



PERSPECTIVE

On the Evolutionary and Behavioral Theories of Organizations: A Tentative Roadmap

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Cyert and March's *A Behavioral Theory of the Firm* has been acknowledged as one of the most fundamental pillars on which evolutionary theorizing in economics is built. Nelson and Winter's 1982 book is pervaded by the philosophy and concepts previously developed by Cyert, March, and Simon. Behavioral notions, such as bounded rationality are also at the heart of economic theories of institutions such as transaction costs economics. In this paper, after briefly reviewing the basic concepts of evolutionary economics, we discuss its implications for the theory of organizations (and business firms in particular), and we suggest that evolutionary theory should coherently embrace an "embeddedness" view of organizations, whereby the latter are not simply efficient solutions to informational problems arising from contract incompleteness and uncertainty, but also shape the "visions of the world," interaction networks, behavioral patterns, and the identity of the agents. After outlining the basic features of this perspective, we analyze its consequences and empirical relevance.

Key words: evolutionary theory; behavioral theory; embeddedness

1. Introduction

Evolutionary economics is microfounded on a theory of firms, organizations, and institutions that owes many of its concepts and most of its philosophy to Cyert and March's (1963) *A Behavioral Theory of the Firm*. Part II of Nelson and Winter's (1982) book entitled *Organization-Theoretic Foundations of Economic Evolutionary Theory* has many citations to the work of Cyert, March, and Simon. Evolutionary economics has mainly used behavioral theory as a tool for providing foundational concepts, alternative to neoclassical theory, on which to build a theory of industry and technological change. Routines, boundedly rational search, productive knowledge, and unresolved conflict provide an alternative to profit maximization and optimal agency contracts. Until recently, evolutionary theory has not developed a full-fledged theory of organizations based on behavioral concepts. In Nelson and Winter (1982) and in most of the works it has inspired, routines are the fundamental units of selection and boundedly rational search is the fundamental variational mechanism that generates the variety of organizational behaviors on which market selection operates.

Concepts and ideas from *A Behavioral Theory of the Firm* are also at the heart of other theories of organization both within the realm of economics (e.g., transactions costs theory) and management and organization sciences (e.g., the resource-based and the capability-based theories of the firm). In this paper, after briefly reviewing the basic concepts of evolutionary economics, we discuss its implications for the theory of organizations (and business firms in particular), and we suggest that evolutionary theory could well offer, together with capability-based theories, an "embeddedness" view of organizations, whereby the latter are not simply efficient solutions to informational problems arising from contract incompleteness and uncertainty, but also shape the "visions of the world," interaction networks, behavioral patterns, and, ultimately, the very identity of the agents.

The paper is organized as follows: In the next section we briefly review basic building blocks of evolutionary theory. In §3 we review recent developments in evolutionary theory and competence-based theory. In §4 we focus on issues of organizational learning and competence accumulation. Finally, we develop implications and empirical predictions and conclude by outlining unresolved problems and possible issues for further research.

2. Evolutionary Theories: Some Building Blocks

For the purposes of this work, let us confine ourselves to basic features of evolutionary theories of *economic* change.¹

1. Notwithstanding possible differences in other more substantive hypotheses, evolutionary theories share the methodological imperative “dynamics first!”. That is, the explanation for why something exists, or why a variable takes the value it does, ought to rest on a process account of how it became what it is. The process story should be provided either by formally writing down a dynamical system, or by telling a good qualitative historical reconstruction (or, much better, *both*). One should be extremely wary of any interpretation of what is observed that runs just in terms of ex post equilibrium rationalizations (“it has to be like that, given rationality”). Existence theorems or purely functionalist claims (entity x exists because it performs function y) are rarely satisfying explanations. The methodological stance of evolutionary economics is indeed fully shared with *A Behavioral Theory of the Firm*, where process accounts of decision making are one of its major contributions.

2. Theories ought to be microfounded, in the sense that they ought to be grounded explicitly in a plausible account of what typical agents do and why they do it.

3. Realism is a virtue and in certain respects a necessity. Although theories are necessarily abstract and admit less of reality than they omit, there are some broad features of reality that are omitted at the theorist’s peril—in the sense that the conclusions are unreliable guides to the interpretation of reality.

4. Among these features is the fact that agents have at best imperfect understanding of the environment they live in, and, even more so, of what the future will deliver. Hence, bounded rationality is generally assumed, with its specific content varying with context.

5. Imperfect understanding and imperfect, path dependent, learning entails persistent heterogeneity among agents, even when facing identical information and identical opportunities. Capturing heterogeneity is crucial to the representation of aggregate dynamics.

6. Agents are capable of discovering new technologies and ways of organizing, and of adopting new behavioral patterns. Allowing for the *possibility of novelty* in the system is a major theoretical and modeling challenge that must be addressed.

7. Although (imperfect) adaptation and discovery generate variety, collective interactions within and outside markets operate as *selection mechanisms*, generating differential growth (and possibly also survival) of different entities that are the carriers of diverse technologies, routines, strategies, and so on.

8. As a result of this, aggregate phenomena, such as regularities in the growth process or in industrial

structures, are often captured theoretically as *emergent properties* (i.e., the collective and largely unintentional outcome of microinteractions and heterogeneous learning). Such properties often have a metastable nature, in the sense that although persisting on a timescale longer than the processes generating them, they ultimately disappear.²

9. A similar style of representation and interpretation should apply to the emergence and self-maintenance of *organizational forms* and institutions: They are partly the result of directed (purposeful) action by the agents but also, partly, the unintentional outcome of the interplay of agent learning and collective interactions.

10. The relation of the higher-level regularities manifested in institutions, rules, and organizational forms to lower-level evolutionary processes is a complex one of *coevolution* across *levels of analysis* and *timescales*. Although the former are emergent phenomena of the latter, they may be considered as relatively invariant structures that constrain and shape the latter on short timescales.

This is the overarching program of research on evolutionary economics, as we see it. It is obviously impossible to review here the rapidly growing literature of contributions that share some or all of the foregoing theoretical building blocks.³

Several important new research developments have occurred in evolutionary economics. First, there has been an increase in the number of formal models and historical interpretations of economic growth as an evolutionary process propelled by technical change. Second, the diffusion of innovations has been fruitfully analyzed as an evolutionary path-dependent process. Third, the very development of an evolutionary perspective has been deeply intertwined with the historical analysis of the processes by which technical change is generated, ranging from the microeconomic level all the way to national systems of innovation. Fourth, a growing number of industrial case studies and models of industrial change fit the evolutionary conjectures outlined above. Fifth, research is starting to explore learning itself as an evolutionary process at the levels of individuals, organizations, and markets. This work links with a tradition of studies in the field of organizational economics, which is beyond the scope of this article (but see the remarks in Winter 1986, 1995).

Indeed we have a rich and growing body of economic literature that tackles change and evolution, where increasing returns are the norms rather than the exception, where history counts, and where agents are presumed to be less than perfectly rational and knowledgeable. But where do organizations fit in this picture? Let us now turn to this issue.

3. The Nature of Business Organizations

Business organizations are *behavioral entities*⁴ characterized by seemingly quite different arrangements in

terms of operational and cognitive division of labor, as well as equally different hierarchical setups, patterns of access to information, incentives, and control structures. Correspondingly, economic organizations embody specific and rather inertial compromises between different functions. Indeed, organizations perform (i) resource allocation, (ii) information processing, (iii) efforts elicitation, (iv) coordination (largely through nonprice devices) among multiple cognitive and physical tasks, (v) governance of competing claims on the total generated surplus, and (vi) experimentation and learning.⁵ In turn, these different organizational functions yield multiple coexisting levels of interaction amongst organizational members.

Clearly, a thorough understanding of what organizations are and how they operate ought to take on the analysis of the foregoing organizational processes. Although research still falls short of these objectives, over the last four decades multiple endeavors have enriched our understanding of the nature of economic organizations.

On the one hand, the dominant strand of contemporary economic analysis starts with primitives of the interpretation of the nature of organizations based on sophisticated, self-seeking agents. Together, the behaviors of these self-interested actors are viewed as typically directed by market forces. Only in those settings in which, due to failures of information and contract incompleteness, markets are less effective; organizations are called for to surrogate such imperfections.⁶

Conversely, a small—but growing—minority of the economics profession has placed “primitives” of the analysis of the nature of economic organizations in their problem-solving features, which are in turn nested in forms of human bounded rationality, imperfect processes of learning and variations in the distribution of cognitive labor. The root of this approach can be found in the works of Herbert Simon, Alfred Chandler, Richard Cyert, James March, Richard Nelson, and Sidney Winter. A foundational root is *A Behavioral Theory of the Firm* (Cyert and March 1963).

According to the Cyert and March book, the problem-solving activities of the firm can be conceived as combinations of physical and cognitive acts, within a procedure, leading to the achievement of a specific outcome. The internal organization of the firm determines the distribution of informational inputs across specific task units and, as such, the division of cognitive labor. The general idea is that firms possess specific problem-solving competencies associated with their own operational procedures and routines, which in turn are embedded in the patterns of intraorganizational division of labor and assignments of decision entitlements. Through problem solving, firms generate their productive knowledge and shape their organizational structure.

An illustrious antecedent of this view dates back, indeed, to Adam Smith’s pin-factory example in the *Wealth of Nation* (1776):

One man draws out the wire, another straightens it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving the head; to make the head requires two or three distinct operations; to put it on, is a peculiar business, to whiten the pins is another; it is even a trade by itself to put them into the paper; and the important business of making a pin is, in this manner, divided into about eighteen distinct operations, which, in some manufactories, are all performed by distinct hands, though in others the same man will sometimes perform two or three of them.

And, relatedly, such patterns of division of labor match specific channels of information flows and lines of command.

Table 1 offers a comparison between the incentive and the problem-solving approaches to organizations along significant dimensions and theoretical building blocks.

Clearly, there are elements of truth in both the incentive view and the problem-solving view, and bridging them ought to be part of the research ahead. The starting point for such a bridge-building exercise has consequences for the sort of bridge one creates. The starting point embodies a commitment to some assumptions on first-order versus second-order effects. We pick the last explored alternative, the problem-solving approach, as our point of departure.

We assume *weak incentive compatibility* (see Dosi and Marengo 1995) in the sense that there are selection pressures that generate connections between performance and rewards. But, consistent with the behavioral theory of the firm, such connections are quite loose. Once that connection is established, one focuses first on the diverse problem-solving characteristics of different organizations, and second on the ways in which incentive structures interact with problem-solving knowledge.

The archetype *incentive view* censors any competence issue associated with what organizations do and how well they do it—except for issues of misrepresentation of “intrinsic” individual abilities and adverse selection, or incentive misalignment in effort elicitation. By contrast, the *problem-solving view* censors the incentive-alignment issue. All agents are in a first approximation willing to cooperate in order to achieve a common organizational goal, although they might have different views and ideas on how to achieve the goal.

An organization embodies problem solving in several ways. First, the organization displays the operational competencies associated with its actual problem-solving procedures (see the discussions of routines in Nelson and Winter 1982, Cohen et al. 1996). Second, the organizational structure determines the distribution of informational inputs of tasks and of the *allowable acts*, i.e., “who can do what to whom.” Third, the organization shapes the search heuristics for yet unsolved problems.

Such a *capability-centered view* of business firms finds a core root in elements of *A Behavioral Theory of the Firm*, emphasizing the view of an organization as an “adaptive system,” which solves problems

Table 1 Pure Incentive View vs. Pure Problem-Solving View of Organizations

Dimension of analysis and theoretical building blocks	Pure incentive view	Pure problem-solving view
1. Problem solving/cognition/knowledge	No	Yes (central dimension of analysis)
2. Incentive governance	Yes (central dimension of analysis) via equilibrium contracting	Not so far (but see Coriat and Dosi 1998, and Dosi et al. 2003)
3. Behavioral microfoundations	Perfect, far-sighted, rationality	Bounded rationality (usually with “myopic” attributes)
4. Organizational behavior	Strategic (in the game-theoretic sense)	Driven by routines, heuristics, rules etc.
5. Learning	No	Yes (central dimension of analysis)
6. Unit(s) of analysis	—Transactions —Strategies —Allocation of information —Allocation of property rights	—Elementary “bits” of knowledge —Routines and other elementary behavioral traits.
7. Noneconomic dimensions of organizations	Not as “primitive” dimensions	Power, trust, identity building etc.

relying on shortcuts, routines, standard operating procedures (Cyert and March 1963), which in turn are modified through time via processes of adaptive learning and “problemistic search” (pp. 169–176). The capabilities (or knowledge-)based view builds on such intuitions by exploring in increasing detail (i) the link between organizational knowledge and patterns of organizational behaviors such as organizational routines, (ii) the forms and outcomes of organizational learning, (iii) the relationship between the latter and the patterns of cognitive division of labor within organizations, and (iv) the implications of organizational capabilities in terms of corporate boundaries and corporate performance. Fundamental questions in the interpretation of the nature of organizational competencies/capabilities concern include the loci where they reside and the extent to which they are *additive* in the skills and knowledge of organizational members. It is usually important to specify where in the organization particular knowledge is stored and who has learned it (Simon 1991).

4. Patterns of Learning and Competence Accumulation

In acquiring and adapting their competencies/capabilities over a period of time, organizations do something that can reasonably be called *organizational learning*. As behavioral and evolutionary theories espouse a process view of decision making, where organizational behavior is based on routines and is strongly history dependent (Levitt and March 1988), we argue that learning is the most fundamental process through which routines are formed and organizational knowledge is created and stored.

Learning may occur in circumstances whereby agents have an imperfect understanding of the world in which they operate due to (a) a lack of information, (b) an imprecise knowledge of its structure, (c) mastery of only a limited repertoire of actions in order to cope with whatever problem they face, or (d) when agents have

only a blurred and changing understanding of what their goals and preferences are.

Thus, learning is an ubiquitous characteristic of individual and organizational behavior, especially in cases in which: (a) heterogeneous agents systematically display various forms of bounded rationality; (b) there is a persistent appearance of novelties, both as exogenous shocks or as the result of technological, behavioral, and organizational innovations by the agents themselves; (c) markets (and other interaction arrangements) perform as selection mechanisms; (d) aggregate regularities are primarily emergent properties stemming from out-of-equilibrium interactions (see Dosi et al. 2005).

The organizational learning literature is a large literature embracing a wide range of specific intellectual ambitions, methodologies, and techniques. Only a few works seek to directly speak to managers (e.g., Senge 1990). Facilitating certain types of organizational learning is a major objective of quality management, and indeed the large literature on such topics provides another port of entry into the subject of organizational learning and hence to organizational capabilities. Classics in the area include Deming (1982) and Juran (1989); for a recent assessment of the quality movement see Cole (1999). More recently, consultants and corporate executives have evinced great interest in *knowledge management*, a rubric that spans a substantial number of concerns, many of which relate to efforts to improve capabilities through learning.⁷ In particular, the quest of improved performance through *benchmarking* and the identification and transfer of *best practices* are activities that are widely and systematically pursued. Careful studies of the microprocesses of organizational learning have been conducted both in the field (see Hutchins 1991, Adler 1993, Von Hippel and Tyre 1995, Narduzzo et al. 2000, Argote and Darr 2000) and in the laboratory (see Cohen and Bacdayan 1994, Egidi 1996, among others).

As to the sources of learning, Levitt and March (1988) distinguish between learning from direct experience, learning from the interpretation of experience, and learning from the experience of others. The first is mainly

learning-by-doing, whose importance has been long recognized by economists and organization scholars; and the latter have outlined the circumstances that lead to higher rates of learning by doing. The second is a kind of cognitive learning that has been discussed by researchers in evolutionary theory (e.g., see Gavetti and Levinthal 2000, Marengo 1996): Interpretation of experience leads to the construction and modification of models and theories about the world in which individuals and organizations operate, and in turn such learning is shaped by the organizational structure. The third type of learning, learning from the experience of others, has received considerable attention from organizational researchers who study knowledge transfer (e.g., Argote and Darr 2000, Szulanski and Winter 2002) and economists who focus on knowledge spillover.

Simon (1991) argues that strictly speaking organizational learning is only a metaphor because all learning takes place inside human heads: thus, an organization learns in only two ways, (a) by the learning of its members, or (b) by injecting new members who have knowledge the organization did not previously have. Conversely, without denying the importance of individual learnings, a number of authors have attempted to disentangle—both in theory and from empirical evidence—the patterns of change of some sort of *collective intelligence* that organizations embody: see, in particular, Levinthal (2000) and Marengo et al. (2000) on the theory side; Narduzzo et al. (2000), Fujimoto (2000), Coriat (1995), Dosi et al. (2003) for empirical investigations; and Warglien (1999) on both.

According to the *collective view* of organizational knowledge it is firms, not people who work in firms, that know how to make gasoline, automobiles, and computers (Winter 1982); and, dynamically, organizational learning is a social phenomena and cannot be reduced to individual learning processes of the members of the organization (see Marengo 1996). Organizational knowledge is not only incorporated into the heads of organizational members but also into (a) a set of routines, other organizational practices, and shared representations, and, (b) a set of material artifacts that shape intraorganizational relations and individual behaviors. Cohen et al. (1996) and Argote and Ingram (2000)⁸ argue that knowledge is embedded in organizational members, tools (technological components), and tasks (organizational goals, intentions, and purposes), as well as in the networks resulting from the combination of members, tools, and tasks. Thus, for example, the task network incorporates knowledge about how to perform a sequence of tasks, whereas knowledge about which member performs which task is embedded in the member-task network.

Both caricatures acknowledge diverse organizational structures: foster learning by individual members of the organization in certain *directions* and hinder it in others; affect the rates at which individuals learn, shape

the efficacy at which individual skills are exploited and contribute to the overall performance of the organization; and affect the rates at which individual skills and broader competencies are diffused throughout the organization. The collective view also adds dynamic aspects to the idea that there is an intrinsically organizational dimension of organizational knowledge embodied in the routines, hierarchical structures, and culture of an organization. Hence, according to the collective view: Organizational learning goes together with changes in routines and possibly organizational structures; and in order to become organizational, the learning that results from organizational inquiry (and, we would like to add, also that is absorbed from the environment) must be embedded in the images of organization held in its members' mind and/or in the epistemological artifacts (the map, memories, and programs) embedded in the organizational environment (Argyris and Schön 1996).⁹

Organizational learning is obviously linked with the change of individual skills—sometimes indeed with the loss of some of them—but also with changes of collective representations, rules, and even of hierarchical setups (Narduzzo et al. 2000). In essence, organizational knowledge and organizational learning ought to be partly considered—in the collective view—as an *emergent property*, shaped by the interaction amongst multiple learning and adjustment processes occurring within the organization itself—ranging from the levels of the individual, to teams, departments, and organizations (see Reagans et al. 2005).

Some important implications of the collective view are worth emphasizing:

(i) The organizational nature of learning is reflected by its being linked with changes in organizational practices that might not display any evident correlation with what individuals “know.”

(ii) All forms of long-lasting organizational learning imply some mechanisms of codification of knowledge and interaction procedures. Despite a fundamental incompleteness of codification mechanisms themselves, codification (imperfectly) deals with the persistence of organizational knowledge beyond the mobility of organizational members. (For discussions on this debate see Dosi et al. 2005, Pavitt 1987, and Dosi et al. 2005). Relatedly, the very codification of individual skills is a fundamental aspect of the establishment of an organizational memory.

(iii) Organizational learning is never a purely cognitive process: Rather processes of social adaptation, learning and modification of organizational rules, development of shared interaction patterns, and so on are crucial ingredients. Changes in the collective knowledge of nature and the procedures to master it (e.g., procedures for design and production of a new products) usually go together with changes in skills distributions, information flows, action patterns, and so on. But the converse does

not necessarily hold: One may indeed observe significant changes in the social division of labor or in action patterns without any dramatic change in the technical competencies of the organization. This lack of one-to-one correspondence between technological and organizational innovation is also a necessary premise for the comparison of the performance of diverse organizational setups, while holding strictly technological knowledge roughly constant. In turn, this bears far-reaching implications in terms of comparative assessment of different organizational archetypes (e.g., “the Japanese firm” versus “the American firm”).

(iv) Organizational learning is ridden with path-dependencies whereby incumbent competencies shape and constrain the patterns of future exploitation. One need not subscribe to Weick and Westley’s (1996) extreme view that organizing and learning are essentially antithetical processes... to learn is to disorganize and increase variety to acknowledge the widespread occurrence of competency traps, lock-ins into history-reinforced specializations and way of doing things, hierarchical arrangements, and action patterns (Levitt and March 1988, Cohen and Sproull 1996, Levinthal 2000, Cantwell 2000). Some form of organizational innovation (whether successful or not) occurs whenever an organization changes its protocols for the coordination of the information and knowledge distributed across its individual members, for the monitoring and governance of its conflicts of interest across organizational members, and for the distribution of authority assignments. All this might or might not go together with changes in technological competencies. A crucial but still largely unexplored question is how organizational innovations occur.

(v) One may distinguish two “ideal types” of learning processes: internal learning processes versus acquisition of external competencies and organizational models. As far as *organizational competencies* are concerned, there is no equivalent to R&D departments. However, there is no functionally specialized locus invested with *organizational search*. Rather, experimentation and adjustments are diffused throughout the organization. But with that come delicate problems of interpretation of experience, opaqueness in the relations between actions and outcomes, and ambiguities in “credit assignments” of successes and failures to subunits of the organization (Argyris and Schön 1996, Sproull 1981, Levinthal 2000).

The problem associated with the acquisition of external practices and competencies is more generally stemming from forms of indirect experience. Learning tends to concern primarily codified forms of knowledge. Issues of interpretation of external models and local adaptation remain fundamental, and with that also the question of the degree to which there are identifiable, relatively invariant, organizational models that undergo interorganizational diffusion.

Both internal and external forms of organizational learning entail subtle links with organizational structures. For example, Marengo (1996) emphasizes the intrinsic tension between knowledge *decentralization*, which promotes variety and experimentation, and *centralization*, which guarantees coherence in the exploitation of these diverse forms of learning. Higher degrees of decentralized learning are not necessarily conducive to higher degrees of organizational learning: Only when the former can be integrated and made coherent with the overall organizational learning process.

5. Interpretative Implications and Empirical Predictions

The foregoing discussion suggests that the interpretation of observed corporate structures and performance ought to primarily concern the relationships between the internal working of firms themselves and the interactive environment in which they operate. Indeed, one of the fundamental propositions shared by evolutionary economics and the capability view of business organizations is that firms have ways of doing things that show strong elements of continuity. A related and equally fundamental proposition is that firms have distinctive ways of doing things: Firms are generally heterogeneous even in the ways they accomplish functionally similar tasks, not to mention the large-scale differences that separate the chemical firm, the automobile manufacturer, the mass retailer, and so on. Taken together, these propositions set the stage for the dynamic interplay of the evolutionary triumvirate of variation, selection, and retention. Variety in the form of heterogeneous firm-behavioral patterns and structures gives the market-selection process something to work on. If variety is not a transient property, bound to disappear as selection does its job, but on the contrary is persistent, then market selection and promotion of successful firms ought to bear significant systemic consequences over time.

Early roots of these ideas go back to Edith Penrose’s (1959) notion that the profitability and growth of a firm should be understood in terms of its possession and development of unique and idiosyncratic resources. These ideas are now shared, albeit with different interpretations, by resource-based and capability or knowledge-based views of the firm. Scholars who identify themselves with the *resource-based view* examine the question of what sorts of resources confer lasting competitive advantages, how these advantages can be extended and “leveraged,” and what considerations prevent the elimination of the gap between the cost of the resources and the market value of the output produced. Many discussions in this vein seem to imply that firm resources are idiosyncratic in only a weak sense: Resources are relatively discrete and separable from the context of the firm and are the sorts of things that would naturally carry a market

price correctly reflecting their value for any organization. On this interpretation, the resource rubric does not subsume capabilities. Some authors, notably Dierickx and Cool (1989), offer a sharply contrasting view, suggesting that competitively significant resources are gradually accumulated and shaped within the firm and are generally nontradable. Unique, difficult-to-imitate capabilities acquired in a protracted process of organizational learning are examples of resources seen as sources of competitive advantage. An implication of the *capability view* discussed above is that strong idiosyncratic differences across firms ought to be widespread, notwithstanding the powerful influence that specific types of problem-solving activities exert on the structure and boundaries of business organizations. Moreover, another fundamental implication is that idiosyncratic capabilities persistently shape corporate performance.

If the nature of problem-solving activities is central to the explanation of organizational forms, taxonomic exercises on types of problems ought to map into corresponding taxonomies of organizational forms. Consider as a sort of extreme example the Taylorist/Fordist organizational archetype. In the foregoing terminology, the decomposition of the overall design/production/distribution problem is solved top down and once and for all, involving a first “cut” of broad subproblems (e.g., production) attributed to the various divisions and a much finer decomposition at the operational level into minute tasks to be tackled in highly routinized fashions.

At the opposite extreme, however, a much less studied archetype is when organizational design problems cannot be solved once and for all and therefore the distribution of problem-solving knowledge is much more fluid. Dosi et al. (2003) consider six ideal types of organizational forms, ranging from the purely functional form, with separate functional departments, to the project-based form, where the entire organization is dedicated to one or more complex projects and there are no clear-cut functional boundaries. Within such a taxonomy, the researchers present an analysis of the coevolution of problem-solving knowledge and organizational design in complex, nonroutinized, and nonstable tasks. In particular, they focus on the so-called complex product systems (CoPs), including complex capital goods which consist of many interconnected and customized elements that sometimes exhibit emergent properties during their production (i.e., unpredictable properties which reveal themselves only at the stage of system engineering and integration, or later during their actual use).

CoPs include relatively traditional goods, such as train engines, but also mobile communication systems, military systems, corporate information technology networks, aircrafts, air traffic control systems, tailored software packages, and many others. Their complexity is due to the number of components and inputs required,

the presence of many design choices, the degree of customization, and the breadth and depth of knowledge involved in design and production.

The project-based form seems to be well suited to the problem complexity and fuzzy decomposition tasks characteristics of CoPs. A good illustration of how the nature of technical/organizational problems and of the related knowledge bases shape organizational arrangements stems from the comparison of the role of the project manager under project-based form versus under traditional functional patterns of division of labor. In the first mode, decompositions tend to be rather loose and credit assignments/incentive schemes ill defined. This, however, demands a core role for the project manager, who represents the main channel of communication and is pivotal in the coordination and integration of specialist functions and solutions to sub-problems. Indeed, the evidence suggests that the overall project management is undertaken by distinct firms that perform as *system integrators* (Brusoni et al. 2001).

At the other end of the spectrum, one finds integrated organizations that produce complex products but do so under rather precisely defined decompositions, lines of command and incentive schemes (e.g., the classic Fordist automobile industry). In these circumstances project management is nothing but one of the many functions within the firm.¹⁰

Another promising domain to which the *capability view* can be fruitfully applied regards the proximate boundaries of the firm. Almost all large firms and many small ones are multiproduct, both in a *vertical sense* (i.e., they produce some of their own inputs) and in a *horizontal sense* (i.e., they produce more than one output). Moreover, as Rumelt (1974, 1982) has shown, after World War II, at least in the United States, the largest corporations increasingly diversified their production. Between 1949 and 1974 “the proportion of the largest 500 industrial firms that were substantially diversified more than doubled, rising from 30% to 63%” Rumelt (1982). Using a sample of 100 firms and the definition of categories of firms ranging from single business to unrelated business, Rumelt (1974) observes a steady decline of the number of single product firms and a rapid growth of diversified ones. A similar pattern is described by Montgomery (1994) for the period 1985–1992, who also cites evidence about other countries (Japan and United Kingdom) that is consistent with the U.S. pattern.

There are, of course, different theoretical candidates for the explanation of such empirical patterns, including these broadly deriving from agency theories (Holmstrom and Roberts 1998), transaction cost considerations (Williamson 1975, 1985, 2000; Holmstrom and Roberts 1998), and the resource-based and capabilities views (see Montgomery 1994, Rumelt 1982, Markides and Williamson 1994, Bettis 1981, Palepu 1985, Zollo and

Reuer 2001, Teece et al. 1994). In particular, Teece et al. (1994) stress three fundamental characteristics of modern corporations: (i) their multiproduct scope, (ii) the nonrandom distribution of product portfolios of firms conditional on their principal activities, and (iii) the stability in the composition of firms' portfolios over time. They suggest that firms are "coherent" in their portfolios in so far as they diversify by adding activities that share with the existing ones some market or technological characteristics. That is, firms build on the capabilities they already have (see also Chang 1996). The boundaries of the firm—and thus the predicted degrees of diversification and coherence—can be understood in terms of characteristics of (i) learning, (ii) path dependencies, (iii) technological opportunities, (iv) selection environments, and (v) firms' endowments of complementary assets. Thus, for example, rapid learning, rich technological opportunities, and tight path dependencies will correspond to (nearly) single-product, fast-growing firms. Conversely, within a context of rapid learning, converging technological trajectories, and tight selection, one can expect to see coherent diversifiers. Moreover, the interpretation suggests that unrelated diversification is likely to be viable only under conditions of weak market selection.

Evolutionary and capability-centered views have implications for the determinants of the vertical as well as horizontal boundaries of the firm. A well-known interpretation of *vertical boundaries* is in terms of relative costs of governing market-mediated versus hierarchically coordinated transactions (Williamson 1975, 1985, 2000). Although not denying the importance of transaction-cost considerations, a few studies have begun to explore resource-/capability-based explanations of the choices between market and other forms of governance of input/output flows (Argyres 1996, Jacobides 2000, Jacobides and Hitts 2005, Delmas 1999). The central conjecture here—as well as in the earlier discussion of the governance of CoPs—is that the degree of vertical integration and the selection of governance forms is shaped by the nature and distribution of problem-solving knowledge. Consider for example Delmas' (1999) study of an industry characterized by high technological and regulatory uncertainty. Her evidence indicates that the major determinant of the vertical boundaries of the firm is the distribution of capabilities across segments of activities and across firms: "Firms will rely on alliances for tacit technologies in highly uncertain environments. Although incurring high transaction costs, collaborations are perceived as possessing the flexibility and the adaptability necessary to build competencies and to gain a competitive advantage" (p. 664).

So far we have mentioned *some* of the interpretative implications of a knowledge-centered theory of the firm and related empirical predictions. But what are the implications of such a theory for strategic management?

What does the theory predict that managers do? And at which variables and processes *should* they look in order to improve organizational performance?

Indeed, an important theme in the recent strategy literature is the idea that the most distinctive role of business firms in general is the way they bring knowledge to bear on productive effort. This and related ideas have been discussed under the heading of the *knowledge-based* theory of the firm (Grant 1996, Kogut and Zander 1992, Dosi and Marengo 1995). As with the notion of resources, this discussion converges with the capabilities discussion in so far as knowledge is conceived as know-how embedded in the organization's activities, as opposed to passive, library-like stocks in the heads of participants.¹¹

In this perspective, as forcefully argued by Teece et al. (1997), strategic management has a key role in shaping: (i) *Organizational processes*, by the establishment of specific organizational structures and, equally important, by introducing and by *breaking* particular organizational routines, (ii) the *position* of the firm (broadly defined to cover their specific assets, their locations along the value chain, and their relationship with suppliers and customers), and (iii) *paths* (i.e., the patterns of change in the former two sets of characteristics). These activities are at the core of what Teece et al. (1997) call the *dynamic capabilities* of the firm.

Moreover, managerial tasks involve: (iv) Presiding over the *replication* within the organization of well-performing bundles of routines (Szulanski and Winter 2002, Winter 2005), (v) defining the *cognitive frames* and the *aspiration levels* of the organization (that is, the shared representations and perceived fitness landscapes),¹² and (vi) mastering the persistent and tricky dilemmas between *exploitation and exploration*, between the improvement of what the organization "is already good at" and the search for more radical innovative opportunities (March 1991).

These tasks, in turn, involve the rethinking of traditional management tools—such as team staffing and mobility, incentive policies, and information storage and retrieval—conceptualizing them as tools for setting the parameters of intrafirm (exploitation/exploration) dynamics (Warglien 1999). In such a context, the management of a *variety of exploration trajectories* implies a view of an organization as an artificial ecology (Levinthal 2000) wherein managers look somewhat like contemporary bioengineers trying to "fine-tune" *ex ante* the discovery of new traits/biochemical properties, and *ex post* to test and select among them. It is important to note that this perspective on organizations, organizational learning, and their management clearly shifts the focus of analysis from "clever strategizing" against market rivals to the process of problem solving and organizational governance, and to capability-enhancing strategies (see Tidd et al. 1997 for an insightful management text in this perspective).

6. Conclusions and Research Tasks Ahead

We concluded the previous section by outlining how behavioral, evolutionary, and capability theories sketch a vision of managerial agency that contrasts with traditional “rational” decision theory. Consider for instance, as a useful contrast, how in disciplines that employ the theoretical tools of decision theory, key assumptions about skills and capabilities often remain implicit. Take, for example, the simple and basic tool called a pay-off matrix: an array with choice alternatives on one side, “states of the world” (or opponent choices) on the other, and the outcome utility values in the cells. Typically, choices are actions or entail actions. Although in some cases the choices listed are everyday actions that are familiar and perhaps available to the typical reader of the analysis (“carry umbrella”), in other cases they are not (“conduct seismic tests,” “shut down nuclear reactor”). In these latter cases, the availability of the actions is apparently presumed to inhere in the identity of the decision maker, but this presumption goes untested.

Further, choices available to the decision maker are, in decision theory, feasible by definition: Any uncertainty attached to the consequences of *trying* to take specific action (the sort of choice that is in fact readily available) is subsumed in the uncertainty attached to states of the world. This is in principle an inconsequential formal convention, but in practice significant questions of feasibility tend to get swept under the carpet in the process of abstracting an analyzable problem from a real situation. The rich sequence of unfolding events that often follow failed attempts may involve wholly unanticipated outcomes and learning that could be represented in a sufficiently elaborate decision-theoretic formalism.

These habits of decision-theoretic thought contribute to the obscurity in which capability issues have long resided in economic analysis. The entries in the menu of choices are specified and taken for granted, even when choices involve complex actions. Little is seen of the costly and protracted learning processes that place alternatives on the menu. The consequences for future menus of the choices made today, for example, the likely strengthening of capabilities that are exercised and the likely withering of those that are not, are generally abstracted away. These practices leave a major gap in the understanding of behavior, a gap best filled, perhaps, by the use of tools other than decision theory.

Just as the market system accomplishes remarkable feats of coordination without the aid of a central plan, organizational learning produces the coordinated performance of organizational capabilities without the aid of a comprehensive plan. According to the mainstream tradition in economics, economic actors do not have to understand the price system for it to work. Similarly, an organization produces coordinated activity without anyone knowing how it works, although participants may

well be aware of managerial intentions to achieve coordination. There are far more tacit aspects to coordination than any amount of observation will uncover or any imaginable set of manuals will ever record. Tentative choices that are actually incompatible or substantially subversive of the overall performance get rooted out in the course of learning, not in response to the imperative “follow the recipe!” but in response to “try something different!” Choices compatible with the overall performance are allowed to stabilize and become habitual, without either the choices or the habits necessarily being recognized as such along way. Finally, in the well-established capability, the activity in progress is its own best and only operating manual.

One role of management is to painstakingly steer the process while both recognizing the weight of the path dependencies in knowledge and organizational practices inherited from the past and trying to detect the “windows of opportunities” ahead. Certainly, there is no general recipe for managerial success (and there *cannot* be). Simply, consider the foregoing remarks as pointing at *managerial heuristics* and *diagnostic tools* which, in our view, are at the core of the dynamic capabilities of business organizations.

On the interpretation side, it is time for a more complete view of organizational processes taking explicitly on board first—their “political” aspects, conflicts, and their quasiresolution. This is where refinements on the seminal *A Behavioral Theory of the Firm* can offer accounts of (imperfect) incentive governance in organizations that do not rely on empirically implausible assumptions about individual rationality and collective equilibria.

Another very important part of the original “behavioral theory” has been almost entirely neglected by subsequent developments and ramifications. This concerns those organizational capabilities associated with procedures leading to organizational actions with an immediate economic relevance, such as setting the price, a desired output, a policy, and a schedule for expansion investments. Cyert and March (1963) still offer one of the best examples of a sequence of routines leading to price setting. Little work has been done in this area since. Progress here, however, is likely to yield fascinating returns concerning the predictions that organization theory has to offer in terms of *micro* and *aggregate* properties, such as production, prices, investments. The relationship between micro- and macroprocesses is a major frontier bridging organizational and economic analysis that we believe is a fruitful area for future research.

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Endnotes

¹For a more detailed account we refer the reader to Nelson and Winter (2002), Hodgson (1993), Nelson (1995), Silverberg and Verspagen (1995), Metcalfe (1992), Anderson et al. (1988), Witt (1993), Dopfer (2005), and Lesourne and Orléan (1998).

²On the notions of the “emergence” and “metastability,” cf. the suggestive discussion in Lane (1993); see also below.

³Note that, given the above broad definition of an “evolutionary research programme,” it may well partly cover contributions of authors who could not call themselves “evolutionist” in any strict sense.

⁴We borrow this expression from Kreps (1996).

⁵This categorization refines on a similar one suggested in Coriat and Dosi (1998).

⁶A few more detailed epistemological remarks are provided in Dosi (1995) and Coriat and Dosi (1998).

⁷See special issue on Knowledge and the Firm (R. E. Cole, ed.) of the *California Management Review* (Vol. 40, Spring 1998).

⁸See also Argote and Darr (2000).

⁹Kieser and Koch (2002) propose an alternative view of organizational learning based on the idea of *transactive memory*. Members of the organization can hold a very specialized knowledge but at the same time they can simulate a joint memory through which it is possible to identify the relevant knowledge and to localize it without the need for sharing it. Routines and formal organizational rules provide the basis for the recombination of the knowledge of specialized members, and mechanisms like prototyping can represent the means through which they can contribute without extending their cognitive capabilities. See also Lewis et al. (2005) on this point.

¹⁰In the literature one begins also to find exploratory attempts to identify, so to speak “bottom-up,” the seemingly viable combinatorics amongst multiple interrelated organizational traits: see, on automobile manufacturing, McCarthy et al. (1997).

¹¹For a broader discussion of the recent emphasis on capabilities in the strategic management literature, see Rumelt et al. (1991), Teece et al. (1997), and Stalk et al. (1992).

¹²For some impressionistic hints cf. Massini et al. (2002).

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