander, 1993).

All knowledge is created on an individual level but can transcend that level and become group or organisational knowledge (Argyris & Schon, 1996; Grant, 1996b; Huber, 1991; Kim, 1993; Nonaka & Takeuchi, 1995; Sanchez, 1997). Exploiting knowledge therefore requires knowledge sharing, including integrating knowledge held by a single or multiple individuals (Grant, 1996b; Van Den Bosch et al., 1999), transferring knowledge between different parties and the development of organisational knowledge (Argyris & Schon, 1996; Kim, 1993; Nelson & Winter, 1982). Argote and Ingram (2000) define knowledge transferring as "the process through which one unit is affected by the experience of another." However, sharing complex bundles of (often tacit) knowledge is a complex process. Knowledge is not only embedded in individuals but is also embedded in communities of practices with their own particular actions and mental models (Brown & Duguid, 1991; Lave & Wenger, 1991; Liedtka, 1999). Learning and knowledge sharing are situated in the community. Learning between communities is only possible when such learning is embedded in another overlapping community

(Araujo, 1998). Wright et al. (2001) refer also to the necessity to have a shared mindset in the organisation to combine the dispersed knowledge. Furthermore, Argote and Ingram (2000) explain that a successful transfer requires moving not only the knowledge but the whole context, including interactions between people, tasks and tools. Moreover, knowledge sharing is a process of combining, integrating, reconfiguring and sense-making (De Boer, Van Den Bosch, & Volberda, 1999; Grant, 1996b; Hislop, Newell, Scarbrough, & Swan, 1997). Transferring knowledge as an objectifiable package is insufficient to build skills and capabilities, because that knowledge will be difficult to use in other contexts. On the one hand the difficulty to transfer gives a protection to knowledge in organisations but on the other hand this non-transferability might give the knowledge low strategic value. Hence, the sticky, dispersed, embedded and context-related character of knowledge makes knowledge sharing highly complex (Szulanski, 1996; Tsoukas, 1996). When discussing the sharing of 'bundles' of knowledge, the complexity is further increased. Therefore, we take the complexity of knowledge into account when studying knowledge sharing.

Knowledge-sharing practices should not aim at diffusing best practices but should establish adaptable processes in order to build 'dynamic' capabilities (Fiol, 2001; Teece et al., 1997; Wright et al., 2001). Capabilities are dynamic if they refer to the ability to adapt and reconfigure knowledge following market changes (Eisenhardt & Martin, 2000; Teece et al., 1997). Hence, the level to which knowledge sharing needs to be dynamic depends on the environment. Dynamic capabilities demand adaptable structures and processes (Eisenhardt & Martin, 2000). Consequently, flexibility in knowledge sharing is required when the task environment is frequently changing – and so new knowledge or knowledge from different parts in the organisation is required (Gargiulo & Benassi, 2000) – or when existing knowledge needs to be reconfigured (Grant, 1996b). In studying knowledge sharing, the required flexibility should be incorporated. Knowledge sharing might be a burden to the construction of dynamic capabilities when this sharing results in enforcing best practices organisation-wide as fixed routines. This would not only destroy the creative diversity but can also impede further dynamism in the organisation. Attention, therefore, needs to be paid to the lessons from the learning organisation literature concerning the importance of a structure allowing learning and change (Argyris & Schon, 1996; Senge, 1994).

FOUR MAIN TYPES OF COORDINATION MECHANISMS

To combine knowledge-sharing processes embedded in daily work and interaction processes and more structural mechanisms, configurations of interactions are studied (Barley & Kunda, 2001). Every change in the nature of work will alter social networks and relationships, which in turn shape organisation structure (Barley & Kunda, 2001). Consequently, linkages between units are a useful proxy for studying the effects of structure on work practices and here in particular on knowledge sharing during those work practices. Several authors have highlighted the importance of coordination to provide communication and coordination channels between units of large organisations (Burckley & Carter, 1999; Egelhoff, 1991; Ghoshal et al., 1994; Gupta & Govindarajan, 2000; Martinez & Jarillo, 1989). We integrate different streams of literature to include a broad range of potential linkages between units. Martinez and Jarillo (1989) revealed that the evolution of research on coordination mechanisms follows the changes in management practices. Those changes, in particular making more use of informal mechanisms, are due to the changing environment. The last decade brought again new forms and new literature on the topic further emphasising the social aspect in coordinating and integrating units.

The 'nature of the relationship' between people and units determined by coordination mechanisms is important when studying implicit knowledge and knowledge-sharing processes. Hence, we choose to classify the existing coordination mechanisms for the purpose of this study according to the dimensions personal–impersonal (Adler, 1995; Nidumolu, 1996; Van De Ven, Delbecq, & Koenig, 1976) and formal–informal (Barnard, 1948; Ghoshal et al., 1994; Martinez & Jarillo, 1989). We hereby follow the classifications based on the characteristics that are most widely accepted in the literature. We synthesised the coordination mechanisms using these two dimensions in Table 1. The great majority of formal organisations uses more than one mechanism and most apply all four types (Grandori, 1997). Moreover, it is important to recognise that while specific tasks and inter-unit cooperation might be based primarily on one mechanism, these mechanisms do not operate in a discrete fashion, but are interdependent and intertwined. Thus, we consider these different mechanisms rather as characteristics of linkages between units. To simplify we labelled these types as systems, norms, formal networks and informal networks.

Table 1. The Coordination Mechanisms.

Coordination Mechanisms	Formal	Informal
Impersonal	*Systems*: Planning, procedures, manuals, standards, rules, goals, policies, schedules, hierarchical decision-making	*Norms*: Values, routines, social norms
Personal	*Formal networks*: Teams (including projects), integration roles, liaisons	*Informal networks*: Personal networking

The classic organisation design mainly emphasised the systems and formal coordination mechanisms (Galbraith, 1973; Grandori, 1997; Mintzberg, 1989; Thompson, 1967; Van De Ven et al., 1976). The systems mechanisms are plans, rules, procedures, goals, manuals, standards, goals, policies and hierarchical decision-making. Formal coordination mechanisms, also called lateral or horizontal coordination mechanisms, include teams, project groups, mutual adjustment, integration roles and coordinators. Norms is used for coordination through values, implicit routines and socialisation norms. This mechanism was already mentioned by March and Simon (1958) and later by Nelson and Winter (1982) but received new attention as coordination mechanisms in the literature on communities of practice (Brown & Duguid, 1991). The fourth category, informal networking, was developed within the network and social capital literature (Gargiulo & Benassi, 2000; Hansen, 1999; Nahapiet & Ghoshal, 1998). These are the possible ties between units in organisations, which determine what and how much information and knowledge can be exchanged (Egelhoff, 1991; Galbraith, 1973; Makhija & Ganesh, 1997; Turner & Makhija, 1999). A second influence on knowledge sharing is the fact that the linkages determine who should cooperate and interact with whom. The personal coordination mechanisms, such as teams, mutual adjustment and integrating roles, bring people with different knowledge stocks together (Grant, 1996b; Nonaka & Takeuchi, 1995; Wathne et al., 1996). Nonetheless, questions remain on the appropriate configurations of linkages to share knowledge from one unit to another in a sufficient intensive and flexible way.

Hence, our study focuses on the cooperation between two business units and the coordination mechanisms used to link them. We assume on the basis

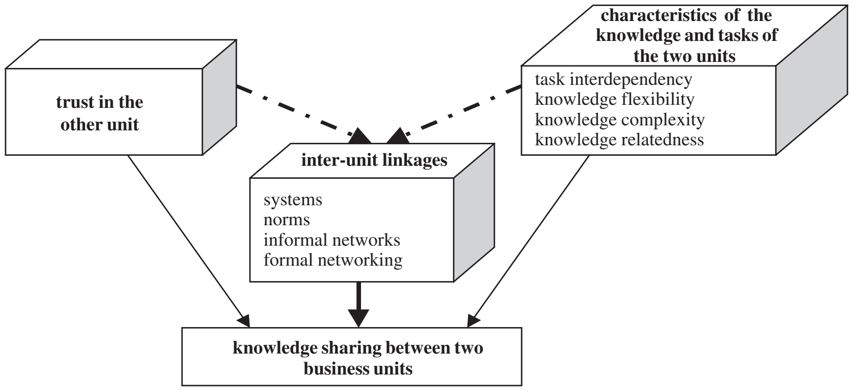

Fig. 1. Theoretical Framework of Our Study.

of the literature, which we will discuss in the next paragraphs, that knowledge sharing between units in these cooperations is also affected by the characteristics of the tasks and the knowledge in the cooperating units. Therefore, to assess how inter-unit coordination should be organised to optimise knowledge sharing, we combine the classification of coordination mechanisms with the knowledge and technology characteristics in the organisation, such as sharing needs based on interdependency, required flexibility in sharing and complexity of the knowledge. Fig. 1 displays those groups.

In addition to the mechanisms that determine the linkages and the technology characteristics; trust is another important leverage for sharing knowledge between units (Adler, 2001; Andrews & Delahaye, 2000; Newell & Swan, 2000). Trust breaks down in three dimensions (Mayer, Davis, & Schoorman, 1995; McAllister, 1995; Mishra & Spreitzer, 1998). Reliability is based on the capabilities of the other parties and the value of the knowledge. Openness is related to the will of sharing, while concern indicates a kind of helpfulness and altruistic behaviour. Those are the main building blocks of trust. Behaviour which might be (bounded) rational from an individual stance can reduce trust and hence knowledge sharing. This will be the case when personal goal seeking results in power and a politized organisation or in opportunistic behaviour (Brown & Woodland, 1999). We include those aspects in our study because of their importance and effects on knowledge sharing.

We assume a direct influence of these three groups on knowledge sharing (Fig. 1, full lines) and combined effects of trust and task characteristics with the inter-unit linkages (Fig. 1, dotted lines). In other words, the effects of the coordination mechanisms depend on the kind of tasks and knowledge in the units and the level of trust that exists among those units.

INTER-UNIT LINKAGES LEVERAGING KNOWLEDGE SHARING

Based on the work of Thompson (1967), Galbraith (1995) and Grandori (1997), it can be concluded that formal networks are more suitable than other coordination types for more intense sharing and sharing complex knowledge (Galbraith, 1995; Grant, 1996b; Van Den Bosch et al., 1999). Galbraith (1973) mentions several mechanisms, which can help to share information and knowledge. Complexity makes sharing more difficult. Only more complex coordination mechanisms, such as teams, coordinating roles and mutual adjustment, are able to cope with high levels of knowledge complexity. Hence, formal networks will be more effective in knowledge sharing. Grant (1996b) builds on the classic organisation theory literature to explain that formal and impersonal coordination is not fit for sharing tacit or complex knowledge. The systems mode of coordination, with planning, standards, etc. as coordination mechanisms allows sharing small amount of simple knowledge (Galbraith, 1973). This mode allows only more codified forms of knowledge. We can make the assumptions from the mentioned literature that higher complexity in the task and the knowledge and higher needs to share knowledge require more complex and flexible ways of coordination, such as lateral relations and teams. Hence, the use of systems mode of coordination is only suitable to share knowledge between units when knowledge-sharing need is low and knowledge is simple.

Van Den Bosch et al. (1999) use the concept absorptive capacity to evaluate the extent to which a company is able to absorb new knowledge in order to adapt to its evolving environment. They explain that certain structures and forms are better fit to allow for broader scope or more flexibility in knowledge absorption. When more flexibility is required in the tasks and in the knowledge, less systems or systematic coordination should be used. However, Van Den Bosch et al. (1999) did not find evidence in their empirical research for a relationship between system coordination and absorbing new knowledge on the organisational level. Nonetheless, there might be inflexibility in knowledge sharing 'between units', when the relation is based on programmed systems, due to unlearning (Levitt & March, 1988; Senge, 1994). This coordination mode only adapts slowly. The hierarchical aspects in this mode enforce the length of the adaptation process and might create resistance to change. The latter often occurs when such change lacks communication (Kotter, 1995). Consequently, systems are insufficient for inter-unit linkages requiring high knowledge-sharing flexibility.

The network literature provides further insight into the relationship between structure and knowledge sharing. One often mentioned classification is weak versus strong ties (Granovetter, 1973; Hansen, 1999). Hansen (1999) tested the effects of strength of ties and type of knowledge on the time used in projects to obtain the required knowledge. He found that weak ties are helpful to provide project teams with necessary knowledge but that these are insufficient when complex knowledge needs to be shared. Weak ties exist among groups who have less knowledge in common, while strong ties are existing in groups with a lot of knowledge in common, making the former suitable to share codified knowledge and the latter fit for sharing non-codified complex knowledge (Hansen, 1999). Strong ties result in a greater willingness to go through the large effort to share highly complex knowledge (Granovetter, 1973). Moreover, according to structural hole theory, tight networks hinder coordination because of the lack of autonomy of the actors in the network (Burt, 1992). Moreover, networks might be the source of power. In particular, knowledge about the network and power relationships make some people more powerful than others (Krackhardt, 1990). Gargiulo and Benassi (2000) show also that strong ties might impede the coordination of complex tasks, especially when changes in task requirements are demanded. Hence, strong informal networks between units reduce the flexibility in knowledge sharing. Thus, on the one hand, strong ties are less fit when more flexibility in knowledge sharing is required (Burt, 1992; Gargiulo & Benassi, 2000). On the other hand, the literature on organisation theory and organisational learning explains that network modes allow knowledge flexibility (Grant, 1996b; Senge, 1994; Van Den Bosch et al., 1999). There is evidence in the learning organisation literature on the importance of teams and in particular self-regulated teams to allow knowledge sharing and learning (Ayas & Foppen, 1996; Senge, 1994). However, the latter refer to 'formal' coordination mechanisms. We might therefore assume that inflexibility is especially a problem in informal network modes of inter-unit coordination. Nonetheless, such an assumption needs further study.

This is recently further emphasised by the social capital literature (Leana & Van Buren, 1999; Nahapiet & Ghoshal, 1998). However, Adler and Kwon (2002) warn us that the new concept, social capital is too broadly defined in the literature and that this capital is not all of a blessing to the company. It is, however, without doubt a good knowledge integrator (Adler & Kwon, 2002). Nevertheless, the arguments against social capital refer also to inflexibility and power. Furthermore, social networks develop sub-units in the organisation blocking information and knowledge exchange with the broader community, resulting in higher discrepancies between those subgroups of networks. Hence, knowledge might be hard to share between units when those units are not included in 'one' social network (Adler & Kwon, 2002; Coleman, 1988). Informal networks facilitate the sharing of complex bundles of knowledge when the units are taking part in one social network. Informal networks impede the sharing of complex bundles of knowledge when the units are part of two separate social networks.

Lave and Wenger (1991) emphasise that all learning is situated in communities of practice. The situational character makes it hardly possible to capture knowledge; instead knowledge is shared by storytelling and narratives (Barley & Kunda, 2001). To become a member of such a community requires learning, often by apprenticeship, and socialisation (Barley & Kunda, 2001). Learning the norms, rules and culture of the practice is very important in the learning process (Lave & Wenger, 1991). Shared mental models and norms will have a positive effect on knowledge sharing and the success and satisfaction on this sharing. Norms are also less fit when there is a high need in flexibility in knowledge sharing (Van Den Bosch et al., 1999). Walsh (1995) mentions that knowledge structures are necessary to process information and take decisions, but meanwhile these can limit the information processing of new external information and decision-making. Processing new knowledge often causes abandoning obsolete routines and mental models. In other words, unlearning is required but this needs time. Unlearning is a major limitation to knowledge sharing (Levitt & March, 1988; Von Krogh & Roos, 1996).

As already mentioned, there is a necessity for a common mindset between the units to understand each other's capabilities and being able to absorb these. Whatever linkages exist between the unit there is always a need for a minimum amount of such common (shared) knowledge, e.g. in the form of shared social identity, mental models or culture (Marengo, 1993). Differences between units should not be too large to allow a minimum common knowledge base making knowledge sharing possible. Therefore, common mindsets can be considered as a bare necessity; of which the lack would not allow any working of the four types of coordination mechanisms (Grant, 1996b; Kogut & Zander, 1996; Marengo, 1993). Consequently, mental models are integrating knowledge through developing organisational knowledge, which in turn leverages the working of systems and networks.

Furthermore, common understanding builds trust and willingness to share knowledge (Newell & Swan, 2000).

EVIDENCE FROM A LARGE MULTINATIONAL ORGANISATION

Knowledge sharing should be studied in its context including individual, unit and organisational factors and is therefore multi-level research. We need to gather data on structural factors that are unit- and organization-specific and on micro-level work practices. A case study is appropriate because it allows gathering data from different levels in the organisation (Eisenhardt, 1989; Leonard-Barton, 1990). Although field studies are not well fit for generalisation to the population, they are very well fit to improve theory or construct new theories (Emory & Cooper, 1991). Case study research has the intention to make generalisation to theoretical propositions (Yin, 1994). We mentioned that several relationships can be found in the literature but also many contradictions or vague assumptions. Our case study strategy will allow us to make these statements stronger. We want to study knowledge sharing between units in organisations but with the reservation that such sharing is embedded in a context.

A case study in a British multinational company in the production and retail sector provides empirical evidence of our assumed relationships between linkages and knowledge-sharing possibilities. This company is active in the traditional consumer goods sector. Headquarters are in the U.K. but the company operates worldwide. Overseas activities are larger than the U.K. activities. The environment of this company is stable. The company has about 12,000 employees worldwide. It is growing both through internal and external growth. The structure is a traditional, functional structure with two main groups, marketing and sales as one group and operations as another separated group. It is highly decentralised and dispersed with HR, IT, marketing and finance functions in every little unit. Before these groups were established, the company was more decentralised with 'country' companies and non-integrated pre-acquisition companies. The restructuring in several groups allowed more central control and more integration. Acquired companies are now fully integrated. However, full integration does not mean high centralisation. The company is still highly decentralised and dispersed with HR, IT, marketing and finance people in every business unit. Many efforts were taken to restructure the company into one global company. The independence of the business units is being reduced now on all levels and areas, such as freedom to determine budget, marketing strategy, HR policy, IT systems, etc. Headquarters control the business units on profits and sales and provide the units with general support but especially focussed on marketing issues. For other areas, such as HR, there are only some general rules to be followed. However, there are no consequences for business units that are not following headquarters rules.

Data were collected in the HR and marketing business units worldwide and in the IT business units within Western and Eastern Europe by means of interviews and questionnaires. We collect company documents to obtain background information on the evolution of the organisation, financial results, takeovers, products and internal structure. Yin (1994) emphasises that documents are very relevant for case studies. The documents are public-available information on websites, annual reports, brochures, marketing folders and press articles and private information consisting of internal notes and intranets. The internal notes give information on the internal structure and systems and on marketing or more strategic decisions. The next step in our data collection consisted of explorative meetings with three sponsors in the organisations. Further, we selected people for the semi-closed interviews based on their position in the organisation. In total, 20 open interviews of a half-hour each were executed with people on different levels in the organisation. In our study, the inter-unit cooperations are the interactions in which the knowledge-sharing process is embedded. Inter-unit cooperation is broadly defined as any interaction between two units to perform a specific task. Such cooperations can be of all kinds, ranging from very routine daily cooperation to an exceptional project. Therefore, we selected people who had good knowledge on the working of the organisation, the cooperations between the units internationally and who were involved in several of these cooperations or heads of business units. However, not only senior managers were interviewed, also middle and lower managers were in the position to provide us with the necessary information and allowed us to judge on cooperations and knowledge sharing on different hierarchical levels in the organisation.

All interviews were taped and fully transcribed. These were then coded based on a coding scheme with the variables and concepts from our theoretical framework. We are looking for relationships between our variables, explanations for these relationships and processes (Miles & Huberman, 1994). Patterns in the effects of each group of independent variables and in the effects of the particular case context are analysed. In such an approach, it is investigated whether predicted outcomes of a certain action can be found.

If predicted outcomes cannot be found, the expected predicted outcome can be modified and other situations or actions where the adapted predicted outcome can be assessed are sought, but still using the same variables based on the theory. This goes on for all identifiable actions or patterns. In our study, each interviewee discusses several different cooperations. We study each of the patterns in each of these cooperations to collect our evidence. However, there will be no quantification of the findings because each cooperation mentioned is unique, providing confirmation or alternative outcomes.

ANALYSIS

A knowledge manager is in place, which is also one of our sponsors in the company. She belongs to the HR department. The fact that there is a knowledge manager but located in the HR department indicates that knowledge is considered important by top management but also considered as part of HR practices. The knowledge manager is initiating different knowledge-management projects, such as building communities of practices or organising global conferences to make employees of the company meet colleagues working on the other side of the world. Those initiatives just started and the effects were yet limited at the time of data collection. In the IT and marketing departments, intercontinental sharing does not seem to be necessary. Although there are some voices saying that there is a large knowledge-sharing need, it does not seem to be a priority. Inter-functional sharing is very much limited to that what is really necessary to perform the tasks. Among most people, there is a clear understanding that practices and policies need to be more global to increase efficiency and to make use of the benefits of being a global company. Especially middle management is emphasising knowledge-sharing needs.

We will review each of the three parts of our framework, namely coordination mechanisms, the task and knowledge characteristics and trust in relation to knowledge sharing between business units.

There are hardly any *systems* applied as mechanisms for facilitating co-operation and coordination between units, except of course for some formal communications, such as newsletters, bulletin boards and roadshows to communicate the corporate strategy. One IT manager indicated "So when I say formal communication from the centre, those meetings are very much about the IT directors or the IT management team based in the U.K. that inform the rest of Europe of things that are coming up, projects, changes and initiatives." The large extent of autonomy for the business units results in inefficiencies and low enforcement of central guidelines. According to an HR manager: "The business is more like a confederation than a global business. On a day to day business, most of the people run their own show…There is a corporate global reward group, they have set some direction, which we follow as long as it is appropriate. But they do not really design it, we have to do it ourselves any way."

Although formal systems are limited, the existence of such systems seems to have a positive effect on knowledge sharing. Formal structures, such as matrix and agreements, helped communication and cooperation for instance between an HR unit from headquarters and several local HR units. Clear goal setting helped to share knowledge as well. A new global rule for knowledge sharing in HR is now established. This rule is imposing on business units that when one unit starts something new (e.g. a new assessment procedure for middle managers), existing information and initiatives on this issue in HR units worldwide need to be collected first before it is allowed to develop anything new. This is to avoid 'reinventing the wheel'. Sometimes a best practice becomes known and is shared more globally or recognised and imposed globally, such as the training manual for leadership development. A case occurred where a person asked if something existed and it did not. However, by the time they developed an own new system, the others had developed one independently as well but without communicating this to the others, although both knew about each other's intentions. There is a need for some formality in checking whether others have similar practices. Furthermore, managers of local business units have their formal contacts within headquarters to receive directions and solve problems. Such formal channels for reporting have a positive effect on knowledge sharing because these channels open possibilities for knowledge sharing. Some IT units for instance report to financial directors, what resulted in closer cooperation between finance units and IT units.

Finally, there is a huge problem of lack of knowledge in other units, other people and what is going on in the organisation. This is of course partly due to the multinational character and large size of the company, but some kind of information systems might be very helpful, such as an intranet. One of the respondents indicated that: "Knowledge sharing is not going too bad but it can be improved and we need to be more structured about it. And some knowledge sharing tools, we should look at in some stage in the future so we can improve our communication and intelligence." Hence, systems are not very important in this company and have limited effect on knowledge sharing. However, there is a need for more supportive systems to facilitate knowledge sharing (Cabrera & Cabrera, 2002). Such systems are often IT based, such as intranets and who-is-who databases (Cohendet et al., 1999; Hellström, Kerlim, & Malmquist, 2000). The usefulness of such systems for knowledge sharing is questioned in the literature because the conditions to motivate people to use the systems are often absent (Cabrera & Cabrera, 2002; Purvis, Sambamurthy, & Zmud, 2001). This problem was partially present in our study as well. On the one hand, there was a large demand for more supportive intranet-based systems and people demanding the systems did not see any problems in using them; however, on the other hand existing tools were hardly used.

Several of the theoretical assumptions are about relationships between coordination, task and knowledge characteristics and knowledge sharing. There is no evidence found that systems would only be suitable for knowledge sharing when the knowledge is only easy transferable. There is rather a general need for goal setting and rules as guidance for any cooperation and knowledge sharing whatever the knowledge transferability level. The use of systems for inter-unit cooperation is so low that it could not be a burden even when high levels of flexibility are required.

Formal networks are established by coordinators, liaisons and project groups. However, this is fairly limited. Someone mentioned that people in the local business units were surprised that there is actually someone in the headquarters coming to listen to them and who has been coordinating the business units as his or her task. People in headquarters are the coordinators for different groups in the region. They collect, filter and spread information and knowledge; as indicated by a marketing manager: "Country x ask me that they thought Spain was doing this, is that truth and then I talk to Spain to ask it and went back to that country to explain it." Sometimes their primary roles seem to be information transmitters, although this should not be the case. They are also the boundary spanners between the regions and headquarters, spokespersons for the regions at headquarters but also the 'police' controlling the enforcement of headquarters rules. They are access points, often the only ones for certain regional groups, not only for what is happening in headquarters but also for what is happening in the neighbouring business units. Communication between two business units in Europe for instance goes via headquarters, not because of the authority role of headquarters, but because there are just no horizontal communication lines established. Headquarters is clearly having a brokerage role to link business units and to have business units share more knowledge horizontally (Kostava & Roth, 2003).

There is also quite some project and cross-functional teamwork. Sometimes a person from one HR unit moves temporarily to another to learn or teach some practice or just to help in case of resource shortages. Even in the latter situation there are great opportunities to share experiences. This seems something that has been going on between the United States and the U.K. and the United States and Latin America. Within the food part of the business, cross-functional teams seemed to be necessary to enforce the role of HR and to improve cross-functional learning. HR has also several intercontinental teams working around specific HR topics. This seems to be already well established and working quite well. Middle managers are involved in several of those teams. Most formal meetings and teamwork in marketing and HR are situated on middle management level. These people are therefore most involved in knowledge-sharing projects. Within each local business unit there are also regular formal cross-functional management meetings to discuss regional issues, but these are rather high-level management meetings, involving also only a few of the top managers of the business unit. An European IT manager states that: "There are initiatives such as the global IT group, who meet every quarter or three four times a year consisting of all IT directors. There has recently been a CIO appointed for the group. He needs to draw the IT functions closer together."; indicating the formal networks on top management level within IT. However, there is a lack of teamwork at the top of the company, especially between production and sales, which is causing lack of teamwork on lower levels. We can confirm that formal networks are indeed bringing different knowledge stocks together as assumed in the literature (Boone & Van Olffen, 2000; Gold, Malhotra, & Segars, 2001; Hansen, 1999; Nonaka & Takeuchi, 1995). Knowledge sharing is somewhat forced through literally putting people together and imposing them to cooperate in a certain project or task group.

The existence of *informal networks* is extremely important for horizontal knowledge sharing, especially over the business unit borders because of insufficient systems and formal networks. Informal networks are often the only channels for knowledge sharing. The importance of informal networking is widely recognised and accepted. However, there need to be opportunities to create such networks. Job rotation is one such opportunity. An HR manager explains her informal networking: "I know a lot of the corporate team, in fact I was a HR director for corporate in my last role. I am very fortunate because I have an experience around the world, knowing a lot of people and practices helped us a lot. For example last January we had to make a performance management development workshop into the region because we did not have one, so I simply picked up the phone and I said, not only could you bring that program over but could you help us deliver it. But that was really born out of the fact that I had worked in corporate." Higher levels enforce networking on their team or at least highly encourage it. Knowing people personally seems to be necessary to be able to contact and ask for help. Otherwise the request might remain unanswered or answered somewhat slower and with less enthusiasm. It is mentioned that if you are not friends, then there needs to be a clear reason to contact each other, such as being involved in a particular project. International meetings (the global conferences) are another important source for networking. Such meetings, however, are limited in number and restricted to the higher management levels.

The dominant role of friendship and networking is especially found at the higher levels. Network contacts go beyond the pure necessity and knowledge is shared even if there is no urgent need for such sharing. This results in discovering opportunities for more cooperation. However, it is hard to keep the network going and it requires a lot of effort and time, which not everybody seems to be willing to spend. Once you are known and engaged in formal and informal networks, you get involved in knowledge sharing and projects. This leads to more workload and obligations, which have to be met in time and with quality. This is often a too heavy burden that might restrain people from being involved in those networks.

The problem with informal communication is that it is sometimes not there when it is needed or expected and sometimes it is there when not expected. Top management knows that there is some informal networking but nobody knows exactly what and where networking exists. Informal networking also differs within the organisation, e.g. in IT informal networking is more scarce. Some informal contacts in HR and marketing are extremely intensive, often even on a daily basis. The informal networks mentioned in our case study are all of the 'strong' network type.

The data revealed that informal networking was resulting in more willingness to share knowledge because the people who were able to share knowledge, able to see opportunities and believing in the benefits of networking were also engaging in the networks (Burt, 1992). Kostova and Roth (2003) mention that, although social networks are primarily established for achieving personal benefits, social networks can become public when a group of people or a unit in an organisation can tap from the resources made available through the network. In fact Kostova and Roth are referring to the networking people as a kind of boundary spanners in multinationals connecting units with headquarters. Such boundary spanners were clearly present. Informal networks arise among people who had been working together in previous jobs or projects and therefore, who had developed some related knowledge. The knowledge shared in those networks is non-codified know-how and thus more complex knowledge, which is thus in compliance with the literature.

Due to recent formal networking initiatives, regular video or phone meetings and liaison persons, there is now a greater feeling of belonging and identification with the organisation, especially among the smaller business units. Mental barriers are not a huge problem considering the national differences and geographical dispersion. One major problem, however, is that everybody just thinks he or she is the best and therefore cannot learn from others. Sharing knowledge, speaking to each other, trying to learn from each other is not part of the culture. It should be a natural habit but it is not. The differences in *mental models* are very high between sales and production, which were in the past forced to just look to their own part making them drift away from each other. They are so different that forcing these parts to work together would not really result in knowledge sharing. The activities are of course very different but where differences in activities are not an obstacle, mental models are. An HR manager pointed to the fact that ‘‘People have been thinking in silo's and were not encouraged to broad their horizons and think about other issues. If we expect the organisation to think more innovative and globally, what are we as HR doing?'' People are too much oriented towards their own problems. The fact that different products are sold in different regions and not so much globally enforces the local mindsets. Local differences are often used only as an excuse for not sharing while it is more thinking differently than being different.

In Latin America, due to similarities in local cultures and languages, the mental models are more coherent and integration of the different Latin American countries seems to work more smoothly. The same goes for units in Spain but not so much for Spanish units with the rest of the world. Spain has a long history and tradition, long before the current company was established. Spanish business is taken over by the British. There is a feeling in the Spanish units of not being recognised and being disrespected by headquarters. Hence, business units do not share a similar mindset unless they are historically and culturally close related, such as Latin American countries. The openness to other cultures and approaches is rather small. National differences are mentioned as absolute barriers to knowledge sharing. Another HR manager said: ‘‘People sometimes say: because there are so many countries who are very different in terms of languages and cultures, the argument is than that you cannot share.'' Clearly, the absence of company-wide shared values, e.g. through company-wide identification (Pratt & Foreman, 2000), involves here the risk of subgroups with their own values and norms, which are filtering knowledge from outside the group.

The *interdependency* between the units is small. There were promises made for sharing knowledge or better cooperation. However, they were not always met, due to time problems or other priorities but also due to the low interdependency resulting in a low need for sharing. People from headquarters complain that local units do not communicate but they do not really need to communicate because they work perfectly independent. "There is not anything pan-European that they are working on together," said one of the interviewee. There are hardly any necessary cooperations within one functional area (i.e. HR France and HR Croatia) but there are of course cooperations between functions for providing services, such as HR and IT services. However, these operational cooperations are not an important basis for knowledge sharing. Cooperations between similar functional units often exist to share practices and not because there is a real need to cooperate. However, business units mostly do not even know each other's activities so they do not know if there are similarities and opportunities for knowledge sharing or cooperation. This was the case even for business units within the U.K. An IT manager emphasised: "It was decided to keep coordination to things where there was a clear benefit to standardise it, but in fact each region could have dealt alone with its IT."

With respect to knowledge transferability, nobody mentioned that knowledge is too tacit to be shared or understood. However, it is emphasised that there should be more codification. An HR manager noted that: "*We need to learn more about each others projects before we start a project, for example, if we close down a factory in one part of the world, it would be good if that process would be documented, the process, what they learnt from it etc, if that was in a database then we could learn from that and avoid the same mistakes. Now we don't know*." Much process knowledge could be codified and stored for later use by other people in the organisation. It would also help to retain knowledge when people leave the organisation. There are currently hardly any steps taken to avoid knowledge loss due to employee turnover. There exist a lot of data in information systems, such as files, databases, lotus notes supported systems. However, these data are very dispersed, non-standardised and unstructured. To find information in those systems takes a long time. As a result people tend to ask for information personally instead of using information available on the network. Another HR manager points to the fact that the real problem is about not knowing who has the knowledge; "we have a lot of people who are really good facilitators and who do a lot of delivery of soft skills training to their management team, you ask for their information and they are more than happy to share it. You have to know who to talk to, who does it and who does it well. We should somehow capture that. It is very much about knowing who and whether it is actually someone who talks to you."

Good practices can be transferred but the implementation requires sometimes the help of someone experienced in the practice. Know-how and specific skills should be shared more, but again the first step is to know who has those skills before one can appeal to these skills. One method used to transfer implicit knowledge is job rotation. This has been one of the best methods to transfer implicit knowledge and to build informal networks causing further sharing of implicit knowledge. Temporal employee shifts were successful in sharing knowledge and especially in implementing certain practices.

Flexibility in knowledge sharing is especially important for certain units, such as the marketing innovation unit. In general, the need for flexibility in knowledge sharing is not that high because there is not a high need for sharing in the first place. However, knowledge sharing is not structured so there is a need for flexibility at this moment. Especially for sharing best practices there is a need to seek as broadly as possible and to contact new units with whom there had not been any cooperation before. Change is, however, a problem in the organisation because of the long history of stability and lack of change projects and experience in change. Someone even mentioned that it looked like the organisation was asleep. An interviewee stated that: "*It is not a pro-active company at all and very much doing the necessary day to day things.*" Now there are somewhat more changes and people are somewhat more stretched but it is just the beginning.

The most striking difference in *related knowledge* is between sales and production; an intended gap, which is now being questioned again. Some task differences between those two groups are that high that cooperation is almost impossible or at least would not be beneficial. In some cases the work is country-specific and hence, task differences are to some extent unavoidable. A balance needs to be found between standardisation and local differences. An IT manager states it as follows: "The current project will at least standardise so that the underlining is clean and accurate and correct. Than we can move to the other level to provide the good knowledge." We already mentioned that being different is an often (mis)used excuse for why knowledge sharing is not happening enough. It is also not only about worldviews but also about other activities, approaches and alternative ways of doing business. In the marketing units, they started with sharing and integrating strategies and plans. This should at least provide a basis for the next step, namely sharing more knowledge. The marketing managers formulated this: "Because of the shared marketing strategy and plans, we now have the opportunity and motivation to share best practices, if you have different strategies and advertising campaign then there is no need that markets like France speaks with Italy. But now we are in the position to share best practices.'' The differences in activities, operations and languages are indeed major obstacles to knowledge sharing. Finally, also an HR manager adds: ''Within our business unit there is a lot more autonomy than there really ought to be, what leads to inefficiency because it leads to duplication, we do not have standard systems, standard ways of measuring, which is lunacy because we cannot compare, that is bound to have an impact on the services we are providing to our customers.''

Often the differences between local markets are mentioned to motivate why there is no need or reason to share knowledge. The operational basis even wonders if this will add value at all. There is a demand for information on the strategy and on what is going on, just to see the big picture but not for work practices since all units are used to work in a self-sufficient way. Standardisation achieved through sharing knowledge and practices, can create a common knowledge base, which is very helpful for reaching high levels of knowledge integration in multinational firms (Argyres, 1995). However, such higher integration was feared because it might increase centralisation of decision-making too much in the hands of headquarters. This threat was a stimulus for business units to hoard their knowledge in our case study (Burckley & Carter, 1999). Our study clearly faced a dilemma. On the one hand, knowledge sharing could result in large gains through mobilising knowledge assets worldwide (Almeida, Song, & Grant, 2002; Burckley & Carter, 1999; Kogut & Zander, 1993; Kostava & Roth, 2003). On the other, more knowledge sharing is very time consuming considering the geographical dispersion, national differences and different mental models and is viewed with anxiety and scepticism (Gupta & Govindarajan, 2000; Tsai, 2002). Consequently, the role and position headquarters is taking in the knowledge-sharing processes between business units is determining among others the choice between knowledge hoarding or sharing.

There is a problem with trusting each other's reliability as well. An HR interviewed mentioned that: ''Three years ago, HR had no credibility in this organisation. They were not respected, they were not viewed as knowledge experts.'' Knowledge coming from others is not always found trustworthy or considered to be of good quality or at least not considered as being of better quality than the own knowledge. Some even openly criticise the competences of others, stating that they are incompetent and therefore that any cooperation is useless. Another HR interviewed states: ''I am not saying that all my colleagues are incompetent, if you are continuously invited in meetings and asked there to do things that make no sense at all for the business, because they are designed by people we do not understand what the hell the business is about than this will generate resistance.'' So there clearly is a problem of arrogance and different mindsets. There might be a real problem of incompetence as well but that is not proven. It might be very much a problem of disliking different views. There is also no culture in which one learns from others' stories. They do not seem to be interested in others' experiences. Such individualistic culture can result in low trust. Openness towards other units is low, although once information is asked for, it is provided. Trust, similarity in experiences and mental models are clearly related. In the project groups intended to achieve some change or knowledge sharing, only people are selected who are open and willing to cooperate. We have mentioned in the theoretical part that there are three generic types of trust, namely will-based trust, ability-based trust and attitude-based trust (Maguire, Phillips, & Hardy, 2001; Mayer et al., 1995; McAllister, 1995; Mishra & Spreitzer, 1998; Newell & Swan, 2000; Shapiro, Sheppard, & Cheraskin, 1992). Whatever the type or source of trust, it is assumed that the effect on knowledge sharing will be positive, which is confirmed by our data. Nonetheless, our data showed that especially ability-based trust is very important and was unfortunately missing in several cooperations. Particularly in a multinational context, the lack of trusting others' competencies is an important issue (Gupta & Govindarajan, 2000).

Trust is not a problem in the informal networks. It is the people who already trust the other units who are getting involved in networking. Thus, trust and formal networking are mutually enhancing each other in their role in stimulating knowledge sharing. The same goes for shared values and trust.

Most people claimed that the organisation is also not *political*. An HR manager reveals that: ''*The organisation is not a political organisation, they just work all individual, they are not aware of each other but they are somewhat open*.'' Only a few indications of political processes, influence and power use or abuse are found. The fact that knowledge is not shared enough is more related to not having the culture of sharing than of keeping control on knowledge or using knowledge as power. However, liaisons between regions and headquarters are often the spokespersons for the local business units at headquarters and the defenders of the local units' goals and wishes. Hence, those liaisons have clearly a lot of power. The IT manager said: "I travel around to see how things are going but I come back here as a champion for the Nordic region in the headquarters, I am their voice here, and it is a matter of having more influence.'' We also see that the local business units have huge differences in size and importance. Larger business units are more influential on headquarters strategy and can more easily protect their interests.

On the other hand, there is also some influence of headquarters towards the local business units in order to make them comply with headquarters' regulations and advises. The historical autonomy of the local units often results in non-compliance with headquarters rules and hence, some influence is necessary to make them comply. There are no punishments or incentives available for this, so convincing and power use are required. A member of HR headquarters states: "To get things done on an international basis, you have to influence people and get them to accept it. If it does not fit their local needs it is not gonna happen." The people in the informal networks were clearly more knowledgeable than others and more able to use power over others (Burt, 1992; Krackhardt, 1990). Those people are thus in a better position to share knowledge and have a lot of opportunities to share knowledge through their network, however, the sharing is often covering a hidden agenda.

There is no real *knowledge protection* but more a lack of unawareness on the importance of knowledge sharing and also a lack of knowing who has what knowledge. Even the central teams in headquarters do not know enough about what happens in the regions, although they know a lot more than people in the local business units. Often knowledge that is shared between two parties is not further spread, even when it turns out to be very useful knowledge for the whole organisation. Even when central teams play a liaison or knowledge broker role, knowledge remains in the business units at the top level, or the knowledge or information is just pushed back towards the business units without filtering or transforming. There is dissatisfaction about the lack of spontaneous sharing and the lack of capturing and keeping track of processes and capabilities for later use. Although, mostly when people are asked to share their knowledge, this is done with pleasure. Only one case mentions a situation where clear resistance occurred.

Success is the success of your business unit and not of the whole organisation. Such competition is stimulated by the strong decentralisation. Competition between units was (not any more) used before by top management at headquarters to increase the performance and results of the business units. A manager from operations indicated: "They compete actually quite heavily with each other and in that environment that is driven from the top, it is very difficult to implant knowledge management systems, the environment and culture that you need for knowledge management, you need an environment where people are interested in sharing but also go with a strong external view, and that is not the case."

DISCUSSION AND CONCLUSIONS

We reviewed the classic literature on organisation theory and design and the literature on learning organisation, networking and communities of practice to discover the role of coordination mechanisms in facilitating the sharing of knowledge between units. With this chapter we seek to contribute to this body of work by developing further the relationship between structure and knowledge. In particular, we intended to give an overview of the basic coordination modes and their potential to enhance knowledge sharing between units. This is proposed as an attempt to review the classic organisation design principles and to provide some insights into how capabilities between units in large organisations can be spread.

However, not all the theoretical insights could be confirmed in the empirical study, such as the negative effect of systems. In the interviews it is even mentioned that there are not enough systems to support sharing. We also found some evidence of the role of trust (especially competence-based trust), networking, complexity of knowledge and the importance of a strategy supporting knowledge integration. The lack of the latter results in low shared norms, formal coordination mechanisms and different worldviews making the development of trust low. It might even result in the subjective feeling that knowledge is complex and hard to share. There are also indications that informal networks are not the solution to improve knowledge sharing because of the very situational character of these networks.

The knowledge in this organisation cannot be considered as very complex. Most of it in all three areas can easily be explained, written down and transferred but the lack of coordination mechanisms to share knowledge and different mental models, unrelated tasks and lack of trust result in a feeling of complexity. Knowledge sharing is considered as difficult and complex because it is that hard in the current organisational settings and not because it is in fact tacit or difficult to codify or to teach it to others. Hence, when such feeling of complexity occurred, it resulted in low knowledge sharing.

Haas and Hansen (2001) study the negative effects of knowledge sharing empirically in a consulting firm. The disadvantages of knowledge sharing lack theoretical and empirical studies. Haas and Hansen strongly emphasise the need for research, addressing the issue of whether knowledge sharing between units actually benefits the performance of these units. They analysed several types of costs related to knowledge sharing and found that experienced teams – who did not really need other teams' knowledge – were performing less well rather than better due to knowledge sharing. Those teams incurred unnecessary search costs and even used knowledge from other units while having the knowledge already in their team. The shared knowledge replaced their own valid knowledge and actually reduced creativity in searching and combining knowledge to create new and better insights (Haas & Hansen, 2001). Although our discussion did not emphasise the negative effects of knowledge sharing, this is implicit in our focus on optimal knowledge sharing. Moreover, respondents indicated that they fear ineffective and inefficient knowledge sharing. Throughout this chapter it was suggested that linkages should be adapted to the sharing needs of the organisation in terms of intensity, complexity and flexibility. In our study, the low level of coordination mechanisms of all kind fit with the low task interdependency but leave clearly a huge efficiency potential aside by not sharing enough good practices. There is a fit between the strategy of independence and decentralisation for the units, the task characteristics, coordination mechanisms and actual knowledge-sharing level. The dissatisfaction with knowledge sharing can especially be found in the awareness that sharing more could reduce costs. The organisation is not global but international and local. Knowledge is situated on the national level. However, up to now, negative effects of sharing knowledge could not be detected. This is because knowledge sharing is still on a low level. Nevertheless, there is hesitation by the units to engage in more knowledge sharing because they fear the disadvantages of sharing good practices. Some knowledge could become the dominant knowledge in the organisation without guarantee that this is the best knowledge and especially not the best for each particular situation.

It is clear that this organisation is not able to build organization-wide competences because it did not yet come to a sufficient level of sharing knowledge. To achieve this a change in strategy is required and more formal coordination mechanisms must be developed. Another mentioned problem is that top management does not show exemplary behaviour when it comes to knowledge sharing. Especially middle management is convinced of the need for sharing but not the top level or operational level. Even on the top level we see a lack of competence-based trust. One of the major steps to be taken in this organisation is to increase this kind of trust.

Further research has of course to be done in empirical testing in other sectors, departments and countries to avoid potential effects of the particular company settings. Nevertheless, typical characteristics of this multinational, such as the decentralisation versus centralisation and standardisation trade-off, are common to many large multinationals. The influence of the local culture increased the low competence-based trust, again a typical multinational firm problem. The selected organisation is not atypical but can serve as a 'normal' multinational in the retail sector. Hence, our findings extend the particular case study. The fact that we did not find significant differences in the relationships and values of the variables among the different continents indicates that the findings might not be country- or region-specific. However, including more organisations in the study would help to assure this.

Few indications of the role of strategy in knowledge sharing can be found in the literature. The role of middle management has been emphasised by Nonaka and Takeuchi (1995), which turned out to be very important in our study as well. Further research should, therefore, include the role of middle and top management and strategy support (Earl, 2001; Zack, 1999). Furthermore, the ambiguous role of informal networking needs more exploration. A lack of systems was frequently mentioned during the interviews and has, like informal networks, an ambiguous role depending on the contextual settings. This aspect seems hard to prove (cf. also the study on absorptive capacity of Van Den Bosch et al., 1999). In the study of knowledge sharing the willingness to accept others' knowledge and to unlearn ones own knowledge is extremely important. Our study showed that the acceptance of company-wide competences and using other's knowledge was resisted. The need for flexibility and building dynamic capabilities is not that large. Hence, simple copying practices would not immediately endanger the dynamism of the organisation. Nevertheless, the current intentions of the organisation to copy and standardise more might be a danger to the development of sustainable and dynamic long-term capabilities. Further theoretical insight into the connection between change and knowledge management is required. Furthermore, the traditional strategic choice of multinationals between globalisation or acting local as multinational is very relevant as well to develop the right knowledge management strategy. Finally, our study indicated the importance of the task characteristics. All knowledge and knowledge sharing are embedded in daily practices. The characteristics of those 'daily practices' might be more influential than has been suggested in the literature, except in the work of Lam (1997).

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REFERENCES

Aadne, J. H., Von Krogh, G., & Roos, J. (1996). Representationism: The traditional approach to cooperative strategies. In: G. Von Krogh & J. Roos (Eds), *Managing knowledge: Perspectives on cooperation and competition* (pp. 9–31). London: Sage Publications.

Adler, P. S. (1995). Interdepartmental interdependence and coordination: The case of the design/manufacturing interface. *Organization Science*, *6*(2), 147–167.

Adler, P. S. (2001). Market, hierarchy, and trust: The knowledge economy and the future of capitalism. *Organization Science*, *12*(4), 215–234.

Adler, P. S., & Kwon, S.-W. (2002). Social capital: Prospects for a new concept. *Academy of Management Review*, *27*(1), 17–40.

Almeida, P., Song, J., & Grant, R. M. (2002). Are firms superior to alliances and markets? an empirical test of cross-border knowledge building. *Organization Science*, *13*(2), 147–161.

Andrews, K., & Delahaye, B. L. (2000). Influences on knowledge processes in organizational learning: The psychosocial filter. *Journal of Management Studies*, *73*(6), 797–810.

Araujo, L. (1998). Knowing and learning as networking. *Management Learning*, *29*(3), 317–336.

Argote, L., & Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. *Organizational Behavior and Human Decision Processes*, *82*(1), 150–169.

Argyres, N. (1995). Technology strategy, governance structure and interdivisional coordination. *Journal of Economic Behavior and Organization*, *28*, 337–358.

Argyris, C., & Schon, D. A. (1996). *Organizational learning II*. Reading, MA: Addison-Wesley Publishing Company.

Ayas, K., & Foppen, J. W. (1996). *The learning organization and organization learning*. Rotterdam: Rotterdam School of Management.

Barley, S. R., & Kunda, G. (2001). Bringing work back in. *Organization Science*, *12*(1), 76–95.

Barnard, C. I. (1948). *The functions of the executive*. Cambridge, MA: Harvard University Press.

Barney, J. B. (1991). Firm resources and sustained competitive advantages. *Journal of Management*, *17*(1), 99–120.

Boisot, M. (1998). *Knowledge assets*. Oxford: Oxford University Press.

Boone, C., & Van Olffen, W. (2000). *Psychological team diversity and strategy implication: Theoretical considerations and an empirical study*. Maastricht: Maastricht University.

Brown, B. R., & Woodland, M. J. (1999). Managing knowledge wisely: A case study in organisational behaviour. *Journal of Applied Management Studies*, *8*(2), 175–198.

Brown, J. S., & Duguid, P. (1991). Organizational learning and communities-of-practice: Towards a unified view of working, learning and innovation. *Organization Science*, *2*, 40–57.

Brown, J. S., & Duguid, P. (1998). Organizing knowledge. *California Management Review*, *40*(3), 90–111.

Burckley, P. J., & Carter, M. J. (1999). Managing cross-border complementary knowledge. *International Studies of Management and Organisation*, *29*(1), 80–104.

Burt, R. S. (1992). *Structural holes: The social structure of competition*. Cambridge, MA: Harvard University Press.

Cabrera, A. & Allen, D. B. (1999). *The architecture of organizational cognition*. Paper presented at the academy of management, Chicago.

Cabrera, A., & Cabrera, E. (2002). Knowledge-sharing dilemmas. *Organization Studies*, *23*(5), 687–710.

Cohendet, P., Kern, F., Mehmanpazir, B., & Munier, F. (1999). Knowledge coordination, competence creation and integrated networks in globalised firms. *Cambridge Journal of Economics*, *23*, 225–241.

Coleman, J. S. (1988). Social capital in the creation of human capital. *American Journal of Sociology*, *94*, 95–120.

Conner, K. R., & Prahalad, C. K. (1996). A resource-based theory of the firm: Knowledge versus opportunism. *Organization Science*, *7*(5), 477–501.

Davenport, T. H., & Prusak, L. (1989). *Working knowledge*. Boston, MA: Harvard Business School Press.

De Boer, M., Van Den Bosch, F. A. J., & Volberda, H. W. (1999). Managing organizational knowledge integration in the emerging multimedia complex. *Journal of Management Studies*, *36*(3), 379–398.

De Geus, A. (1997). *The living company*. London: Nicholas Brealey Publishing.

Dierickx, I., & Cool, K. (1989). Asset stock accumulation and sustainability of competitive advantage. *Management Science*, *35*(12), 1504–1511.

Drucker, P. F. (1993). *Managing for the future*. London: Butterworth-Heinemann.

Earl, M. (2001). Knowledge management strategies: Towards a taxonomy. *Journal of Management Information Systems*, *18*(1), 215–233.

Egelhoff, W. G. (1991). Information-processing theory and the multinational enterprise. *Journal of International Business Studies*, *22*(Third Quarter), 341–367.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, *14*(4), 532–550.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, *21*, 1105–1121.

Emory, W. C., & Cooper, D. R. (1991). *Business research methods* (4th ed.). Homewood: Irwin.

Fiol, M. C. (2001). Revisiting an identity-based view of sustainable competitive advantage. *Journal of Management*, *27*, 691–699.

Galbraith, J. R. (1973). *Designing complex organizations*. Reading, MA: Addison-Wesley Publishing Company.

Galbraith, J. R. (1995). *Designing organizations* (1st ed.). San Francisco, CA: Jossey-Bass Publisher.

Gargiulo, M., & Benassi, M. (2000). Trapped in your own net? Network cohesion, structural holes, and the adaptation of social capital. *Organization Science*, *11*(2), 183–196.

Ghoshal, S., Korine, H., & Szulanski, G. (1994). Interunit communication in multinational corporations. *Management Science*, *40*(1), 96–110.

Gold, A. H., Malhotra, A., & Segars, A. H. (2001). Knowledge management: An organizational capabilities perspective. *Journal of Management Information Systems*, *18*(1), 185–214.

Grandori, A. (1997). An organizational assessment of interfirm coordination modes. *Organization Studies*, *18*(6), 897–925.

Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, *6*, 1360–1380.

Grant, R. M. (1996a). Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. *Organization Science*, *7*(4), 375–387.

Grant, R. M. (1996b). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, *17*(Winter Special), 109–122.

Gupta, A. K., & Govindarajan, V. (2000). Knowledge flows within multinational corporations. *Strategic Management Journal*, *21*, 473–496.

Haas, M. R. & Hansen, M. T. (2001, August). *When using knowledge can hurt performance: An empirical test of competitive bidding in the management consulting industry*. Paper presented at the AOM, Washington.

Hamel, G., & Prahalad, C. K. (1994). *Competing for the future* (1st ed.). Boston, MA: Harvard Business School Press.

Hansen, M. T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly*, *44*, 82–111.

Hellström, T., Kerlim, P., & Malmquist, U. (2000). Knowledge and competence management at Ericsson: Decentralization and organizational fit. *Journal of Knowledge Management*, *4*(2), 99–110.

Hislop, D., Newell, S., Scarbrough, H., & Swan, J. (1997). Innovation and networks: Linking diffusion and implementation. *International Journal of Innovation Management*, *1*(4), 427–448.

Huber, G. (1991). Organizational learning: The contributing processes and the literature. *Organization Science*, *2*(1), 88–115.

Jensen, M., & Meckling, W. (1992). Specific and general knowledge, and organizational structure. In: L. Werin & H. Wijkander (Eds), *Contract economics* (pp. 251–274). Oxford: Basil Blackwell.

Kim, D. H. (1993). The link between individual and organizational learning. *Sloan Management Review*, *35*(1), 37–50.

Kogut, B., & Zander, U. (1993). Knowledge of the firm and the evolutionary theory of the multinational corporation. *Journal of International Business Studies*, *24*(4), 625–645.

Kogut, B., & Zander, U. (1996). What firms do? Coordination, identity, and learning. *Organization Science*, *7*(5), 502–518.

Kostova, T., & Roth, K. (2003). Social capital in multinational corporations and a micro-macro model of its formation. *Academy of Management Review*, *28*(2), 297–318.

Kotter, J. (1995). Leading change: Why transformation effort fail. *Harvard Business Review*, *73*, 59–67.

Krackhardt, D. (1990). Assessing the political landscape: Structure, cognition, and power in organizations. *Administrative Science Quarterly*, *35*, 342–369.

Lam, A. (1997). Embedded firms, embedded knowledge: Problems of collaboration and knowledge transfer in global cooperative ventures. *Organization Studies*, *18*(6), 973–996.

Lank, E. (1997). Leveraging invisible assets: The human factor. *Long Range Planning*, *30*(3), 406–412.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Leana, C. R., & Van Buren, H. J. (1999). Organizational social capital and employment practices. *Academy of Management Review*, *24*(3), 538–555.

Leonard-Barton, D. (1990). A dual methodology for case studies: Synergistics use of a longitudinal single site with replicated multiple sites. *Organization Science*, *1*(3), 248–266.

Levitt, B., & March, J. (1988). Organizational learning. *Annual Review Sociology*, *14*, 319–340.

Liebeskind, J. P. (1996). Knowledge, strategy, and the theory of the firm. *Strategic Management Journal*, *17*(Winter Special), 93–107.

Liedtka, J. (1999). Linking competitive advantage with communities of practice. *Journal of Management Inquiry*, *8*(1), 5–16.

Maguire, S., Phillips, N., & Hardy, C. (2001). When 'silence = death', keep talking: Trust, control and the discursive construction of identity in the Canadian HIV/AIDS treatment domain. *Organization Studies*, *22*(2), 285–310.

Mahoney, J. T. (2001). A resource-based theory of sustainable rents. *Journal of Management*, *27*, 651–660.

Makhija, M. V., & Ganesh, U. (1997). The relationship between control and partner learning in learning-related joint-ventures. *Organization Science*, *8*(5), 508–527.

March, R. M., & Simon, H. A. (1958). *Organizations*. New York: Wiley International.

Marengo, L. (1993). Knowledge distribution and coordination in organizations: On some social aspects of the exploitation vs exploration trade-off. *Revue Internationale De Systémique*, *7*(5), 553–571.

Martinez, J. I., & Jarillo, J. C. (1989). The evolution of research on coordination mechanisms in multinational corporations. *Journal of International Business Studies*, *20*(3), 489–514.

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. *Academy of Management Journal*, *20*, 709–734.

McAllister, D. J. (1995). Affect- and cognition-based trust as foundations for interpersonal cooperation in organizations. *Academy of Management Journal*, *38*(1), 24–59.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousands Oaks, CA: Sage Publications.

Mintzberg, H. (1989). *Mintzberg on management – inside our strange world of organizations* (1st ed.). New York: The Free Press.

Mishra, A. K., & Spreitzer, G. M. (1998). Explaining how survivors respond to downsizing: The roles of trust, empowerment, justice and work redesign. *Academy of Management Review*, *23*(3), 567–588.

Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital, and the organizational advantage. *Academy of Management Review*, *23*(2), 242–266.

Nelson, R. R., & Winter, S. G. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Harvard University Press.

Newell, S., & Swan, J. (2000). Trust and inter-organizational networking. *Human Relations*, *53*(10), 1287–1327.

Nidumolu, S. R. (1996). A comparison of the structural contingency and risk-based perspectives on coordination in software-development projects. *Journal of Information Systems*, *13*(2), 77–113.

Nohria, N., & Eccles, R. G. (1992). *Networks and organizations*. Boston, MA: Harvard Business School Press.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company*. Oxford: Oxford University Press.

Pratt, M. G., & Foreman, P. O. (2000). Classifying managerial responses to multiple organizational identities. *Academy of Management Review*, *25*(1), 18–42.

Purvis, R. L., Sambamurthy, V., & Zmud, R. W. (2001). The assimilation of knowledge platforms in organizations: An empirical investigation. *Organization Science*, *12*(2), 117–135.

Quinn, J. B. (1992). *Intelligent enterprise: A knowledge and service based paradigm for industry*. New York: Free Press.

Sanchez, R. (1997). Managing articulated knowledge in competence-based competition. In: R. Sanchez & A. Heene (Eds), *Strategic learning and knowledge management* (pp. 163–187). New York: Wiley.

Sanchez, R. (2001). The dynamic capabilities school: Strategy as a collective learning process to develop distinctive competences. In: H. W. Volberda & T. Elfring (Eds), *Rethinking strategy* (pp. 143–157). London: Sage Publications.

Sanchez, R., & Heene, A. (1997). A competence perspective on strategic learning and knowledge management. In: R. Sanchez & A. Heene (Eds), *Strategic learning and knowledge management* (pp. 3–18). New York: Wiley.

Sanchez, R., Heene, A., & Thomas, H. (1996). Introduction: Towards the theory and practice of competence-based competition. In: R. Sanchez, A. Heene, & H. Thomas (Eds), *Dynamics of competence-based competition: Theory and practice in the new strategic management* (1st ed., p. 403). Oxford: Pergamon.

Sanchez, R., & Mahoney, J. T. (1996). Modularity, flexibility, and knowledge management in product and organization design. *Strategic Management Journal*, *17*(Winter Special Issue), 63–76.

Senge, P. M. (1994). *The fifth discipline: The art and practice of the learning organization* (1st ed). New York: Currency Doubleday.

Shapiro, D., Sheppard, B., & Cheraskin, L. (1992). Business on a handshake. *Negotiation Journal*, *8*(4), 365–367.

Szulanski, G. (1996). Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal*, *17*(Winter Special Issue), 27–43.

Szulanski, G. (2000). The process of knowledge transfer: A diachronic analysis of stickiness. *Organizational Behavior and Human Decision Processes*, *82*(1), 9–27.

Teece, D. F., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*, 509–533.

Teece, D. J. (1998). Capturing value from knowledge assets: The new economy, markets for know-how, and intangible assets. *California Management Review*, *40*(3), 55–79.

Thompson, J. D. (1967). *Organizations in action*. New York: McGraw-Hill.

Tsai, W. (2002). Social structure of "competition" within a multinunit organization: Coordination, competition, and interorganizational knowledge sharing. *Organization Science*, *13*(2), 179–190.

Tsoukas, H. (1996). The firm as a distributed knowledge system: A constructionist approach. *Strategic Management Journal*, *17*(Winter Special), 11–25.

Turner, K. & Makhija, M. V. (1999, October). *The relationship between organizational control systems and a firm's management of knowledge and capabilities*. Paper presented at the SMS, Berlin.

Van De Ven, A. H., Delbecq, A. L., & Koenig, R. (1976). Determinants of coordination modes within organizations. *American Sociological Review*, *41*(April), 322–338.

Van Den Bosch, F. A. J., Volberda, H. W., & De Boer, M. (1999). Coevolution of firm absorptive capacity and knowledge environment: Organizational forms and combinative capabilities. *Organization Science*, *10*(5), 551–568.

Von Krogh, G., & Roos, J. (1996). Imitation of knowledge: A sociology of knowledge perspective. In: G. Von Krogh & J. Roos (Eds), *Managing knowledge: Perspectives on cooperation and competition* (pp. 32–54). London: Sage Publications.

Von Krogh, G., Roos, J., & Slocum, K. (1994). An essay on corporate epistemology. *Strategic Management Journal*, *15*, 53–71.

Walsh, J. P. (1995). Managerial and organizational cognition: Notes from a trip down memory lane. *Organization Science*, *6*(3), 280–321.

Wathne, K., Roos, J., & Von Krogh, G. (1996). Towards a theory of knowledge transfer in a cooperative context. In: G. Von Krogh & J. Roos (Eds), *Managing knowledge: Perspectives on cooperation and competition* (pp. 55–81). London: Sage Publications.

Wright, P. M., Dunford, B. B., & Snell, S. A. (2001). Human resources and the resource based view of the firm. *Journal of Management*, *27*, 701–721.

Yin, R. K. (1994). *Case study research: Design and methods*. Thousand Oaks, CA: Sage.

Zack, M. H. (1999). Developing a knowledge strategy. *California Management Review*, *41*(3), 125–145.

PART III:
LEARNING WHILE DEVELOPING NEW PRODUCTS

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ORGANIZATIONAL LEARNING IN PROJECT-BASED ORGANIZATIONS: THE CASE OF NEW PRODUCT DEVELOPMENT PROJECTS

Laurent Bourgeon and Jean-Claude Tarondeau

ABSTRACT

The aim of this research is to point out organizations' learning abilities with respect to their structure. The empirical analysis deals with R&D units in which the project-based structure has supplanted functional structure. The conditions for organizational learning during new product development projects (NPDPs) seem to be linked to the organizational structure adopted by the firm to manage this activity. It appears that a project-based organization promotes organizational learning during NPDPs as a result of the autonomy conferred on project teams. Project-based organization contributes to establishing favorable conditions for organizational learning during projects.

INTRODUCTION

Some organizations learn better than others and exploit the knowledge that they generate in a more effective way than others. Learning organizations

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strive to succeed in these two sometimes contradictory dimensions. Functional structures were conceived to concentrate and develop expertise in a functional domain. These are structures based on specialized knowledge that facilitate an organization's development and accumulation of new knowledge. However, they are accused of withholding knowledge and of closing down the environment for learning. Multi-divisional organizations assimilate information from the environment better but ineffectively share their strategic assets.

In project-based organizations, part of the activity of the firm is carried out through temporary organizational units: the projects. The development of this type of organizational structure can be explained through the resource-based view of the firm (Rumelt, Schendel, & Teece, 1991). This mode of organizing has processes as the basic unit, i.e. a package of resources and competences specific to the company. A project-based organization is more likely to apply learning by interaction between individuals or groups endowed with specialized knowledge (Tarondeau & Wright, 1995) and seems the best adapted to knowledge-based strategies (Lorino, 1995).

However, a project is a temporary process, and upon completion of the project's objective (new product development, for instance), the temporary organizational unit is dissolved and the project-actors move on to new projects or move back to their original functional department or to their previous duties (DeFillippi, 2002; DeFillippi & Arthur, 1998; Hobbay, 2000). Their ephemeral quality and their focus on limited objectives have raised doubts about the capacity of project-based organizations to store the new knowledge developed in action, and to transfer this knowledge to other projects or organizational units.

The aim of this research is to highlight the learning capacity of organizations in relation to their organizational structure. An empirical analysis was carried out on R&D units in which the project-based organization tends to supplant functional organization. The results of this analysis provide support to the characterization that the project-based organizations have better learning capacities than functional organizations.

LEARNING ORGANIZATIONS

From Taylor and Fayol to Aoki, companies have organized themselves to exploit knowledge resources. In the following discussion, we review forms of organization in the context of their learning and knowledge environments.

The Taylorian Vision of the Organization

The Taylorian vision of the organization rests on certain assumptions regarding the distribution and accumulation of knowledge. The sources of knowledge are localized in the leaders' or specialists' brains who must pave the way for this knowledge to be passed on in conditions where it will be applied to perfection. The rules, specifications and formal procedures, and systems of reward and punishment are conceived as a means of transmitting this knowledge and ensuring behavioral conformity. Structured by knowledge, the Taylorian organization restricts non-controllable learning, which is considered by upper management as a source of uncertainty or even failure. The individual then seems to be controlled by a brain other than his own. Obviously, the model, presented here in a caricatured way, has never worked in such a mechanistic way (De Terssac, 1992). This model prevailed, however, during the greater part of the 20th century until it was called into question as a result of economic reasons and new concepts of the role of individuals in the organization.

Functional and Multi-Divisional Organizations

The functional and multi-divisional organizations were conceived to improve performance in complex and interdependent activities in which the division of labor determines the relationship between individuals and the group. Industrial concerns at the beginning of the 20th century favored the development of specialized resources and grouped individuals by functional area to implement homogeneous or related knowledge. The individual's role became limited to routine, repetitive operations. Although this form of organization initially led to increased productivity, as the environment became more turbulent and complex the negative consequences were revealed. Specialization engenders rigidity, and since a specialized individual possesses strictly necessary and sufficient skills to carry out a particular operation, this individual is maladjusted for the new context as products change and techniques evolve.

Specialization may also become an exclusionary factor in a particular knowledge domain. In functional structures, clannish and corporatist behavior often unites the holders of specialized knowledge. Interfaces between functions become the basis of confrontation between specialists (e.g. marketing against logistics) and the source of numerous problems (delays and errors in delivery). Decisions are made to achieve local objectives without taking into account their effects on the whole organization. Information from the environment does not cross the borders between functions, and the contribution of each function to value creation is obscured. Thus, specialization is a major factor contributing to narrow-mindedness (McCann & Galbraith, 1981).

Multi-divisional structures superimpose a level consisting of strategic activities onto the functional structures. All other things being equal, there is less potential for learning from interaction among specialists than in the functional structures. The company perceives the various environments in which it is evolving and defines its behavior to adapt itself to each of them. The decisions made are intended to maximize the interest of every division that is a multi-functional entity. But this adaptation is limited by the difficulties of arbitration between divisions for the allocation and transfer of strategic assets which creates rigidity.

The Emergence and Attributes of Learning Organizations

The emergence of learning organizations is due to economic and human factors including growth of variety and complexity, reduction in the lifespan of strategic activities and products, development of technologies reducing the importance of direct work in production, and increases in customer and consumer aspirations. Learning organizations are often referred to as flexible organizations, since they are capable of perceiving these environmental changes and of transforming to adapt to them. This kind of organization "combines efficient local activities with the efficient activities of the whole group" (Veltz & Zarifian, 1994), prioritizing its strategy over that of any division or function. It requires a dynamic environment conducive to increased communication and interaction supported by well-integrated technical systems. The learning organization is conceived to stimulate individual learning and to encourage the pooling of individual knowledge so that the organization can serve as a receptacle for that knowledge as well as organize its deployment.

The attributes of the learning organization most often mentioned are flexibility, openness, autonomy, and the capacity of integration (Garvin, 1993). In learning organizations, the leaders are designers, trainers, teachers, and senior servants who contribute to the forming of a shared vision of the firm and its future and to the construction of a common ambition (Hamel & Prahalad, 1993).

A flexible organization may assume a variety of states or potential configurations. In the sociology of work, such as the research of the Tavistok Institute, a flexible organization is characterized by highly qualified and versatile staff, a weak formalization of rules and procedures, and the intensive use of lateral communication to resolve problems. More recently, research on quality management and the reduction in the R&D cycle has evaluated the flexible organization in autonomous multi-functional groups and noted a good adaptability to non-anticipated events (Wheelwright & Clark, 1992).

The multi-functional group is the basic organizational unit of the flexible organization and is characterized by over-capacity or non-exploited skills, which allow the group to adapt quickly and effectively to unforeseen events. This over-capacity is also referred to as organizational slack (Cyert & March, 1963). Over-capacity makes the flexibility of an organization expensive and is only justified when faced with uncertainty (Moisdon & Weil, 1992).

The numerous redundancies present in learning organizations are sources of flexibility and the means of developing collective knowledge. This characteristic is observable in many Japanese companies (Imai, Nonaka, & Takeuchi, 1985; Nonaka, 1990), in which product development teams partly overlap or are even put in competition on identical projects. Individuals in the organizations change functions to develop a vision of the firm incorporating different perspectives. The totality of organizational information, except for individual files, is available to all and sundry (Nonaka, 1991). The boundaries between functions, services, or projects are either reduced or suppressed. Members of the organization are invited to maintain relations based on listening, dialog, and constructive criticism (Garvin, 1993). Numerous other examples of learning companies can be found in management texts (Adler & Cole, 1993; Leonard-Barton, 1992).

ORGANIZATIONAL LEARNING IN PROJECT-BASED ORGANIZATIONS

An organizational structure defined as a set of projects aims to counter the exclusionary tendencies apparent in firms structured according to specialized knowledge domains and to encourage strong relations between each of the components of the firm as well as between the firm and its environment. A project structure imposes contact and coordination between different knowledge areas and the "in action" development of competences.

This conception of an organization finds its source in the psychological theories of the plan of action (Weick, 1991). "Analysing organizations as activity systems avoids the conception of knowledge as independent from actors, as an objective resource like any other; nor is knowledge conceived independently from action, a product of discourse and interpersonal communication alone" (Blackler, 1993). These researchers claim that knowledge, in particular expertise or competences, builds itself up during the plan of action.

Neutralizing an environmental threat or exploiting an environmental opportunity requires the implementation of a more or less complex chain of action or application of processes. These processes are sometimes repetitive and stable. Other times, however, they are exceptional and then take the form of projects. A project combines multiple resources, capacities, and competences to produce a result or output having value for an external client.

The focus of a project-based organization is what the internal or external client wants. Which functional departments are involved is not as important as the level of cooperation and coherence among them to achieve the desired goal. Such an organizational structure then naturally engenders learning and synergy, breaking down the boundaries between traditional functional territories. The value received by the client is not just the sum of the successive efforts of individual functional managers involved in the process, but the result of the quality of the integration obtained between the activities carried out by the various functions.

Research Hypothesis

We propose that companies that opt for a project-based organization for their new product development activity are characterized by better learning conditions than companies that opt for a functional or matrix organization of this activity.

We chose to study new product development, since this activity concerns all the functions of a company and presents a fairly non-repetitive character with regard to operational processes. In addition, the development of new products, which by definition has a voluntarily limited duration and cost and establishes a limited organizational space, allows for experiments on a reduced scale in terms of time, space, and cost to the company to test the validity of emerging hypotheses. NPDPs test a company's capacity to manage cross-functional activities and can be used as tools to strengthen the relationships between functions while ensuring the improvement of each function's expertise (Leonard-Barton, 1992).

METHODOLOGY AND DATA ANALYSIS METHOD

To test this research hypothesis, a survey was conducted with the heads of Research and Development of 264 French industrial companies.[1]

An identification tool of the organizational structure of the NPDPs implemented in the company, based on the work of Larson and Gobeli (1988), was developed and a measurement method of learning conditions during these projects was derived from the work of Shrivastava (1983) and Purser, Pasmore, and Tenkasi (1992).

Organizational Structure Variables

The identification of the organizational structure of the NPDPs is based on the typology developed by Larson and Gobeli (1988), who distinguished several types of project structures according to the following criteria:

- The authority and responsibility of the project director for completing the project;
- The authority of functional managers over their specific segments of the project;
- The responsibility of functional managers for their specific segments of the project;
- The autonomy from their functional hierarchy of all functional personnel assigned to the project.

We used these criteria as variables and added two variables of our own:

- The hierarchical reattachment of the project director;
- The dedication of the project-actors throughout the duration of the project (i.e. the assignment of functional personnel to the project on a full-time basis) and the implementation of a project platform (i.e. specific location for the project).

This last variable takes into account the temporal and spatial organization of the NPDPs.

Organizational Learning Variables

The collective learning developed during the R&D projects is measured through the conditions, the implementation of which comes under the competence and responsibility of the project manager, and that make the project a participative learning system (Shrivastava, 1983).

Based on the research work of Shrivastava (1983) and of Purser et al. (1992) propose the concept of barriers to the development of knowledge, the confirmed existence of which reveals a failure in the implementation of the conditions for an effective participative learning system within the project. We used this operational research as a basis for constructing a tool for measuring collective learning conditions during NPDPs. The variables listed in Table 1 express conditions unfavorable to learning during NPDPs.

Other Variables

Other variables included in the questionnaire sent to the R&D directors of the companies in the sample and those intended to describe the activity of new product development in the company. The first of these variables is the organizational mode (functional, matrix, and horizontal) of NPDPs as described by the R&D director. The other descriptive variables concern the

Table 1. Variables for Measuring Achieved Learning during NPDPs.

1	Absence of knowledge at the disposal of the project team.
2	Poor use of available knowledge by the project team.
3	Absence of knowledge-sharing within the project.
4	Lack of cooperation.
5	Language barriers between the project-actors.
6	Involuntary setting aside of actors.
7	Non-relevant involvement of actors.
8	Lack of planning.
9	Unrealistic deadlines.
10	Divergent values possessed by the project-actors.
11	Absence of informal non-programed meetings to address problems encountered during the project.
12	Formal and scheduled meetings.
13	Neglecting internal consultation.
14	Neglecting external consultation.
15	Process of political type decision.
16	Interdisciplinary competition.
17	The absence of overall and shared understanding of the project objectives.

Adapted from Purser et al. (1992).

Table 2. Descriptive Variables of New Product Development Activity.

1	The announced organizational structure of NPDPs.
2	Size of the company.
3	Industry.
4	Implementation date of the "announced" organizational structure.
5	Number of projects in the development phase.
6	Average number of projects managed by the company.
7	Average budget for projects managed by the company.
8	Average duration of projects managed by the company.
9	Existence, within the company, of a project management charter.
10	Existence, within the company, of an integrated information system.
11	Setting up by the company of procedures for the systematic recording of the results of the experiments.
12	Systematic updating of the design guides.
13	The logic of constitution of the project teams preferred by the company.

characteristics of the company (sector of activity, size) and the NPDPs in the company (number, average budget, average duration, and average staffing), as well as the means and practices implemented to manage these projects and their staff (staffing approach of the project teams, the project management charter, the integrated information system, the database recording procedures, updating design guides). The variables used to describe the development activity for a company's new products are presented in Table 2.

Data Analysis Procedure

A three-stage data analysis procedure was carried out (see Fig. 1). In the first stage, a factor analysis was used to reduce the number of variables characterizing each phenomenon (i.e. the organizational structure of NPDPs and the conditions of organizational learning during the projects). The main dimensions of these two phenomena were thus identified. In the second stage, a cluster analysis was carried out to identify and assess the underlying group structure of the sample firms in relation to each phenomenon. Finally, in the third stage, the membership group of the companies based on the organizational learning conditions were processed through a discriminant analysis to explain this membership by way of variables retained a priori for their theoretical explanatory power.

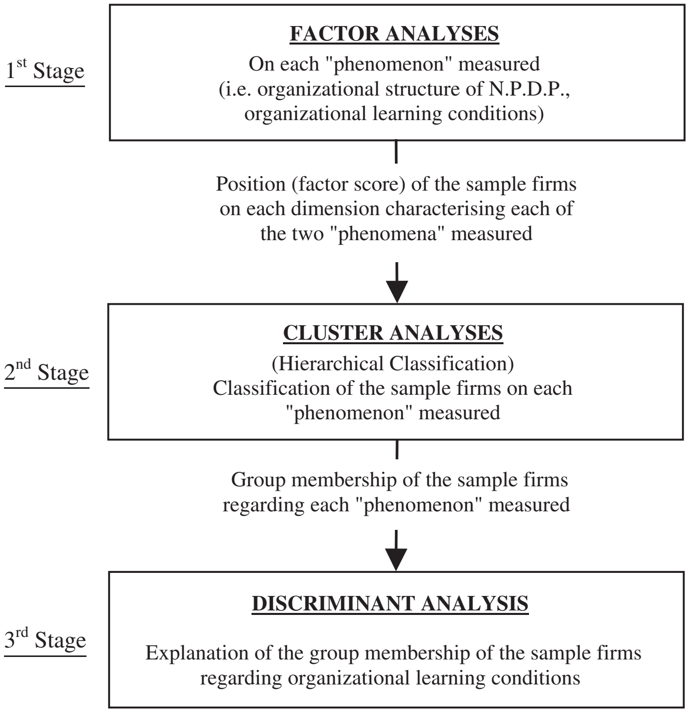

Fig. 1. Data Analysis Process.

PRESENTATION AND DISCUSSION OF THE RESULTS

The results of the data analysis are presented following the three successive stages of the data analysis method.

Main Dimensions of NPDPs

Organizational Structure

The aim of this first factor analysis is to determine which of the organizational structure variables are the main dimensions of the organizational structure of NPDPs. The application of Kaiser's criterion (eigenvalue > 1) led to the retention of three factors.

The first factor characterizes the organization of NPDPs as established by the authority and responsibility of the project director. This dimension contrasts companies in which the project director alone has authority over the project (without sharing it with functional managers) and assumes all the responsibility for the completion of the project with companies in which the project director shares authority and responsibility with functional managers.

The spatial and temporal unity of the projects in the company constitutes the second dimension of the organizational structure of NPDPs. This factor sets companies characterized by the setting up of project platforms and the dedication of project-actors for the duration of the projects against companies that do not grant a spatial–temporal organizational dimension to their NPDPs. In other words, this factor compares companies that confer a specific organizational unity (both spatial and temporal) on the projects to companies in which the projects have to fit somehow into their existing structures.

The third factor contrasts companies in which project-actors depend, from a hierarchical point of view, only on the project director with companies in which project-actors depend on the hierarchy of the functional department from which they themselves come. In the first case, hierarchical attachment of the project-actors with the project director confers a relative autonomy on the project vis-à-vis the structure of the company. This degree of autonomy constitutes the third dimension that characterizes the organizational structure of NPDPs.

To summarize, the results of the factor analysis carried out on the data in relation to the organizational structure of NPDPs in the firms studied revealed the three main dimensions characterizing this phenomenon:

1. The authority and responsibility of the project director,
2. The spatial and temporal unity of the projects,
3. The autonomy of the project team.

It is on the basis of the respective positions (factor scores) of the sample's companies on these three dimensions that the organizational structure characterizing their NPDPs is highlighted in the second stage of the data analysis.

Organizational Learning

The factor analysis carried out on the data in relation to organizational learning highlighted the main learning dimensions characterizing this phenomenon. The application of Kaiser's criterion (eigenvalue > 1) led to the retention of five factors. To facilitate the interpretation of the retained factors, a Varimax-type rotation was carried out to maximize the correlation coefficients of the most correlated variable with these factors.

The first factor contrasts companies with frequent meetings during NPDPs, problems such as the involvement of non-relevant actors, unrealistic deadlines, a lack of economic planning and of cooperation among the project-actors, and divergent values possessed by the project-actors to the companies that rarely face these types of problems. This first learning dimension of NPDPs refers to the cohesion of the project team. The team's cohesion can be defined here as the bond between the members of the team and as the commitment to the objective of the project (Carless & De Paola, 2000).

The second factor compares the companies frequently confronted with issues that lead to difficulties for the project team in using available knowledge and in the political decision-making process, to companies where these factors are rarely a problem. The learning dimension, corresponding to this factor, is the involvement of the project team in error detection and correction processes during the project.

The third factor points out the companies engaged in projects where oversights in preliminary consultations with internal or external actors are a frequent problem bearing on decisions about the progress of the projects, as well as the companies that do not experience these difficulties. This third learning dimension of the learning conditions in the NPDPs corresponds to the setting up of a participative management mode within the project.

The fourth factor distinguishes companies in which there is an absence of knowledge sharing among the project team's members and where there are language barriers among them, from companies which are rarely confronted with these type of problems in their NPDPs. This factor embodies the dimension of knowledge sharing in the NPDPs.

Finally, the fifth and last factor sets the companies in which the problems emerging throughout the projects are addressed during scheduled meetings that punctuate the progress of the project, against the companies in which this type of problem is addressed during non-programed, informal meetings, which are held as necessary and where all the project-actors with knowledge useful for these meetings are present. The learning dimension characterizing this factor axis is the adaptative treatment of the problems inherent to the projects.

So, the five main dimensions of organizational learning conditions in NPDPs highlighted by this factor analysis are:

1. Cohesion of the project teams,
2. Involvement of the project teams in error detection and correction processes,

3. The implementation of a participative management mode,
4. Knowledge sharing among the project members,
5. The adaptative treatment of the problems inherent to the projects led by the firm.

Arising from this factor analysis, the sample companies can be grasped according to their respective positions (factor scores) on the main dimensions (factor axis) of learning conditions during NPDPs, and it is on the basis of these factor scores that the companies are classified into different homogeneous groups according to the more or less favorable character of the learning conditions during the projects.

Project-Based Organization and Favorable Conditions for Organizational Learning During NPDPs

The first cluster analysis (hierarchical classification) classifies the sample companies according to the organizational structure of their NPDPs as defined by their respective positions on each of the retained dimensions. Taking into account the announced organizational structure, the time elapsed between the implementation of this organization in the firm, and the date of the survey makes up an element of explanation for the possible reclassification of a company implied by the cluster analysis.

An initial division into three groups – functional, matrix, and project-based organization – engenders a major reclassification of the sample companies according to the reported organization mode: more than two-thirds of the sample companies (71.06%) are reclassified. This reclassification is particularly important (82.97%) for the companies for which the organizational structure announced is of the matrix type.

The extent of the reclassification has two main explanations: first, it is due to the newness of the implementation of the reported mode; second, it is related to the fact that the matrix organizational structure covered different organizational realities.

Larson and Gobeli (1988), whose work served as a basis for the development of the identification tool for the organizational structure used here, highlighted the three different types of matrix organization: the "functional" matrix organization, the "balanced" matrix organization, and the "project-oriented" matrix organization. This diversity of the matrix structures, not represented in the survey for the sake of simplicity, explains the important representation of this type of organizational structure in the sample

(58.02%) as well as the importance of the reclassification carried out on the announced modes due to the heterogeneity of the real situations grouped together under the matrix rubric.

So, a partition into two groups[2] within the same hierarchical classification was preferred. The first group consists of the companies with a functional structure characterized by the very weak responsibility and authority of the project directors as well as a weak organizational unity conferred on the projects. The second group comprises those companies having adopted a project-based organization characterized by strong authority and responsibility of the project directors and a significant organizational unity granted to the projects themselves (cf. Fig. 2).

Even if the main point of the division into two groups rests on the discriminating power of the first dimension (i.e. the authority and responsibility of the project manager), the choice of retaining this division aims to maintain the relevance of the announced organizational mode rather than searching for a more refined classification into three groups.

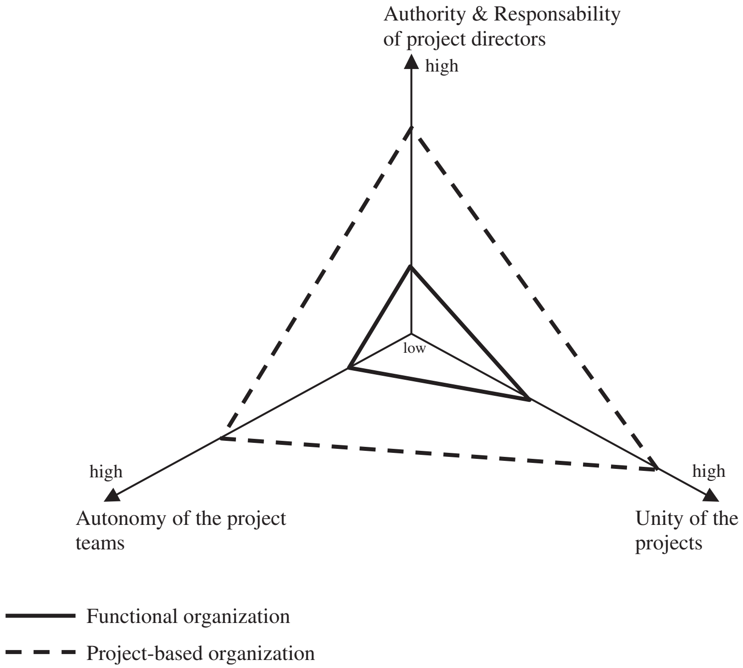

Fig. 2. Dimensions of Project-Based Organization.

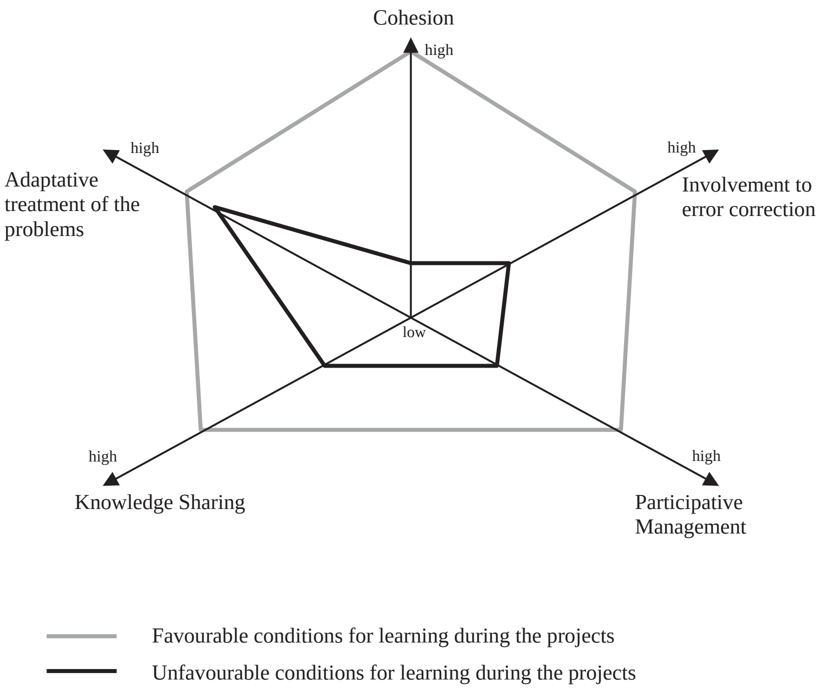

Fig. 3. Dimensions of Organizational Learning Conditions.

The objective of the second cluster analysis (hierarchical classification) is to establish homogeneous groups of the sample companies as distinct as possible from their respective positions on the five dimensions characterizing organizational learning during the NPDPs.

The first group of companies was characterized by negative average positions on each of these five dimensions (cf. Fig. 3). In other words, the companies accumulated the identified conditions as being unfavorable conditions for organizational learning during the NPDPs.

As for the second group of companies, they presented positive average positions on each of the learning dimensions. This group of companies gathers together the learning conditions during the NPDPs they lead.

Explanatory Factors for Learning Conditions during NPDPs

The implementation of the discriminant analysis is aimed at highlighting the explanatory elements in the sample companies' membership of the groups

Table 3. Explicative Variables Retained a priori.

1	Number of projects in development phase led by the company (NPR)
2	Average staffing of NPDPs led by the company (EPR)
3	Average budget for the NPDPs led by the company (BPR)
4	Average duration of the NPDPs led by the company (DPR)
5	Organizational structure of the NPDPs managed by the company (GORG)
6	Existence, within the company, of a project management charter (CGP)
7	Existence, within the company, of an integrated information system (SII)
8	Implementation, by the company, of procedures of systematic recording of the results of the experiments carried out during the projects in databases (EXP)
9	Systematic updating of the design guides at the end of project (GCO)
10	The project teams' staffing approach implemented by the company (CEP)

arising from the cluster analysis processed on the main dimensions of the learning conditions during NPDPs.

The explained variable (i.e. dependant variable) is the more or less favorable character of the learning conditions during the projects carried out by these companies. The explicative variables (i.e. independant variables), a priori retained[3] (cf. Table 3), are relative to the characteristics of the projects led by the companies (number, average budget, average duration, and average staffing), to the organizational structure of these projects (measured organizational mode) such as managerial practices (the staffing approach of the project teams, the existence within the firm of a project management charter, the implementation of an integrated information system, the use of systematic recording procedures of experimentation results in databases, and practices of updating design guides).

Among the variables a priori retained, few of them seem to significantly distinguish the companies characterized by favorable learning conditions during the NPDPs from those encountering unfavorable learning conditions (see the appendix): the staffing approach of project teams, the organizational structure of NPDPs, the implementation within the company of an integrated information system, the implementation of recording procedures of the results of the experiments carried out during the projects, and the average duration and budget of the projects.[4]

First, two variables that characterize NPDPs, the average duration and the average budget of the projects, appear as being discriminant learning conditions during the projects and take on average values significantly higher for the companies in which the projects are experiencing favorable learning conditions.[5] The average budget and the average duration of the projects associated with the existence of favorable learning conditions are greater than for those companies with unfavorable learning conditions. But if the duration of the projects seemed to contribute to the emergence of favorable learning conditions during the projects, beyond that, it is the permanence of the presence of the project-actors within the projects that plays a critical role. In this perspective, it seems paramount to avoid the turnover of project-actors by paying particular attention to their recruitment when the project team is constituted and, similarly, to appoint the team members for the whole project duration insofar as there is available staff in the company.

In addition, the companies with favorable learning conditions have implemented an integrated information system accessible to all the project-actors; this system is effective for nearly half of them (48.8% number observed superior to the theoretical number with a 1% risk of error). This information system is accompanied by the implementation of systematic recording procedures, using databases, of the results of the experiments carried out during the projects in more than two-thirds of these companies (67.29%). Otherwise, the implementation of an integrated information system is only effective in less than a third of the companies encountering unfavorable learning conditions and the systematic recording procedures are not effective in 45% of them. The first two identified factors are the existence of an integrated information system accessible to all the project-actors and the setting up of procedures for systematic recording in databases of the results of experiments carried out during the projects. This tool and the procedures which accompany it, by providing access to information learned during previous projects, enhance organizational learning during new projects led by the company.

Finally, the organizational structure of NPDPs and the logic underlying the staffing of the project teams appear to be discriminant variables for learning conditions during NPDPs. Therefore, the companies for which NPDPs are characterized by favorable learning conditions seem to mainly favor (58.54%) a staffing approach on the basis of individuals having participated in an isolated way in various projects led by the firm, but having never had the occasion to work together within the framework of a project.

So the logic underlying the staffing of project teams in the company seems to play a determining role in the more or less favorable character of the learning conditions during the projects. The logic of staffing the project teams aiming to insure the rotation of functional actors in the various projects led by the firm participates in the realization of favorable learning conditions during NPDPs. Inversely, a staffing logic consisting of the reappointment of teams having already proven themselves in the management of previous projects – a logic being likely to produce what Leonard and Strauss (1997) called "comfortable clone" – seems to be concomitant with unfavorable learning conditions. Moreover, this staffing approach of project teams appears to be a distinctive characteristic (8.39% risk of error, χ^2 probability test) of companies having adopted a project-based organization (60.53% of these implemented this approach, whereas 37.21% of the companies were organized by functions).

Moreover, the more or less favorable character of the learning conditions during the projects led by the company seems connected to the organizational structure of NPDPs. Therefore, confirming the hypothesis of this research, it seems that a project-based organization, because of the autonomy that it confers on the project teams, contributes to the realization of favorable learning conditions during the projects.

Throughout this study of R&D activity, it has been shown that the companies having opted for a project-based organization of this activity appeared as having more capacities for using knowledge and developing learning. This research design necessitates the development of an identification tool for the organization mode of NPDPs to be set up in the company as well as a tool to measure the occurrence of favorable learning conditions. Beyond the inherent limits in a survey in which only the R&D directors were questioned, it is doubtless that the operational definition adopted for the concept of learning which constitutes the main limit of this research.

Nevertheless, this research has confirmed the validity of the motivations behind the implementation of a project-based organization of new product development activity that is beyond the improvement of performance for the concerned projects (Larson & Gobeli, 1988) and the achievement of favorable learning conditions during these projects. In addition, the setting up by the company of specific means assuring the transfer and recording of knowledge (an integrated information system associated with systematic recording procedures in databases) is likely to question the tendency toward "knowledge dilution" in the company, or at least the increased difficulty in capitalizing on the learning achieved during the projects – a limit perceived as inherent in project-based organizations. According to this logic, particular attention must also be paid to the management of the projects' actors, vectors of learning transfer (Meyers & Wilemon, 1989). Companies having implemented project-based organization make up interesting examples in this domain.

This research raises a number of questions regarding the redefinition of the role of functional departments in a project-based organization that favors the horizontal dimension of the organization – the projects – over the vertical one – the functional department.

In a project-based organization of R&D activity, the role of traditional competence poles in the company, which are the functional departments, find themselves modified (Midler, 1993). The lack of feedback on the experiences introduced in this domain leaves a number of questions unanswered about the redefinition of the role of the functions. Is the role of the functions limited to a gatekeeper or does it concern the development of specialized knowledge through the elaboration of the development plans for the means and tools more generally? Can this development really fall within the framework of the projects or does it remain beyond the scope of this kind of framework?

Another question refers to the storage of the new knowledge developed during the projects. Of an ephemeral nature, the whole project turns on the achievement of its mission through the optimal use of the resources, which have been allocated to it. Storage of the knowledge acquired during the project to enable its retrieval for future projects does not appear as a natural concern in this kind of logic. On the other hand, the functional departments structure the company on the basis of specialized knowledge and constitute receptacles for this new knowledge. Most companies having adopted a project-based organization are already aware of the difficulty in reconciling these two dimensions of knowledge management.

NOTES

1. A random sample of 264 French industrial firms was drawn from the France-Innovation database. A postal survey was carried out for reasons of cost efficiency and generalizability. The survey was sent to the R&D director of each firm, of which 93 were returned (81 responses were valid, representing an effective response rate of 35.5%).
2. This division into two groups leads to a reclassification on a weak scale, because 83.95% of the sample companies appear to be correctly classified against only 28.39% (cross-table diagonal of the measured mode and the reported mode) divided into three groups.
3. The first stage of the analysis consists of verifying the discriminating character of the variables retained.
4. The discriminating character of these variables is reflected in their standardized coefficients (not presented here) highlighted in the interpretation of the discriminant axes, which constitute the second stage of the analysis.

5. The verification of the quality of the Discriminant Analysis showed that the groups arising from the discriminant analysis are significantly different (risk = 0.024%, χ^2 probability test). The confusion matrix (not represented) enabled the estimation of the classification validity arising from the discriminant analysis. The percentage of "correctly" classified companies (the diagonal of this matrix) is 71.60% and satisfactory.

REFERENCES

Adler, P. S., & Cole, R. E. (1993). Designed for learning: A tale of two auto plants. *Sloan Management Review*, *34*(3), 85–94.

Blackler, F. (1993). Knowledge and the theory of organizations: Organizations as activity systems and the reframing of management. *Journal of Management Studies*, *30*(6), 863–884.

Carless, S., & De Paola, C. (2000). The measurement of cohesion in work teams. *Small Group Research*, *31*(1), 71–88.

Cyert, R. M., & March, J. G. (1963). *A behavioural theory of the firm*. Englewood Cliffs, NJ: Prentice-Hall.

DeFillippi, R. J. (2002). Organizational models for collaboration in the new economy. *Human Resource Planning*, *25*(4), 7–22.

DeFillippi, R. J., & Arthur, M. B. (1998). Paradox in project-based enterprise: The case of film-making. *California Management Review*, *40*(2), 125–139.

De Terssac, G. (1992). *L'autonomie dans le travail*. Paris: Presses Universitaires de France, Sociologie d'aujourd'hui.

Garvin, D. A. (1993). Building a learning organisation. *Harvard Business Review*, *71*(4), 78–91.

Hamel, G., & Prahalad, C. K. (1993). Strategic intent. *International Review of Strategic Management*, *4*, 63–88.

Hobbay, M. (2000). The project-based organization: An ideal form for managing complex products and systems. *Research Policy*, *29*, 871–893.

Imai, K., Nonaka, I., & Takeuchi, H. (1985). Managing the new product development process: How Japanese companies learn and unlearn. In: K. B. Clark, R. H. Hayes & C. Lorenz (Eds), *The uneasy alliance: Managing the productivity-technology dilemma*. Boston, MA: Harvard Business School Press.

Larson, E. W., & Gobeli, D. H. (1988). Organizing for product development projects. *Journal of Product Innovation Management*, *5*, 180−190.

Leonard-Barton, D. (1992). The factory as a learning laboratory. *Sloan Management Review*, *34*(1), 23–38.

Leonard, D., & Strauss, S. (1997). Putting your company's whole brain to work. *Harvard Business Review*, *75*(4), 110–120.

Lorino, P. (1995). Le déploiement de la valeur par les processus. *Revue Française de Gestion*, *104*, 55–71.

McCann, J., & Galbraith, J. R. (1981). Interdepartmental relations. In: P. C. Nystrom & W. H. Starbuck (Eds), *Handbook of organizational design, Remodeling organizations and their environments* (Vol. 2). New York: Oxford University Press.

Meyers, P. W., & Wilemon, D. (1989). Learning in new technology development teams. *Journal of Product Innovation Management*, *6*, 79–88.

Midler, C. (1993). *L'auto qui n'existait pas. Management des projets et transformantion de l'entreprise*. Paris: InterEditions.
Moisdon, J. C., & Weil, B. (1992). L'invention d'une voiture: Un exercice de relations sociales. *Annales des Mines, Gérer et Comprendre*(Sept-Dec), 28.
Nonaka, I. (1990). Redundant, overlapping organizations: A Japanese approach to managing the innovation process. *California Management Review*, *32*(3), 27–38.
Nonaka, I. (1991). The knowledge creating company. *Harvard Business Review*, *69*(3), 96–104.
Purser, R. E., Pasmore, W. A., & Tenkasi, R. V. (1992). The influence of deliberations on learning in new product development teams. *Journal of Engineering and Technology Management*, *9*, 1–28.
Rumelt, R., Schendel, D., & Teece, D. (1991). Strategic management and economics. *Strategic Management Journal*, *12*(8), 5–30.
Shrivastava, P. (1983). A typology of organizational learning systems. *Journal of Management Studies*, *20*(1), 7–28.
Tarondeau, J. C., & Wright, R. W. (1995). La transversalité dans les organisations ou le contrôle par les processus. *Revue Française de Gestion*, *104*, 112–121.
Veltz, P., & Zarifian, P. (1994). De la productivité des ressources à la productivité par l'organisation. *Revue Française de Gestion*, *97*, 59–66.
Weick, K. (1991). The non-traditional quality of organizational learning. *Organization Science*, *2*(1), 116–125.
Wheelwright, S. C., & Clark, K. B. (1992). *Revolutionizing product development, quantum leaps in speed, efficiency and quality*. New York: The Free Press.

APPENDIX

The table highlights the discriminating character of each of the explicative variables retained in terms of the mean values accorded by the variables for each of the groups (and the standard deviation) as well as the results of the *F* test carried out for each of these variables. Values in bold represent average and values in italics represent standard deviation.

Explicative Variables	Explained Variable Learning Conditions during NPDPs			
	Group 1	Group 2	*F*	Significance
CEP	**1.825**	**2.220**	3.419	**0.068**
	0.958	*0.962*		
CGP	3.700	3.878	0.304	0.583
	1.488	*1.417*		
GORG	**1.385**	**1.561**	2.841	**0.096**
	0.490	*0.502*		
SII	**2.900**	**3.878**	10.626	**0.001**
	1.355	*1.345*		
EXP	**3.075**	**3.951**	8.372	**0.005**
	1.526	*1.182*		
GCO	2.825	3.292	2.104	0.151
	1.483	*1.418*		
NPR	1.825	1.854	0.021	0.884
	0.781	*0.963*		
EPR	1.575	1.658	0.115	0.735
	0.957	*1.237*		
BPR	**1.375**	**1.878**	3.687	**0.058**
	0.897	*1.399*		
DPR	**2.225**	**2.609**	5.294	**0.024**
	0.659	*0.833*		

TARGET COSTING AND ORGANIZATIONAL LEARNING IN NEW PRODUCT DEVELOPMENT: THE THEORY OF ACTIVITY APPLIED TO MANAGEMENT TOOLS

Philippe Lorino

ABSTRACT

Cost planning and control in New Product Development (NPD) must solve basic cognitive problems, such as knowledge integration. Most decisions to be made in design and development processes have important economic consequences, but have strong technological and marketing content. To a large extent, economic performance in NPD depends on cooperation and mutual knowledge-building between different types of knowledge and professional crafts (economics, marketing, technology). Target Costing aims to achieve this integration by managing product value and product cost jointly. However, several empirical studies show that Target Costing may lead to quite different managerial practices. To understand how Target Costing might achieve the best impact on

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organizations, this research builds a theoretical framework for analyzing management tools used in NPD organizational learning.

This framework integrates concepts from semiotics (Peirce), pragmatism (Dewey), and the psychological theory of activity (Vygotsky). Human activity (and consequently experience-based learning) is mediated by signs (language, tools) that help people make sense of action. Management tools can be analyzed as signs to be interpreted by actors in the course of their action, helping them to make sense of their experience to generate new forms of action. In this semiotic perspective, management tools have two components: objective artifacts (calculation formulas, logical models, material substrates) and a mental scheme of interpretation about how to use the artifact (scheme of utilization). To understand how management tools like Target Costing impact organizational learning in NPD, we investigate the ways in which schemes of utilization depend upon cultural and historical variables such as professional craft definition, individual and collective responsibility, and learning archetypes.

INTRODUCTION

Economic management of New Product Development (NPD) faces two main issues: controlling the cost of development itself, and ensuring the profitability of the future product over its life cycle (cost planning and product profit planning).

In some industries such as aerospace and automotive, cost planning is a major issue because of the magnitude of development expenses. Cost planning is also a difficult management problem, because many NPD activities are non-repetitive and creative, whereas classical budgeting and cost control techniques have been designed for repetitive activities. In many cases, however, profit planning is an even more important and more difficult issue. For an industrial company, its products are its vectors of profit, and the economic stakes attached to a product over its life cycle are much greater than the cost of development alone. Product profitability is mainly determined during planning and design. Approximately 80% of total product life cycle costs are pre-determined by decisions taken during design and development – before production of the first product unit, even though some 80% of costs are actually incurred after production begins (CAM-I, 1988, 1992; Lorino, 1997). The economic profit optimization of a new product is difficult because projections of profit and cost for a future product usually must be made under significant uncertainty.

Current research literature and industrial practices in product profit and cost planning follow two main currents which do not often overlap. Accounting and control approaches focus on the ''hard'' technical aspects of costing and accounting methods, using tools such as Target Costing and Cost Planning. General management and organization approaches, on the other hand, focus on ''soft'' managerial or cultural aspects (project management methods, cross-functional integration, organizational learning) but often give little attention to economic and financial management tools. Clark and Fujimoto (1991) stress this dichotomy: ''(Most firms') time and energies are spent either implementing new tools or programs with insufficient attention to the soft side, or they spend their time in 'off-site' meetings, with no thought for the necessary tools.'' Nevertheless, formal management techniques and tools play an important role in organizational dynamics, even if that role does not always follow an expected path and is not able to exercise a deterministic influence upon behaviors.

In this article, we show how managerial approaches commonly labeled as ''Target Costing'' can have a significant impact upon the characteristics of an organization and its ability to ''learn.'' To analyze this impact, Target Costing is not defined simply as a set of costing techniques, but rather as a complex combination of technical artifacts and specific managerial practices linked with the use of those artifacts. To explain how management tools may trigger and support organizational processes and competence building, we depart from a simple view of management tools as accurate representations of economic truths. Instead, we invoke an interpretative/semiotic approach to understanding management instruments. In this approach, NPD will be considered as an ''organizational learning'' process,[1] based upon individual interpretation processes by actors within an NPD system of action (division of labor with shared use of instruments). NPD will also be considered as an ''enquiry'' process in Dewey's sense (1967), in which Target Costing instruments play a key role in making situations meaningful for involved actors and open possibilities for collective action by making sense of engineering and planning situations.

This study is supported by personal field experiences, spread over a long period of time. We shall adopt an abductive methodological frame, following the definition of *abduction* given by Umberto Eco (1990): an attempt to make sense out of complex and surprising observations and to formulate a theory which gives a plausible account of facts, but should be tested later.

THE CONCEPTUAL MODEL OF TARGET COSTING AND ITS LIMITS

Product Life Cycle Economics: the Importance of Managing Future Product Cost in NPD

The major part of distribution and production costs depends on performance factors ("drivers") that are largely determined by product planning and design decisions. It is therefore more feasible to address product costs before structural design factors are frozen: "It is much easier to design out costs before production, than to control out costs during the production phase" (Morgan, 1993). Fig. 1 suggests this relationship between design decisions and product costs, and that something like 80% of total life cycle cost incurred by a product are already pre-determined before production and sales start.

As a consequence, design and planning decisions have a much greater impact on the future performance of a company (through their impact on future operating costs and revenues), than on the current performance of the company (through their direct consumption of budgeted resources). Activities at the beginning of the life cycle must be managed with a clear view to global life cycle costs. Cost then becomes an essential "language" for

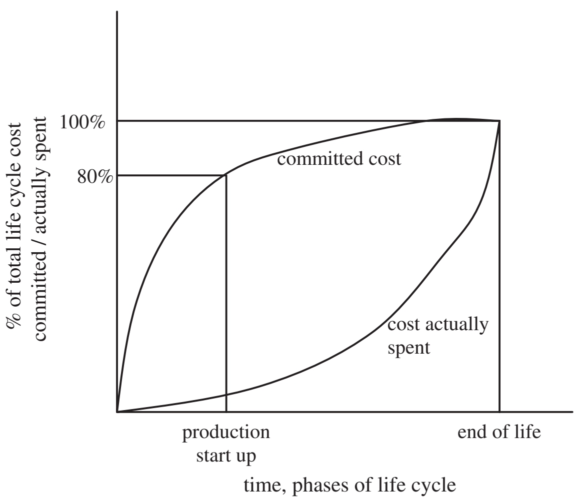

Fig. 1. The Life Cycle Cost Profiles.

communication between the upstream and downstream phases of the cycle, as noted by Webster (1991): "The necessity of making trade-offs among frequently diverse life cycle considerations makes cost even more important as a common denominator in achieving life cycle design optimisation." The purpose of Target Costing is to assure that upstream decisions optimize the future financial performance of a product. Stressing the upstream part of the cycle is becoming all the more essential because decades of continuous improvement in production processes have realized most of the potential for cost reduction in downstream phases. As Tanaka (1993) points out: "Japanese managers are becoming convinced that more opportunities for cost reduction can be found in product planning and development than in production." Kato (1993) also states: "As a general tendency, leading Japanese manufacturers are looking at the upstream of production: design, research and development and product planning. The most fundamental cost drivers are in the earlier stages of new product development."

Effectiveness of Targeting as a Learning Tool

It is necessary to define cost objectives for a future product during design and development phases in order to guide design and development decisions to ensure the economic profitability of the product. For this purpose, cost targeting (establishing a target level for cost and then trying to reach it) seems to be more effective and to inspire stronger personal commitments than more complex optimizing approaches (trying to minimize the future cost or maximize the future profit margin) (Locke & White, 1981; Locke & Latham, 1984; Cooper & Slagmulder, 1997). The question then is, How should a target cost be derived?

There are several ways to establish cost targets: (1) Analytical engineering studies that start from the detailed design of the product to determine the main characteristics of a suitable production process and to estimate costs based on historical standards. (2) Past experience and references that adjust actual cost of previous similar products according to improvement objectives to establish an experience-based target cost for a new product. (3) Managerial prerogative to impose improvement targets for strategic or financial reasons – for example, when Renault C.E.O., Louis Schweitzer in 1999 imposed the rule "minus 2000" requiring Renault to reduce the cost of all vehicles by 2000 francs each. (4) Benchmarking and comparison to competitors to establish market price references, as to what the future customer will be ready to pay, and then subtracting some profitability requirement.

Those methods can be classified as internally based (oriented toward in-house experience, competencies, and capacities) or externally based (oriented toward market and competition requirements). Psychological considerations suggest why externally based methods are more convincing than internally based references: their legitimacy is less questionable than a leader's more or less arbitrary decisions or engineering- and accounting-based estimated standards. Externally based cost targets are also less open to internal bargaining, because the cost target appears to be an issue of success and survival, of maintaining a service level to customers. Externally based cost targeting is also a powerful way to create a market culture within a company, as stressed by Clark and Fujimoto (1991, p. 125): "What seems important is the diffusion of a shared sense of competitive reality and customer orientation." Moreover, purely internally based references cannot assure the eventual economic success of a product, because a product can generate insufficient profits or losses even though internally dictated processes are implemented in a very efficient way.

Market-based cost targets, however, ignore the specificities of the firm – its strengths and weaknesses, its technological options – since they are economic targets based on future customer demands for value and not internal firm considerations. Thus, at some stage and in some form, internally based cost considerations reflecting the specific competences and resource-array of a firm should be taken into account in setting target costs.

The Basic Coupling in Target-Costing: Market-Based Value with Organization-Based Cost

The Target Costing approach focuses on managing the gap between a target cost and a current prediction of cost, assuming that the future selling price of a product will be set by the marketplace. The desired profit to be generated by a product depends on the strategy of the firm for rate and type of growth, financial position, and marketing and sales. Cost is therefore not an unconstrained objective variable, but rather is a target that must be achieved by the company to meet its strategic objectives within the based relationship

$$\mathrm{TC} = \mathrm{SP} - \mathrm{TP}$$

where TC is the target cost, SP the future selling price, and TP the target profit.

On the basis of its existing resources, skills, and technologies, a company can calculate the cost at which it will normally be capable of manufacturing a new product – the "estimated cost" (EC). EC generally exceeds TC (Target Cost) by some amount CR – the Cost Reduction goal. CR expresses the gap between the market requirement (value-based view) and the projected resource consumption by the firm (cost-based view). Therefore, CR reflects a competitiveness gap – i.e., a strategic gap to be bridged (Sanchez, Heene, & Thomas, 1996). The target costing model can consequently be summarized by the formula (Tanaka, 1989):

$$CR = EC - TC = EC - (SP - TP)$$

CR in target costing may also be influenced by factors other than a gap of competence. For instance, managers in charge of cost estimation may have some political reason to overstate estimated costs (perhaps to justify new investments that can be made as part of an NPD project). The managers in charge of target cost evaluation may also have political reasons to overstate a target cost (for instance, to obtain permission to start the project) or to understate it (for instance, to keep a financial "safety margin"). Such distortions may not matter as long as concerned actors believe that the competence gap exists, or are ready to act as if they believed it. The practical effect of Target Costing is therefore based upon the meaning collectively given to the cost gap by actors, not upon what the source of the gap really is. In this sense, as with any management tool, Target Costing does not establish a relation of truth to economic realities, but rather creates a relation of meaning to action because it helps to "make sense" for the actors involved in NPD.

Because market-oriented value and internal competence-oriented cost form the basic coupling of Target Costing, throughout the NPD process actors can try to manage this gap through two "levers." They can try to reduce the estimated cost of the product by improvements in product or process design – for instance, by standardizing parts, simplifying or modularizing the design, or replacing expensive technologies with cheaper ones. They can also try to modify the value of the product for the future customer by improving its functional definition. The core challenge of target costing is managing ongoing trade-offs between cost and value. This represents a departure from the typical cost-cutting approach to NPD in many companies. In pure cost-cutting approaches, a target cost is established on the basis of marketing and strategic considerations; then efforts are focused upon cost cutting to reach the target. In Target Costing, however, this sequential approach to value and cost is replaced by concurrent management of both value and cost. For instance, design decisions which increase the cost of a product can be accepted if they add even greater value. Conversely, design decisions that decrease product value can be accepted if they decrease cost even more. Thus, in Target Costing, functional specifications of a product are not frozen.

Tools and Techniques

Target costing incorporates management and technical tools. Tool requirements can be identified through the basic formula of Target Costing:

$$CR = EC - TC = EC - (SP - TP)$$

SP (selling price) is based upon market research. TP (target profit) must be derived from strategic goals. TC (target cost) is then obtained by subtraction of target profit from forecast selling price for the finished product. However, to be used as a management instrument for product development, this global target cost must be broken down into product sub-assemblies and components.[2] EC is obtained through cost estimating methods that have been in use for years in engineering activities (e.g., utilization of tables and databases for technical cost elements, utilization of data supplied by the accounting function like hourly rates, and implementation of parametric models). To achieve the CR goal (the difference between estimated cost and target cost), several types of design optimization methods can be used (value analysis, value engineering, part standardization, modular design, last-point differentiation) (Horvath, 1993; Makido, 1989; Sakurai & Huang, 1989; Tanaka, 1989). Many companies try to use all of these techniques in managing the product Value/Cost coupling. Nevertheless, as the Bull case will show us, simple use of these techniques is far from sufficient to achieve a Target Costing objective.

The Example of Bull Company (1993)

In the mid-1990s, Bull was a large French electronics group, established in the US market. It designs and manufactures computer hardware, with five main organizational structures: headquarters functional departments (including Strategy and Finance), sales networks, R&D division (responsible for designing and developing new products), manufacturing division, product line management (responsible for strategic marketing and the life cycle management of products).

The life cycle of Bull's products is tightly controlled through periodic independent reviews and decision-making meetings. Strict rules define the documents which must be submitted at each step (marketing plan, advanced engineering plan and volume production plan, business plan), as well as the evolution of the product business plan as the development process moves forward. These rules were introduced into Bull when the company was controlled by General Electric in the 1970s.

Bull applies value analysis, product functional analysis, cost estimation, and profit planning techniques as follows:

1. Product line management defines the general (marketing) specifications for the new product. It carries out a market survey and a strategic study, and defines target cost (C1), designed to achieve a profitability level compatible with the global strategic projections of the company. The financial forecasts of the product business plan are based on cost C1, which is communicated by product line management to the R&D and manufacturing divisions as a target which must be met to ensure the economic success of the product.

2. The R&D division carries out initial design work on the basis of specifications supplied by product line management. When the detailed design stage is reached, the R&D division brings in its value engineering team to prepare a detailed cost estimate, based not on the company's normal production conditions, but on ideal production conditions (i.e., assuming the lowest hourly rates in Europe, components purchased at lowest prices, maximum productivity, continuous adjustment of capacities to actual production volumes). This cost (C2) is communicated by the R&D division to the manufacturing division. C2 is supposed to measure the cost level which the design of the product should enable the manufacturing division to meet, provided it can achieve the best attainable performances in production.

3. On the basis of the detailed product design, the manufacturing division completes production engineering, and calculates a new estimated cost (C3), based upon the actual manufacturing conditions of the company (actual salaries, accessible technologies, etc.). Product line management then has to negotiate a revised product business plan with the manufacturing division and the sales networks.

This process gives rise to a few comments. Cost C1, which could be regarded as a target cost, appears to be used by product line management only, in support of the decision to initiate the R&D phase or not. On completion of the initial phase, cost C1 is discarded, and it is not used for comparison with subsequent cost figures. This is reflected in a tendency by product line management to underestimate cost C1 in order to get a new product accepted, bearing in mind that the managers of various product lines are competing with each other to obtain investment resources. Cost C2, calculated using sophisticated quantification instruments (cost tables, functional and organic analysis, and databases), is determined by the R&D division at the detailed technical design stage, at which point it is too late to have a significant influence on design options. Although treated as a design optimization tool, it cannot actually play that role, because it emerges too late in the design process. In fact, cost C2 clearly is meant as a check on manufacturing performance, and to define a clear divide between the designer's and the manufacturer's responsibilities. Designers in this process are very attached to the calculation of cost C2, in order, in their terms, "to distinguish the respective competitiveness of the designer from that of the manufacturer." The manufacturing division regards cost C2 (not without some justification) as unrealistic and non-significant, and hurries to recalculate its own estimated cost C3. When the final version of the product business plan is prepared, the difference between the initial hypothetical cost C1 and the estimated production cost C3 is invariably significant.

In this example, we can observe a number of key points. In Bull, the various tools were used separately, not in the context of a cross-functional dialogue, but essentially within each function. The formula "Target Cost = Selling Price – Target Profit" is repeatedly applied, but in a disconnected way by the different functions, each with its own views and objectives. The tools and algorithms are not used to provide coordinated direction and guidance to each concerned function, but to assure that no function is held responsible for the non-achievement of objectives by other functions, and in particular those functions situated further downstream. In effect, the technical methods usually involved in Target Costing were used, but with managerial purposes quite contrary to what Target Costing is supposed to be in theory: a process tool for global value/cost optimization.

From Target Costing (TC) to Target Cost-Based Management (TCBM): Managerial Practices in Strategic Competence

As the Bull example shows, effective Target Costing implementation originates not so much from the tools it uses or from the type of cost calculation formula used, but rather from the managerial practices in which the tools are used. The strategic advantages which are the most important benefits to be obtained from Target Costing are thus the hardest to acquire and reside in the area of managerial practices. As Clark and Fujimoto stress (1991, pp. 243–245): "Because attitudes are pervasive and difficult to change, this informal aspect of the engineering organization might be an important source of long-term advantage for integrated problem-solving…." The Target Costing tools used by many American and European firms do not result in the Target Costing methods described by Japanese researchers and practitioners, because those methods go against some deeply rooted habits. Strategic advantages obtained from the effective use of Target Costing must therefore be found in the effective combination of both Target Costing tools and management practices.

To understand how Target Costing can provide sustainable strategic advantages, we can draw on resource-based and competence-based strategic theories. In order to differentiate itself from its competitors, a firm should set up a resource portfolio which is valuable in the competitive context where it operates (Selznik, 1957; Wernerfelt, 1984; Barney, 1991). Sanchez et al. (1996) define competences as the ability of an organization to sustain coordinated deployments of resources. In this study, we adopt the definition of competence given by Sanchez et al. (1996) as a "demonstrated and reproducible capacity to achieve some form of pre-defined result through organized action" – i.e., through processes. A competence combines different types of resources – physical, technical, human, and organizational. Competence is not defined just by the portfolio of resources utilized, but also includes management practices in using resources. Experience-based competences are context- and historical path-dependent, are therefore difficult to imitate and to substitute, and, as such, they are potential sources of sustainable competitive advantages (Tarondeau & Lorino, 2002).

What is rare, difficult to imitate, and difficult to substitute in Target Costing is neither a costing formula, nor a technical tool, as sophisticated as those might be, but rather the complex and subtle combination of such tools within collective organized practices based upon long experience. That is also what the CAM-I consortium (1988, 1992) stresses: "Target Costing Management (TCM) is a management framework which … encourages organizational learning. TCM is an organizational competence based on behavior and management systems: it must be grown over time, [and] it cannot be installed as a single project or set of tools."

TCM as an organizational capability cannot be reduced to certain types of organizational structures, such as cross-functional teams. As Clark and Fujimoto (1991) observe: "Product managers are found in almost every automobile company, but their actions and attitudes can differ significantly across companies. Cross-functional teams, however prevalent, do not guarantee effective development."

The informal practices and behaviors that are important in TCM may be difficult to identify, to observe, and to analyze in a specific setting. Efforts to introduce TCM practices may raise political problems. Some practices such as non-communication of information or exclusivity in efforts to maintain contact with customers can have strong political overtones. Cognitive problems may also arise. Product design issues can be technically complex and out of reach for non-technical managers who must support design processes. Cultural problems may also occur. Certain types of cross-functional practices may be closely integrated with the social definition of professional communities in a specific country; changing practices can destabilize those definitions and lead to resistance by actors in NPD. For example, Lefebvre, Roos, and Sardas (2001) have investigated how the engineering profiles and careers of engineers in French automotive and aerospace industries have undergone deep transformations in response to changes in NPD practices. In many cases, management slogans promoting TCM processes of integration, cross-functional cooperation, global optimization, project management, concurrent engineering, empowerment, supplier partnerships, transparency in cost-cooperation between suppliers and buyers, etc. remain mere slogans, with little practical content, especially when management practices in budgeting and planning, performance evaluation, incentives, management by objectives (MBO), and costing are not redesigned.

The vital importance of social and managerial practices is not adequately reflected by the "Target Costing" expression, which focuses upon "costing" techniques, as some authors in accounting research tend to do (Cooper, 1992). In this chapter, we shall from now on use "Target Cost-Based Management" (TCBM) to refer to the more complex concept of managerial practices supported by Target Costing instruments.

GROUPE BULL CASE CONCLUSIONS AND FURTHER EMPIRICAL FINDINGS

My personal experience in Groupe Bull as a chief-controller in charge of redesigning management helped me to understand that Cost Planning in NPD is a key issue in organizational learning. NPD is a key process for developing new competences leading to technological and market innovations developed through problem solving. The learning capacity of an organization in NPD cannot be understood by studying "soft" practices and "hard" aspects of management tools separately. Learning dynamics result from interactions between collective practices, on one side, and formal artifacts (systems, structures, and tools), on the other side.

Later I had further opportunities to study the role of Target Costing in NPD. In 1993, an exploratory study about Target Costing was done with a European working group within the CAM-I research consortium, in nine divisions of three European manufacturing groups. Of these, Bull, Valmet, and Aerospatiale were under my supervision. I have also consulted with Renault automotive company about Product Cost Planning in engineering phases (1994 and 1999). I also did field studies in Germany and Japan, interviewing engineering managers in six German and five Japanese companies (1998 and 1999). I report below some findings from these experiences.

Renault (1994)

Renault is a large European automotive group that has made strong project management, a priority for product development since the 1980s, resulting in significant performance improvements. For example, in the 1990s development time shortened from 7 to 4 years, while achieving higher quality standards. Nevertheless in the 1990s Renault's economic performance was not satisfactory. The cost of new vehicle development was too high and was steadily growing.

New development projects had a high level of autonomy. The cross-project "Product Division" was a lightweight structure with a limited coordination role. It essentially brought marketing support to projects and managed the overall coherence of the Renault product range. In the Control Department, there was a cost-estimating team composed of 30 engineers with considerable experience in cost estimation of automotive components and manufacturing operations, particularly in stamping, painting, and welding. Several attempts to introduce value analysis and value engineering in Renault had failed in the past.

Project management followed a precise phased process, based upon internal contracting between the project manager and the functional departments (marketing, quality, design, engineering sectors, etc.). An internal contract to develop a new vehicle was signed 40 months before starting sales. In the contract, the functional departments (marketing, sales, quality, engineering teams) committed to time, quality, and cost objectives. One year before the contract signature, a "pre-contract" was established between the same partners. It ended an exploratory phase and established the basic characteristics of the project (concept, first business plan, general specifications, time schedule), which were formally agreed by the different functions concerned. The pre-contract officially started the project, but precise objectives were only defined in the contract.

These contractual practices played an important role in the history of Renault from a managerial viewpoint and became an important part of the company's basic culture. They broke a bureaucratic tradition by making actors more responsible and establishing shared objectives. The contract was an important power tool for the project manager and it improved his bargaining capacity with "vertical" functional departments. The contract also made technical and economic commitments formal.

In 1991, in cooperation with a university, the Product Division developed a target costing tool named "objective cost method" at a time when target costing was still little mentioned in Europe. It included all the characteristics of target costing methods. A vehicle target selling price was based upon market studies; the target selling price was then transformed into a target cost by integrating profitability objectives adopted in the corporate strategic plan. Utility analysis broke down the vehicle into 18 major functions and, according to market segments, evaluations of the "degrees of importance" of the 18 functions were assigned for different categories of customers. For instance, for "young mechanic fans," engine and mechanical performance are more important than for urban family customers, who are more interested in comfort and space. Each market segment was assigned its own set of degrees of importance for each of the 18 functions. A portion of the vehicle target costs was then allocated to each of the functions on the basis of its degree of importance.

In the context of Renault, with its strong emphasis on project management and a growing practice of simultaneous engineering, the new "objective cost method" offered the opportunity to embed a market orientation in engineering activities and to introduce systematic value engineering practices. Nevertheless, the new method was not adopted on a large scale. One project manager, Mr. P., only tested the new method in the first phase of his project, to support his negotiation of contracts with functional departments. He did not use it as an "official" tool to be shared with other departments and used in their discussions, but rather as a personal source of information and a kind of "hidden" reference or benchmark in his negotiations with the functions. The method was not transferred to development teams, who in fact did not even know about it.

In 1994, when this story took place, Mr. P. had a project that was halfway to completion. The project manager was faced with the simultaneous economic deterioration of automotive markets and an upgrading of Renault's financial requirements. He realized it would be necessary to re-define the project economic objectives and to renegotiate contracts in an effort to impose target cost decreases. It promised to be a delicate enterprise for everybody, because once the original contract had been signed, it should be respected. Mr. P. thought he might be able to use the "objective cost method" (essentially, Target Costing) to justify the necessary contract revision by introducing more objective market-based analysis.

Beside these particular circumstances, Mr. P. thought that all projects might improve their performance by applying the "objective cost method" in a systematic and continuous way as an ongoing project economic reassessment tool, not just as a planning tool in the initial phase of the project to establish formal targets. He believed the method would make the NPD process more responsive to market evolutions, would enhance communication between functions, and would provide a tool for managing flexible trade offs between cost and value. He first re-introduced the "objective cost method" into his ongoing project to prepare for the re-negotiation of contracts and to update targets. He then proposed that the Product Division, the Cost Estimating Department, and the Control Department document and extensively disseminate the method, in order to get it adopted by other project managers and to make it a basic feature of Renault project management.

The Product Division managers were hesitant, however, because they knew this method was a genuine innovation in the context of Renault corporate culture, which was dominated by engineers and technology. They preferred to keep the method as an experiment with limited application and communication. The Control Department leaders were skeptical, if not openly hostile, for both cultural and bureaucratic reasons (cost-estimation, an important role in the company, was their monopoly). They did not like the idea of the Product Division actively involving marketing in vehicle cost planning; moreover, in their rational technical and cost view, it would have been confusing to get two different figures – a market-based target cost developed by the Product Division, and an engineering-based Estimated Cost developed by the Control Department. Last but not least, cost-estimators, engineers, and controllers did not believe in cost targets based upon "subjective," "fuzzy," and "soft" considerations such as the "degrees of importance," "degrees of contribution," and "utility levels" used in utility analysis. The proposal to adopt the "objective cost method" was finally abandoned.

There were other cultural reasons for this failure. Renault culture in that time was mainly engineering-oriented, even in control and marketing functions, in which engineers were dominant. As a consequence, people were highly rationalistic, and evaluation methods based upon "subjective" considerations (consumer psychology, experts' judgments) were regarded as unreliable. There was also much distrust of formal management systems, particularly in development and engineering, where people feared bureaucratic interference in activities that were considered creative. They feared that too much transparency would reduce engineers' freedom of choice and would endanger their innovativeness. There was also a strong tradition of informal communication ("too much paper is a nuisance") and craft autonomy. As mentioned before, however, the culture of contract was strong. "Responsibility" meant "contract," and "contract" meant "respect for signed commitments." Some managers feared that target costing might lead to frequent revisions of contractual commitments and destroy their credibility.

In the context of Renault in 1994, what was essentially target costing was colliding with another instrument for change – managerial contracting – and was interpreted by some people as a step backward to reduced levels of commitment and weaker project management.

Account of the Japanese Enquiry

In the summer of 1998, Prof. Okano of Osaka City University and I interviewed engineering department and product line managers in five Japanese manufacturing firms. We visited Toyota's Technical Centre, NEC's "optical video disk camera" project, Komatsu's engineering department, Matsushita-Panasonic's video division, and Sharp's opto-electronic devices division. Interviews were semi-structured and took about 2–3 h each. All of the companies interviewed were known as target-costing practitioners in Japan.

In all five firms, the calculation elements of Target Costing could be observed. There were strong practices of ongoing cost estimation, based upon sophisticated tools (most frequently, cost tables), and a systematic practice of Value Analysis and Value Engineering (VE). VE was the main method used to fill the gap between target cost and estimated cost. This was confirmed by an extensive inquiry about target costing in Japan by Prof. Tani from Kobe University: 83% of Japanese firms practiced VE in development and detailed design phases of NPD.

In all five firms, engineers calculated and controlled their own costs. At NEC, engineers used cost tables, whereas Toyota made use of VE which was considered part of an engineer's basic competence. This led to an interesting misunderstanding in the course of the interviews. When I asked the Toyota engineering executive team if there was a systematic practice of VE, they answered affirmatively without any hesitation. When I asked where the VE team was situated – was it part of the engineering department, of the control department, or of some specific expert service – they did not understand my question and just repeated that VE was quite extensively used. I thought my question had not been correctly translated, so I repeated it. It then became obvious that my question had been correctly translated, but not understood for more fundamental reasons. Then one of the senior engineering managers smiled and answered: "There is no VE team. Everybody does VE. Every engineer has to practice VE. VE is part of their basic mission." In those Japanese companies, engineers had a strong awareness of economic product performance, and they practiced VE within any engineering operation as a systematic basis for their decisions. In this context, it was not surprising to be told subsequently that the finance and control function was relatively weak in the engineering department, because there was a general practice in these companies of "self-control" of their economic performance by engineers themselves, and relatively low effort to impose economic control functions in engineering departments.

Target Cost was allocated from the assembled product to its various functions and major components, mainly through negotiation between a project manager (or product manager or chief engineer) and engineering teams. Managerial culture favored a search for consensus, with a will to integrate different viewpoints. There was also a general practice of collectively sharing development risks. In case of difficulties in reaching some cost targets, engineers in the visited firms said they avoided pointing at individuals as failing. As one person interviewed said, "we must always and above all protect the persons."

Suppliers were generally involved in product development very early and very actively in all five firms. In most cases, they were asked to provide full transparency about their costs long before negotiating supply contracts, even though at such early phases of development they had neither any guarantee of getting commercial contracts nor any certainty about the final level of selling prices. In most cases, suppliers were asked to collaborate in component cost optimization for months before commercial selling prices could be negotiated. Prices for components were never discussed before joint management of cost. This practice was supported by very close integration and long-term relationships between vendors and buyers.

Account of the German Inquiry

In the fall of 1998, I interviewed five companies in the Stuttgart area of Baden-Wurttemberg: Alpha (high precision reducers and gears, with 75 million Deutsche Marks in sales), Behr (cooling and air conditioning systems for the automotive industry, with 2.6 billion Deutsche Marks in sales in 1997), Porsche (cars, with 5.1 billion Deutsche Marks in sales), Siemens A.T. (electronic systems for the automotive industry, with 5.7 billion Deutsche Marks in sales), and Trumpf (metal-cutting machine-tools, with 1.4 billion Deutsche Marks in sales).

These five firms all had a strong technological basis, with much cultural importance given to technology, innovation, and quality; powerful engineering functions; strong management involvement, and globalization strategies. They all practiced product business planning and cost estimation. But compared to the Japanese companies I interviewed in 1998, there was rather limited practice of Value Analysis/Value Engineering. (This observation was corroborated by Arnaout (2000), who found that 47% of German firms practiced VE at the development phase and only 30% in the detailed design phase, compared to more than 80% in both activities in Japanese firms studied.)

Generally speaking, the economic awareness of engineers in these firms did not seem to reach the level I observed in Japan, and the traditional approach to cost control was still very influential in most of these companies – i.e., controlling by auditing the economic basis of engineering decisions by staff from outside engineering. Compared with the Japanese firms I interviewed, the five German firms seemed to practice more economic control of engineering than economic self-control by engineers, and had more separate technical and economic cultures.

Target Cost in the German firms was allocated from the assembled product to the functions and major components mainly through negotiation, but here too there seemed to be some difference with Japanese firms in managerial culture. The managerial practices seemed to be less homogeneous in Germany than in the Japanese companies. In some German firms, there was a strong practice of MBO, with individual commitments of managers to targets and incentive schemes, whereas in others there was an explicit policy to protect individuals and avoid assigning blame to individuals for not meeting cost objectives. Some firms used a risk provision fund at the project level to cushion development risk, but in others such practices were viewed as a threat to the commitment of teams to reach their targets. In some of the German firms, managers were aware of significant slack in engineering teams, selfish behaviors (unwillingness to "give back" resources to other teams), and lack of cooperation, whereas the managers in other firms expressed their strong belief that culture and social pressure limited such phenomena to quite unimportant levels. Most of the German companies visited insisted upon the importance of achieving cultural integration, without reaching the apparent levels of cultural integration observed in the Japanese firms.

Cooperation between suppliers and customers also followed different tracks in Japan and Germany. In Japanese firms, the relationship between supplier and customer was often strongly integrated from both the technical and the economic point of view, with open cooperation and transparent communication in the cost optimization of the product. In the German companies, the relationship between suppliers and customers was often fairly integrated from the technical point of view, with early involvement of suppliers in development work, often through resident engineers, and with the possibility for suppliers to influence the specifications of the product. But the relationship was much less integrated from the economic point of view. It was quite rare for suppliers to give full access to cost information to their customers, and vice-versa. Open cooperation to achieve product cost optimization was unusual before any contractual frame had been defined. The relationship was influenced by market conditions, and the level of mutual trust seemed to be variable, with at times some obvious arm-twisting practices being employed.

Key Issues Derived from Field Observations: The Differentiating Managerial Practices

From those admittedly limited field observations of Bull, Renault, and the Japanese and German companies, it is of course not possible to establish firm and general conclusions about Target Costing practices, but it is evident that the concrete managerial practices referred to as "cost planning" or "target costing" differed significantly from one firm to another and from one country to another, whereas the formal techniques (cost models, profit planning, cost estimation, market-based targets) differed to a much less extent. More concretely, the primary sources of differences in "managerial practice" concerned knowledge integration issues (how to integrate different types of knowledge), inter-company cooperation (relationships between suppliers and buyer), the socializing process (how to integrate individuals into organizational action), and the dominant learning models. Let us briefly consider each of these points of difference in managerial practice.

Knowledge Integration Issues

The cross-functional integration of different types of knowledge raises three key questions: how to integrate economic and technological forms of knowledge, how to integrate market and technological forms of knowledge, and how to integrate different types of technological knowledge. Integrating economic and technological forms of knowledge is central to target costing, since target costing tries to optimize engineering decisions with respect to their economic consequences. It seems that in some cases – particularly in the case of Japanese firms – technical and economic integration is mainly subjective. Individual Japanese engineers are supposed to combine both forms of skill within their own mental processes. This approach is reflected in the type of management instrument used to achieve integration – namely, value analysis and value engineering as systematic tools of the "engineer." In other cases, this form of integration is pursued mainly through organizational processes, through division of work between engineering functions and economic functions such as cost control and finance. This approach is reflected in other types of instruments, such as budgets, MBO, and cost controls. This issue is closely related to the cultural definition of a profession. In a basic way, one could contrast the Japanese engineer, who is individually charged with making economic/technological trade-offs and acquires value analysis and target costing skills as part of his basic engineering skills, with the European engineer, whose professional ethics value freedom in creating new technical solutions. As a consequence, the controller as a professional appears in western companies as the "economic conscience" of the engineering process.

Integrating market and technological forms of knowledge is also central to target costing, since target costing tries to optimize the product value (market-based) and cost (engineering and manufacturing-based) coupling. Again, knowledge integration may be subjective, as when engineers cooperate directly with customers to inject market requirements directly into their engineering work, which seemed to be the case in Sharp. By contrast, the organizational approach would use consensus or arbitration between engineering and marketing to achieve integration.

Integrating different types of technological knowledge is also central to NPD in making economically and technically rational trade-offs between different engineering decisions. Today, there is often a general orientation toward cross-specialty project management within engineering, more or less supported by tools like simulation models and cost tables. Some companies, such as Renault, have developed practices of contracting between project management and various technical professionals. This contractual policy seeks to achieve cross-functional integration through structural, semi-legal solutions (formalizing the power of the project manager) and follows a classical planning approach (targets are established in the first phase of the project and are not to be fundamentally questioned later). Other companies, however, prefer a more continuous and informal form of coordination, based more upon cultural mechanisms and with fewer constraining practices of formal project management.

Cooperation between Companies

Cooperation between companies (suppliers and assembler) to apply target costing to a value chain raises two different types of managerial issues: how to manage multi-firm learning and acquired knowledge (for instance, how to integrate economic and technological forms of knowledge owned by different companies) and what incentive system can best support multi-firm cooperative learning? Some firms follow a classical model of planning and commercial contracting in which the partners plan objectives, negotiate a contract, and must then fulfil the contracted objectives in the subsequent phases of the project. Such a model, however, may prove rigid in complex, uncertain, and risky situations. More flexible types of relationships require a high level of mutuality to achieve cost and technology transparency and to preserve flexibility in informal commitments. Incentives for this more flexible form of integration can be found in the building of durable, mutually profitable, and fairly exclusive partnerships that lead to substantial firm-specific knowledge and assets. In some cases, incomplete contracting focused on creating cooperative coordination procedures rather than on prices can establish win–win profit-sharing alliances, as in some Renault and Aerospatiale partnerships, with a delicate balance between commercial law and informal trust.

The Socializing Model

How can individuals be induced to use their individual skills in seeking to fill the gap between estimated cost and target cost? What kind of incentive and responsibility systems encourage individual commitment to pursue cost targets and contribute to organizational learning? There are significant tensions between responsibility-based costing models (which use management tools like MBO, contracting, target costing combined with strong control) and cooperative costing models (which emphasize protection of the person, shared objectives, flexible contracting). In the first case, Target Costing appears mainly as a planning technique largely restricted to calculation models. Target Costing then seems to be mainly a way to build relevant and legitimate cost targets. In subsequent phases of NPD processes, however, the personal commitment and responsibility demanded in this use of Target Costing may hinder ongoing cross-functional cooperation to manage cost targets. In the second case, Target Costing serves more as a heuristic for continuous steering of new product performance. It avoids issues of individual responsibility, but plays a more active role in continuous problem solving and organizational learning.

The issue of responsibility is also closely related to the management of development risk: Is development risk managed in a collective and mutual way or in a local, decentralized, and perhaps even individual way? Moreover, has a cost target been set as a challenge for collective learning, or is it simply a local objective that can be reached with a high probability of success? These two questions differentiate the ways in which managers use Target Costing in practice.

The Dominant Learning Model

The learning models observed in the Japanese companies I visited seem to emphasize incrementalism and continuity – in comparative cost and value analysis with previous generations of product, a continuous improvement philosophy, fast and frequent new product developments, and component-oriented innovation. By contrast the European learning models observed in Germany and France seem to be characterized more by discontinuity and breakthrough practices driven by architectural innovation, more limited use of cost tables based upon past experience, and less frequent and longer-term product developments.

These empirical observations suggest that Target Costing may be associated with very diverse managerial practices, which impose different potentials and limits on the role of Target Costing in organizational learning. To articulate these relationships between Target Costing tools and managerial practices more formally, we now propose a theoretical framework based upon pragmatic and semiotic descriptions of management tools.

PROPOSED THEORETICAL FRAMEWORK

NPD is basically a process of problem-solving that leads to organizational learning. Target Costing tries to give a formal, quantified economic representation of the strategic gap between existing and desired competences:

$$\text{cost reduction goal} = \text{estimated cost} - \text{target cost}$$

$$\begin{aligned}\text{strategic gap} = {} & \text{existing competence} \\ & -\text{market/competition required competence}\end{aligned}$$

As a set of formal calculation models and logical cause–effect description, Target Costing appears to be only an information tool. To understand its significant impact upon organizational practices, however, we shall draw on some general theories about instruments.

The Theory of Activity and the Instrumental Theory of Tools

What is an instrument? In psychology, a theory of instruments was developed based on the work of Russian psychologist Lev Vygotsky at the beginning of 20th century. Vygotsky (1934) viewed human activity as always situated in a physical body with affective states and in a social context. To act, a human subject always uses intermediate objects. In effect, human activity is always mediated in some way.

> All superior psychic functions are mediated processes, i.e. within their structure they include the use of signs as the central and fundamental means to guide and control the psychic processes… . To explain work as a human activity appropriate to a specific purpose, we cannot limit ourselves to say that work originates in aims, in the problems human beings face, but we must explain it by the use of tools, the application of specific means without which work could not appear (Vygotsky, 1934).

Activity mediation is achieved by artifacts that have a semiotic function: they produce meaning, and they make sense of an activity to generate new activity. A human subject makes sense of his/her own activity through signs (for instance, language), through instruments used, and by involving other people who play an instrumental role. Reciprocally, a subject's activity always produces new signs, new intermediate objects, and new instruments:

activities are interpreted and thereby produce new meaning. Thought itself is experience-based, and it originates in action and uses symbols to give meaning to those actions.

Language and tools have a semiotic function: they establish generic forms of meaning. A word relates a singular object (for example, this concrete table on which I am writing) to a generic class of objects (the class of objects which are named "tables"). When we invent instruments, we are inventing generic procedures to achieve generic types of action. Thus, instruments have a semiotic function which is very similar to the semiotic function of language: they signal generic schemes of action for a given subject in generic situations. Instruments establish a kind of abstract language of activity. For example, a hammer, beyond its inherent material nature (a specific hammer, with its wooden and metal components, in a specific size and shape), also performs a semiotic function by suggesting a generic type of action ("hammer usage").

> Köhler's experiments in the use of a tool by chimpanzees showed that, as soon as they used a stick as a tool to reach an objective once, later they extend that meaning as a tool to all other objects which have something in common with the stick and can fulfill the same function… . Let us assert that in the visual field the stick acquired a functional value determined for a certain type of situation; now that function by itself extends to all other objects which have in common with the stick some characteristics of shape and material (Vygotsky, 1934).

An instrument is therefore generic. It is "a" stick, and not "this" concrete unique stick. The stick as instrument is a concept and enables the user to abstract more generally useful experience from a singular and unique context.

The semiotic function of intermediate objects also engenders a socializing function: languages and tools are inhabited by other people who also use them, and even design them. When we use signs and instruments, we are inevitably socializing ourselves. We meet other people through use of intermediate objects. The airline pilot meets air controllers through language and radio systems, just as he meets the plane designers when using the technical artifacts of the plane. The manager who interprets a cost figure to determine some course of action is conversing – perhaps unconsciously – with the designers of the cost system, with the other users of the cost system involved in the decision-making process, and with upstream users who captured the basic data for the cost system. Different users of the same type of tool follow similar procedures and thereby conform to generic ways of acting that are, in effect, imposed by the tool. But while participating in a common generic activity, individuals may still express their own styles, their own ways of interpretation in which they express their experience, their intentions, and their personality. A tool constrains its users. They cannot do anything they may wish to do with it – for example, one cannot screw with a hammer. But a tool also empowers or capacitates them. With a tool, people can do things they would be unable to do without it. For example, it would be very difficult to drive a nail without using a hammer.

Any instrument therefore has two faces. First, it has a technical face, by which I mean its material configuration that gives it some effectiveness to accomplish some type of action in an economic way. For example, the material configuration of a hammer makes it easier to nail, but this technical face also constrains the activity in which the hammer can be used. Second, there is a psychological face that results when an object is interpreted in terms of meaningful utilization, and in being so interpreted gives sense to a certain type of action. Therefore an instrument consists of two components:

- an objective artifact (which can be material or informational)
- a scheme of action which enables the subject to implement the artifact in a given type of action, i.e., the scheme of utilization of the instrument.

Rabardel (1995, 1999) refers to Piaget (1947, 1970) and Vygotsky (1934) in articulating his theory of instruments:

> The instrument is not only the artefact as daily life common conceptualizations would suggest. The instrument is a basically mixed entity, object and subject in the philosophical sense. On the object side, it includes an artefact, or a system of material or symbolic artefacts, and, on the subject side, schemes of utilization which organize activity, and which have representative and operational dimensions. The instrument is not only a part of the world external to the subject, something given and available for action… . Both components, artefact and schemes of utilization, are linked, but they also have a certain level of mutual independence. The same scheme of utilization can be applied to multiple artefacts. In a reciprocal way, an artefact can be inserted into multiple schemes of utilization which will give it diverse meanings and functions.

Instrumental theory had earlier been suggested by John Dewey:

> The fundamental category of logic is order. It is also the fundamental category of all arts. The universal order in all procedures managed with intelligence is means-to-consequences. At the beginning, when a certain result is desired, an existing material can be utilized in its natural state – as a stick which happens to be at hand can be utilized to raise a stone. In that case, the required operations of observation are simply directed towards selecting an adequate stick. But when the need for a certain gender of consequences is recurrent, it becomes prudent to choose the fittest materials to shape tools which produce the desired result in the fastest and most efficient way, in a wide variety of spatio-temporal circumstances. Materials are then chosen and shaped to become levers. An expert mechanician, even without understanding a scientifically formulated law, learns to know a variety of inventions all of which are levers because, in spite of their different sizes and shapes, they have the functional similarity to be the means of a

distinctive, specific, gender of consequence. All tools are strictly relational, their relational form is the means-consequence relation (Dewey, 1967).

Pragmatic/Semiotic Theory Applied to Management Tools

Organizational behaviors result from a complex interaction between formal management systems and actors' subjective schemes of interpretation (March & Olsen, 1975; Lorino, 1996). A management instrument's perceived usefulness results from the inherent characteristics of the artifact and from the interpretation process by which a human subject makes a practical use of this artifact in some patterns of action. For instance, in Target Costing, the artifacts combined in management systems (e.g., the product costing system, cost estimation models, functional analysis models) combine with actors' schemes of interpretation (which are influenced by culturally dominant learning models, culturally dominant responsibility and risk-sharing models, social definition of professions and functions, etc.). The intrinsic internal processes and technology of management instruments – calculation formulas, for instance, in the case of target costing – are therefore not sufficient to define them. To analyze management instruments requires careful examination of actors' schemes of utilization.

Due to their formal nature, systems of management tools constrain action. As a result, they create some forms of inertia to change, and they impose a kind of boundary on experience. They also induce standardization within an organization by constraining local adaptation. Let us mention some examples:

1. Management accounting undertakes to establish causal links between cost drivers and costs incurred. Cost levels are presumed to be linear functions of selected cost drivers. For instance, the cost of drilling is supposed to be a linear function of direct labor time. These causal models may then underlie product cost estimation: if the selected cost driver is direct labor time, then if the production process for product A is more labor time consuming than for product B, the estimated cost of A will be higher than the estimated cost for B. This is important in Target Costing, since cost estimation is based upon costing models which make similar types of assumption about cost behavior. In the cited example, designing a low-cost product will be translated into designing out direct labor.
2. VE systems posit chains of causality linking local design choices and future customer satisfaction. For instance, the choice of some material may enable a reduction in the level of noise by some 5%, which in turn is

presumed to increase customer value by some 2%. Of course, such a logical link between technology choice and market value may be quite hypothetical, but once the link is embedded in the tool, it may be accepted by different actors as valid and will remain invariant through different phases in NPD.

Management systems also provide a reference background against which actors can detect deviations or generate their own deviations. Dissonances will challenge them to change their own schemes of utilization and/or will surprise, shock, or convince other actors to question their usual schemes of utilization.

Management systems play different and complementary roles in organizational learning: they create inertia to change and encourage continuity, while they may also facilitate cross-organizational coherence and coordination and provide a background landscape that helps to create deviations and to innovate. Management systems impose some degree of organizational uniformity and stability, but they do not directly determine behaviors, since they can only act as artifacts which are subject to individual interpretation. In this way they leave space for possible "distortions." Their embedded purposes may constrain and guide, but cannot fully dictate the patterns of action they will be used in. They prevent some types of action from being developed by actors, and they favor other types of action, but they do not fully determine concrete utilization. Management systems interpretation by actors depends upon their individual schemes of interpretation. This view breaks with the positivist tradition of analyzing intrinsic attributes of management systems independently from interpretation and utilization schemes.

Breaking with the "Representationist" Tradition

This semiotic and pragmatic approach to interpreting tools (including management tools) differs from traditional positivist approaches, which are "representationist," substitutive, and computational. In this view, the operational effectiveness of a tool is credited to its inherent capacity to replicate and simulate some reality. The tool is taken to be a representation of reality which offers an amplifying substitute to human action (for instance, the shovel replaces and amplifies the human hand). Some tools are symbolic representations of reality. They make use of logical symbolic languages and allow implementation of calculation procedures (e.g., computational models). In this view, the physical and informational characteristics of tools are determined by the "real environment," and they in turn determine possible and effective actions in the real world. A tool is therefore seen as a (more or less) accurate copy of reality. It therefore exists beyond human subjectivity, and it can compute and produce results for actions without being affected by interpretations of subjective actors.

For management tools, this representationist view is reflected in concepts like "accurate economic measurement" of the real environment. For instance, if one assumes the "economic rationality of markets," then measuring economic activities within a firm requires unique kinds of economic measures that would not vary from firm to firm. In the same way as the mass or temperature of an object relates it "objectively" to broader computational systems (mechanics, thermodynamics) which transcend the particular concrete circumstances of human experience and the diversity of shapes and colors of objects, management tools are assumed to abstract the economic essence of an activity from the actual technical and socio-human processes using the tools in specific contexts. A management tool is therefore presumed to produce a "correct" symbolic representation of some aspect of an organization. Its representation is taken to be substantive: a correct economic reproduction of reality. Thus, a cost defined by an accounting system should be the "true" cost, or at least as true as possible (rationality can be "bounded" but still rational). Within a representationist view, management tools are presumed to transform concrete human activity into measurable representations with objective equivalence to social and economic reality. Cognitivist views (Simon, 1981, 1982) transfer the concept of representation from representing reality to representing rational human thought about reality, but they are still rationalistic and representationist rather than interpretive.

In the representationist view, target costing appears as a predictive planning technique and must be as realistic and accurate as possible, especially if used as a basis for planning and objective contracting (MBO). In that case, the legitimacy of objectives and plans depends upon the ability of target costing to provide targets and estimations that are close to actual results. Based on my observations, this "predictive planning" view seemed to be dominant in Renault in 1994 and in some of the German companies I visited in 1998.

By contrast, in the pragmatic (Dewey, 1967), semiotic (Peirce, 1978; Vygotsky, 1934), and situated (Suchman, 1987) view, a tool is an artifact which is interpreted by actors as a sign to make sense of action and to shape their activity. In this view, the essence of tools is not a reflection of reality, but a mediation between an actor's subjective thought processes and real objects, which is rooted in the concrete process of action. Thus, there is no opposition between "(objective) measurement" and "(subjective) interpretation," because any tool – and particularly measurement and management theories and tools – are the expression of human actors' subjective interpretations. Management tools receive and provide information which is captured, read, used, interpreted, and handled by human subjects with specific points of view, interpretive frameworks, and judgments (Sanchez, 2000). Tool utilization is seen as an interaction between human subjectivities and objective contexts. From their great diversity of concrete experiences, human actors abstract and build schemes of action. They assume that given schemes of action can be re-implemented in specific categories of situations identified with prior successful cases of utilization. In that sense, schemes of action are generic (from the "genus" of situation, Dewey, 1967), and are not universal.

Through specific systems of symbols or languages (accounting, finance, quality, performance measurements), management tools support the interpretation of a firm's resource consumption and value creation activities in economic terms. Target Costing makes use of several symbolic languages (accounting, finance, functional analysis) to translate highly complex situations (engineering design options) into economic quantifications. Like many other management tools, Target Costing translates a system of complex polymorphic activities (with their technological and human dimensions) into the one-dimension language of economic evaluation scales. These economic evaluations are symbolic representations intended to provide a basis for making judgments (internal and external) about the economic performance of an organization.

In this pragmatic view, Target Costing no longer appears as a predictive planning technique, but rather as an instrument (tool) directly rooted in human action and in the ongoing human interpretation of action. Target costing is bounded (i.e., it only looks at certain aspects of a situation) in order to make economic sense of engineering and planning activities. Its use is not to establish fixed commitments based on its economic analyses, but rather to provide heuristics for continuous interpretation and steering of project performance. It is in this sense that management tools in general, and Target Costing in particular, play a role in organizational learning within the pragmatic and semiotic view.

A Pragmatic and Semiotic Approach to Organizational Learning

A key question for our discussion then is, What is "organizational" about organizations, and in particular, what is organizational about knowledge in organizations? Organizations *per se* do not think, and thus strictly speaking cannot be said to have knowledge (see footnote 1). Knowing as a mental activity, and knowledge as a form of mental representation, occurs in the minds of individuals (Sanchez, 2000). Due to the division of labor and the need for resource-sharing, however, *action* within organizations is specifically *organizational* – i.e., it involves *coordination* of individuals and cannot be wholly reduced to a simple sum of individual actions. Through socially organized processes of action, the work of multiple actors is coordinated to achieve results that isolated actors could not achieve on their own. That is why we propose pragmatic definitions of organization as ''a socially organized system of action'' and of organizational knowledge as ''individual schemes of interpretation which enable organizational action'' (cf. Sanchez, 2000). In this view, management tools play a key role in creating and designing an organization, since they are the symbols or signs that help individuals understand how they might engage in collective activity. The concept of ''sign,'' as defined by C.S. Peirce a century ago, is the cornerstone of this theory.

Peirce's Triadic Semiotics

The pragmatic and semiotic view of organization rests on Peirce's triadic theory of sign. According to Peirce (1978), human experience and knowledge result from triadic interpretations of experience, which always involve three elements:

The object interpreted: In the context of organizational action, objects are interpreted by actors to understand specific situations of work – What happens here? What should I do? These interpretations normally result from an individual's previous activities and experiences.

The interpretant: This is the conceptual pattern which organizes and enables interpretation, allowing a human subject to select and read the interpreted object and to make sense of it. The interpretant is based upon the personal history and experience of the actor, his or her cultural context, and the actor's position in the organization; it is the actor's interpretive scheme, his or her evolving interpretive framework (Sanchez, 2000).

The representamen: This is a specific way of ''translating'' an interpreted object into a particular field of significance. It is generated through the interpretive scheme of an individual. The representamen answers the questions, What is the meaningful attribute of this object, and how can I make sense out of the object for a specific purpose?

For instance, the word ''table'' is the representamen which conceptually supersedes the specific, physical wooden object I have in front of me, and brings to it the categorical meaning of ''table.'' Another example can be found in the situation of a drilling operator in a mechanical factory. The operator, noticing the color and smell of a drilling tool, may warn the maintenance team that the tool is going to break. One object (the specific tool) is interpreted by the operator on the basis of his experience (interpretant) and translated into a representamen of the drill, in this situation, that is his diagnosis and verbal formulation.

As a human mental activity, tool utilization involves a triadic interpretation. Tool utilization replaces an object, a concrete and specific aspect of a work situation,[3] by a sign that points to a certain category of meaning, and then to a specific scheme of utilization for the artifact that is applicable to the generic class of situations which encompasses the current work situation. This interpretation process enables purposeful action: the concrete utilization of the tool in a specific situation.

Application of the Theoretical Framework to Target Costing

The whole process of NPD, in which Target Costing plays a role, can be described as an interpretation process. As highlighted by Clark and Fujimoto (1991), ''The product as a physical object is only the medium by which the product experience and the producer's messages are delivered to customers. Product development creates value carrying-messages.'' In this sense, the product is a sign formulated within the interpretive schemes of the producers and becomes an object to be interpreted through customers' interpretive schemes. The product development process itself is a chain of successive interpretations (''translations''):

1. The product concept translates information on future market needs, technical possibilities and other conditions.
2. Product planning translates the product concept into specific for product detailed design. Product planning represents the first opportunity to interpret the product concept in physical form.
3. Product engineering translates product planning information into detailed product design.
4. Process engineering translates detailed product design into process designs.

(Clark & Fujimoto, 1991).

For example, a prototype will be interpreted by a stamping specialist in terms of future stamping process solutions. To serve that purpose, a prototype should be designed as a "map" of stamping issues and options, in the same way as a geographical map made for car drivers will be designed to give a specific view of possible car itineraries. The product prototype should not be asked to reflect the future object with complete accuracy, but only to represent the future object in a way that is meaningful for the purpose (or action) of designing the stamping process.

Similarly, in a product cost planning system, there will be representations of a "cost" for a type of design envisaged. The only test of the cost system's representation is validation through action – i.e., does this cost planning or target costing system lead to useful interpretive results by actors in the collective action of the NPD process? It is in this sense meaningless and irrelevant to ask whether the cost planning system reflects the "true" cost of a design. But it is meaningful and relevant to ask what kind of "message" about cost makes sense – or more precisely, helps to make sense – for an actor in this type of situation. For instance, the message of a cost system would have to be quite different if delivered to a Japanese engineer who is expert in value engineering and is convinced that the economic success of the product is part of his professional challenge, versus a French engineer who wishes to protect his freedom to innovate.

CONCLUSIONS

Target costing tools favor certain types of action and organizational behavior. They tend to transmit market pressures to all product design-related functions within a company. They distinguish between appraisals of a firm's current abilities (estimation) and desired performance (target). They help to make strategic gaps visible and to create psychological and social incentives for learning to close the gap between estimated and target costs. They tend to produce individual and collective stress and sense of urgency, since the target costs are typically both difficult to reach and, as market requirements, vital to reach.

Nevertheless, through field observations, we have seen that identical Target Costing tools can be used in very different ways within very different schemes of utilization. They may be used in ways that deepen cross-functional integration, providing a means to merge different functions' efforts, or even to integrate different types of objectives and knowledge within the same mental process in an engineer's head. This was the kind of use that

I observed in five Japanese companies. Alternatively, Target Costing tools may be used to reinforce planning and control, legitimizing targets by introducing market factors, and strengthening managers' responsibility and internal contracting. They may even be used to support functional self-justification and finger-pointing against other functions. In some situations, people may interpret the signs of Target Costing as pointing to political manipulations and arm twisting relationships. Thus, the tools used in Target Costing do not have a universalistic, "objective" meaning, but rather potentially many different meanings derived from different schemes of interpretation.

Even in the cases in which the intention is to implement "true" TCBM processes, the practices symbolically referred to under the TCBM banner will in practice depend upon a number of interpretive factors closely related to national, industry, professional, and corporate cultures. A number of related issues that we have touched on in this discussion will determine the meaning that TCBM takes on in a specific organizational setting:

- What role does the market play in the corporate culture? What are the relationships between technical culture and market culture? Are engineers "market-oriented" or are they "craft-oriented" to their profession? Is market culture the exclusive attribute of marketing and sales functions? What is the relative weight of market considerations in technical performance evaluation and management?
- What is the place of economic culture in the corporate culture? What are the relationships between technical culture and financial culture? Are engineers "cost and profit-oriented" or "craft-oriented?" Is profit culture seen as the exclusive attribute of control and finance functions?
- How are professional values defined? What are the relationships between professional values and corporate values? Do people belong first to a profession or craft, or do they belong first to a corporation? How are involved professions socially defined? What is their boundary, and what is their intellectual content? For instance, if someone is socially defined as an "engineer," what is he or she supposed to know?
- What modes of knowledge integration are used? Is the coordination between different types of knowledge (market/economics/technology) pursued through "subjective integration" in the minds of individuals, or through "social integration" across the division of labor and different functions like engineering, control, marketing?
- How is the relationship between individuals and the organization managed? Is technological and market risk managed on an individual level or

on an organizational level? What are the culturally dominant philosophies with respect to responsibility and risk sharing? If there is a culture of collective responsibility and individual protection, do these give rise to transparency about costs and/or tend to diminish stress when negotiating prices between vendors and buyers? If there is a culture that emphasizes personal commitment of managers to formalized MBO and internal contracts, does this tend to increase stress and opacity about performance potentials, and/or to strengthen personal commitments to objectives?

- How is the relationship between different firms within the same value chain managed? What is the relative importance of market-based models (with emphasis on price, negotiation, contract, commercial secrecy, enforceable commitments, etc.) versus associative/clannish models? Is the cooperation between firms (vendor/buyer) mainly competitive and commercial contract based, or are transactions partnership and cooperation oriented? Are the legal norms in use flexible enough to leave room for ongoing adaptation?
- What are the culturally dominant learning models? Is learning carried out through continuous, incremental processes? For example, does most new product design start from the previous product generation and seek incremental improvements? Or does learning follow a "white sheet" discontinuous, breakthrough pattern? For example, does the design of a new product start with the architectural design of the new product generation?

In conclusion, Target Costing provides a good example of a management tool which is commonly defined in "objective," universalistic terms, but which proves to be implemented in practice in very different ways in different cultural contexts. Its impact upon NPD processes and particularly upon organizational learning in NPD depends fundamentally on the interpretation processes and symbolic sensemaking occurring in a given organizational context, not on some assumed improvement in accuracy in predicting cost and value future parameters. The accuracy of target costs may be checked *ex post*, but the value of the tool is derived from the way the tool serves human actors as an *ex ante* support for sensemaking and action facilitation. Given such considerations, a management tool – for instance, Target Costing – is neither true or false, right or wrong, but simply conveys some types of meaning for actors.

Perhaps the essential lesson of this discussion for future research in the competence perspective is that Target Costing and other management tools cannot be presumed to have universal "objective" meanings in all organizational contexts. Rather, management tools must be understood to have meanings that depend on the dominant cultural schemes of interpretation applied to those tools. In our examples, we observed that, in some cases, TCBM appears mainly as a planning tool to establish targets and commitments on a legitimate and credible basis. In other cases, TCBM appears mainly as a heuristic for continuous steering and learning within the NPD project. It would be important then for future research to differentiate between these two systems of meaning (and perhaps others that may be identified), and to recognize that different implemented meanings of TCBM or other management tools may operate and evolve in very different ways.

NOTES

1. Unlike Argyris and Schön (Argyris & Schön, 1978), we use the expression "organizational learning" essentially as a metaphor. Strictly speaking, we believe that the subject of learning cannot be an organization, since learning involves an individual's subjective mental activity. Division of labor and coordination, however, makes the processes of action "organizational." To be correct within our theoretical position, we should speak of "coordinated individual learning processes within and about organizational processes of action." It is simpler, though less rigorous, to speak of "organizational learning," and so our use of the term "organizational learning" in this chapter should be taken to represent individual learning within organizational processes of action.
2. Methods for breaking down target costs in this way include utility analysis, which weighs the relative importance of product functions, subassemblies, and components in satisfying customers' requirements as specified by market inquiries.
3. We adopt here Pierre Rabardel's (Rabardel, 1999) definition of "artifact" and "instrument." We use the "artifact" concept to neutrally designate any purposeful thing of human origin. Artifacts can be material as well as symbolic. An artifact can have different status for the subject and, particularly, what is of interest for us here, the status of instrument when it is means of action for the subject.

REFERENCES

Argyris, C., & Schön, D. (1978). *Organizational learning. A theory of action perspective*. Reading, MA: Addison-Wesley.

Arnaout, A. (2000). *Target costing in German industries*. Doctoral thesis, University of Stuttgart, Stuttgart.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99–120.

CAM-I (1992). *Target costing management – profit by design.* Work paper of the target costing European interest group, Poole.

CAM-I, Berliner, C., & Brimson, J. A. (Eds). (1988). *Cost management for today's advanced manufacturing*. Boston, MA: Harvard Business School Press.
Clark, K. B., & Fujimoto, T. (1991). *Product development performance – strategy, organization and management in the world auto industry*. Boston, MA: Harvard Business School Press.
Cooper, R. (1992). *Target costing*. Communication to CAM-I European research group.
Cooper, R., & Slagmulder, R. (1997). *Target costing and value engineering*. Montvale, Portland: Productivity Press The IMA Foundation for Applied Research.
Dewey, J. (1967). *Logic: The theory of enquiry*. Henry Holt and Co. 1938. *Logique, La théorie de l'enquête*. Paris: PUF (in French).
Eco, U. (1990). *I Limiti dell'Interpretazione*. Milan: Fabbri, Bompiani, Sonzogno.
Horvath, P. (1993). *Target costing, state of the art review, a CAM-I research project*. Kempston Bedford (UK): IFS International Limited.
Kato, Y. (1993–94). Target costing support systems. *Management Accounting Research*, *4*(1), 33–47.
Lefebvre, Ph., Roos, P., & Sardas, J. C. (2001). *Rationalisation de la conception et recomposition des dynamiques professionnelles*. Contribution to Berlin Seminar, 26 January.
Locke, E. A., & Latham, G. P. (1984). *Goal setting: A motivational technique that works!*. Englewood Cliffs, NJ: Prentice-Hall.
Locke, E. A., & White, F. (1981). Perceived determinants of high and low productivity in three occupational groups: A critical incident study. *Journal of Management Studies*, *18*, 375–387.
Lorino, Ph. (1996). *Comptes et récits de la performance. Essai sur le pilotage de l'entreprise*. Paris: Editions d'Organisation.
Lorino, Ph. (1997, 2001). *Méthodes et pratiques de la performance*. Paris: Editions d'Organisation.
Lorino, Ph., & Tarondeau, J. C. (2002). From resources to processes in competence-based strategic management. In: J. Morecroft, R. Sanchez & A. Heene (Eds), *Systems perspectives on resources, capabilities, and management processes*. Oxford: Pergamon.
Makido, T. (1989). Recent trends in Japan's cost management practices. In: Y. Monden & M. Sakurai (Eds), *Japanese management accounting*. Cambridge, MA: Productivity Press.
March, J., & Olsen, J. (1975). The uncertainty of the past: Organizational learning under ambiguity. *European Journal of Political Research*, 3. La mémoire incertaine. Apprentissage organisationnel et ambiguïté. In: J. March (1991) *Décisions et organisations*. Paris: Editions d'Organisation (in French).
Morgan, M. J. (1993). A case study in target costing: Accounting for strategy. *Management Accounting*, (May), 20–24.
Peirce, C. S. (1978). Ecrits sur le signe. Paris: Editions du seuil. Translated from *Collected papers of C.S. Peirce* (1932–1954). Boston, MA: Harvard University Press.
Piaget, J. (1947). *La psychologie de l'intelligence*. Paris: Armand Colin.
Piaget, J. (1970). *L'épistémologie génétique*. Paris: PUF.
Rabardel, P. (1995). *Les hommes et les technologies*. Paris: Armand Colin.
Rabardel, P. (1999). Le langage comme instrument? Eléments pour une théorie instrumentale élargie. In: Y. Clot (Ed.), *Avec Vygotski* (p. 283). Paris: La Dispute.
Sakurai, M., & Huang, Ph. Y. (1989). A Japanese survey of factory automation and its impact on management control systems. In: Y. Monden & M. Sakurai (Eds), *Japanese management accounting*. Cambridge, MA: Productivity Press.

Sanchez, R. (Ed.) (2000). *Knowledge management and organizational competence*. Oxford: Oxford University Press.

Sanchez, R., Heene, A., & Thomas, H. (Eds) (1996). *Dynamics of competence-based competition*. Oxford: Elsevier Science.

Selznick, P. (1957). *Leadership in administration*. New York: Harper & Row.

Simon, H. (1981). *The sciences of artificial*. Cambridge: MIT Press.

Simon, H. (1982). *Models of bounded rationality*. Boston: MIT Press.

Suchman, L. (1987). *Plans and situated actions, the problem of human-machine communication*. Cambridge, MA: Cambridge University Press.

Tanaka, M. (1989). Cost planning and control systems in the design phase of a new product. In: Y. Monden & M. Sakurai (Eds), *Japanese management accounting*. Cambridge, MA: Productivity Press.

Tanaka, T. (1993). Target costing at Toyota. *Journal of Cost Management*, (Spring), 4–11.

Vygotsky, L. S. (1934). *Thought and language. Pensée et langage*. Paris: Messidor (in French).

Webster, D. W. (1991). Activity-based costing facilitates concurrent engineering. *Concurrent Engineering*, (November/December).

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(2), 171–180.

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NEW PRODUCT DEVELOPMENT AS KNOWLEDGE MANAGEMENT IN THE ITALIAN AUTOMOBILE INDUSTRY: HOW MANY GOALS HAVE BEEN SCORED?

Nicoletta Buratti

ABSTRACT

Many companies, seeking ways to develop new high-quality products more quickly and efficiently, are remodeling their new product development (NPD) processes and management practices on approaches adopted by leading firms worldwide. The rationale for these changes lies in the need to balance new knowledge generation, which is a time-consuming process, and timely product development. In this chapter we attempt to interpret changes in the Italian automobile industry, by describing the approaches developed by Fiat Auto, the well-known Italian car manufacturer, during a decade. Our purpose is to point out the specific patterns followed when implementing the transition toward a new model of NPD, based on principles emerging in knowledge-management studies and practices.

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INTRODUCTION

The development of new products and the research of the most appropriate organizational and managerial strategies for guaranteeing the success of innovative projects constitutes one of the most fertile and richest fields for inquiry, study and reflection.

The theme in fact presents great significance from a practical point of view, inasmuch as the capability of developing and introducing new products onto the market with success represents one of the principal sources of competitive advantage for a company (Clark & Fujimoto, 1991; Wind & Mahajan, 1997; Buratti, 2000). Added to this, is the fact that the intensification of competition (D'Aveni, 1994) forces companies to build capabilities for managing this process with ever greater speed and continuity (Valdani, 2000): being able to introduce new products onto the market in a short time allows companies to reduce risk in mismatching between market expectations and their interpretation, and to anticipate the competition. Developing a continuous stream of innovations, moreover, allows the company to have a solid base on which to construct and maintain over time relationships of trust with the market, increasing notoriety and reinforcing brand image, and more in general, achieving superior results of an economic–financial and relationship nature through an increase of the level of trust of the various stakeholders of the company (suppliers, financiers, public opinion, etc.).

But there is also another reason, of an eminently theoretical nature, that amplifies the interest aroused by this theme: the development of new products, and more in general of innovation in the company, is the result desired and actively pursued, but not fully controllable or programable, of efforts intended to balance creativity with organization, freedom of conducting exploratory research with method and strict control on results, experimentation of the new and appreciation of resources and abilities already in existence (Vicari, 1998; Verona, 2000).

In other terms, it means managing a process that generates new knowledge, utilizing knowledge and skills that are already available in the company, or that can be activated through relationships with external subjects that possess specialized complementary skills (Badaracco, 1991; Leonard Barton, 1995).

In this process, time represents an extremely critical variable that must be managed, both from a strategic as well as an operational perspective: the strategy for innovation must balance the speed of the transformation of the external environment with the slowness of the process of the transformation of abilities, resources, business systems on which innovative skills are based.

In the planning phase of the structures and processes for creating the new product, it is necessary to balance the need posed by guaranteeing freedom of expression, experimentation, exploration in the phase of creative conceptualization with that of speed of development, planning a rigid division of times relative to the various activities that make it up. Last, in the actual performance of the latter, it is necessary to balance once again the needs posed by socialization among members of the work group (project team) with respect for the time frame allotted (timing) for the realization of the project.

The goal of this work is to propose a reading of the principal models and concepts that emerged in the area of management studies over the course of the last decade, trying to underscore the ways in which the challenge of innovation and management of the time factor may be dealt with, to then explore through the analysis of a case study, the implementation of such principles in a specific context, illustrating the problems dealt with and the criticism that emerges. The reference literature was selected using an approach to product development understood as the disciplined process of problem-solving (Brown & Eisenhardt, 1995): it is in this area in fact that we may classify the great majority of studies on the development of new products coming out in the second half of the 1980s, that deal with the problems of organization and management of the process in a perspective that underscores the cognitive nature of this activity and also underscores the social aspects of interaction among members of the work group. To this we add a few reflections that lead back to the current of management studies on skills and knowledge based on the view of the firm that have mostly focused attention on the creation of skills for innovation and the product development process as "a lens" for analyzing strategic and organizational problems implied in the building and leveraging of knowledge as a fundamental factor on which to found competitive advantage of the business in the c.d. new economy of immateriality, networks and knowledge (Heene & Sanchez, 1997; Sanchez, 2001a, b).

The case study refers to the automobile industry, considered significant for several aspects. First of all, it is a mature sector, characterized by intense competition, by a progressive saturation of demand, and by a growing differentiation of expectations. Second, the "car" is without a doubt definable as a complex product in consideration of the number of parts, components, systems that make it up and the technologies incorporated.

The innovation of the product therefore presents specific problems that are particularly significant from our perspective: first of all, for the intrinsic systemic nature of the product that requires the possession of the capability to integrate between specialized and complementary contributions, often found outside the borders of the company. Second, for the characteristics of competition and demand that impose the possession of capabilities necessary to continually develop new products, faster than the competition (time) and guaranteeing maximum efficiency (cost) and increased performance (quality). It means, therefore, an industry that allows for analyzing innovation according to a particularly illuminating perspective (and rich in theoretical contributions and concrete examples).

The firm analyzed is the Italian carmaker, Fiat Auto, a company which is going through a phase of important strategic and organizational perspective. As we will have occasion to point out following, the analysis of the case does not attempt to be, differently from the majority of case studies, the illustration of a best practice, but it may be considered an exemplary case, in that it allows for some reflections on the importance of development of adequate capability for innovation, highlighting some critical factors in the management of these fundamental activities for competitiveness and business development.

The chapter is organized as follows: first, we briefly outline the basic literature on new product development (NPD) management, trying to point out key concepts and frameworks for the analysis of the case study.

Second, we concentrate on the automobile industry and analyze the approach developed by Fiat Auto, the well-known Italian automobile manufacturer, illustrating the main organizational innovations introduced during the past decade. By describing its specific NPD process, organization and efforts to obtain better integration with the market and with suppliers, we seek to understand how the company has progressively modified its NPD management and how it has internalized the principles emerging in management studies.

Finally, we attempt a discussion of the experiences of the two Italian firms, and provide ideas for further research.

FACTORS INFLUENCING THE DEVELOPMENT OF SUCCESSFUL NEW PRODUCTS IN A KNOWLEDGE PERSPECTIVE

NPD is a Process of Knowledge Integration…

Since the very beginning of the emergence of a new perspective on NPD, it has emerged that it may be considered a lens for investigating the process of building and leveraging capabilities underlying dynamic competition: over the last decade, several management studies have highlighted that successful firms are those that are able to manage their knowledge potential in order to innovate continuously. It has been shown that a firm's capability to successfully face competition in a dynamic and turbulent environment, is based on the ability to nurture, adapt and regenerate its knowledge-base, while developing and retaining the organizational capabilities that translate that knowledge-base into useful actions (Teece & Pisano, 1994; Iansiti & Clark, 1994; Leonard Barton, 1995).

Dealing with the NPD process in a knowledge-management perspective implies the definition of how firms generate, use and renovate the knowledge they possess or may activate through external links. This in turn requires a deep understanding of the very nature of knowledge and its transformation. Among others, the study by Nonaka and Takeuchi (1995) may be considered a milestone: knowledge is considered both in its epistemological (tacit vs. explicit) and ontological dimensions (individual vs. collective). The capability of firms to successfully generate continuous innovation is linked to the ability to manage the full cycle of transforming knowledge, through processes of socialization (tacit/tacit at individual level); externalization (tacit/explicit, at group level); combination (explicit/explicit, within groups); and internalization (explicit/tacit, from group to individuals again).

Subsequent studies have pointed out the management tasks for coordinating and implementing the full cycle of transforming knowledge into firm critical assets and capabilities over time. Sanchez (2001a), among others, illustrates a model of the process of knowledge creation articulated into five cycles whose management requires specific actions: (1) Creation and renewal of knowledge at an individual level, which requires actions aimed at fostering the individual learning cycle through the assessment of individual knowledge and interpretative frameworks, and the creation of stimuli to their renewal. (2) Transfer of knowledge from individual to individual, thus creating new knowledge at a group level through appropriate modes of interaction. (3) Consolidation of new knowledge within groups, sustaining the process of renewal of group capabilities and routines. (4) Transfer of knowledge from groups to organization, favoring the diffusion of new knowledge. (5) Renewal and use within the organization, sustaining the extensive use of the new knowledge at all levels and in every business, through renewal of interpretative frameworks embedded in systems.

In order to do this, managers have to sustain the process of new knowledge acquisition from the outside, give incentives to knowledge workers to articulate their knowledge into explicit forms, and invest in information systems for rapidly disseminating explicit knowledge throughout the organization. In practice, articulate strategies for development and exploitation of knowledge.

In NPD, knowledge integration is seen as a process of bringing together all relevant knowledge deriving from different sources, either internal or external, for the implementation of each specific project (integration within a project). The new knowledge generated (about the product, the process, the organization of the project) during implementation must then be capitalized on, so that it is integrated across projects and over time.[1]

Developing organizational mechanisms that fuel the *knowledge integration process* becomes a key factor for successful innovators.

Traditional literature on NPD and organizational structure has underlined the role of integration within a project. This kind of integration, named internal integration by Iansiti and Clark, "is the capacity for extensive coordination between different specialized subunits within an organization, and explicitly targets the implementation of a given project concept" (Iansiti & Clark, 1994, p. 569).

In a turbulent environment, external integration is of paramount importance, i.e. integration with respect to the main sources of uncertainty which may hinder the efficacy of the innovative project: integration of knowledge of the market and the customer base (the capacity to link information and knowledge about future customers and their use of the product to the development process and the details of engineering); the capacity to link and integrate knowledge of emerging technologies.

Managing this process is a complex task for many reasons. First of all, think of the portion of knowledge embedded in people whose transfer – even within the same firm – is often far from simple: its partly tacit nature makes transfer of knowledge slow, costly and uncertain (Kogut & Zander, 1992). Moreover, the efficiency with which knowledge can be transferred also depends upon its potential for aggregation (Grant, 1996). Indeed, as knowledge transfer requires both transmission and receipt, the capability of recipients to absorb the transferred knowledge is critical (Cohen & Levinthal, 1990; Arora & Gambardella, 1994).

The need for effective understanding of the specialist knowledge transferred requires the use of a *common language*, while the need for the aggregation of different pieces of knowledge highlights the importance of designing *coordination mechanisms* and *integrative roles, both within each NPD project and across different projects*.[2]

In this perspective, *management of cross-functional teams* is a matter of particular concern.

Effective cross-functional teams are those designed in order to satisfy the principle of requisite variety,[3] and the need for free flow of communication, so as to produce redundancy of information.[4] Effective management of cross-functional teams also means that the skills and mental models of potential team members, whose role will be chosen according to capabilities, need to be carefully assessed. A unique, information-rich location where team members work elbow-to-elbow must be available; and finally formal and informal checkpoints should be designed, in order to build trust among team members (Madhavan & Grover, 1998).

As regards the key capabilities of team-members, special importance is attributed to individuals who act as a bridge between different areas of knowledge: T- and A-shaped skills[5] are becoming an essential ingredient for the effective functioning of development teams (Iansiti, 1993; Leonard Barton, 1995).

The problem of integrating different pieces of knowledge is emphasized by the growing need to assemble knowledge generated and possessed by external sources: suppliers, research centers, customers, sometimes even competitors.[6] Importing and absorbing knowledge from the outside requires a new approach to potential sources of new knowledge. The need for a common language, mutual understanding and convergence of goals has in fact led to an active search for organizational mechanisms able to foster truly cooperative customer relations, based not only upon intensive and effective two-way exchanges of information and upon joint problem-solving, but very often based upon joint development teams in co-location, as a means to the establishment of credibility and trust among partners.

Perhaps even more difficult is the task of integrating knowledge coming from the market, and the ability to transform it into knowledge usable in developing successful new products (Li & Calantone, 1998). As highlighted by several studies (Booz, Allen, & Hamilton, 1982; Cooper, 1992; Day, 1994) market research and market testing are of paramount importance in orienting the process of NPD, and effective coordination mechanisms between R&D and marketing functions may have a sound impact on performances of NPD projects (Gupta, Raj, & Wilemon, 1986; Griffin & Hauser, 1996). Notwithstanding, innovative firms have to cope with two sources of uncertainties which may hinder the effectiveness of information gathered by the marketing department[7]: the first, concerns the appropriateness of the research method used for exploring customer expectations; the second, regards the right identification of people to whom the inquiry must be made. The first problem is strictly linked to the nature of knowledge that researchers are able to extract from people; especially in the earlier stages of NPD process, when the firm is exploring alternative concepts, it is difficult to activate an effective transfer of the real value of the idea and of the benefits for customers deriving from the use of the new product. Even more difficult for the development team is assessing the market trend, finding the source for the winning idea.[8] Finally, it is worthwhile to note that an excessive focus on current customers may limit the attitude of the firm toward greater novelty, thus slowing down its ability to renovate its competences through major innovations (Hamel & Prahalad, 1994; Christensen & Bower, 1996). But this problem leads us to the other critical factor in developing successful new products: the search for the correct balance between time control and creativity.

….Which Requires to Become Fast Knowledge Integrators while Fostering Creativity

As highlighted by several studies (Takeuchi & Nonaka, 1986; Wheelwright & Clark, 1993), the final output of NPD is the result of an iterative process, mainly based on trial and error, on experimentation, failure and learning. For this reason, it is a time-consuming process. And in fact, in the knowledge view of the firm, the creation of new knowledge to be embodied in the product is a process that requires various cycles. Each cycle, starting with the sharing of experience among the team members and ending with the building of a prototype, is linked to the following one, which starts either to improve upon the outcome or to overcome the shortcomings of the previous cycle.

Moreover, redundancy of information, one of the basic enabling factors which spur new knowledge generation, increases the amount of information to be processed and can generate information overload. It may even negatively impact the cost of knowledge creation – at least in the short run – through decreased operational efficiency.

Therefore, as growing competitive pressures require reduced lead times, companies are now actively seeking methods and organizational procedures that enable them to reach a satisfactory trade-off between reduction of time, successful NPD and creativity (Stalk, 1988; Stalk & Webber, 1993; Smith & Reinertsen, 1991; Griffin, 1997; Bourgeon, 2002).

Concurrent engineering has been a keyword in this move. In its most extensive meaning, it implies parallel product development, i.e. division of labor among specialized teams, and the simultaneous move by all function departments, running together to meet the targeted cost, performance level and launch date; but also intense communication flows between teams working in parallel, often supported by the extensive use of information and communication technologies (ICT).[9]

Finally, the capability of the innovative firm to capitalize on past experiences is crucial. For this reason, innovating firms need to plan methods that will enhance the diffusion of knowledge within the organization, in order to reuse knowledge available "on the shelf." Technical memoirs, shared databases, virtual communities of experts (specialists as well as operators), are among the most common methods to reduce the time of NPD, thus allowing greater attention to those components and systems that actually generate value for customers.

The adoption of modular product and process architectures,[10] which enable the firm to separate the processes for developing and producing the components, thus rendering them autonomous from an organizational perspective, may be an effective tool for managing knowledge articulation and dissemination and for strategically guiding organizational learning.

In this way, the firm can improve its ability to develop and leverage technical and market knowledge, through greater focus on its technical distinctive capabilities and larger outsourcing;[11] greater variety of products and greater speed in facing the changing requirements of customers.

Moreover, the adoption of product and process modular architecture enables the firm to plan its future development more precisely, identifying new kinds of components needed to bring new functions, features and performance to new products. Finally, it enables the firm to stimulate continuous innovation, in contrast with the prevailing view that generating creative new products requires a creative organizational environment, i.e. unstructured, unfettered, in which people may freely try out through experimentation and trial and error learning processes every kind of new idea for products and ways of doing things. Sanchez (2001b) argues that "the architectural perspective makes plain that a disciplined adherence to a well-defined modular development process can enable many new configurations of products and processes to flourish" (p. 248).

For these reasons, Sanchez argues that product and process architecture may be used as formal systems for articulating, codifying, and leveraging technical and market knowledge in supporting a strategy for speed exploitation of the knowledge base of the firm.

BUILDING AND LEVERAGING INNOVATIVE CAPABILITIES IN THE AUTOMOBILE INDUSTRY

The pattern toward the implementation of this set of rules is especially clear in the automobile industry, where changes in NPD management have been taking place since the 1980s.

Shortening product life cycles, falling margins and increasing customer expectations represented great challenges for companies worldwide. Manufacturers had to nurture their capability to innovate while controlling time of development: for this reason, automobiles provide a perspective on the process of dynamic capability building where customer demands are changing (Iansiti & Clark, 1994).

The success of Japanese companies in managing this trade-off has been studied for over a decade (Womack, Jones, & Roos, 1990; Imai, Nonaka, & Takeuchi, 1985; Wheelwright & Clark, 1992; Johansson & Nonaka, 1996; Kamath & Liker, 1994; Sobek II, Liker, & Ward, 1998), through in-depth analysis of their NPD process and organization. The specific features of a different style of management have thus been revealed, which soon became the basis for *the new approach to NPD* in the worldwide automobile industry.

Implementing the new approach to product development able to cope with challenges of a dynamic competition, involves several actions, affecting the process and its organization:

1. To recast the entire process, fostering higher quality, while controlling time and cost.
2. To strengthen links with external sources of new knowledge, both technical and market knowledge.
3. To organize project development teams, in ways, which encourage intra- and inter-company communication flow, thus enabling learning processes.

Among these features, the role of suppliers within NPD and the management of relationships with them appeared to be of paramount importance (Lamming, 1993).

Indeed, carmakers have been trying to improve the flexibility of their organization, and have encountered great difficulties when attempting to harness the entire range of knowledge and technologies necessary to develop their complex products. These difficulties have induced carmakers to progressively externalize primary innovation functions, such as complex component and system design, and revise their supplier networks. Carmakers have acknowledged the opportunities that are generated when suppliers take on an active role within the generation of knowledge to be embodied in the final product. Relationships have therefore been tiered and partnerships with suppliers chosen on the basis of their innovative capabilities have been established.[12]

In any case, it should be underscored that the results achieved in the study by Iansiti and Clark (1994) have shown that in the auto industry:

1. A significant correlation exists between the quality of products on the company level and external integration toward the market.
2. Reduced lead time is necessary to keep the pace with rapid changes in the client base, whereas high levels of productivity are important for achieving a variety of product that the market requires, given the limited availability of organizational resources for development. Control on the time factor and productivity are achievable through heightened internal integration.

It appears evident, therefore, how in the industry the critical external integrative capabilities for success are constituted by the company's ability to spread principles of market orientation among the product development teams, so as to shape the NPD process as an actual bridging process (Day, 1994). Therefore, the core problem is to implement a coordinated set of actions aimed at strengthening market perception and customer relation capabilities on the one hand, and at ensuring the link with internal process optimization capabilities on the other hand. Reaching these targets involves: orientation of the NPD process toward the attainment of external goals; the presence of a marketing manager in team development, at all levels; full sharing within the teams involved in project development of all the market information necessary to make correct decisions at the right time.

PROMOTING KNOWLEDGE INTEGRATION CAPABILITIES IN THE ITALIAN AUTO INDUSTRY: THE FIAT AUTO CASE

The analysis of case studies is habitually used in management studies as a method for appropriate research not so much to falsify or validate specific hypotheses of the research as to analyze in depth complex cases, rather, with the intention of exploring problems of an organizational nature.

Case studies become particularly significant when they are conducted in a longitudinal way, over a period of time that is rather extended: as is known, every relevant modification of an organizational type requires a rather long time to be metabolized and internalized in procedures, systems, organizational routines (Stake, 1995; Yin, 1994).

In this chapter, we describe the main features of the approach to NPD management at Fiat Auto: the case proposed presents some specific characteristics that are worth calling attention to.

First of all, it is difficult to currently classify the experience of Fiat Auto as a success tout court: as is known, in fact, the company has recently dealt with one of the most serious crises of its history.[13] And notwithstanding this, it has a history of development of new products that even in recent times and especially at the present is characterized by examples of success.

At present, the management of Fiat Auto is taking up some main challenge, in the effort to overcome the great crisis of past years; some changes in the whole organization are taking place, and the process of NPD is itself under reviewing. For this reason, it is difficult to give a definitive picture of the process and its organization; notwithstanding, we would like to point out some features that are of particular interest, if analyzed in our perspective. As we will try to highlight in the final comment to the case, the actions that were illustrated to us during the course of interviews with managers who "lived through" the organizational modifications conducted over the past 5 years and who performed central roles in the processes of product development, seem to trace back to problems of construction and appreciation of key skills for innovation and therefore lend themselves to some reflections on the current trends underway in the industry and problems related to the implementation of principles and adoption of more suitable instruments for managing the company and innovation in the context of a knowledge economy.

For this reason, we first describe the rationale for the strategy of product innovation and the archetype of the NPD process (its structure and its organization). Then we will try to point out some recent changes, introduced in order to guarantee more effectiveness and efficacy of the process. Finally, we will attempt to rationalize the case, coming back to the literature explored in part 2, and trying to point out some areas for further research on this topic.

The method used for gathering information on the NPD process and management was based on extensive interviews with managers of the Platform Core Team, engaged in NPD projects of paramount relevance for the firm.

Interviews were first conducted in July and September 1998. A second round was carried out by July 1999, in order to reappraise the approach adopted and its implementation in current practices. Finally, a third round was implemented in March 2004, with the specific aim to update the case and trace the future directions followed in renewal of organizational competences for innovation.

Experimenting a New Approach to NPD Management at Fiat Auto: The 1990s

Fiat Auto[14] is the main company of the Fiat group.[15] Its history began over a century ago, at the dawn of Italian industrialization, in which the company has always played a leading role. Its history is punctuated by many events and awards: as regards innovation and commitment to research, the launch of two new cars (the 500 and 1400 models) in the postwar period marked the introduction of heating and ventilation systems in mass production. Nowadays, it is worthwhile to mention the launch on the market in 2003 of a car (Nuova Punto) equipped with the innovative 1.3 Multijet 16v (created by Fiat-GM Powertrain), an engine system born on the evolution of the Common Rail[16] principle, which offers fuel savings and top performances, while in the same year, the Alfa Romeo 147 incorporated the Uniair System, developed by Centro Ricerche Fiat (CRF),[17] which was awarded the prize for the best technological innovation in the automotive field at the Auto Show held in Barcelona.

Fiat Auto has traditionally specialized in the development of successful small- and medium-sized cars: the 127, Panda, Uno, Punto, Nuova Punto and Nuova Panda are among its most popular models. The Fiat brand today can boast eight awards as "Car of the Year," the most sought-after recognition in the automotive world.[18]

Fiat Auto's three brands, Fiat, Alfa Romeo and Lancia, cover almost all market segments, with the aim of offering automobiles with distinctive features and a specific brand image.

It is worth pointing out that Fiat Auto, which at the end of the 1990s had a product range composed of 38 different models, was the European carmaker with the widest range of products. Of course, this increased its need for standardization of components and subsystems, in order to reach efficiency in product development and scale economies of production and purchasing.

For this reason, an essential feature of the product innovation strategy is the unwritten rule that at least two-thirds of the archetype of each new product must be based on components available on the shelf or under planned development. The product innovation strategy is thus based on two main principles: *standardization* of nonvisible parts, through a sharp policy of components development, and *differentiation*, through a careful policy of style-oriented design and development of components, and through strong brand imaging. This is why the development of innovative components and solutions for the shelf, i.e. available for application to different models, either directly or through adaptations,[19] has become another of the main tasks of NPD management. Even before the development of a specific project is initiated, the new product to be developed, whose concept still needs to be defined, is subdivided into its functional subsystems, and an active search for solutions readily available on the shelf is initiated. When the process of NPD starts, it is essential that all opportunities for carryover have been explored, so the team can focus on the design and development of the components and systems specific to the model under development.

The Process and its Reorganization

Changes in Fiat's process and organization of NPD have been taking place since the end of the 1980s.[20]

As in many other firms, product development was traditionally organized according to the classic linear view, as there were no organizational mechanisms able to ensure effective inter-functional integration.

More specifically, product development was problematic and slow due to the lack of integration between product engineering and the other activities necessary to complete the process. Projects moved on to production only at the end of the development phase, and there was no preliminary involvement of process engineers. The release of documentation was usually done in the spirit of "tossing ideas over the wall." The entire process was therefore strictly sequential and linear.

This approach was lengthy and therefore generated high development costs. Moreover, the absence of adequate communication channels among the departments involved limited the circulation of information and experience, leading to the loss of potential opportunities for development of the company knowledge base.

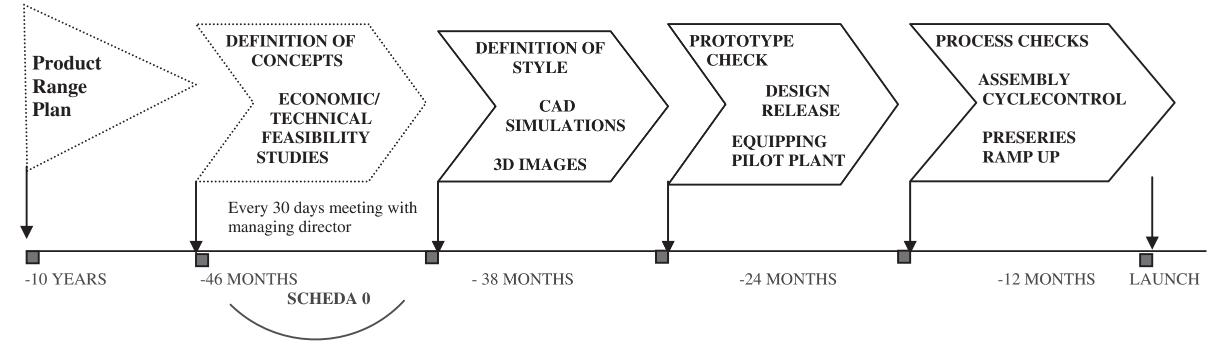
From the operational perspective, the new model, which was inspired by the managerial experiences emerging at the international level, and more specifically by the Japanese style of NPD, was characterized from the very beginning by two basic elements:

a. *Concurrent engineering*, which was gradually spreading among the most innovative firms
b. *Inter-functional teams*, as a solution able to foster the communication and exchange of specialist knowledge, thus nurturing processes of new knowledge generation.

The new NPD process starts with the release by the Product Department of the Heavy 0 Chart,[21] which formalizes the main features of the new model to be developed, as defined in the Product Range Plan, and outlines the content of innovation of the model to be developed.

The process ends with the launch of the new product, and lasts, on average, 38 months.

It is articulated in three macro-phases,[22] with several milestones and project reviews (see Picture 1). Phases are characterized by extensive



PRODUCT RANGE PLAN	**SURVEYS:**	KEY ACTIVITIES		
▪ LAUNCH TIMING ▪ DIMENSIONS (TYPE OF WHEELBASE) ▪ ENGINE ACCORDING TO THE ENGINE RANGE PLAN ▪ VOLUMES ▪ INVESTMENT	**1) New Car Buyer** Positioning of current product compared to competition. Identification of customer profile (age, employment, make-up of family, reason-to-buy, likes & dislikes) and analysis of customer expectations **2) Focus groups** Organized by independent companies to evaluate the validity of the concepts proposed by designers **3) Quality profile tests** Tests carried out by customers on automobiles produced by competitors to compare features **4) Cost value management** Economic analysis of project **DEFINITION of:** 1. Engines 2. Furnishings and optionals	▪ Meeting between Fiat Style Center and 3 or 4 independent stylists to present different proposals ▪ Check of performance and aesthetic goals ▪ 3D virtual imaging ▪ CAD simulations ▪ 1/1 maquette ▪ Prototypes of a few components ▪ Choice of interior and exterior style	▪ Issue of drawings with part details ▪ Building of prototypes ▪ Tests ▪ Equipping pilot plant	▪ Control of process for identification of corrective actions to eliminate non-conformity between expected performance and features of product resulting from process ▪ Assembly cycle check to ensure compatibility among subsystems to be assembled ▪ Process improvement actions ▪ Modification of drawings ▪ Modification of equipment ▪ Start of pre-series at pilot plant for removal of further functional problems ▪ Start of Mass Production

Picture 1. The NPD Process at Fiat Auto: Key Activities and Timing.

overlapping of activities: the main goal is to "parallelize" the design and development of the product and process, so that the Design and Production functions can work simultaneously and lead times can be reduced. This approach requires that related activities be performed concurrently, and strong, efficient and effective communication channels between the teams be planned.

The structure of the new process has been developed with the primary goal of shortening the development cycle time. If we look at the time to market as the time between concept finalization and product launch, we observe that great improvements have been made: from the initial 48 months (Punto model) to 36 months (Bravo–Brava models) to 24 months (Nuova Punto model).[23] At the same time, development cost and product quality have also been improved.[24]

The management of reviews and modifications has become essential.

The goals to be achieved are established in the Heavy 0 Chart, and formal checkpoints are planned, according to the various milestones and management systems design review.

More specifically, the task of reviewing the ongoing project has been deeply modified, according to the rationale of concurrent engineering.

The time to market imperative requires constant reviews to the project. This need, however, contrasts with the lack of complete, stable information: the logic of concurrent engineering makes it necessary for people working on the NPD project to manage ambiguity and apparent chaos.

For this reason, checkpoints are no longer positioned at the end of specific phases of the process, and are no longer the responsibility of a few people only (the Heads of Departments or the Project Managers). In the new approach, they are increasingly linked to the development of the product, and fall under the responsibility of all those who take part in the process.[25]

The management of the whole process was thus carefully planned, as required by concurrent engineering. Within the development of each project, however, there remained ample room for improvisation, which was often needed to compensate for unanticipated delays. Changes to procedures, when proved to be successful, became the standard for later projects.[26]

The Role of Inter-Functional Teams and Co-Location

The new organization for NPD has been built around the key concept of Platform, which identifies a range of products whose technical origin is the same, as they are based on the same chassis and are considered highly consistent from a marketing perspective. Indeed, the Platform coincides with a specific market segment.[27]

Platforms were first introduced in 1990: the development of the Punto model was the first product of the new organization.

Through Platforms, the principles underlying the matrix structure became operative: horizontal lines coincide with products lines, which in turn coincide with Platforms, while vertical lines coincide with functions, which have the task of developing resources and carrying out innovation projects.[28]

The rationale of the new structure is based on a few basic assumptions: first, it should improve cross-functional communication, as a means to improve the performance of each NPD project, through reduction in time and costs and higher quality of the output. If a constant and rich flow of communication is guaranteed, along with early involvement of all the functions interested in the development of the new product, it may be possible to limit the risk of costly modifications in the last phases of development, when investments in specific production equipment have already been decided. Moreover, the unification of all NPD projects aimed at the same market segments and founded on the same technical base (the chassis), should allow optimal use of the knowledge base of the Platform.

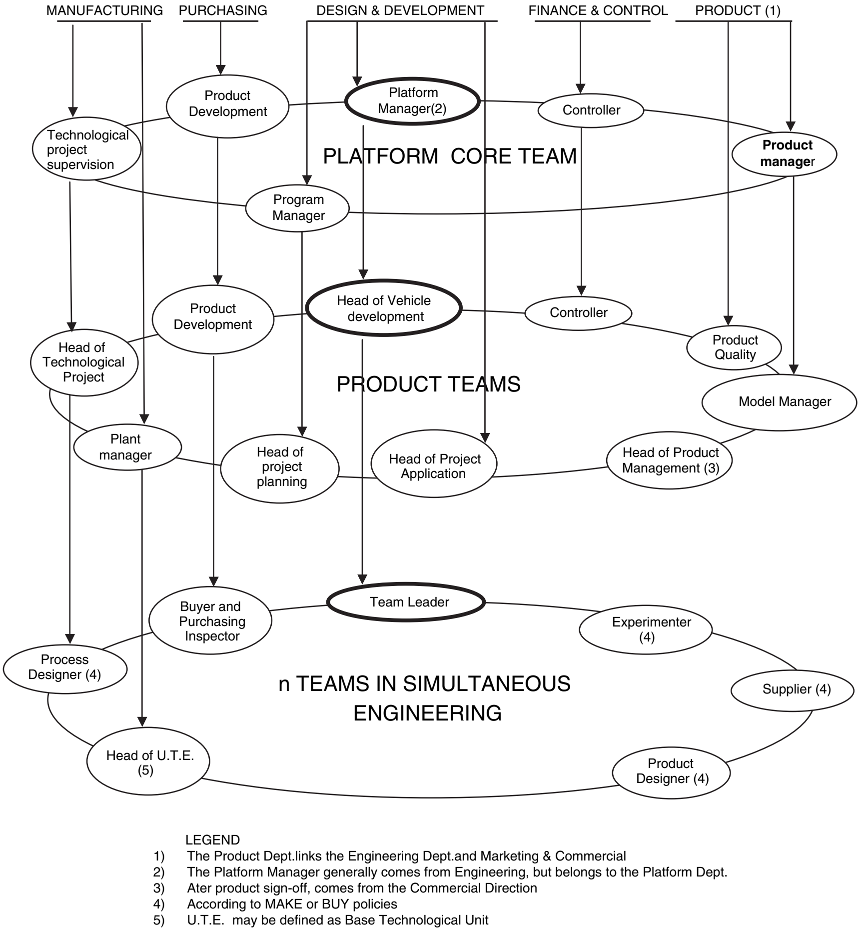
Each Platform head manager, who is responsible for the NPD projects, reports directly to the Head of the Platform Direction. In turn, he coordinates the core team, and through a system of mandates, he coordinates all the temporary teams involved. However, he cannot hierarchically control any individuals assigned to the development of the project.

Work is organized through teams along three levels (see Picture 2): there is a permanent core team, made up of the Head of Platform[29] and by members of all the functional Departments: Engineering, Technology, Production, Purchasing, Product, Finance and Control.

The member of the Product function plays a pivotal role in the core team, as he supports the head of Platform during the entire duration of the project, and specifically as he manages the core team during the Style definition, he ensures coordination with the market and the alignment of the new product with customer expectations.

As the Platform has the responsibility of developing various car models, a product development team is established for each new model under development.

The organization for NPD is completed by a variable number of temporary teams, related to the development of components. They are teams of simultaneous engineering, coordinated by a team leader, who reports



Picture 2. Platform Organization Structure at Fiat Auto.

functionally (and not hierarchically) to the Vehicle Development Manager and, through him, to the Platform Director.

The *team leader* is usually the same person from the beginning to the end of the component development; he is responsible for the attainment of the team's goals, but has no formal power over the other team members. For this reason, his ability to obtain cooperation from the other team members strictly depends on his own reputation and expertise.

In order to ensure coordination between the teams that develop specific components belonging to functional systems (such as the engine, electric/electronic equipment, body, trim) a specific role within the product development team is assigned to the member coming from the Engineering function, i.e. the Application Project Manager, whose main tasks are to verify the actual compliance of the development project to formal specifications, and to supervise the communication channels between teams and functions as regards innovation, and with teams developing products in other Platforms.[30]

An important issue regarding the organization of the teams is the decision to co-locate the members, so they work together, side by side, for the entire duration of the project.[31]

Ever since the implementation of the new organization for product innovation was started, co-location has been considered an essential instrument for enhancing the transfer of tacit knowledge among individuals through socialization, and facilitating the transformation of tacit knowledge into explicit knowledge, through dialogue and direct communication.[32]

The Co-Development Strategy: How to Capitalize on Suppliers' Knowledge
Within the new organization for NPD, suppliers play an important role, with far greater responsibility and autonomy than in the past.

This process has been ongoing since the first half of the 1990s, with increased involvement of suppliers in the design of new components for new products (see Table 1).[33]

Co-designing suppliers are often members of the development team: in this case, they work in co-location, although not all work is carried out jointly and with the same degree of interaction. Resident engineers who operate as inter-organizational relays are appointed by the supplier. Because they operate within the Platform, they can socialize with the other members of the development team, thus reducing the risk of misunderstandings and modifications to the original project during the ramp-up phase.[34]

Table 1. Outsourcing at Fiat Auto from the 1980s (%).

	UNO	TIPO	PUNTO	BRAVO BRAVA	NUOVA PUNTO
Production	50	52	65	70	70
Engineering	30	30	45	59	70

Source: Fiat Auto.

Collaborative work is also carried out during pre-series reviews, during assembly trials in the pilot plant, and finally at the plant assembly lines, together with the teams of the integrated plant.

Further, suppliers are involved in the different design review activities that check the attainment of goals. This is an essential step, because the definition of reviewing systems enables the partners to check each other and verify the ability to meet established objectives.[35] In a dynamic perspective, this lays the foundations for reciprocal trust, an essential ingredient for building true partnerships.[36]

Stable, durable links between Fiat and its partner-suppliers are sometimes established through joint design offices[37]: permanent co-location may facilitate the cooperation required when customer–supplier relationships evolve toward partnership.

As mentioned earlier, leading car manufacturers tend to ask their first tier suppliers for value-adding innovations, rather than only for the best solutions to defined problems. Within this context, suppliers also need to recast their relationships with customers, and to take on an active role well before the stage at which the concept is defined.[38]

Different degrees of product novelty and customization generate the need for different levels of interaction with customers during the project development phase.

For the most complex products, customer–supplier interaction is the result of a process comprising several steps and characterized by a cyclical nature. As mentioned earlier, this is a time-consuming process, which needs to be managed correctly: if, on the one hand, interaction is a crucial source of knowledge generation, on the other, suppliers must carefully monitor compliance with deadlines.[39]

This process may be subdivided into different stages:

1. Preliminary exchange of ideas, information and knowledge, aimed at the presentation of the innovative idea to the customer. Potential product performance is illustrated and differential advantages as compared to existing products are highlighted.
2. Identification of basic project targets, including product features and development time and cost.
3. Start-up of joint project, with extensive interaction taking place between the players in order to ensure socialization of knowledge. Different approaches are possible: appointing a resident engineer, establishing mixed work-teams, setting up a schedule of joint meetings, exchanging documentation. In general, interpersonal communication channels are

widely acknowledged as the means allowing optimal socialization of knowledge.

Not all activities relating to the development phase may be performed in co-location. Therefore checkpoints for the presentation of prototypes[40] are employed to monitor the work independently managed by the supplier.

The "New Age": Leveraging Competences for Successful Innovation

The picture emerging from the preceding description is that of a company that has performed a substantial organizational change, in line with the principles and indications emerging from management studies as the most significant in order to achieve an organization able to compete in turbulent markets, characterized by continuous change and that require superior capabilities of innovation.

At the end of the 1990s, innovations in processes and structures presented an organic quality and their implementation extended to multiple aspects regarding the development of new products, including the management of the relationship with suppliers.

Even though the results achieved were encouraging in terms of time, cost, perceived quality, the company still headed toward one of the most serious crises in its history.

Among the causes of the crisis raised by the analysts were also some questions regarding innovative capabilities that were not developed in an adequate manner in order to be able to meet the challenges of a competitive environment that was increasingly aggressive and a consumer who was increasingly demanding and with a tendency to be less faithful.

Beyond some of the excessively critical judgments, it should be recognized that the trend of the market data seems to confirm the existence of a weak ability to translate the potential for innovation into a flow of income capable of feeing the circuit and sustaining the evolution and development of the company.

More precisely, one of the weak links in the chain of innovation seems to be the ability to construct a strong tie with the market, adequately valuing the company's brands which have a high brand awareness that however does not necessarily generate a clear perception of distinctive elements of the product with respect to the competition and a market response that is just as positive.

Obviously, this problem has an impact on all the company's activities and processes, including those regarding client service and after-market management, but what interests us here is to underscore the implications on the activity of NPD.

In other terms, turning to conceptual categories used in the first part of this study, one of the reasons for the crisis could be found in the relative weakness of the capacity for external integration (market integration) that could be made more powerful. This does not mean only increasing the quantitative and qualitative level of resources aimed at research, at understanding and evaluating potential customers' expectations and their transformation into a flow of specialized knowledge to be combined with technical/technological knowledge, but also guaranteeing that such a combination happens according to criteria of efficiency and productivity that represent the other fundamental component of the success of new products.

The ratio of more recent interventions should be viewed in this perspective, in our opinion: the company's objective is that of guaranteeing the achievement of maximum possible efficiency, exploiting every potential synergy in the development of new products, therefore "reutilizing" the knowledge already available in the company (the above-mentioned principle of integration) but at the same time, being able to develop new product concepts that present distinctive valences clearly perceived by the market through the development of models with specific attributes and characteristics for each individual brand, characterized in turn by a strong and distinctive market positioning (principle of differentiation).

To respond therefore to this double objective within Fiat Auto, on the one hand, the constitution of the Strategic Business Unit (SBU) with precise brand responsibilities, and within each SBU, the constitution of Platforms for Product Development coherent with the reference market segment. On the other hand, the maintenance at a central level (defined internally by governance) of a Head that takes care of the development of standardized components and systems.[41]

As regards aspects more properly tied to structuring and organization of the process of product development, instead, it should be underscored in our opinion that notwithstanding some changes currently being studied to increase efficacy and efficiency, the model implemented in the 1990s is being substantially reconfirmed. The overlapping of activities (parallelization) and concurrent engineering has up to now borne fruit in terms of time reduction (that does not appear to be further compressible) and increased productivity of the planning activities.[42]

Instead, the technological tools supporting NPD are being given more power, with NPD understood as an activity for creating knowledge both on the level of the individual project as well as in a wider perspective for renewal of the base of company knowledge.

ICT technologies are to be included in the first type, in support of communication/data exchange among groups, especially in the case of projects for shared development with suppliers[43] and the use of software of virtual prototyping that allows for reducing costs and time for development.

The "Boards for Product Development"[44] and systems for Knowledge Based Engineering (KBE)[45] should be framed in a context of adoption of systems of knowledge management.

Despite this, it should be underscored that the company's management attributes a fundamental relevance to the socialization among individuals as an element capable of catalyzing the processes of creating knowledge and innovation.

The co-location that strongly characterizes the way of working on development of new products already in the second half of the 1990s is still strongly followed, especially in projects characterized by great uncertainty, due to the level of novelty in the output and to the composition of the work team. For the project of shared development of a new Fiat-GM platform, this choice proved to be of great importance for allowing members of the group of different nationalities to create the social conditions that facilitated interaction and achievement of the assigned goals.[46]

In synthesis, the most significant challenge that the company is trying to deal with regards, on the one hand, the necessity of continuing down the path of commitment to efficiency in development of new products through a substantial confirmation of choices already made in the recent past of restructuring and reorganization of process, but with incentives for behavior aimed at increasing commitment to the effective respect of "theoretical" times for achievement and above all toward the reduction of modifications and changes along the way to projects that occasion activities not planned by the official programs, with subsequent lengthening of time that can be recuperated only by turning to costly solutions (constitution of a task force or subsequent transfer onto suppliers of the relative burden with the risk of a deterioration of the relationship with suppliers).

Exceptions of this type that in the recent past have taken place on several occasions are today strongly discouraged, which implies also that there is the diffusion of a culture of respect for time that is based ever more on a double interpretation of the relationship between time and innovation. As observed, "much time and dedication is required to understand a market, to understand a need that is changing, to understand the weak signals to imagine and then plan a winning product. But as soon as an idea for a product (or a service) becomes strong, then speed in its development, production and distribution become essential. Two rhythms are therefore necessary in a business: the meditative reflection that is necessarily slow in order to identify the new product in function of new needs and to plan its development, and then the frenetic spark is needed to plan, create and insert it successfully in the market."[47]

DISCUSSION AND CONCLUSIONS

The case study highlights how the process of renewal of capabilities for innovation is the result of multiple interventions that interest various but complementary aspects of the product development strategy, that cannot be limited to an analysis of the changes in the process of innovation but that are extended to choices related to the product architecture, to the management of relationships with suppliers, to brand strategy. In this perspective, it has been shown how the modular product architecture that implies a sharp policy of standardization of components, of systems, of platforms to take advantage of the scale and scope economies, to be a source of competitive advantage requires contextual capabilities of creating variety that has value for the customer.

This is not so much and not only in terms of multiple options available to the potential customers, who can thus personalize the product by "choosing" from among a high number of alternatives, but also and above all as a strategic capability to define a distinctive positioning for each brand in the range of products offered.

It is a strategic question with a few relevant repercussions on NPD: it is evident that each NPD project must take into account from its inception the values underlying the brand image to conceive a product concept coherent with these values and then develop a product with distinctive features that are clearly perceivable by the potential target.

The link to the market becomes therefore extremely critical in the NPD organization, that is, the ability to interpret the market trends and proactively translate them into creative choices for the product.

The existence of a cross-functional team in which on various levels (the platform core team and the vehicle development team) a manager of the marketing function is present, should guarantee such a "sensitivity" and constitute the basis for development of external integration capabilities. The model adopted in the company during the 1990s attributed such a task to managers coming from Product Department; indeed, as the Platform core team still was not focused on individual brands but on product segments, it was not always able to infuse in the product choices a marked sensitivity to elements of differentiation coherent with brand positioning.

The current reconfiguration of the basic organizational structure that, as has been said, privileges an approach to the market that is more sensitive to management of differences among brands through the creation of specific SBUs – while maintaining the responsibility of choices about models on the level of Platform Direction – still should contribute significantly to creating conditions for better integration with respect to the market. The Nuova Panda project, definable as a case of success on the basis of the first market results, is exactly the product of such an organizational evolution.

As regards the other component of the external integrative knowledge (technology), the growing trend to make choices of outsourcing and management of relationships with suppliers should still be commented, with the goal of finding solutions aimed at obtaining better efficiency in the acquisition of standard components and better efficiency in the search for innovative solutions that take advantage of technical skills of supplier partners in projects of shared development.

Internal integrative skills rely on very precise choices of structuring and organization of the process, in a context of substantial continuity with respect to the past: the choices of parallelization of activities, concurrent engineering, turning to virtual prototyping in the phase of testing, represent the most important areas of intervention, from the very first experimentations of the new development model.

As regards on the other hand more specifically the organization of the process, centered on the constitution of cross-functional teams rooted in a matrix-shaped structure, at the moment no special novelties emerge with respect to solutions implemented in the second half of the 1990s. It is worth mentioning indeed how the empowerment and diffusion of advanced instruments of knowledge management supported by ICT applications (such as for example the boards for product development, systems of KBE, etc.), are flanked by a diffuse and rooted conviction of centrality in the processes of socialization as a critical element for the success of innovation projects.

Finally, one last annotation regarding the management and very concept of the time factor in the area of NPD. As underlined in point 2, businesses are outfitted to respond to the challenge of speed, by adopting measures on various levels. It emerges rather clearly even in our case how the company managed to renew its procedures, systems, organizational mechanisms underlying development of new products, with the objective (among others) of effecting a reduction in time to market, and how such a goal was achieved.

However, as observed, the relationship between time and innovation is not only controversial, but above all it appears to be tainted by a fundamental ambiguity.

There is in fact a time that regards the achievement of the project and a time that regards the creative phase, of conceptualization, experimentation of alternative concepts. While the first may be defined and measured in detail (and the objective of the successful company is to minimize the time related to the completion of the process, checking every detail and adopting coherent solutions with respect to the goal), the second, relative to the creative phase (to use the jargon of the company, to what comes before the 0 Chart is released), must be dilated to the maximum to enhance every possible source of creativity.

The challenge is therefore to learn to think and to work with a double approach: on the one hand, to stimulate creativity, freedom of expression, experimentation, openness to what is new; on the other, to guarantee that the "freezing" of the concept of the product chosen be effectively respected by all as the indispensable premise for achieving goals of time for achievement.

This philosophy, that in the 1990s already appeared clearly in the declarations of principle but in fact was bypassed, requiring costly intervention to meet the additional work necessary to achieve changes during the course of the project, is today pursued with greater determination.

The ways that the creative phase is managed still must be explored, in our opinion, in which the capacity of reading and anticipating market trends carry great weight: once again the centrality of integrative capability with respect to the market is seen.

In conclusion to this work, it may be useful to formulate some reflections that, taking a cue from this case, may lend themselves to generalizations indicating also a few directions for future research.

The case seems to confirm the centrality of external integrative skills with respect to the market, as a specific factor on which to base competitive advantage deriving from the capacity of innovating within the automobile sector. But this raises a few interrogatives about which there is a growing interest on the part of scholars, and that would merit further exploration:

How can the needs of creativity, customer satisfaction, time to market be reconciled in a market-oriented company?

How can firms develop outstanding capabilities to extract knowledge – especially tacit knowledge – from customers, and using it for developing successful new products, given that socialization is one of the basic means for the process of knowledge creation to occur?

How can efficient processes for learning from the market and enhancing the circuit of transformation of knowledge coming from the market be activated, interiorizing in the procedures and in the organizational systems?

NOTES

1. As observed: "... Each development project draws on knowledge from the existing capability base, processes the knowledge through a sequence of concept development and implementation activities and produces outputs that are valuable to the organization. They create two types of output: new products and new knowledge bases which renew the firm's competence base" (Iansiti & Clark, 1994, p. 567).

2. The importance of cross-functional coordination mechanisms in NPD was pointed out in studies deeply rooted in knowledge management principles prior to the emergence of the new paradigm (see Ruekert & Walker, 1987; Olson, Walker, & Ruekert, 1995). What is different now is the acknowledgment of the need to promote both *social* interaction among team members, and *cognitive* processes, with several implications on team management.

3. According to Ashby (1967), in order to face challenges posed by the environment, an organization's internal diversity must correspond to the variety and complexity of its environment. Requisite variety enables organization members to cope with contingencies; it may be enhanced by combining information differently, flexibly and quickly, and by providing equal access to information throughout the organization.

4. Redundancy of information is the existence of information that goes beyond the immediate operational requirements of organizational members. A way to build redundancy in the organization is to establish two or more competing groups working on the same project as a way to enhance new knowledge generation.

5. People with T-shaped capabilities are those whose expertise relates to specific technical areas (the vertical stroke of the T), but who are also intimately acquainted with how their discipline interacts with others (the horizontal top stroke). People with A-shaped capabilities, though very rare, embody technology fusion: they have two disciplinary legs on which to stand, and they are an important source of potential innovation, because they know how to combine different pieces of knowledge in order to obtain an effective output.

6. As suggested by Leonard Barton (1995), "very few, if any, companies can build core capabilities without importing some knowledge from beyond their boundaries." Nonaka–Takeuchi further observe that "one of the main features of Japanese firms' ability to bring about innovation continuously and incrementally is their propensity to seek knowledge held by those outside of the firm."

7. Let us ignore problems linked to bad implementation of work done by the marketing department, taking for granted that the company is able to (1) conduct market research of a satisfactory/adequate qualitative level; and (2) adopt opportune techniques for translation of signals that are coming from the market specifically about the product.

8. Day (1998) reports an interesting opinion expressed on this subject by R. Lutz, the Vice-Chairman of Chrysler during an interview: "Let's face it, the customer, in this business, and I suppose in many others, is usually, at best, just a rear-view mirror. He can tell you what he likes about the choices that are already out there. But when it comes to the future, why, I ask, should we expect the customer to be expert in the clairvoyance or creativity? After all, isn't that what he expects us to be?", (p. 5).

9. Actually, parallel product development is not necessarily quicker than its sequential equivalent. Where interaction and exchange of information on partial results or on modifications brought after the definition of product specifications are lacking, actors will realize too late that they have worked on single activities which cannot be assembled or further developed if not after problems have been tackled. In this case, a parallel process remains too slow to satisfy increasing competitive pressure.

10. The architecture is the way a product (or process) design is decomposed into its component parts and the way they interact, through the definition of interface specifications. In modular architecture, component parts are designed in order to be "plug and play" compatible with other component designs within the product as a system of components.

11. The loose coupling of components within a modular architecture is obtained through the standardization of component interface specifications, thus allowing component development tasks to be performed independently by autonomous development group and this in turn enables the organization to manage extensive networks of component developers, accessing important sources of specialist knowledge beyond its boundaries (Henderson & Clark, 1990; Sanchez, 1997, 1999, 2001b).

12. The supply network is usually represented in the shape of a pyramid divided into different layers. At each layer there are suppliers who have a specific and differentiated role. At the top are "first tier suppliers" which are classified according to product complexity: suppliers of modules, of complex components, of single and standardized parts. Each type requires a different purchasing approach. Among first tier suppliers of Japanese carmakers, only a dozen are real partners, whereas the intensity of the linkage to the remaining suppliers is proportional to the importance of the supplies (Kamath & Liker, 1994).

13. In 2002, Business Week entitled its European Cover Story: "Fiat: Running on Empty? Management is in turmoil, cash is low, and there's no hot model in sight. Can Fiat be saved?" (Business Week, May 13, 2002).

14. The auto business was set up as an independent company in 1979: Fiat Auto s.p.a. included the brands Fiat, Lancia, Autobianchi, Abarth, Ferrari. In 1983, the company took over Alfa Romeo and acquired Maserati, a prestigious sports car brand.

15. The Fiat Group includes other firms operating in the automotive industry or related sectors: Iveco (industrial vehicles), CNH (agricultural and construction equipment), Ferrari–Maserati (luxury and sports cars), Magneti Marelli (design and production of components and systems for the automotive industry), Comau (automation systems for the automotive industry) Teksid (production of iron and magnesium castings for the automotive industry) CRF (research and technology development) Elasis (automotive engineering R&D).

16. The Common Rail Technology, developed by CRF, represents one of the most important innovations in the engine systems, for which the CRF obtained in 2002 the Economist Innovation Award.

17. CRF was founded in 1976 as an Engineering Centre providing R&D services to each of the different companies within the Fiat group: the links with Fiat Auto and other companies of the group remains strong, but the Centre operates on the market as an independent company, and over the last 10 years it has adopted a strategy for extended collaboration, opening its doors to business with other companies and organizations which are seeking to achieve and maintain leadership in their respective fields of activity.

18. The Car of the Year Award is given by an international panel of 58 specialized journalists, coming from 22 European countries. Fiat Panda is the first car of the A segment awarded by the prize; in the last decade, Fiat Auto has won five editions of the Award: Fiat Punto nel '95, Fiat Bravo/Brava nel '96, Alfa 156 nel '98, Alfa 147 nel 2001 e Fiat Panda nel 2004.

19. A Components Platform was established in 1997 for this purpose.

20. For an extensive description, see Calabrese (1997), Volpato (1995), and Lipparini and Melloni (1994).

21. At present the document is called more simply Chart 0.

22. This representation of the process may differ from the official one, because it is not a simple reproduction of internal company documents. It is based on interviews with the Product Platform Manager, and may be viewed as the internalization of rules by an individual who covers a key position within the process.

23. Best American players seem to have reached an even better performance: "thanks to engineering improvements, the development cycle time has been reduced to 14.5 months" (Business Week, January 25, Naughton, 1999). It is difficult to compare time performances of different firms without detailed information about their process; indeed, the actual importance of this piece of news is that it underlines the very competitive dynamics of this industry, which oblige firms to make continuous improvements.

24. A project performance evaluation between two products of the same market segment developed before and after the introduction of the new organizational model, has shown satisfactory reductions in time, costs and quality measured by the Initial Customer Perception Index as well as by other specific measures.

25. Moreover, unlike in the past, financial aspects of the project are also reviewed.

26. The Product Development Manager of Platform B illustrated this philosophy in an interview.

27. Actually, the term platform has at least two different meanings: the first, relates to its technical nature, and is used as a synonym of chassis; the second stems from its organizational application and identifies a specific area of responsibility over market segments and related products. Under the first perspective, it is possible to identify 11 platforms; from the other perspective, six Platforms were established from the very beginning of the new course: "A," "B," "C," "D," "E," which correspond to as many market segments, plus, as already mentioned, a Components Platform, with responsibility for developing components and optimizing their use.

28. The Platforms are in charge of developing new products, and manage current products, through direct links with the plants: for this reason, they are called Long Platforms.

29. Generally comes from the Engineering Department. At present, only one Head of Platform comes from the Production Department. For the future, a shift is expected toward the Marketing Department, as organizational and managing capabilities are increasingly being viewed as key success factors. The company is currently training new graduate employees through a career path that involves periods of training in different functional areas.

30. In order to be effective, individuals who cover this position must have broad understanding of ongoing application and innovation projects , as well as of the technical knowledge base of the company as a whole.

31. The term "Platform" not only identifies an organizational structure, but also a physical space, where all members of teams working on a specific project meet. While the project is under way, the space is more or less crowded. When the project ends, people either return to their original function, or are assigned to new projects.

32. All team members, at all levels, from the core team to the product development team, and to the components development teams, recognize that the communication channel most frequently used is interpersonal communication; a survey carried out by Calabrese (1997), showed that, on average, between 70% and 80% of communication among individuals involved in development projects occurred through co-location, while only 10% took place via computerized systems, and the rest through written documents and telephone calls. It is worth noting that recent developments of CAD should double the percentage of communications through computerized systems (*ibid*, p. 232).

33. Suppliers are tiered and divided into direct and indirect suppliers. Fiat has direct links with direct suppliers only. The latter are further subdivided according to the type of supply: suppliers of subsystems, of complex components, of standardized components and of raw materials. Although Fiat's policy aimed at stimulating the participation of suppliers during the early stages of new product development, before the definition of style, at the end of the 1990s they were more often activated when the style had already been defined.

34. Of course, data exchange is supported by the use of ICT, such as compatible CAD systems and databases which may be shared, according to defined access rules that discriminate between suppliers belonging to the Fiat group and external; among the latter, further differentiation is applied, according to their specific features.

35. In addition, co-designing suppliers must take on the responsibility of self-certifying and self-qualifying their work.

36. The implementation of co-location has surely contributed to the creation of a context that enables socialization and knowledge transfer. Indeed, increasing integration between the two organizations, through specific mechanisms of coordination such as long-term relationships is needed, in order to nurture the process of trust and loyalty creation, which is essential for capitalizing on the partner's knowledge.

37. Permanent joint design offices have been set up with a few firms: among others, with Robert Bosch and Marelli.

38. The establishment of the "Component Platform" at Fiat Auto is aimed at satisfying this need. Within the "Platform" policies for the development of new systems or components to be installed on car models being developed are defined jointly with suppliers in partnership.

39. It is worthwhile noting that, in the supplier's perspective, at times changes are brought to the original project, frequently induced by new customer requirements rather than by lack of compliance with initial specifications. A new development cycle is thus initiated, with extensive interaction aimed at re-establishing project specifications. Modifications are implemented and their impact on the project as a whole is evaluated. These changes heavily weigh on development time and cost, and quite often their impact is entirely borne by the supplier. For this reason, there appears to be greater simplicity of interaction when customers adopt a highly structured product development approach, including clear definition of product specifications and expectations (in terms of cost and performance). This approach allows the supplier to ensure timely development, thus eliminating potential grounds for conflict.

40. In order to evaluate modifications brought to complex products, virtual prototyping is preferred to time-consuming and costly physical prototypes.

41. Called Product Process Engineering Department, it is the repository of engineering and development knowledge.

42. The time to market, measured by the phase of approval of the style to the launch, is currently about 31 months.

43. In 2001 a project of "Collaborative design" was launched, supported by Internet, with the goal of allowing Fiat Auto to plan the components in real time along with the suppliers. Currently, the computer tool that allows for online management of relationships with suppliers of engineering is the sharing in client-server architecture of the Product Data Management (PDM) applications, already used by Fiat. This solution allows for management of engineering data within one single virtual work environment, through the exchange of CAD/CAM documents. Another tool also exists, the Technical Data Interchange, a sort of customized Edi for the exchange of CAD files.

44. This is about structures for the management of informational heritage aimed at the reduction of the development cycle for new products, increasing competitiveness, pursuing the quality of the product, improving client satisfaction, increasing profitability.

For every platform (Small, C, High-Class Cars, 178 and derivatives, commercial vehicles, Premium) there exists one or more boards dedicated to the management of documents of a model (in development or in use) and the general information of the platform. They are accessible on an enterprise wide level from personnel of Fiat Auto, of the Group and suppliers who cooperate in the development of models.

There exist transversal boards that gather information of a general methodological type, common to all platforms (new process of product development, cost engineering, product direction, technical direction).

45. The environment of Fiat Auto product development is currently based on CAD Unigraphics and on PDM iMAN. In 2003 a joint project was launched with CRF and Elasis for the development of a planning environment that makes the functions of the new KBF systems available. The goal of the project is to realize technological archetypes able to help the designer in developing a new vehicle and especially in the development of the body.

Such archetypes are software developed in the language of knowledge fusion containing the know-how of the expert designer; the realization and maintenance of archetypes is currently very burdensome in that it involves both designers and programmers, with very different problems of language. The goal is to reduce time dedicated to the creation of new archetypes, reducing thus the cost of managing a KBE system, maintaining in line at the same time the know-how deposited in the knowledge base with technological and normative progress.

The KBE systems are based on acquisition of knowledge on the part of expert designer users, on their cataloging and memorization and on the possibility of use on the part of junior users, to whom the system signals errors or furnishes solutions on the basis of what was deposited in the knowledge base.

46. It should be underscored that the team in question received the prize as best team for innovation in the area of the GM group on an international level (company source).

47. G.C. Michellone, CEO of CRF.

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REFERENCES

Arora, A., & Gambardella, A. (1994). The changing technology of technological change: General and abstract knowledge and the division of innovative labour. *Research Policy*, *23*(5), 523–532.

Ashby, W. R. (1967). *An introduction to cybernetics*. London: Chapman and Hall.

Badaracco, J. L. (1991). *The knowledge link*. Boston, MA: Harvard Business School Press.

Booz, Allen, & Hamilton (1982). *New product management for the 1980s*. New York: Booz, Allen and Hamilton Inc.

Bourgeon, L. (2002). Temporal context of organizational learning in new product development projects. *Creativity and Innovation Management*, *11*(3), 175–183.

Brown, S. L., & Eisenhardt, K. M. (1995). Product development: Past research, present findings, and future directions. *Academy of Management Review*, *20*(2), 343–378.

Buratti, N. (2000). Lo sviluppo di nuovi prodotti. *Modelli ed esperienze nei mercati industriali.* Torino: Giappichelli.

Calabrese, G. (1997). Fare auto. *La comunicazione e la cooperazione nel processo di sviluppo prodotto*. Milano: Franco Angeli.
Christensen, C. M., & Bower, J. L. (1996). Customer power, strategic investment, and the failure of leading firms. *Strategic Management Journal*, *17*, 197–218.
Clark, K. B., & Fujimoto, T. (1991). *Product development performance: Strategy, organization and management in the world auto industry*. Boston, MA: Harvard Business School Press.
Cohen, W., & Levinthal, D. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*, 128–152.
Cooper, R. G. (1992). The new prod system: The industry experience. *Journal of Product Innovation Management*, *9*(2), 113–127.
D'Aveni, R. (1994). Hypercompetition. *Manging the dynamics of strategic maneuvering*. New York: The Free Press.
Day, G. S. (1994). The capabilities of market-driven organizations. *Journal of Marketing*, *58*(October), 37–52.
Day, G. S. (1998). What does it mean to be market-driven? *Business Strategy Review*, *9*, 1–14.
Grant, R. (1996). Towards a knowledge based theory of the firm. *Strategic Management Journal*, *17*(Special Issue), 109–122.
Griffin, A. (1997). The effect of project and process characteristics on product development cycle time. *Journal of Marketing Research*, *33*, 24–35.
Griffin, A., & Hauser, J. R. (1996). Integrating R&D and marketing: A review and analysis of the literature. *Journal of Product Innovation Management*, *13*, 191–215.
Gupta, A. K., Raj, S. P., & Wilemon, D. (1986). A model for studying R&D-marketing interface in the product innovation process. *Journal of Marketing*, *50*(2), 7–17.
Hamel, G., & Prahalad, C. K. (1994). *Competing for the future*. Boston, MA: Harvard Business School Press.
Heene, A., & Sanchez, R. (Eds) (1997). *Competence-based strategic management*. Chichester: Wiley.
Henderson, R., & Clark, K. B. (1990). Architectural innovation: The reconfiguration of existing products technologies and the failure of established firms. *Administrative Science Quarterly*, *35*, 9–30.
Iansiti, M. (1993). Real world R&D: Jumping the product generation gap. *Harvard Business Review*, *71*(3), 138–147.
Iansiti, M., & Clark, K. B. (1994). Integration and dynamic capability: Evidence from product development in automobiles and mainframe computers. *Industrial and Corporate Change*, *3*(3), 557–605.
Imai, K., Nonaka, I., & Takeuchi, H. (1985). Managing the new product development process: How Japanese companies learn and unlearn. In: K. B. Clark, R. H. Hayes & C. Lorenz (Eds), *The uneasy alliance: Managing the productivity–technology Dilemma*. Boston, MA: Harvard Business School Press.
Johansson, J., & Nonaka, I. (1996). *Senza tregua – L'arte giapponese del marketing*. Milano: Baldini e Castoldi.
Kamath, R. R., & Liker, J. K. (1994). A second look at Japanese product development. *Harvard Business Review*, (Nov-Dec), 154–173.
Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities and the replication of technology. *Organization Studies*, *3*, 383–397.
Lamming, R. (1993). *Beyond partnership: Strategies for innovation and lean supply*. Hempstead: Prentice Hall.

Leonard Barton, D. (1995). *Wellsprings of knowledge*. Boston, MA: Harvard Business School Press.

Li, T., & Calantone, R. J. (1998). The impact of market knowledge competence on new product advantage: Conceptualization and empirical examination. *Journal of Marketing*, *62*, 13–29.

Lipparini, A., & Melloni, A. (1994). La reingegnerizzazione dei processi in Fiat Auto. *Economia & Management*, *3*, 111–119.

Madhavan, R., & Grover, R. (1998). From embedded knowledge to embodied knowledge: New product development as knowledge management. *Journal of Marketing*, *62*(4), 1–12.

Naughton, K. (1999). The global six. *Business Week*, 16–21 (January, 1999).

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company*. New York: Oxford University Press.

Olson, E. M., Walker, O. C., & Ruekert, R. W. (1995). Organizing for effective new product development: The moderating role of product innovativeness. *Journal of Marketing*, *59*(1), 48–62.

Ruekert, R. W., & Walker, O. C. (1987). Marketing's interaction with other functional units: A conceptual framework and empirical evidence. *Journal of Marketing*, *51*, 1–19.

Sanchez, R. (1997). Managing articulated knowledge in competence-based competition. In: R. Sanchez & A. Heene (Eds), *Strategic learning and knowledge mangement*. Chichester: Wiley.

Sanchez, R. (1999). Modular architectures in the marketing process. *Journal of Marketing*, *63*(Special Issue), 92–111.

Sanchez, R. (2001a). Managing knowledge into competence: The five learning cycles of the competent organization. In: R. Sanchez (Ed.), *Knowledge management and organizational competence*. Oxford: Oxford University Press.

Sanchez, R. (2001b). Product, process, and knowledge architectures in organizational competence. In: R. Sanchez (Ed.), *Knowledge management and organizational competence*. Oxford: Oxford University Press.

Smith, P. G., & Reinertsen, D. G. (1991). *Developing products in half the time*. New York: Van Nostrand Reinhold.

Sobek, D. K., II., Liker, J. K., & Ward, A. (1998). Another look at how Toyota integrates product development. *Harvard Business Review*, (July–August), 36–49.

Stake, R. E. (1995). *The art of case study research*. Thousand Oaks, CA: Sage Publications.

Stalk, G. (1988). Time – the next source of competitive advantage. *Harvard Business Review*, *66*, 41–51.

Stalk, G., & Webber, A. W. (1993). Japan's dark side of time. *Harvard Business Review*, *71*, 93–102.

Takeuchi, H., & Nonaka, I. (1986). The new product development game. *Harvard Business Review*, *1*(Jan–Feb), 137–146.

Teece, D., & Pisano, G. (1994). *The dynamic capabilities of firms: An introduction*. WP-94-103, IIASA.

Valdani, E. (2000). *L'impresa proattiva. Competere nell'era dell'immaginazione*. Milano: McGraw Hill.

Verona, G. (2000). *Innovazione continua*. Milano: Egea.

Vicari, S. (1998). La creatività dell'impresa. *Tra caos e necessità*, Milano: Etas.

Volpato, G. (1995). *Il caso Fiat: Una strategia di riorganizzazione e di rilancio*. Torino: Isedi.

Wheelwright, S. C., & Clark, K. B. (1992). *Revolutioning product development*. New York: The Free Press.

Wheelwright, S. C., & Clark, K. B. (1993). *Managing new product and process development*. New York: The Free Press.
Wind, J., & Mahajan, V. (1997). Issues and opportunities in new product development: An introduction to the special issue. *Journal of Marketing Research*, *34*(1), 1–12.
Womack, J. P., Jones, D. T., & Roos, D. (1990). *The machine that changed the world*. New York: Macmillan.
Yin, R. K. (1994). *Case study research: Design and methods*. Thousand Oaks, CA: Sage Publications.

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