Capturing Value from Knowledge Assets:

The New Economy, Markets for Know-how, and Intangible Assets

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Management is always confronting new challenges. Sometimes these are simply yesterday's challenges presented anew in a slightly different context. But from time to time, new challenges emerge that have no close precedent. Managing intellectual capital in the information age is possibly one such challenge, as advanced industrial economies have entered a new epoch. Many sectors are animated by new economics, where the payoff to managing knowledge astutely has been dramatically amplified, in part because of the phenomena of increasing returns, in part because of new information technology, and in part because of the changing role of intellectual property. Moreover, the context in which knowledge assets are created and exploited is today truly global.

Knowledge and Competitive Advantage

It has long been recognized that "economic prosperity rests upon knowledge and it useful application."[1] Indeed, "the increase in the stock of useful knowledge and the extension of its application are the essence of modern economic growth."[2] Enlightened economic historians have long emphasized the role of technology and organization in economic development.

Accordingly, one must inquire about the present cacophony on knowledge management. At least two classes of explanations appear to be valid. One class is simply that policy and strategy analysts have worn intellectual blinders, so that what has been obvious to some—namely, that knowledge and its applications are at the very roots of modern economic growth and prosperity—has not been transparent to all. Competing theories that stressed the role of the capital

stock and natural resources would appear to have received unwarranted extended play in textbooks and policy pronouncements. Meanwhile, the study of innovation and knowledge transfer has been, until quite recently, relegated to a backwater in mainstream economics as well as in the other social sciences.

However, a small cadre of dedicated economists have long emphasized the role of technological innovation, often with few accolades.[3] Now the mainstream economic theorists[4] and mainstream business have begun to recognize the importance of this literature. Moreover, the ideas have become established and disseminated to a wider audience through the efforts of insightful protagonists like Ikujiro Nonaka and Hirotaka Takeuchi.[5]

The second class of factors relates to structural changes that have occurred in the economies of advanced developed countries. These have modified the nature of what is strategic and have served to highlight the importance of knowledge and its management.

Liberalization of Markets

Since the Kennedy round of trade negotiations in the 1960s, markets for goods and services have become increasingly liberalized. Tariff and non-tariff barriers have been lowered. While the world is far from being properly characterized as having adopted free trade, significant progress has been made. Final goods, intermediate goods, and factors of production flow globally with far more freedom than in earlier times. Restrictions on knowledge transfers by both importers and exporters have also been relaxed.

Accordingly, firms cannot so rapidly earn supra-competitive returns by locating behind trade barriers. Transportation costs have also fallen, and information about market opportunities often diffuses instantaneously. Together, these developments have reduced the shelter previously afforded to privileged positions in domestic markets. Competition has been sharpened.

Expansion of What's Tradable

Markets have not only liberalized, but also have been created for many types of "intermediate" products where markets hitherto didn't exist. This has been most amplified in securities markets where swaps and swaptions, index futures, program trading, butterfly spreads, puttable bonds, eurobonds, collateralized mortgage bonds, zero-coupon bonds, portfolio insurance, and synthetic cash are now commonplace.[6] This sudden burst of financial innovation began but 20 years ago, propelled by the move to floating exchange rates and the need to protect transactions from uncertainty. It has been aided by developments in computer and information technology, which have enabled the design of new financial products and the execution of complex transactions. Also contributing has been the desire to circumvent taxation and regulation.

In addition, firms have shown greater affection for outsourcing as suppliers take advantage of the growth in the number of potential suppliers at home

and abroad. In the petroleum industry, for instance, markets exist not only for many grades of crude oil and refined products, but also for a range of intermediate products (e.g., MTB) which were rarely traded, if at all, a mere decade ago. Moreover, certain forms of intellectual property are "exchanged" (cross-licensed) or sold with far greater frequency than was hitherto experienced.[7]

Whenever a market exists that is open to all qualified comers, including newcomers, then competitive advantage for firms cannot flow from participation in that market.[8] Except in rare instances where one or a few firms can "corner the market," having a market-based exchange relationship cannot yield competitive advantage because it can be so easily replicated by others, who can simply enter the same (efficient) market and secure access to the same inputs or dispose of the same outputs. In short, efficient markets are a great leveler.

Strengthening of Intellectual Property Regimes

Intellectual property is an aspect of property rights which augments the importance of know-how assets. Knowledge assets are often inherently difficult to copy; moreover, like physical assets, some knowledge assets enjoy protection against theft under the Intellectual property laws of individual nation states. In advanced nations, these laws typically embrace patents, trademarks, trade secrets, and copyright.

Intellectual property systems have been strengthened since the 1980s, both in the U.S. and abroad. Moreover, intellectual property is not just important in the new industries—such as microelectronics and biotechnology—it remains important in pharmaceuticals and chemicals and is receiving renewed interest in more mature industries such as petroleum and steel.

The growth of information technology has also amplified the importance of intellectual property and has injected intellectual property into new contexts. For example, it is not uncommon to discover the foundations of corporate success for wholesalers and retailers buried in copyrighted software and in information technology supporting order entry and logistics.

The Growing Importance of Increasing Returns

Contemporary textbook understandings of how markets operate and how firms compete has been derived from the work of economists such as Marshall and Chamberlain. These views assume diminishing returns and assign industry participants identical production functions (implying the use of identical technologies by all competitors) where marginal costs increase. Industry equilibrium with numerous participants arise because marginal-cost curves slope upwards, thereby exhausting scale advantages at the level of the firm, making room for multiple industry participants. This theory was useful for understanding 18th century English farms and 19th century Scottish factories and even some 20th century American manufacturers. However, major deficiencies in this view of the world have been apparent for some time—it is a caricature of the firm.

Moreover, knowledge is certainly not shared ubiquitously and passed around at zero cost.[9]

In this century, developed economies have undergone a transformation from largely raw material processing and manufacturing activities to the processing of information and the development, application, and transfer of new knowledge. As a consequence, diminishing returns activities have been replaced by activities characterized by increasing returns. The phenomena of increasing returns is usually paramount in knowledge-based industries. With increasing returns, that which is ahead tends to stay ahead. Mechanisms of positive feedback reinforce the winners and challenge the losers. Whatever the reason one gets ahead—acumen, chance, clever strategy—increasing returns amplify the advantage. With increasing returns, the market at least for a while tilts in favor of the provider that gets out in front. Such a firm need not be the pioneer and need not have the best product.

The increasing returns phenomena is itself driven by several factors. Consider, first, standards and network externalities. To establish networks and interoperability, compatibility standards are usually critical. If such standards are proprietary, ownership of a dominant standard can yield significant "rents." The more a protocol gains acceptance, the greater the consumer benefits (network externalities), and the better the chance the standard has of becoming dominant.

Second, consider customer lock-in. Customer learning and customer investment in high-technology products amplify switching costs. This pushes competition "forward" in the sense that providers will compete especially hard for the original sale, knowing that sales of follow-along equipment and other services will be easier. While such "lock-in" is rarely long lived, it need not be momentary.

Third, consider large up-front costs. Once a high-tech industry is established, large up-front research, development, and design engineering costs are typical. This is most amplified with software products where the first copy costs hundred of millions, and the original cost of the second copy is zero, or very nearly so.

Fourth, consider producer learning. In certain cases, producers become more efficient as experience is gained. If the underlying knowledge base is tacit, so that it resists transfer to other producers, competitors with less experience are at a comparative disadvantage. Producer learning is important where complex processors and complex assembly is involved.

The economics of increasing returns suggest different corporate strategies. In winner-take-all or winner-take-the-lion's-share contexts, there is heightened payoff associated with getting the timing right (one can be too early or too late) and with organizing sufficient resources once opportunity opens up. Very often, competition is like a high-stakes game of musical chairs. Being well positioned when standards gel is essential. The associated styles of competition are, as Brian Arthur points out, much like casino gambling.[10] Strategy involves choosing what

games to play, as well as playing with skill. Multimedia, web services, voice recognition, mobile (software) agents, and electronic commerce are all technological/market plays where the rules are not set, the identity of the players poorly appreciated, and the payoffs matrix murky at best. Rewards go to those good at sensing and seizing opportunities.

Seizing opportunities frequently involves identifying and combining the relevant complementary assets needed to support the business. Superior technology alone is rarely enough upon which to build competitive advantage. The winners are the entrepreneurs with the cognitive and managerial skills to discern the shape of the play, and then act upon it. Recognizing strategic errors and adjusting accordingly is a critical part of becoming and remaining successful.

In this environment, there is little payoff to penny pinching, and high payoff to rapidly sensing and then seizing opportunities. This is what is referred to here and elsewhere[11] as dynamic capabilities. Dynamic capabilities are most likely to be resident in firms that are highly entrepreneurial, with flat hierarchies, a clear vision, high-powered incentives, and high autonomy (to ensure responsiveness). The firm must be able to effectively navigate quick turns, as Microsoft did once Gates recognized the importance of the internet. Cost minimization and static optimization provide only minor advantages. Plans are often made and junked with alacrity. Companies must constantly transform and retransform. A "mission critical" orientation is essential.

Decoupling of Information Flows from the Flow of Goods and Services

New information technology and the adoption of standards is greatly assisting connectivity. Once every person and every business is connected electronically through networks, information can flow more readily. The traditional nexus between the economics of goods and services and the economics of information can be broken, and information can be unbundled.

The traditional trade-off between reach (connectivity) and richness (customization, bandwidth) is also being transformed, or at least modified. An insurance salesman is no longer needed to sell term life policies. Sufficient information can be collected by mail or on an internet to enable customers to engage in comparative shopping, and for underwriters to do sufficient assessment of policy holders. As a result, traditional distribution channels are no longer needed for simple life or auto insurance products.

Historically, the transfer/communication of rich information has required proximity and specialized channels to customers, suppliers, and distributors. New developments are undermining traditional value chains and business models. In some cases, more "virtual" structures are viable, or shortly will be viable, especially in certain sectors like financial services. New information technology is facilitating specialization. Bargaining power will be reduced by an erosion in the ability to control information, and customer switching costs will decline, changing industry economics.

The new information technology is also dramatically assisting in the sharing of information. Learning and experience can be much more readily captured and shared. Knowledge learned in the organization can be catalogued and transferred to other applications within and across organizations and geographies. Rich exchange can take place inside the organization, obviating some of the need for formal structures.

Ramifications of New Information and Communications Technologies

Linked information and communications systems in production, distribution, logistics, accounting, marketing, and new product development have the potential to bring together previously fragmented flows of data, thereby permitting the real time monitoring of markets, products, and competitors. The requisite data can then be fed to multifunctional teams working on new product development. Networked computers using rapid communications systems thus enable major advances in corporate and intercorporate monitoring and control systems. Within organizations, computer networks can strengthen links between strategic and operations management, while also assisting linkages externally to discrete and geographically dispersed providers of complementary services.

Network computing, supported by an advanced communications infrastructure, can thus facilitate collaborative entrepreneuralism by stripping out barriers to communication. It challenges existing organization boundaries, divisions, and hierarchies and permits formal organization to be more specialized and responsive. Interorganizationally, networked organizations have blurred and shifting boundaries, and they function in conjunction with other organizations. The networked organization may be highly "virtual," integrating a temporary network of suppliers and customers that emerge around specific opportunities in fast-changing markets. Recurrent reorganization becomes the norm, not the exception.

Service firms, such as lawyers, accountants, management consultants, and information technology consultants—pose interesting issues. If knowledge and experience remain personal and are not somehow shared (either by transfer to other organization members or by being embedded in product) then the firm can at best expect to achieve constant return to scale. Larger organizations will have no advantage over boutiques and will possibly suffer bureaucratic burdens that will sap productivity.

Formalization, the sharing of personal knowledge, and the development of structural approaches as a mechanism to transfer learning throughout the firm may on the other hand sap creativity and impede learning. Ideally, one would like to develop approaches or models which have a common essential logic, but which enable customization of particular features. This is but one of the many challenges to service firms in the new economy where knowledge sharing itself can often be the basis of competitive advantage.

Product Architecture and Technology "Fusion"

With complexity becoming increasingly common, new products are rarely stand-alone items. Rather, they are components of broader systems or architectures. Innovation at the architectural level is more demanding and takes place with less frequency than at the component level, but it has greater impact.

The development of system-level integration [SLI] of ASICs—so-called systems on a chip—illustrates the point. New manufacturing processes and improved design tools have fostered SLI. Because million-gate ASICs are now possible, they can support entire systems on a single piece of silicon. If Dataquest is right, and if industry will be able to place 40 million gates on a single chip by 2000, it will be technically possible to place multiple systems on a single chip.[12]

SLI ASICs have already been designed into high-volume applications such as set-top boxes, multimedia, and wireless telephony. Dataquest estimates that SLI ASICs will pass $15 billion in revenues by the year 2000. However, what is even more significant is the ability of SLI ASICs to fuel further growth of consumer electronics through dramatic reductions in size and power usage, enhanced differentiation and functionally, quicker product development, and still lower cost. This is what the technology can deliver.

Whether the technology does in fact yield its potential depends, however, on certain organizational and managerial changes. Design reuse is of paramount importance when designing high-complexity ASICs or SLI devices. System designers must design on the block level and be able to reuse and alter intellectual property in a number of subsequent designs. As Dataquest notes, "design methodology, design reuse, and intellectual property will play vital roles in determining the winners among both suppliers and users."[13]

The organization of firms and industries and the architecture of products are interrelated. Since, the relevant intellectual property needed to effectuate SLI is almost never owned by a single firm but is widely distributed throughout the industry, new arrangements are needed to support rapid diffusion and expansion of SLI architecture. Indeed, harnessing the full potential of the technology necessarily involves cooperation amongst industry participants, many of whom might also be competitors.

A related development is the increase in convergence or integration of previously disparate technologies. One thinks not just of the convergence of computers and communications, but of mechanical industries and electronics ("mechatronics")[14] or of "robochemistry," the science of applying computerization to drug molecule research, which according to some accounts is leading to "a new age in medicine."[15] This by no means occurs automatically and requires internal structures that are flexible and permeable.

Implications

These developments suggest a different dynamic to competition and competitive advantage. The expansion of markets illustrates the point. Since markets

are a great leveler, competitive advantage at the level of the firm can flow only from the ownership and successful deployment of non-tradable assets. If the asset or its services are traded or tradable in a market or markets, the assets in question can be accessed by all; so the domains in which competitive advantage can be built narrows as markets expand. Not even human resources can provide the basis for competitive advantage if the skills at issue can be accessed by all in an open labor market.

One class of assets that is especially difficult, although not impossible, to trade involves knowledge assets and, more generally, competences. The market for know-how is riddled with imperfections and "unassisted markets are seriously faulted as institutional devices for facilitating trading in many levels of technological and managerial know-how."[16] Hence, the development of many types of new markets has made know-how increasingly salient as a differentiator, and therefore as a source of the competitive advantage of firms. This can be expected to remain so until know-how becomes more commodity like; and this may happen soon for some components of intellectual property.

The strengthening of intellectual property is an important counterforce to the growing ease of imitation. As the diffusion of knowledge and information accelerates, intellectual property becomes more salient. While intellectual property can be traded, and can sometimes be invented around, it can no longer be infringed with impunity and without penalty.

Increasing returns frequently sharpens the payoff to strategic behavior and amplifies the importance of timing and responsiveness. Meanwhile, the decoupling of information flows from the flow of goods and services is transforming traditional value analysis, and it is suggesting the benefits of more virtual structures and obviating some of the need for hierarchy. Simultaneously, the march of technologies such as integrated circuits is transforming the linkage between intellectual property and products. Technological innovation is requiring the unbundling of the two and the formation of more robust markets for intellectual property. It is in this new environment that a critical dimension of knowledge management has emerged: capturing value from innovative activity.

Capturing Value from Knowledge and Competence

The proper structures, incentives, and management can help firms generate innovation and build knowledge assets. The focus here is not, however, on the creation of knowledge assets, but on their deployment and use.[17] While knowledge assets are grounded in the experience and expertise of individuals, firms provide the physical, social, and resource allocation structure so that knowledge can be shaped into competences. How these competences and knowledge assets are configured and deployed will dramatically shape competitive outcomes and the commercial success of the enterprise. Indeed, the competitive advantage of firms in today's economy stems not from market position, but from difficult to replicate knowledge assets and the manner in which they are

deployed. The deployment dimension—involving as it does both entrepreneurial and strategic elements—is where dynamic capabilities are especially important.

It is always useful to distinguish between the creation of new knowledge and its commercialization. The creation of new knowledge through autonomous (specialized) innovation is a critical function. It can be the domain of the individual, or of the research laboratory, or of autonomous business units. It need not require complex organization. Indeed, one can argue that such knowledge creation is increasingly well suited to smaller organizational units.

However, the commercialization of new technology is increasingly the domain of complex organization. The new challenges require new organizational forms and the development and astute exercise of dynamic capabilities. They also require an understanding of the nature of knowledge and competence as strategic assets. The nature of knowledge and the manner in which it can or cannot be bought and sold is critical to the strategic nature of knowledge and competence.

The Nature of Knowledge

Knowledge can be thought of in many ways. In a business context, the following taxonomies are useful.

Codified/Tacit[18]

Tacit knowledge is that which is difficult to articulate in a way that is meaningful and complete. The fact that we know more than we can tell speaks to the tacit dimension. Stand-alone codified knowledge—such as blueprints, formulas, or computer code—need not convey much meaning.

There appears to be a simple but powerful relationship between codification of knowledge and the costs of its transfer. Simply stated, the more a given item of knowledge or experience has been codified, the more economically it can be transferred. This is a purely technical property that depends on the ready availability of channels of communication suitable for the transmission of well-codified information—for example, printing, radio, telegraph, and data networks. Whether information so transferred will be considered meaningful by those who receive it will depend on whether they are familiar with the code selected as well as the different contexts in which it is used.[19]

Uncodified or tacit knowledge, on the other hand, is slow and costly to transmit. Ambiguities abound and can be overcome only when communications take place in face-to-face situations. Errors of interpretation can be corrected by a prompt use of personal feedback. Consider the apprenticeship system as an example. First, a master craftsman can cope with only a limited number of pupils at a time. Second, his teaching has to be dispensed mostly through examples rather than by precept—he cannot easily put the intangible elements of his skill into words. Third, the examples he offers will be initially confusing and ambiguous for his pupils so that learning has to take place through extensive

and time-consuming repetition, and mystery will occur gradually on the basis of "feel." Finally, the pupil's eventual mastery of a craft or skill will remain idiosyncratic and will never be a carbon copy of the master's. It is the scope provided for the development of a personal style that defines a craft as something that goes beyond the routine and hence programmable application of a skill.

The transmission of codified knowledge, on the other hand, does not necessarily require face-to-face contact and can often be carried out largely by impersonal means, such as when one computer "talks" to another, or when a technical manual is passed from one individual to another. Messages are better structured and less ambiguous if they can be transferred in codified form.

Observable/Non-Observable in Use

Much technology is (publicly) observable once sold. A new CT scanner, laser printer, or microprocessor is available for conceptual imitation and reverse engineering once it has been introduced into the market. New products are typically of this kind. Process technology, however, is often different. While in some cases the "signature" of a process may be embedded in a product and is therefore ascertainable through reverse engineering, this is generally not the case. While clues about a manufacturing process may sometimes be gleaned by closely observing the product, much about process technology can be protected if the owners of process technology are diligent in protecting their trade secrets in the factory. Thus, process technology is inherently more protectable than product technology, the patent system put to one side.

Positive/Negative Knowledge

Innovation involves considerable uncertainty. Research efforts frequently go down what turns out to be a blind alley. It is well recognized that a discovery (positive knowledge) can focus research on promising areas of inquiry, thereby avoiding blind alleys. However, it is frequently forgotten that knowledge of failures ("this approach doesn't work") is also valuable as it can help steer resource allocation into more promising avenues. For this reason, firms often find it necessary to keep their failures as well as their successes secret, even holding aside issues of embarrassment.

Autonomous/Systematic Knowledge

Autonomous knowledge is that which yields value without major modifications of systems in which it might be embedded. Fuel injection, the self-starter, and power steering were innovations that did not require major modifications to the automobile, although the latter did enable manufactures to put more weight on the front axle and to more readily fit cars with radial tires. Systematic innovation, on the other hand, requires modification to other sub-systems. For instance, the tungsten filament light bulb would not have found such wide application without the development of a system for generating and distributing electricity.

Intellectual Property Regime

There are many other dimensions along which knowledge could be defined or along which innovations could be classified.[20] However, the only other key dimension to be identified here is whether or not the knowledge in question enjoys protection under the intellectual property laws.

Patents, trade secrets, trademarks provide protection for different mediums in different ways. The strongest form of intellectual property is the patent. A valid patent provides rights for exclusive use by the owner, although depending on the scope of the patent it may be possible to invent around it, albeit at some cost. Trade secrets do not provide rights of exclusion over any knowledge domain, they do protect covered secrets in perpetuity. Trade secrets can well enhance the value of a patent position. Different knowledge mediums qualify for different types of intellectual property protection. The degree that intellectual property keeps imitators at bay may depend also on other external factors, such as regulations, which may block or limit the scope for invent-around alternatives.

Replicability, Imitability, and Appropriability[21]

Replication involves transferring or redeploying competences from one concrete economic setting to another. Since productive knowledge is typically embodied, this cannot be accomplished by simply transmitting information. Only in those instances where all relevant knowledge is fully codified and understood can replication be collapsed into a simple problem of information transfer. Too often, the contextual dependence of original performance is poorly appreciated, so unless firms have replicated their systems of productive knowledge on many prior occasions, the act of replication is likely to be difficult.[22] Indeed, replication and transfer are often impossible absent the transfer of people, though this can be minimized if investments are made to convert tacit knowledge to codified knowledge. Often, however, this is simply not possible.

In short, knowledge assets are normally rather difficult to replicate. Even understanding what all the relevant routines are that support a particular competence may not be transparent. Indeed, Lippman and Rumelt have argued that some sources of competitive advantage are so complex that the firm itself, let alone its competitors, does not understand them.[23] As Nelson and Winter[24] and Teece[25] have explained, many organizational routines are quite tacit in nature. Imitation can also be hindered by the fact that few routines are stand-alone. Imitating a part of what a competitor does may not enhance performance at all. Understanding the overall logic of organization and superior performance is often critical to successful imitation.

Some routines and competences seem to be attributable to local or regional forces that shape a firm's capabilities. Porter, for example, shows that differences in local product markets, local factor markets, and institutions play an important role in shaping competitive capabilities.[26] Replication in a different

geographical context may thus be rather difficult. However, differences also exist within populations of firms from the same country. Various studies of the automobile industry, for example, show that not all Japanese automobile companies are top performers in terms of quality, productivity, or product development.[27] The role of firm-specific history is a critical factor in such firm-level (as opposed to regional- or national-level) differences.[28]

At least two types of strategic value flow from replication. One is simply the ability to support geographic and product line expansion. To the extent that the capabilities in question are relevant to customer needs elsewhere, replication can confer value. Another is that the ability to replicate indicates that the firm has the foundations in place for learning and improvement. Understanding processes, both in production and in management, is the key to process improvement, so that an organization cannot improve that which it does not understand. Deep process understanding is often required to accomplish codification and replication. Indeed, if knowledge is highly tacit, it indicates that underlying structures are not well understood, which limits learning because scientific and engineering principles cannot be as systematically applied. Instead, learning is confined to proceeding through trial-and-error, and the leverage that might otherwise come from the application of modern science is denied.

Imitation is simply replication performed by a competitor. If self-replication is difficult, imitation is likely to be even harder. In competitive markets, it is the ease of imitation that determines the sustainability of competitive advantage. Easy imitation implies the rapid dissipation of rents.

Factors that make replication difficult also make imitation difficult. Thus, the more tacit the firm's productive knowledge, the harder it is to replicate by the firm itself or its competitors. When the tacit component is high, imitation may well be impossible, absent the hiring away of key individuals and the transfer of key organizational processes.

Intellectual property rights impede imitation of certain capabilities in advanced industrial countries and present a formidable imitation barrier in certain particular contexts. Several other factors, in addition to the patent system, cause there to be a difference between replication costs and imitation costs. The observability of the technology or the organization is one such important factor. As mentioned earlier, vistas into product technology can be obtained through strategies such as reverse engineering, this is not the case for process technology, as a firm need not expose its process technology to the outside in order to benefit from it. Firms with product technology, on the other hand, confront the unfortunate circumstances that they must expose what they have got in order to profit from the technology. Secrets are thus more protectable if there is no need to expose them in contexts where competitors can learn about them.

The term "appropriability regimes" describes the ease of imitation. Appropriability is a function both of the ease of replication and the efficacy of intellectual property rights as a barrier to imitation. Appropriability is strong when a

technology is both inherently difficult to replicate and the intellectual property system provides legal barriers to imitation. When it is inherently easy to replicate and intellectual property protection is either unavailable or ineffectual, then appropriability is weak. Intermediate conditions also exist (see Figure 1).

FIGURE 1. Appropriability Regimes for Knowledge Assets

Intellectual Property Rights		Inherent Replicability: Easy	Inherent Replicability: Hard
	Loose	Weak	Moderate
	Tight	Moderate	Strong

Appropriability and Markets for Know-How and Competence

Assets can be the source of competitive advantage only if they are supported by a regime of strong appropriability or are non-tradable or "sticky." As discussed earlier, once an asset is readily tradable in a competitive market it can no longer be a source of firm-level competitive advantage. Financial assets today are of that kind.

The main classes of assets that are not tradable today are locational assets, knowledge assets, and competences.[29] Were a perfect market for know-how to someday emerge, knowledge would no longer be the source of competitive advantage. This is unlikely to happen anytime soon, but understanding the limits on the market for know-how is important to understanding how firms can capture value from knowledge assets.

Like the market for pollution rights, or the market for art, buying and selling know-how and intellectual property has special challenges. These complicate exchange, and may limit in some fundamental sense the level of sophistication to which the market can ever evolve. They also explain why the market today is rather primitive.

By way of foundation, it is well recognized that markets work well when:

- there are informed buyers and sellers aware of trading opportunities,
- the objective performance properties or subjective utility of products can be readily ascertained,
- there are large numbers of buyers and sellers, and
- contracts can be written, executed, and enforced at low cost.

Thus the market for (standard) commodities like wheat, coal, stocks, bonds, and sports utility vehicles works well because these properties are largely satisfied.

However, know-how and intellectual property are "products" of an entirely different kind. These products have properties which complicate purchase and sale (see Figure 2). These include:

FIGURE 2. Inherent Tradeability of Different Assets

Characteristics	Know-How/IP	Physical Commodities
1. Recognition of trading opportunities	Inherent difficulty	Posting frequent
2. Disclosure of attributes	Relatively difficult	Relatively easy
3. Property Rights	Limited [patents, trade secrets, copyright, etc.]	Broad
4. Item of Sale	License	Measurable units
5. Variety	Heterogeneous	Homogeneous
6. Unit of consumption	Often Unclear	Weight, volume, etc.
Inherent tradeability	Low	High

- *Recognition of Trading Opportunities*—Parties typically don't know who owns what, and who might be interested in trading. This is less so for patents since they are published. But software (particularly source code) protected by copyright and trade secrets is frequently a matter of great secrecy. There are obvious reasons why even knowledge about the existence of such intellectual property is held very close. Accordingly, out of ignorance, software is often "reinvented" despite the fact that potentially advantageous trades could be consummated.
- *Disclosure of Performance Features*—Buyers must be well informed as to the availability of intellectual property but sellers may be reluctant to negotiate because their intellectual property rights are problematic. Sellers might be reluctant to negotiate because of fear that disclosure, even if pursuant to a nondisclosure agreement, might inadvertently lead intellectual property rights to be jeopardized.
- *Uncertain Legal Rights*—When property rights are uncertain, and confidence in nondisclosure agreements or the law of confidences less than complete, beneficial transactions may be eschewed because of perceived risks. In addition to the disclosure issues identified above, sellers may be uncertain about factors such as the enforceability of use restrictions and sublicensing rights or simply about the ability to measure and collect royalties.
- *Item of Sale*—The "item of sale" may be know-how, or intellectual property rights, complete or partial. When intellectual property is bought and sold, what is transacted is simply a bundle of rights. While rights

are frequently bought and sold [e.g., view rights, pollution rights, airspace rights, mineral rights, rights to use the electromagnetic spectrum, queuing rights], such rights are not a pure commodity. Moreover, ownership requires special policing powers for value preservation. Physical barriers to theft (e.g., locks and keys) don't suffice to protect owners; confidence in contracting and the legal system is necessary to support value.

- *Variety*—While there may be multiple transactions for a given piece of intellectual property (e.g., identical nonexclusive patent license), intellectual property is itself highly variegated. This complicates exchange by making valuation difficult and by rendering markets thin. Thin markets are likely to be less robust than thick markets. Moreover, both buyers and sellers are likely to wish to customize transactions. To the extent to which this occurs, transaction costs increase, and the difficulties of setting up an exchange increase.
- *Unit of Consumption*—Intellectual property is rarely sold lock, stock, and barrel. Hence, metering arrangements of some kind must be devised. These are by no means readily identifiable, particularly for software. Is it a component and if so, should the royalty be a function of the value of the component or the system in which it is embedded. Clearly, the value is a function of other intellectual property located alongside the intellectual property at issue. Questions of the royalty/sales base are by no means straightforward.

Some Sectoral Differences in the Market for Know-How

The inherent difficulties just identified vary according to the type of know-how/intellectual property at issue. It is instructive to compare chemicals and pharmaceuticals with electronics. Indeed, even a cursory examination would suggest that in chemicals and pharmaceuticals, the inherent difficulties associated with licensing are less than in other sectors, like electronics. Figure 3 summarizes some of these difficulties.

There are a number of reasons why the market for know-how generally works better for chemicals and pharmaceuticals. In chemicals and pharmaceuticals, patents work especially well and are ubiquitous. A survey of the efficiency of patents conducted by researchers at Yale University showed high scores for patent effectiveness in this sector.[30] Patents are in one sense the strongest form of intellectual property because they grant the ability to exclude, whereas copyright and trade secrets do not prevent firms that make independent but duplicative discoveries from practicing their inventions/innovations. Accordingly, problems of recognition and disclosure disappear when patents are at issue. Also regulation often bolsters intellectual property since "me too" misappropriators may sometimes face additional hurdles (in the U.S., FDA approval) before being able to launch a product in the market.

FIGURE 3. Some Sectoral Differences in the Market for Know-How

Challenge	Chemical/ Pharmaceuticals	Electronics
Recognition	Manageable	Extremely complex, often impossible
Disclosure	Handled by NDA, patents common	More difficult
Interface issues	Compatability generally not an issue	Compatability generally critical
Royalty stacking, royalty base dilemmas	Infrequent	Frequent
Value context dependent	Strongly so	Very strongly so
Patent strength	Generally high	Sometimes limited
Development cycle	Often long	Generally short
Know-How Market Works:	Generally Well	Often Poorly

Compatibility/interface issues are also less severe in this sector than in some others. While technologies often must work together in chemicals and pharmaceuticals, the close coupling of the kind that characterizes electronics is usually not an absolute prerequisite. Also, the number of individual items of external intellectual property that must be brought together to design a new product is often rather limited. Indeed, the items used may all come from inside the firm, although alliances and licenses are increasingly common. Because there are less complementarities necessary to make a particular product, intellectual property is often less context dependent, and the same royalty rate is appropriate in a multitude of contexts e.g., the float glass process was licensed for the same amount (i.e., 6% of sales) to multiple jurisdictions around the world. Finally, the product life cycle is defined not in months, but often in decades. Hence, requirements for speedy execution of transactions are less severe, and the opportunity to amortize set-up costs over enormous volumes of business is often possible.

The situation in the electronics industry is different. For software, patent protection is uncommon. Hence, if purchasers receive components in source code, they can read and modify programs, thereby possibly skirting intellectual property protection. Put differently, source code can be more readily converted to new programs that don't leave fingerprints. Object code, on the other hand, must first be reverse engineered into a reasonable approximation of source code before it can be advantageously modified. Thus, disseminating software

components (in source code) for external use creates misappropriation hazards. While encryption creates barriers to reverse engineering (decryption), it does not compensate for weak intellectual property. The problem of disclosure (necessary to inform buyers about what they are being offered) has clear hazards in this sector. Furthermore, interface issues are critical, as integration is paramount. Because multiple sources of intellectual property must be combined for systems on silicon, intellectual property rights must be amalgamated.[31]

The market for know-how in electronics thus creates considerable challenges and is unlikely, therefore, to be completely efficient. Accordingly, new innovations (such as system-level integration in silicon) involve new organizational challenges, orders of magnitude greater than previously encountered, and perhaps orders of magnitude greater than the technological challenges. Royalty stacking situations—where intellectual property owners fail in their pricing proposals to take into account the need for the buyer to combine other intellectual property to create value—are likely to be frequent, at least until a new business model is firmly established. Also, the tremendous premium on speed and time to market puts enormous pressure to accomplish intellectual property transactions quickly. This is impossible if intellectual property agreements are customized. However, there is at present almost no standardization in intellectual property agreements, so the market can readily become bogged down by transactional complexity.

Because of these difficulties, there is at present little if any market for software components. Estimates of the annual aggregate costs in the U.S. for "reinvention" are put at between $2 and $100 billion. These estimates, if correct, speak to the value of a properly functioning market for software intellectual property. Absent such a market, certain new product architectures (e.g., systems on Silicon) may just not happen, or may not realize but a fraction of their potential.

What was just described for know-how assets also applies to competences, which can be thought of as clusters of know-how assets. Competences include discrete business-level organizational processes fundamental to running the business (e.g., order entry, customer service, product design, quality control). But they also include generalized organizational skills such as "miniaturization," "tight tolerance engineering," and "micromotors."

Competences are tangible, and can be quite durable. They are typically supported by routines, not dependent on a single individual, and generally reside inside the business functions. Like know-how assets, they cannot be readily bought and sold, absent a transaction for the entire business.

Profiting from innovation is more readily assured when high-performance business processes and/or world-class competences support a product or process offering. This is because the asset/competences cannot be traded, and the forces of imitation are muted. Not only are such assets/competences inherently difficult to imitate because they are likely to be built on a high tacit

component, but there may be opaqueness to the underlying processes and uncertainty, even within the firm, as to the organizational foundations of the competence.

Complementary Assets

The asset structure of the firm is perhaps the most relevant aspect of its positioning when the commercialization of knowledge in tangible products and processes is at issue. Such (upstream) positioning may be more important than the downstream positioning in the product markets for yesterday's product. In many cases there may be a high correlation between a firm's upstream position in an asset and its downstream market position.

Complementary assets matter because knowledge assets are typically an intermediate good and need to be packaged into products or services to yield value. There are notable exceptions, of course. Software is a classic exception as it does not need to be manufactured, and with the internet, distribution becomes instantaneous and almost costless.

However, when the services of complementary assets are required, they can play an important role in the competitive advantage equation. For instance, the design for a new automobile is of little value absent access to manufacturing and distribution facilities on competitive terms.

The effort to embed knowledge in products and to bring the new product to market must confront the whole question of access to complementary assets. If already owned by the knowledge owner, there is no issue. If not, then one must build, or buy if one can. Because the market for complementary assets is itself riddled with imperfections, competitive advantage can be gained or lost on how expertly the strategy for gaining access is executed.

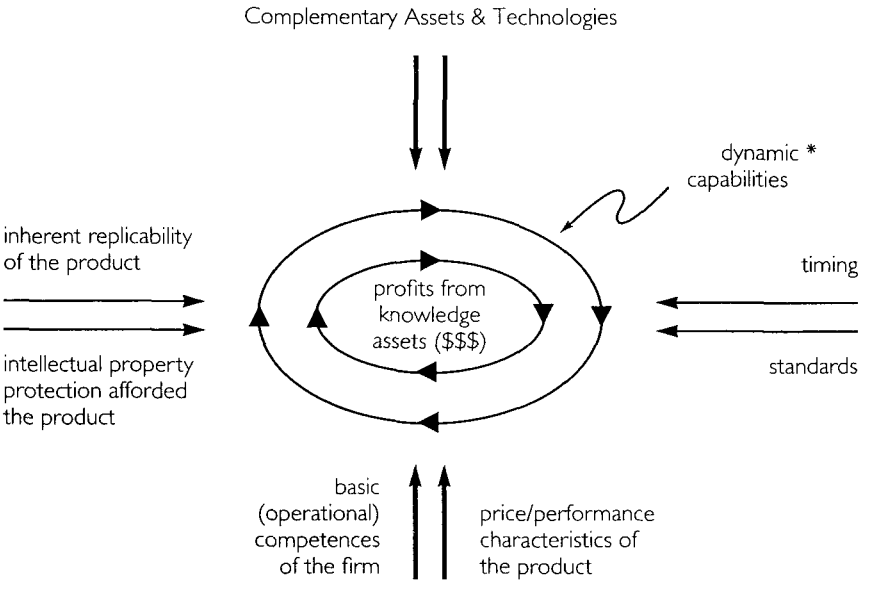
Circumstances of such co-specialization can benefit the asset owner, as demand for the innovation will increase demand for the co-specialized asset. If difficult to replicate or work around, the complementary asset may itself become the "choke point" in the value chain, enabling it to earn supernormal rents. Thus, ownership of difficult to replicate complementary assets can represent a second line of defense against imitators and an important source of competitive advantage.

Dynamic Capabilities

In many sectors in today's global market, competitive advantage also requires dynamic capabilities. (See Figure 4.) This is the ability to sense and then to seize new opportunities, and to reconfigure and protect knowledge assets, competencies, and complementary assets and technologies to achieve sustainable competitive advantage.

It is relatively easy to define dynamic capabilities, quite another to explain how they are built. Part of the answer lies with the environmental and

FIGURE 4. Capturing Value from Knowledge Assets



*Dynamic Capabilities are the capacity to sense opportunities, and to reconfigure knowledge assets, competencies, and complementary assets and technologies to achieve sustainable competitive advantage.

technological sensing apparatus that the firm has established, and part lies with the choice of organizational form, and part lies with the ability to strategize.

External Sensing

In order for an organization to exhibit dynamic capabilities, it must sense the opportunity and the need for change, properly calibrate responsive actions and investments, and move to implement a new regime with skill and efficiency. During "sensemaking," the organization receives and interprets messages about new markets, new technologies, and competitive threats. This information is necessarily evaluated in the light of the individuals' and the organization's experience and knowledge. In formulating an action plan, the organization is necessarily guided to some extent by rules and routines, which structure inquiries and responses.

Sensemaking, or interpretation, is a critical function. Well performed, it can enable the organization to connect with its environment and invest its resources wisely, thereby generating superior returns. The fundamental challenge to sensemaking is bounded rationality; one cannot learn all there is to learn about a situation or an opportunity, and action must proceed based on hunches and informed guesses about the true state of the world. In essence,

business organizations and their management must interpret the world about them. Interpretative activity is basically a form of theorizing about market and firm behavior.

Sensemaking can be assisted by sensemaking tools, like scenario planning, as well as the insights of brilliant outsiders—like a Peter Druker or Gordon Moore. Scenario planning can help managers develop mental maps of possible complex future realities. Such mental maps assist in the interpretation of new data and information from the market and help chart courses of action. Shell Oil is well known for its effective use of scenario planning, and its investment in this activity is widely recognized inside and outside the company to have enabled planners and managers to have extended conversations resulting in shared visions of possible futures. The object of the exercise has never been to predict the future, but to understand the fundamental drivers of change and to quickly chart action plans once key uncertainties are resolved.

When the organization has figured out what is going on, and calibrated the opportunity, it must choose among available action plans. These are not infinite in number, but may be restricted to one or two or maybe a handful of viable alternatives that are satisfactory. Actions are likely to be similar to those used in the past. Organizational routines—distinct ways of doing things—come into play. Actions and decision routines are part of the organization's procedural memory. Procedures and policies enable internal competition to be fair, objective, and legitimate. Organizational rationality can exist, despite individuals' bounded rationality, if rules, routines, and procedures guide individual decision making.

The openness of markets, stronger intellectual property protection, increasing returns, the unbundling of artifacts and information, and the possibilities for "integration" using new information technology are necessarily a part of the sensemaking milieu.

Information receipt and interpretation is by no means restricted in its importance to the understanding of business, market, and technological trends. There is also the need to identify relevant external technology and bring it into the firm. An organization's absorptive capacity with respect to external technology is a function of "the technical and managerial competence of the transferee."[32] Absorptive capacity is greatest when what is to be learned is related to what is already known.[33] As Mowery has explained, a firm is far better equipped to absorb the output of external R&D if one is performing some amount of R&D internally.[34] In short, internal and external R&D are complements, not substitutes.

Organizational Action

Once an opportunity is sensed, it must then be seized. This is where the organization's ability to quickly contract up the requisite external resources and direct the relevant internal resources comes into play. Schumpeter referred to

the importance of effectuating "new combinations." This is precisely what management must do. It increasingly involves forming alliances to access the requisite complementary technologies and complementary assets. The alliance structure is favored because markets simply don't exist for much of what must be accessed, and the alliance is a (hybrid) way to do so that shares risks and rewards but achieves a coalignment of strategy.

However, it also requires an organizational structure where decision making is immediate and action is swift. This typically implies high-powered incentives and decision making that is anything but bureaucratic. Smaller entrepreneurial companies appear to excel in many such environments, although dynamic capabilities are certainly not restricted to small companies. Larger enterprises can also deliver much of what is required if they are tuned to changes in their external environments, and if they have adopted decision-making processes that both enable and require quick response.

Implications for the Theory of the Firm

The firm is a repository for knowledge—the knowledge being embedded in business routines and processes. Distinctive processes undergird firm-specific assets and competences (defined as integrated clusters of firm-specific assets). The firm's knowledge base includes its technological competences as well as its knowledge of customer needs and supplier capabilities. These competences reflect both individual skills and experiences as well as distinctive ways of doing things inside firms. To the extent that such competences are difficult to imitate and are effectively deployed and redeployed in the marketplace (reflecting dynamic capabilities), they can provide the foundations for competitive advantage.

The essence of the firm is its ability to create, transfer, assemble, integrate, and exploit knowledge assets. Knowledge assets underpin competences, and competences in turn underpin the firm's product and service offerings to the market. The firm's capacity to sense and seize opportunities, to reconfigure its knowledge assets, competencies, and complementary assets, to select appropriate organization forms, and to allocate resources astutely and price strategically all constitute its dynamic capabilities.

The knowledge perspective presented here requires us to stress the entrepreneurial rather than the administrative side of corporate governance. In high-technology industries, firms are not so much organizations designed to minimize transactions costs—although this they do—but organizational structures capable of shaping and reshaping clusters of assets in the distinct and unique combinations needed to serve ever-changing customer needs. Accordingly, boundary issues (such as vertical integration) are not determined by transactions cost considerations alone. Rather, they are strongly influenced by tacit knowledge and imitability/replicability considerations. Even setting aside strategic and transaction cost issues, the tacit component of knowledge cannot frequently

be transferred absent the transfer of personnel and organizational systems/routines. Tacit knowledge and its transfer properties help determine the boundaries of the firm and may well swamp transaction costs considerations.

Competitive advantage can be attributed not only to the ownership of knowledge assets and other assets complementary to them, but also to the ability to combine knowledge assets with other assets needed to create value. Knowing what assets to develop, and what to abandon, is a critical element in the success equation. Dynamic capabilities are critical if knowledge assets are to support sustainable competitive advantage.[35]

Thus, the competences/capabilities view of the firm sees the proper boundaries of the firm and governance structure being determined not only with reference to transactions costs, but also with reference to technological and knowledge concerns. The boundaries of the firm, and future integration and outsourcing opportunities, must clearly be made with reference to learning and knowledge issues as well as transaction cost economics.

The emphasis on the development and exploitation of knowledge assets shifts the focus of attention from cost minimization to value maximization. Governance decisions involve both questions of what assets to build inside the firm versus accessing externally, as well as how to organize internally. This perspective thus complements transaction cost economics.

Conclusion

Knowledge, competence and related intangibles have emerged as the key drivers of competitive advantage in developed nations. This is not just because of the importance of knowledge itself, but because of the rapid expansion of goods and factor markets, leaving intangible assets as the main basis of competitive differentiation in many sectors. There is implicit recognition of this with the growing emphasis being placed on the importance of intangible assets, reputation, customer loyalty, and technological know-how.

While there is some recognition of these changes, there is perhaps a failure to recognize just how deep these issues go. The value-enhancing challenges facing management are gravitating away from the administrative and towards the entrepreneurial. This is not to denigrate the importance of administration, but merely to indicate that better administration is unlikely to be where the economic "rents" (superior profits) reside. Indeed, if one looks at the sources of wealth creation today, they are markedly different from what they were barely two decades ago. The key sources of wealth creation at the dawn of the new millennium will lie with new enterprise formation; the renewal of incumbents; the exploitation of technological know-how, intellectual property, and brands; and the successful development and commercialization of new products and services.

The implications for management are clearly quite considerable. New forms of business organization—and new management styles that enable intangibles to be developed and dynamic capabilities to be practiced—are clearly critical. There is now sufficient experience with new network organizations and with alliances to sensitize management to the richness of the organizational menu that is now available. Moreover, modern information technology clearly enables a greater variety of transactional structures than was hitherto thought possible. What is apparent is the need to focus on developing a deeper understanding of imitability and replicability issues with respect to intangibles and the role of markets in undermining traditional forms of competitive advantage.

The extension of markets and the growth of competition is a great benefit to the consumer and society. However, the post-war evolution of markets has powerful strategic implications for how and where firms position themselves to build competitive advantage. This does not appear to be well appreciated. It is no longer in product markets but in intangibles assets where advantage is built and defended. There is no such thing as a privileged product market position—unless it rests on some upstream intangible asset. The focus of strategy analysis must change, and is changing, as indicated by the burgeoning literature in strategic management on the resource-based theory of the firm.[36] Managers who figure this out are likely to be well positioned to build and maintain competitive advantage in the next millennium. They must recognize that in open unregulated markets, the domains in which value can be built are likely to be more and more confined. Perhaps Andy Grove is right after all when he warns that "only the paranoid survive."

Notes

1. D.J. Teece, "The Market for Know-How and the Efficient International Transfer of Technology," *Annuals of the American Association of Political and Social Sciences* (November 1981), pp. 81-86.
2. S. Kuznets, *Modern Economic Growth: Rate, Structure, Spread* (New Haven, CT: Yale University Press, 1966).
3. These included the late Edwin Mansfield, Richard Nelson, Chris Freeman, Sidney Winter, Paul David, Nathan Rosenberg, Giovanni Dosi, and David Mowery.
4. See P. Romer, "What Determines the Rate of Growth and Technological Change," World Bank Working Papers, WPS 279, World Bank, 1989.
5. I. Nonaka and H. Takeuchi, *The Knowledge Creating Company* (New York, NY: Oxford University Press, 1995).
6. M. Miller, *Merton Miller on Derivatives* (London: John Wiley & Sons, 1997).
7. P. Grindley and D.J. Teece, "Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics," *California Management Review*, 39/2 (Winter 1997): 8-41.
8. That's not to say that these are not opportunities to take bets against the market, but such bets represent asset plays by investors which ought not be thought of as a foundation for competitive advantage, as gains need not require involvement in operations of any kind.
9. Teece (1981), op. cit.
10. B. Arthur, "Competing Technologies: An Overview," in G. Dosi et al., eds., *Technical Change and Economic Theory* (London: Frances Pinter, 1988).
11. D.J. Teece, G. Pisano, and A. Shuen, "Dynamic Capabilities and Strategic Management," *Strategic Management Journal*, 18/7 (1997): 509-533.

12. Following Dataquest, we define SLI as an integrated circuit that contains a compute engine, memory, and logic on a single chip and has more than 100,000 utilized gates. Two types of SLI devises can be recognized: ASICs (application-specific integrated circuits) that are sold to a single user, and ASSPs (application-specific standard product) that are sold to more than one user.
13. Dataquest, *ASIC's Worldwide*, December 18, 1995.
14. Fumio Kodama, *Analyzing Japanese High Technologies* (London: Pinter, 1991).
15. "A Dynamic Mix of Chips and Biotech," *Forbes*, January 26, 1996, pp. 76-81.
16. Teece (1981), op. cit., p. 84.
17. For analysis of the sources of innovation, see D.J. Teece, "Firm Organization, Industrial Structure, and Technological Innovation," *Journal of Economic Behavior and Organization*, 31 (1996): 193-224.
18. This section is based on Teece (1981), op. cit., p. 82-84.
19. These ideas are developed further in C.E. Shannon and W. Weaver, *The Mathematical Theory of Communication* (Chicago, IL: University of Illinois Press, 1949). I am grateful to Max Boisot for drawing them to my attention.
20. For example, we could identify innovation that were architectural or non architectural, competency enhancing or competency destroying.
21. This section is based in part on Teece, Pisano and Shuen, op cit.
22. D.J. Teece, "Technology Transfer by Multinational Firms: The Resource Cost of Transferring Technological Know-how," *The Economic Journal*, 87 (1977): 242-261.
23. S.A. Lippman and R.P. Rumelt, "Demand Uncertainty and Investment in Industry-Specific Capital," *Industrial and Corporate Change*, 1/1 (1992): 235-262.
24. R. Nelson and S. Winter, *An Evolutionary Theory of Economic Change* (Cambridge, MA: Harvard University Press, 1982).
25. D.J. Teece, "Towards an Economic Theory of the Multiproduct Firm," *Journal of Economic Behavior and Organization*, 3 (1982): 39-63.
26. M.E. Porter, *The Competitive Advantage of Nations* (New York, NY: Free Press, 1990).
27. See K. Clark and T. Fujimoto, *Product Development Performance: Strategy, Organization, and Management in the World Auto Industries* (Cambridge, MA: Harvard Business School Press, 1991).
28. Nelson and Winter, op. cit.
29. Competences may in turn be embedded in other corporate assets, including assets complementary to knowledge assets.
30. S. Winter, "Knowledge and Competence as Strategic Assets," in D. Teece, ed., *The Competitive Challenge: Strategies for Industrial Innovation and Renewal* (New York, NY: Harper & Row, Ballinger Division, 1987).
31. This isn't necessary for broad level integration of physical components, where the bundling of intellectual property in products simplifies intellectual property transactions.
32. D.J. Teece, *The Multinational Corporation and the Resource Cost of International Technology Transfer* (Cambridge, MA: Ballinger, 1976), p. 48.
33. W.M. Cohen and D.A. Levinthal, "Absorption Capacity: A New Perspective on Learning and Innovation," *Administrative Sciences Quarterly*, 35 (1990): 128-152.
34. D. Mowery, "Firm Structure, Government Policy, and the Organization of Industrial Research," *Business History Review*, 58 (1984): 504-531.
35. The astute management of the value in a firm's competence/knowledge base is a central issue in strategic management. D.J. Teece, "Profiting from Technological Innovation," *Research Policy*, 15/6 (1986): 285-305. The firm must therefore be understood not just in terms of its competences, but also in terms of its dynamic capabilities and the ability to orchestrate internal and external assets so as to capture value. Dynamic capabilities reflect the entrepreneurial side of management. Incentives as well as the formal and informal structure of the firm are all elements of governance affecting dynamic capabilities. These elements together help define the firm as we know it. Accordingly, competitive advantage flows from both management and structure.
36. For an excellent compendium, see Nicolai Foss, ed., *Resources, Firms and Strategies: A Reader in the Resource-Based Perspective* (New York, NY: Oxford University Press, 1997).