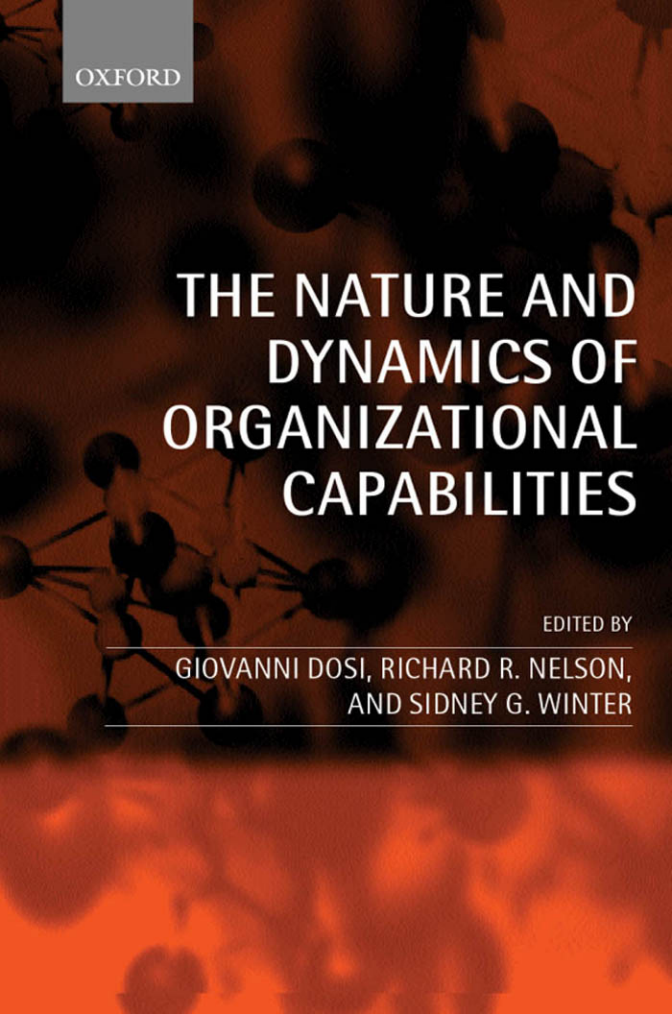
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THE NATURE AND DYNAMICS OF ORGANIZATIONAL CAPABILITIES
EDITED BY
GIOVANNI DOSI, RICHARD R. NELSON, AND SIDNEY G. WINTER

The Nature and Dynamics of Organizational Capabilities

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Preface

This book has painstakingly but excitingly emerged from an international research project which originally grew at the International Institute of Applied System Analysis (IIASA), Laxemburg, Austria within the *Technological and Economic Dynamics* (TED) Project and was completed drawing on the precious support of the '*Dynacom*' Project financed by the European Union (under the TSER/DG XII Programme).

It has been made possible by the enthusiastic effort of a wide invisible college of scholars who accepted to forgo any reasonable cost-benefit analysis in terms of time investment vs. financial rewards in order to contribute to an enterprise which at the start most would have regarded as a far-cry into the properties of self-organization. At least in the judgement of the editors of this book, it turned out to be indeed a major success, possibly a future reference in the field.

It is hopeless to try to acknowledge all friends and colleagues who contributed with their comments and criticism throughout the process. Within the large community of collaborators who made this book possible, we would like just to mention the patient and loyal help of Yasmine Taher, our secretary at IIASA, who motherly followed the vicissitudes of chapter contributors and editors of the book.

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Contents

List of Figures

List of Tables

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Introduction: The Nature and Dynamics of Organizational Capabilities

Giovanni Dosi, Richard R.Nelson, and Sidney G.Winter

It is familiar enough that business firms and other organizations 'know how to do things'—things like building automobiles or computers, or flying us from one continent to another. On second thoughts, what does this mean? Is there not a sense in which only a human mind can possess knowledge? If so, can this proposition somehow be squared with the idea that organizations know how to do things? And if organizational knowledge is a real phenomenon, what are the principles that govern how it is acquired, maintained, extended, and sometimes lost?

Our focus here is on the particular forms of organizational knowledge that account for the organization's ability to perform and extend its characteristic 'output' actions—particularly, the creation of a tangible product or the provision of a service, and the development of new products and services. The range of activities we have in mind is broad, embracing for example automobile manufacturing, brain surgery, identifying and developing new pharmaceuticals, putting on an effective art exhibition, and shipping a package across a continent. Pending a more thorough discussion of terminology, we identify the term 'organizational capabilities' with the know-how that enables organizations to perform these sorts of activities.

The authors represented in this volume share the belief that organizational knowledge is real and a phenomenon of central importance to the understanding of the modern world. Their studies explore the role played by organizations in linking the general fund of knowledge in a society to its practical affairs. Understanding how organizations develop, maintain, and advance their capabilities is, in their view and ours, fundamental to understanding how society works and how it changes. This belief obviously contributes importantly to the intellectual interest that the subject holds for the participants in this undertaking.

As we shall explain in more detail below, research on capabilities is an area invigorated from the 'supply side' by the convergence of different lines of scholarly inquiry, and from the 'demand side' by a range of potential areas of practical and theoretical application. The studies collected here illustrate that range, if they do not fully cover it, and we expect that this volume will be of interest to a number of different audiences.

Accordingly, in this introduction we seek to introduce the subject in a manner accessible to a diverse audience. We first explain what the capabilities discussion is about. It relates, we argue, to distinct phenomena that have not been adequately addressed by the various disciplines and sub-fields that lie adjacent to this subject matter. We hope to evoke the sense that, notwithstanding their familiarity as part of the backdrop of everyday life, organizational capabilities are complex and even somewhat mysterious social phenomena. A further goal in this introduction is to sketch the complex intellectual background of current research on capabilities, and to

identify some of the areas where improved understanding of capabilities would be particularly useful.

We do not, however, attempt a full survey of the book and the principal issues raised by the various contributions; this task is addressed in a 'distributed' way by the introductions to the individual sections. The sections are presented in order of increasing scope. We begin with studies that examine the development of particular capabilities at the microlevel within organizations, then proceed to studies at the level of the firm or productive establishment, then to industry-level patterns. The final section contains a perspective on the development of the capabilities view in strategic management and a theoretical paper that illuminates the causes of some of the basic patterns observed in the empirical studies.

1. The Concept of Organizational Capability

To be *capable* of some thing is to have a generally reliable capacity to bring that thing about as a result of intended action. Capabilities fill the gap between intention and outcome, and they fill it in such a way that the outcome bears a definite resemblance to what was intended.

In the behavior of organizations, however, the most relevant intentions are often remote from the particular action and outcome. They may lie deep in the background of the specific actions that occur, which often come about in a variety of ways not involving intentions—including habitual responses of human beings and the automatic, physically determined responses of machines. The local telephone company intended to provide phone service in the sense that its executives, past and present, construed many of their own decisions in those terms—but the realization of a particular call is automatic. Its feasibility reflects an accumulation of equipment, individual skills, and organizational arrangements generated by a series of specific decisions that implemented and re-implemented the general intention to provide phone service—including a variety of arrangements that link the services of the provider of local service to other organizations in the global telecommunications system.

This example illustrates the typical situation: it is in the building of organizational capabilities that the role of intentionality is most reliably displayed; specific exercise may be intentional (as when an engineering firm builds a factory or bridge to fulfil its contract to do so), but it may be also be quite automatic (as in the phone-call example).

Although the phone call is a simple and familiar action from the caller's point of view, it is made feasible by the operation of an extraordinarily complex system. The system in turn is the product of a long and complex process of technological and organizational change, with associated investments in facilities and training—a process in which intentions to develop a (better) telephone system played a role that was important but intermittent and fragmented. The contemporary global telecommunications system was not produced through the execution of a coherent and comprehensive plan. In this case, and many others, the structure of capabilities at the highest level reflects the outcome of a self-organizing, bottom-up process rather than realization of any comprehensive intention.

The distinction we make here—between the capability itself and the numerous instances of its exercise—parallels similar distinctions expressed in varying terminology about a variety of contexts. In particular, it parallels the distinction at the individual level between a skill and the exercise of the skill. In organizations, there is a distinction between the execution of high-frequency, repetitive daily business by low-level employees and the decisions of executives about the development and deployment of capabilities (serving the french fries versus opening another hamburger stand). There is a corresponding distinction at the individual level between the relatively tacit, subconscious, automatic, and high-frequency character of exercise and the more intentional, deliberate, and intermittent processes involved in skill development and deployment (learning to drive or choosing the destination versus the exercise of skill in keeping the car on the road). The parallels extend to learning processes; different processes are involved in the sort of learning that improves exercise than in original development of skills and capabilities. This parallelism presents an opportunity to use the individual realm as a metaphor to explicate the organizational, and vice versa. The opportunity has been exploited more than once. One significant fact that has become clear only in recent years is that, for individuals, the exercise of skills involves brain processes quite different from those displayed in fully conscious thought and the command of facts.[1]

It has been said that the mark of high skill in an individual is the ability to make some activity look easy when it is actually very difficult, and much the same point applies to organizational capabilities. The more polished the performance, the less attention gets directed to the innumerable hazards of failure that have been over-come, and the more the performance itself assumes a taken-for-granted character. Also, performances that are commonplace in the sense of being reproduced at high frequency come to seem less mysterious and easier than accomplishments that occur only occasionally—although it should be obvious on reflection that frequency *per se* is no indicator of ease or difficulty, once the threshold question of feasibility is settled. The more organizations succeed in making customer encounters simple and uneventful, the more the complex reality of capabilities tends to disappear behind the veil of familiarity.

2. A Note on Terminology

The term ‘capabilities’ floats in the literature like an iceberg in a foggy Arctic sea, one iceberg among many, not easily recognized as different from several icebergs near by.

[1] For the use of organization as a metaphor for the individual, see e.g. Alfred Marshall (Marshall 1920: 21). Marshall's discussion in a footnote anticipates reasonably well recent discoveries relating to brain function and physiology: ‘It seems that the exercise of nerve force under the immediate direction of the thinking power residing in the cerebrum has gradually built up a set of connections, involving probably distinct physical change, between the nerves and nerve centres concerned; and these new connections may be thought of as a sort of capital of nerve force. There is probably something like an organized bureaucracy of the local nerve centres; the medulla, the spinal axis and the larger ganglia generally acting the part of provincial authorities, and being able after a time to regulate the district and village authorities without troubling the supreme government.’ More of the bureaucracy lives in the brain than Marshall thought. See e.g. Squire, 1987*Memory and Brain,* esp. ch. 11.

In this section, we attempt to survey this terminological flotilla and point out distinctive features of some of the floating objects. We make suggestions about terminology that reflect our own understanding and preferences, but we are not under the illusion that terminological anarchy is easily suppressed.

In surveying this somewhat confusing scene, it is useful to keep in mind a distinction between the use of a given term as a label on a black box and the use of that same term as a label on a more transparent box—which can be seen to have other boxes inside it, themselves somewhat transparent. Both types of usage are quite legitimate, and sometimes an author will slip smoothly from one to the other as attention shifts from one issue to another. The chapters that follow are generally concerned with the 'transparent box' version of capability, and even with unpacking the transparent box to examine more closely the boxes inside. This is less true of some of the works that introduced the terms discussed below.

Following the discussion above, it should be clear that we think of 'capability' as a fairly large-scale unit of analysis, one that has a recognizable purpose expressed in terms of the significant outcomes it is supposed to enable, and that is significantly shaped by conscious decision both in its development and deployment. These features distinguish 'capability' from 'organizational routines' as that term is used in organization theory and evolutionary economics—subject to the qualification that *some* organizational routines might equally well be called capabilities. In general, however, the notion of a routine involves no commitment regarding size—large routines are typically structured sets of medium-sized routines, and so on. It involves no presumption regarding evident purpose; one of the interesting things about routines is that they are often found in contexts where nobody can explain what they are for except in the vague terms of 'the way things are done around here'. And there is no presumption of deliberation or conscious choice; a flight crew probably does not choose its response to unexpected turbulence any more than a batter chooses to hit the dirt when the pitch appears to be coming toward his head.

On the other hand, the notion of a routine certainly does not *exclude* the possibility of conscious decisions about exercise. Hence, some routines may appropriately be called capabilities, if they satisfy the other criteria.

Capabilities involve organized activity and the exercise of capability is typically repetitious in substantial part. Routines are units or 'chunks' of organized activity with a repetitive character. Hence, it is basically well said that 'routines are the building blocks of capabilities'—although routines are not the *only* building blocks of capabilities. A marketing capability might require a customer database, for example, which is neither a routine itself nor does it resemble a routine in the way that the working of complex equipment sometimes does. The database is, instead, a contextual requisite of some of the organizational routines supporting the capability.

Individual skills, in turn, are among the building blocks of organizational routines. What we commonly think of as individual skills are quasi-modular components of routines; their names are useful in expressing, for example, the idea that the role played by one skilled machine operator might well be played by another. But

'knowing the job' involves knowing things that are relational—involving other participants—and organization-specific (Nelson and Winter 1982: 100–3). That is why the skilled operator still needs to learn the job when joining an unfamiliar organization to operate a familiar machine—and why someone who is a perfectly adequate machine operator might nevertheless fail to learn the job. Some of the non-modular knowledge required is skill-like, regardless of what it is called—but these are skills that can be learned only through experience in the specific organization.

In our view, clarity would be served by reserving the term 'skills' to the individual level and 'routines' to the organizational level. 'Routines are the skills of an organization' is a metaphorical truth not a literal truth.[2]. In the existing literature, however, our proposed usage convention is violated in both directions. For example, Waterman *et al.* (1980) used 'skills' for what we would prefer to call routines or capabilities, whereas Nelson and Winter (1982:100) slipped into using 'routines' at the individual level when they should have said 'skills' or perhaps 'constituent skills'. Transgressions of this kind will no doubt continue, but, we hope, not by us.

Consistent with this proposal, a useful meaning for the 'skills of the organization' would simply be the collectivity of skills possessed by individuals in the organization, regardless of whether the skills are modular, organization-specific, or not organization-related at all. Then it could be said that organizational routines have the major function of coordinating the skills of the organization, i.e. of turning that collectivity of skills to useful effect.

Turning to another area of the concept flotilla, we find a cluster centred on 'competence'. In organization theory, the idea that an organization tends to be good at some particular thing (if anything) has long been referenced by the term 'distinctive competence'. This term was introduced by Selznick (1957) in his classic work *Leadership in Administration*. In Selznick's original discussion, however, the idea of distinctive competence seems to be at lease as close a relative of the organization's mission statement, or perhaps its 'strategic intent' (Hamel and Prahalad 1989) as of its capabilities. Selznick's concern is with the infusion of means with shared ends, 'the transformation of an engineered, technical arrangement of building blocks into a social organism'. He suggests, as other management theorists have subsequently, that a highly effective organization emerges when a leader helps the organization to transcend a merely technical understanding of its own functioning.[3] An indicator of the distance from the capabilities concept is Selznick's reference to *standardized* building blocks; apparently it is the value-laden 'transformation' and not the building blocks that account for the 'distinctive' part. While Selznick (and others) may well be right to emphasize the importance of values, especially among the best organizations, capabilities theorists think the technical building blocks are often quite distinctive in their own right.

An influential article by Prahalad and Hamel (1990) popularized the term 'core competence'. Only a brief encounter with the article is required to note four points:

[2] The statement is in Nelson and Winter (1982: 124), and it is there introduced as a metaphor.

[3] Peters and Waterman (1982) were emphatic and interesting on this point, see esp. ch. 4.

(i) that large corporations have multiple core competencies (five or six at a maximum, they suggest, not twenty or thirty—but not one, either); (ii) that competencies are fundamental to the *dynamics* of the firm's competitive strength, lending strategic coherence to a string of new and improved products appearing over an extended period; (iii) that the competencies referred to are all areas of 'hard' technology (if Procter & Gamble is properly thought to have core competence in marketing and distribution, or Wal-Mart in logistics, the authors don't mention it); (iv) that while the relationship of competencies to large-scale structural features of the organization is a featured issue, the organizational aspects of the competencies themselves do not capture the authors' attention. Some of the subsequent discussion of core competence seems to lose track of one or more of these points. The fact that the authors titled their article 'The Core Competence of the Corporation' (note singular) may have contributed to a partial eclipse of point (i).[4]

The last two points noted above are much at odds with the concept of organizational capabilities, which need not relate to technology and certainly have significant internal organization. If, however, we ourselves exercise the prerogative of simply ignoring a couple of points, we can move closer to the capabilities concept by focusing on the first two. We then arrive at the idea that a successful large corporation derives competitive strength from its excellence in a small number of capabilities clusters where it can sustain a leadership position over time. This comes very close to the concept of 'dynamic capabilities' advanced by Teece *et al.* (1997: 516): 'We define dynamic capabilities as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.' (See also Teece *et al.* in this volume) In areas of hard' technology, the dynamic capabilities of a firm depend heavily on its R&D resources; in other areas that label may not be applied but analogous investments are made.

There is general agreement, however, that dynamic capabilities cannot be built simply by spending on R&D or making analogous investments. On the contrary—and to an increasing extent as the competitive pace quickens—coordination between R&D and other functions, and often with suppliers or alliance partners, is of the essence. Such coordination is needed, among other things, for effective identification and linking of technological options and market opportunities, and for identifying the strengths and weaknesses of existing resources relative to the requirements of a new product or process.

Thus the concepts of 'core competence' and 'dynamic capabilities' point in the same direction, being broadly concerned with the firm's ability to carry off the balancing act between continuity and change in its capabilities, and to do so in a competitively effective fashion. The discussion of dynamic capabilities has, however,

[4] The use of the singular in 'core competence' encourages a conflation with 'core business'. In practice, 'core business' seems to have primarily a historical connotation: your core business is the one you were in before you started (or resumed) diversifying. Recommendations that a corporation retreat to its core business do, however, seem to rest on the presumption that some resources offering potential competitive advantage do remain there, current poor performance notwithstanding. And there is a presumption that if you can't be good at your core business, you probably can't be good at anything else.

been both broader in scope and more explicit in its treatment of the details of capabilities than the core competence discussion.

Another important idea in this general area is referred to as 'combinative capabilities' by Kogut and Zander (1992). Here again the emphasis is on the firm's ability to handle change by transforming old capabilities into new ones. Two points about the nature of this transformation are emphasized: (i) that firms produce new capabilities by *recombining* existing capabilities and other knowledge, (ii) that the ability of the firm to do this is affected by the organizing principles guiding its operations—principles that include matters of formal structure but, more importantly, internal social relations shaped in part by differences in the knowledge bases of individuals and groups within the firm. Pursuing these ideas the authors develop a view of the firm and the make-or-buy decision quite different from that put forward in transaction cost economics.

There are also examples in the literature where the word 'competence' is not used as an abbreviation for 'core competence' nor as a rough synonym for what we would call a 'capability' or a 'dynamic capability'. Usage in these cases appears to be most closely akin to usage of the same terms in reference to individuals, and has if anything a connotation of breadth rather than specificity—something closer to judgement than to skill. Eliasson (1990), for example, discusses the role of the 'top competent team' in the firm—the *de facto* top management team—which involves making strategic judgements that are not readily amenable to analysis. Such decisions are informed instead by the experience-based tacit knowledge of individuals and by the dialectical interaction within the team. This sort of competence relates not to a specific subject matter or task, but to an entire realm of highly consequential decisions that are difficult to get right, where small percentage improvements over judgements of average quality can be very valuable.

The character of decision-making in this realm, and in contexts in which both competence (or vision) and capabilities play an important role, has been explored by Fransman (1994*a,* 1994*b*). The question of the value that top management competence brings to the firm, and its relation to managerial compensation, has also been studied by Castanias and Helfat (1991), although both the orientation and language is different.

This discussion of terminology would certainly be incomplete without reference to what was (at least to our knowledge) the original use of the term capabilities', in a sense closely akin, if not identical, to our own. George B. Richardson, in his article 'The Organization of Industry', (Richardson 1972: 888) made the fundamental point that 'organizations will tend to specialize in activities for which their capabilities offer some comparative advantage', and that the pursuit of activities that are similar in the sense of drawing upon the same capabilities may lead a firm 'into a variety of markets and a variety of product lines' (ibid.).[5] Richardson's analysis includes a capabilities-based account of the boundaries of the firm that is both clear and plausible—though

[5] This point was further expounded by Teece (1980) in his article on the multiproduct firm, and subsequently reintroduced by Prahalad and Hamel (1990), with 'core competences' rather than 'capabilities' in the starring role.

he does not anticipate every question that today's transaction cost theorists might ask. Finally, Richardson did not see large-scale organizational choices as a spectrum between markets and hierarchies, but saw cooperation as a third alternative. Co-operation includes relational contracting, but also more formal arrangements such as equity participation.

3. The Role of the Organization

Scouting around for wood for the campfire is an example of a productive activity that can be described with no reference to organizations. It is something human beings do today—in parks, on ranches, in wilderness areas, and other settings. Viewed narrowly as an activity, it is not all that different from what humans have done for millennia, from times long before there were formal organizations in their sociocultural environment. Thus, not every activity we engage in today involves a close encounter with an organization. But a great many of them do.

Everyday experience in the modern world involves us in a series of encounters with products and services that permit us to accomplish remarkable things with remarkable consistency and in a remarkably short time—although the remarkable often goes unremarked for the reason previously suggested. The realms of communication, computation, and transportation are particularly rich in examples of remarkable capabilities of very recent origin. It takes only a modicum of historical perspective to recognize that the everyday environment contains many products and services that did not exist five years ago, many more that did not exist twenty-five years ago, and that truly drastic changes have reshaped life in the past century and a half. If we inquire as to where these novelties come from, the straightforward answer is that they come to us from business firms—from the telephone companies, the computer companies, and the airlines, for example.

Obviously this everyday appearance is to some extent deceiving; we must avoid replicating the error of the US congressman who questioned the need for (publicly funded) weather satellites on the ground that the Weather Channel is available on cable TV. The question is, just how deceiving is the appearance? What is the appropriate perspective on the role of organizations in supplying products and services, old as well as new? Our basic proposal here is that everyday appearances are not all that deceiving, especially if we take into account that there are organizational performances that support the organizational performances that deliver the products and services to us. This is not to deny, however, that there are other credible contenders for attention in the grand story of how society creates and uses productive knowledge.

To get a sense of the role of organizations in one of these remarkable contemporary performances, it is helpful to begin by standing close to the action (as many of our authors have). From a vantage point close in, it is possible to see many contributing details of the overall performance that might otherwise be over-looked—even, in some cases, by the managers in charge. Having identified various requisites of the performance as it exists today, we can ask questions about the provision of those requisites and about the historical development of each of them—

with particular attention to the development of the specific knowledge base. What know-how does it take for this to happen, and where did it come from? Each element identified as a requisite of the contemporary performance has its own distinct trail of technological and organizational history, however much that trail may interweave with those of other elements or with broader historical themes. To explore a major fraction of these interweaving trails in any depth would be an enormous project, which would take volume upon volume to report—and there is an important lesson in that observation. It is, however, possible to sketch in the rudiments of an example of such an undertaking.

Consider an airline flight. From the time the passenger arrives at the check-in counter or gate, he or she is pretty much the captive of the airline's organizational routines. The counter routines cover the baggage-checking and providing a boarding pass and directions to the gate. At the gate, the passenger is processed through the boarding routine—first-class passengers and families with small children 'pre-board', please. The ticket is collected and in some cases electronically processed immediately. Behind the scenes there may be a routine matching the passengers who have boarded to the baggage that has been put aboard. The airline has arranged the presence at the gate of the airplane, the flight crew, the baggage handlers, and the food to be put aboard—although the latter may well be a delivery from another company, as may the fuel that is also being put aboard.[6] Of course, the availability of the gate itself has also been arranged by the airline, probably by contract with the airport authority. Behind the scenes again there is a set of routines comprising a broad capability for monitoring and maintaining the aircraft, and another capability for handling the scheduling of crews. As the airplane departs, the crew begins an interaction with a highly complex air traffic control system that will continue intermittently for the duration of the flight.

And so on; any frequent flyer can fill in further details that are somewhere between commonplace and absolutely generic across flight experiences. The airline has accomplished a massive feat of coordination and orchestration to bring all of this together and make it work, as it typically does, quite smoothly. Of course, sometimes the airplane isn't there; sometimes it is there but it doesn't work. Sometimes the flight crew shows up late. Sometimes it seems that gate personnel telling lies about the departure time is also an organizational routine, evoked in the subset of cases where something has gone wrong. Sometimes you may later wish the food hadn't shown up after all. Such 'eventfulness' is an indicator of malfunctioning routines (Szulanski 1996); it serves as a reminder that there actually are routines and that they usually succeed in making flights uneventful.

Of course, the airplane is a prominent artefact in this story. The airline didn't build its airplanes, it bought them, perhaps from Boeing or Airbus. Those companies and their ancestors created capabilities, over an extended period, for designing and building aircraft. They too accomplished massive feats of coordination and orchestration

[6] This example of the fact that capabilities sometimes involve intimate operational connections among distinct firms points to the broader observation that significant capabilities sometimes reside in networks of firms rather than in individual firms. See e.g. Saxenian (1994) ; Powell *et al.* (1996) ; Orsenigo *et al.* (1999).

of design engineers, production-line workers, parts suppliers, metal producers, and so on. But the aircraft companies didn't make the engines, they purchased them from companies with long traditions in engine manufacture. Although it wouldn't seem so central to the story of the flight, a similar tale could be told about the food service or the baggage-handling equipment. Down a multitude of pathways, the story of a single airline flight leads back into the capabilities of a multitude of organizations, each contributing their capabilities in a long story of technological and organizational evolution.

Back along the trail were two brothers who had a bicycle shop, some equipment, and high ambition. Many history books will tell you quite a lot about those brothers, but they say very little about how a multitude of organizations respond to your desire today to get across a continent or an ocean, or how some of those same organizations and many others now extinct contributed to spanning the enormous gap between a few hundred feet of low, slow, uncomfortable, and hazardous flight and thousands of miles of high, fast, comfortable, and remarkably safe flight. Research on organizational capabilities seeks, among other things, to right this balance.

4. Capabilities and Decisions

In economics and other disciplines that employ the theoretical tools of decision theory, key assumptions about skills and capabilities often remain implicit. Consider, for example, the simple and basic tool called the pay-off matrix: an array with choice alternatives on one side, 'states of the world' (or opponent's choices) on the other, and the outcome utility values in the cells. Typically, the choices are actions or entail actions. While 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 emphatically 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, and this presumption goes unremarked. Arguably, the development of the menu of future choices would be a candidate for the first exercise introducing the topic of sequential decision analysis. In fact, the question of where the menu comes from is generally ignored.

Further, choices available to the decision maker are, in decision theory, feasible by definition—any uncertainty attached to the consequences of *trying* to take a 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 rug in the process of abstracting an analysable problem from a real situation. The rich sequences of unfolding events that often follow a failed attempt—sequences that may involve wholly unanticipated outcomes and learning, among other things—could be represented in a sufficiently elaborate decision-theoretic formalism, but generally are not.

These habits of decision-theoretic thought contribute to the obscurity in which capabilities issues have long resided in economic analysis. The entries in the menu of

choices are specified and promptly taken for granted, one situation at a time—even when the choices involve complex action. 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 the capabilities that are exercised and the likely withering of those that are not—are generally abstracted away. These practices may well represent sound, if largely tacit, judgement about the domain where decision theory is useful. They nevertheless leave a major gap in the understanding of behaviour—a gap best filled, perhaps, by the use of other tools.

Just as the market system accomplishes remarkable feats of coordination without the aid of a central plan, organizational learning produces the coordinated performances of organizational capabilities without the aid of a recipe—alternatively, without the aid of a comprehensive plan, optimized or not. 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 be well aware of managerial intentions to achieve coordination. As learning proceeds, innumerable procedural details are settled by individual participants, with or without conscious awareness or consideration. There are far more of these details 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 the way. Finally, in the well-established capability, the activity in progress is its own best (and only) operating manual.

5. Capabilities Research: Areas of Inquiry and Application

The discussion above locates the organizational capabilities discussion and suggests why many of us consider it to be a fascinating area of research, and one that is in large part novel—because of the several factors that have long tended to shroud it in obscurity. Here we extend the case by pointing to areas where improved understanding of capabilities has important applications. These are also areas that have participated in the building of existing understanding of capabilities, and involve ongoing research that continues to contribute to the broad effort to improve that understanding.

5.1. Evolutionary Economics and Firm Capabilities

A fundamental proposition in evolutionary economics 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,

to say nothing of the large-scale differences that separate the chemical firm, the automobile manufacturer, the mass retailer, and the hospital. 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 behaviour patterns gives the market selection process something to work on; because the patterns persist, the market's selection and promotion of successful ones has significant systemic consequences over time.

Research on capabilities advances the evolutionary economics agenda in three significant ways. First, it provides concrete examples and specific empirical evidence that illustrates and supports the view of firm behaviour taken in evolutionary theory. The analysis of firm capabilities illustrates one very fruitful way of conceptualizing the elements of continuity and idiosyncrasy that are central to the evolutionary view of firm behaviour. To the best of our knowledge, no student of firm capabilities has ever proposed that firm capabilities often change radically in short periods of time, except perhaps by the outright acquisition of another firm that already possesses different capabilities. Rather, the emphasis is on the accumulation of capabilities and the fact that the options for further development at each point of time are sharply constrained by the heritage of the past.[7]

The second contribution involves the relationship between capabilities and organizational routines. Routines play a central role in the formulation of evolutionary theory offered by Nelson and Winter. In their introductory discussion, they noted that much business behaviour is not routine within the ordinary meaning of that term, but then remarked '[The point]. . .is that most of what is *regular and predictable* about business behaviour is plausibly subsumed under the heading "routine", especially if we understand that term to include the relatively constant dispositions and strategic heuristics that shape the approach of a firm to the non-routine problems it faces' (1982: 15). The story of the development of capabilities in a firm is very much a story of the shaping role of 'relatively constant dispositions and strategic heuristics' that provide an element of continuity that extends even over time spans long enough for radical change to accumulate in the firm's specific performances. Thus, the capabilities discussion relates specifically to a realm of behaviour infused with intentionality, conscious deliberation, planning, and expertise—as contrasted with the quasi-automatic character of performance of low-level operating routines. And it shows how these elements of intelligence and intendedly rational calculation not only coexist with, but give expression to, the historically grounded uniqueness of the individual firm.

The third contribution is closely akin to the second. Precisely because the development of capabilities also includes elements of intentionality and deliberation, the capabilities discussion provides a bridge between the predominantly descriptive concerns of evolutionary theory and the prescriptive analysis of firm strategy. Accurate description requires acknowledgement of the role of intentionality; likewise, sound advice must be founded on an accurate characterization of the system

[7] These patterns of accumulation are well illustrated by Miyazaki (1995) and Patel and Pavitt (1998).

the decision makers are guiding. Thus the two areas of inquiry are mutually supportive, notwithstanding the substantial difference between their focal concerns.

Evolutionary economics has long been identified with an emphasis on the role of institutions in economic life, and this long-standing connection has recently been revitalized (Hodgson 1988, 1993). The narrower but still extensive set of institutions that shape a nation's science and technology resources and, generally, innovative abilities is another area of institutional and policy concern that has a long-standing connection to evolutionary economics.[8] It is hard to review the history of the aircraft industry, or of computers, or biotech, or many other industries, without getting the distinct impression that something more is going on than the exploitation of the 'given' production functions of firms. Evolutionary economists view firms as building their capabilities in an institutional and policy context, and the exploration of the connections to those contexts remains very much on the research agenda (Metcalfe 1994).

5.2. Firm Capabilities and Strategic Management

As many observers have noted, the past decade or so has seen a marked swing in the attention focus of scholars and practitioners interested in business strategy. Among the aspects of strategic doctrine that now capture attention, issues surrounding the quality of firm capabilities now loom very large. A number of factors have contributed to this development. On the academic side, there is an element of the familiar phenomenon of the swinging pendulum of attention: the concern with capabilities followed a period in which strategy research had been re-energized by economic concepts drawn from industrial organization economics and focused primarily on the firm's relation to its competitive environment. As often happens, one of the truths discovered in this research programme was that its orienting ideas were not as fruitful in illuminating the key issues as had been hoped. The quest for the sources of competitive advantage turned back toward the internal workings of the firm, and in particular to the development of Edith Penrose's idea (1959) that the profitability and growth of a firm should be understood in terms of its possession and development of unique and idiosyncratic resources. 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 or '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; they are relatively discrete and separable from the context of the firm and are the sorts of things that would naturally carry a market price. 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 non-tradeable. Unique, difficult-to-imitate capabilities acquired in a protracted

[8] On the germane field of 'national systems of innovation' see Lundvall (1992) and Nelson (1993).

process of organizational learning are prominent example of the sorts of resources they see as sources of competitive advantage.

Another recent theme in the strategy literature is the idea that the most distinctive role of the business firm in the economic system is the way it brings 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, and Dosi and Marengo 1994).[9] As with the notion of resources, this discussion converges with the capabilities discussion in proportion as the knowledge is conceived as know-how embedded in the organization's activities, as opposed to passive, library-like stocks in the heads of participants.

There is, however, much more to the rising concern with capabilities than simply the swinging pendulum of scholarly interest. One important background fact (in the USA) is the stock market's scepticism toward unrelated diversification, which has been manifested quite consistently for at least fifteen years (even if one could always argue that this phenomenon itself is a scholar-induced fad!). Episodes like Sears Roebuck's 1992 retreat from its strategy of diversification into financial services, and the broadly similar evolution at American Express in 1993 and after, illustrated the power of the market to 'jerk the chain' of wandering CEOs and force a retreat to the 'core business'.[10] That being the case, it is unsurprising that managers and consultants became inclined to focus more on the relatively concrete and specific issues affecting the individual firm's competitiveness in particular markets. Another impulse in the same direction was provided by the rising concern with American manufacturing vis-à-vis Japanese competition in the early and mid-1980s.

So far has this trend progressed that Professor Michael Porter of Harvard, a longtime leader in the strategy field who is active in both the academic and consulting segments, has recently felt compelled to enter an objection in the form of an article titled 'What Is Strategy?' beginning with Section I: 'Operational Effectiveness Is Not Strategy' (Porter 1996). It remains to be seen whether this assessment will do much to diminish the prevailing interest in capabilities-based competition.

Although the discussion of capabilities issues has been quite extensive in both the business press and the academic strategy literature, the fund of solid empirical research that is specifically on the strategic aspects of the subject has accumulated rather slowly.[11] As a result, much of the discussion has remained at a relatively high level of abstraction. Several of the studies in this volume should be of considerable value in promoting understanding of capabilities at a sufficiently detailed level so that the relationships to managerial action become visible.

Of course, as noted above in our discussion of the 'competence' terminology, the capabilities perspective reveals a world where enormous challenges face strategic

[9] For an earlier discussion with similar emphasis but cast in terms of reforming the theory of production, see Winter 1982.

[10] For a more detailed discussion of the relationship between capabilities and diversification patterns, see Teece *et al.* (1994).

[11] For 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). The discussion in Robert Grant's excellent textbook illustrates the appearance of these ideas in the business school curriculum (Grant 1995: ch. 5).

decision makers who must try to accommodate to an uncertain future. In general, scholars of capabilities and evolutionary economics are less sanguine about the response to these challenges than a mainstream economist would be, and they are perhaps less readily reassured by the guidance of management theorists than a strategic management scholar would be. There has been interest in getting the strategic decision process into realistic focus and attempting to determine what approaches might actually generate superior decision in an uncertain world. This concern has been addressed in contributions by Loasby (1983), Kay (1992, 1997), and Fransman (1994*a,* 1994*b*).

5.3. Technology and Organization

Capabilities studies with a strategic management orientation are separated by a not-very-bright line from a large literature that examines the way organizations deal, or fail to deal, with technological challenges. And, more generally, they link with an equally large literature which has studied the patterns of change in the knowledge bases underlying innovative activities and the related dynamics of 'technological paradigms' (cf., among others, Dosi 1984 and Freeman 1982). A broad theme that unites these areas of inquiry is the response of an industry to the appearance of a technology that provides a new way of performing functions of central importance to the industry's activities. Such episodes can be identified on a very large scale—such as the replacement of mechanical and electro-mechanical devices by electronic devices in a wide range of types of equipment—and on a quite small scale—such as the successive generations of displacement of larger disk drives by smaller disk drives in computers (Chistensen and Rosenbloom 1995; Christensen and Bower 1996; Christensen 1997). A common pattern in such episodes is that the leading firms in an industry often seem to react slowly to the challenge, with the result that leadership passes to some of the pioneers of the new technology. Sometimes a previously leading firm even fails to survive, or has a very close call. This pattern is, of course, illustrative of Schumpeter's discussion of capitalism's 'perennial gale of creative destruction', which he saw as the essential contextual feature for 'every piece of business strategy' (1950: 83–4).

One problem is to understand why this happens. Another problem is to understand why it *doesn't* happen—the pattern described is not universal, and the intuitive expectation that a 'bigger' technological change ought to make it more likely is not always confirmed. Among a number of explanations that are complementary and hence difficult to untangle, considerations related to the nature of the adjustment of firm capabilities needed to cope with the challenge have received considerable attention. Two mainstays of this literature are Henderson and Clark (1990) and Tushman and Anderson (1986), two papers that describe different conceptual litmus tests for when new technologies are likely to cause incumbents to stumble, and illustrate the conceptual schemes with careful empirical studies. These four authors, in subsequent individual work and in various collaborations, have substantially advanced understanding of capabilities in other directions as well—as have a number of other scholars.

In acquiring and adapting their capabilities over a period of time, organizations are doing something that can reasonably be called organizational learning. Here again there is a large literature embracing a wide range of specific intellectual ambitions, methodologies, and techniques. There are books that seek to speak directly to managers, a notable and influential example being Senge (1990). Facilitating certain types of organizational learning is a major objective of quality management, and thus the large literature of quality management provides another port of entry into the subject of organizational learning and hence to organizational capabilities. Classics in this 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 seems to span a substantial number of distinguishable concerns—but some of these concerns clearly relate to the effort to improve capabilities through learning.[12] In particular, the quest of improved performance through 'benchmarking' and the identification and transfer of 'best practices' is an activity that is widely and systematically pursued. Careful studies of the microprocesses of organizational learning have been conducted both in the field as in Hutchins (1991), Adler (1993), and von Hippel and Tyre (1995), and in the laboratory, Cohen and Bacdayan (1994) and Egidi (1995).

In general, a major challenge which the whole perspective of research is painstakingly beginning to address is the identification of robust statistical proxies for capabilities themselves, allowing also further exploration of the links between capabilities and revealed organizational performances. So, statistical studies have explored the building of dynamic capabilities through sustained financial commitments to R&D programmes (Helfat 1994, 1997), and a few statistical surveys, especially in Europe, have begun to search for organization-related proxies. However it is fair to say that most of the work is still to be done.

Within any organization, capabilities, in principle aimed to 'solve problems' in the broadest sense – ranging from carrying a passenger across the Atlantic to more purposeful activities of search for new drugs or new machines – come anyhow together with specific mechanism of governance of potentially conflicting interests and incentives. Indeed, the links (and, over time, the co-evolution) between organizational capabilities and governance structures is another major field of inquiry ahead (for some hypotheses, cf. Coriat and Dosi 1998; see also Langlois and Foss 1999 and the remarks in Marengo *et al.*1999).

Organizational learning has also begun to be illuminated by various styles of formal modelling. Nearer the richness of the historical evidence, 'history-friendly' models attempt to formalize the evolution of technological capabilities of heterogeneous firms nested in the competitive dynamics of particular industries (on computers, see Malerba *et al.*1999). At the other, more abstract, end a few works—drawing also from 'artificial sciences' (e.g. artificial intelligence etc.), complexity theory, and cognitive psychology—try to formally represent the properties of

[12] On this, a valuable reference is the special issue on 'Knowledge and the Firm' (R. E. Cole, ed.) of the *California Management Review* (v. 40, Spring 1998)

organizational capabilities as emergent from some combinatorial dynamics among multiple underlying 'bits of elementary knowledge' (Marengo 1992; Birchenhall *et al.*1997; Marengo *et al.*1999).

5.4. Firm Capabilities in Business History

In this area, empiricism led the way. One of the more important spurs leading to the new interest in organizational capability was the pioneering series of business histories written by Alfred Chandler.[13] Prior to Chandler, most business history simply involved a recounting of the history of a firm, in a manner akin to the 'leaders and battles' approach to the history of nations. Chandler's focus was, originally, on the new forms of business organization that were needed in order to exploit the potential for 'economies of scale and scope' opened by the development of the railroads and the telegraph system in the middle of the nineteenth century. For Chandler, the way a firm was organized and governed was an essential constraint on, and key facilitator of, what it could do. In later work, Chandler came to stress what he called the 'three-pronged investments' in large-scale manufacturing facilities, marketing, and distribution systems, and modern management methods. Companies that were among the first to commit to such investments often dominated their industries for decades thereafter. Much of the work on strategy referred to above drew heavily on Chandler. And Chandler's work set in train a whole new tradition of historical work on business capabilities and how they have evolved.[14]

5.5. Organizational Capabilities and Economic Growth

Over the past several years a number of scholars studying the processes of economic development in rapidly growing countries have come to focus on organizational learning and organizational capabilities. For example, detailed studies of the processes through which Korean firms learn to master progressively more complex technologies have been done by Westphal *et al.* (1985), Pack and Westphal (1986), Amsden (1989), and Pack (1994). Hobday's recent work (Hobday 1995) is concerned with the processes by which East Asian firms acquired competence in electronics.

A related body of literature grew up somewhat earlier, concerned with exploring the reasons behind the competitive ascendancy of Japanese firms in electronics, automobiles, and other industries during the 1970s and 1980s. The book *Made in America* (Dertouzos *et al.*1989) attracted much attention with its discussion of the prowess of Japanese firms and, later, *Made in France* (Taddei and Coriat 1993) addressed the general theme of the institutional and organizational roots of competitive performances. More recently, as competitive advantage has shifted back to

[13] Especially *Scale and Scope: The Dynamics of Industrial Capitalism* (1990), but also *Strategy and Structure: Chapters in the History of American Industrial Enterprise* (1962), and *The Visible Hand: The Managerial Revolution in American Business* (1977).

[14] And it also set in train a lot of fruitful controversies: for example, on the importance of organizational scale as a factor conducive to persistent learning and competitive advantages (for refinements of, and debate upon, that view, see Chandler *et al.*1998) ; or, on the role of organizational factors nearer to the shop floor—as opposed to sheer managerial strategies—as determinants of corporate competitiveness (Lazonick 1990).

American firms, there has been a spate of analyses stating that the organizational flexibility and dynamism of American firms vis-à-vis Japanese and European ones is what is giving the American firms the advantage. Although neither of these sets of accounts provides a comprehensive picture of the forces at work in the respective historical phases, both are concerned with considerations that did play an important role. The chapters on automobiles in this volume describe, for example, some of the responses to the very real competitive challenge posed by the Japanese firms.

By a number of different routes, analysis focused on organizational capabilities is influencing the literature on economic development and international competitiveness. Improved understanding of the dynamics of capabilities at the level of the individual organization provides the foundation for an improved and qualitatively different understanding of the mechanisms of aggregate economic growth. While there has long been wide agreement on the centrality of innovation and technical progress in the growth process, the concepts and tools employed in the quest for analytical understanding have typically sought causal insight at the aggregate level, where the phenomena themselves—often characterized as the 'stylized facts' about national economic growth—reside.

Innovation, however, is intrinsically a matter of specifics and details in its origins and impacts—in inspiration, incentives, products, processes, firms, markets—and innovations do not aggregate in any simple way. Nevertheless, the tendency in mainstream growth theory, old and new, has been to try to have it both ways—to acknowledge innovation's centrality to growth but to resist the implication that better understanding of growth must be grounded in better understanding of the microlevel processes that produce economic change.[15]

An emphasis on firms as fundamental repositories of economic knowledge leads to quite a different view of many issues in growth theory than is suggested by standard approaches in neoclassical growth theory, old and new. Perspectives that regard technology as a highly codified public resource fail to apprehend the role of a variety of factors shaping the effectiveness with which the actual role is performed (Pack 1994). Similarly, the emphasis on capital accumulation tends to focus on saving rates and on capital allocation processes at the sectoral level, rather than on capital allocation among firms and within firms. The capabilities-based view, on the other hand, sees aggregate economic progress largely as the consequence of a multiplicity of actions at the firm level. Among the external forces that affect the quality of these performances are a number of aspects of the environment that might be subject to policy influence—particularly the competitive characteristics of input and output markets, the determinants of firm access to financial capital, and the legal framework surrounding 'intellectual property'.

As noted above, capabilities research is burgeoning today in the areas we have surveyed. Compelling evidence for that claim is provided in the chapters that follow.

[15] Research agendas on growth well in tune with the centrality of microeconomic capabilities and learning are discussed in Nelson 1998 and Dosi *et al.* 1993. When such an agenda is put to practice, it yields indeed quite different interpretative results from standard growth theories: see, on the 'Asian Miracle', Nelson and Pack 1999.

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Part I

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Introduction to Part I

Organizational Capabilities: The Micro Evidence

The four papers in Part I put a microscope on the particularities of organizational capabilities and learning. The paper by Narduzzo, Rocco, and Warglien, is concerned with two sets of capabilities developed and implemented by a cellular phone network company. One of these capabilities is for the installation of new stations. The other is for maintenance and problem-solving. The authors use the study of these complex examples of capabilities as an opportunity to explore the usefulness, limits, and meaning of the treatment of capabilities as bundles of routines. They conclude that, in their case at least, effective capabilities certainly do involve the mastery and use of certain routines, but also the ability to do particular and often idiosyncratic things that are appropriate to a particular context.

The company studied in this paper has different operations in different regions. The authors also explore the question of the extent to which capabilities, and practices, are company-wide, as contrasted with developing regional- or group-specific idiosyncratic elements. They conclude that the latter are important.

The chapter by Argote and Darr is concerned with the apparently humble capabilities in making a good pizza in an economical way. One of their central questions is the extent to which learned capabilities are built into particular people, and the mechanisms and extent to which capabilities can be regarded as organizational, in the sense that individuals can leave and be replaced without erosion of the capability. They also are concerned with the extent to which new learned capabilities are transmitted and contained within an organization, in this case a set of franchise operations, as contrasted with all comers. A hallmark of the chapter is detailed examination of the way new knowledge is made organizational, and spread throughout the franchise.

The chapter by Szulanski also is concerned with the mechanisms through which routines are made common across a group of related organizations, in this case the member banks of a bank group. The group of banks associated with Banc One has been expanded through acquisition. Banks choose to become members of the group because of the significant financial success that group members continue to have, and because of a strong belief that that success is due in good part to certain bundles of routines that are used in Banc One operations. At the same time, the philosophy of Banc One admits that individual units should have a certain freedom to accommodate to the particularities of their individual circumstances. The study describes in elaborate detail the processes through which a new acquisition of Banc One is taught and learns the basic routines that define the Banc One system.

The chapter by Flaherty is concerned with learning and effective control in semiconductor manufacturing. In contrast with the technologies considered by other papers in Part I, semiconductor manufacturing is extraordinarily complex. There are

many different processes involved, and each process, and the interactions across the various processes, easily can get 'out of control'. There is a major problem in assuring quality of the output.

A central problem, therefore, in semiconductor manufacture is to be able quickly to spot production aspects that seem to be getting 'out of control', to diagnose these problems, and to solve them. An essential aspect of these processes is that the relevant 'knowledge' generally is distributed among a number of different people. Another factor is that certain kinds of experimentation to diagnose and solve a problem can themselves be highly expensive in terms of lost production. Flaherty's study puts a microscope on these issues, and illustrates nicely the complexities that often are involved in organizational capabilities.