



Strategies for Managing Knowledge Assets: the Role of Firm Structure and Industrial Context

David J. Teece

In the new economy, the sustainable competitive advantage of business firms flows from the creation, ownership, protection and use of difficult-to-imitate commercial and industrial knowledge assets. Such assets include tacit and codified know-how, both technical and organisational, whether or not protected by the instruments of intellectual property such as trade secrets, copyrights and patents. Competitive advantage undergirded by such assets can be sustainable to the extent to which it is transferable and useable inside the firm, but difficult for outsiders to access and/or recreate. Knowledge management can be used to describe the panoply of procedures and techniques used to get the most from a firm's knowledge assets. Information technology can assist knowledge management, but knowledge management involves much more than the astute use of IT tools. In particular, knowledge management requires the development of dynamic capabilities... the ability to sense and then seize opportunities quickly and proficiently. This is especially so in environments characterised by increasing returns, irrespective of the appropriability regime. Companies slow to respond to the new reality will be severely handicapped. © 2000 Elsevier Science Ltd. All rights reserved.

Introduction

There is increasing recognition that the competitive advantage of firms depends on their ability to create, transfer, utilise and protect difficult-to-imitate knowledge assets. The shift to knowledge assets as the basis of competitive advantage has become compelling with the liberalisation and expansion of markets both domestically and internationally. These trends

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have created a business environment in the United States and in many other developed countries where components and inputs are available to all firms everywhere at similar prices. Even if components or inputs do not trade, firms are free to locate so as to access them at low cost. Fuelled by free market philosophy and assisted by new information technology, these developments have a levelling effect with respect to competitive advantage. The trend is well established, and unlikely to be reversed, in societies where openness to trade is the dominant ethos. In this article, certain general implications of this are distilled.

The managerial challenges that flow from the centrality of knowledge and intellectual property are rather different from those of a bygone era where physical assets were the key to competitive advantage. Furthermore, there are also major differences in knowledge management requirements from situation to situation according to the underlying cost and demand logic at work, the 'appropriability regimes' in which the firm operates, the importance of compatibility standards, the nature of innovation at issue, and the richness of the technological opportunity facing the firm. This article analyses knowledge management requirements in these different contexts. But first, some background.

Creating value with knowledge assets

The nature of knowledge assets is that they cannot be readily bought and sold. Because they frequently cannot be bought, they must be built in-house by firms; and frequently they must also be exploited internally in order for full value to be realised by the owner. This observation follows from the fact that the market for know-how is far from complete, and where it exists it is far from 'efficient'. This condition derives from the absence of commodity-like markets for knowledge assets, a condition that arises in part from the nature of knowledge itself and, in particular, the difficult to articulate and codify 'tacit dimension'.¹

These transactional difficulties are mainly associated with organisational knowledge. Personal knowledge can, of course, be more readily bought and sold. Transactions in personal knowledge occur every day, when particular (individual) talent is hired and fired. Organisational knowledge or organisational competence is a different matter, being embedded as it is in organisational processes, procedures, routines and structures. Such knowledge cannot be moved into an organisation without the transfer of clusters of individuals with established patterns of working together. This is most frequently accomplished through personal relations or through alliances, joint ventures, and mergers and acquisitions of business units. Thus when Ford Motors in the United States became committed to making smaller cars in the US, it turned to its European subsidiaries for help. The subsidiaries transferred design and production

groups to the US to help establish small car design and manufacturing competence in North America. In short, the absence of a well developed market for knowledge renders it imperative that firms innovate internally. Put differently, innovation cannot be outsourced in its entirety, even though internal efforts can be successfully augmented through technology transfer and external acquisition activities.²

Specification of the internal environment and processes required to support rapid innovation is, of course, a topic upon which much is written, and a good deal is understood. Accordingly, this topic will not detain us further in this article, despite its great importance. Rather, attention is given to several related aspects of knowledge management: extracting value through: (i) disembodied transfer inside the firm (internal technology transfer and utilisation); (ii) disembodied external transfer; and (iii) bundled sale of technology (embodied in an item or device).

But first, a basic observation. Much knowledge is of limited commercial value unless bundled in some way. A line of software code is of little utility until it is combined with other pieces of software to constitute a program. (For example, units of software smaller than ‘applets’ cannot typically be bought and sold.) Accordingly, know-how does not usually command significant value until it is embedded in products. Only then can its value be fully extracted.

There are exceptions: even when they are not items of sale, knowledge assets relating to production processes can generate great value inside the firm. The internal technology transfer and use of process know-how is less compromised by the absence of a market for know-how. Indeed, the very essence of a large, integrated firm can be traced in substantial measure to its capacity to facilitate the (internal) exchange and transfer of knowledge assets and services, assisted and protected by administrative processes.^{3,4} We will examine various modes of extracting value from knowledge, as each raises distinctive knowledge management issues.

Transferring knowledge assets

In the 1960s and 1970s knowledge transfer inside the firm was viewed as being mainly one-way: out from R & D to the divisions, and out from the US to the rest of the world. Now, if not then, the flow is in all directions. Research and development is no longer as centralised organisationally as it used to be. Moreover, the sources of knowledge are diffused geographically, requiring flows from the periphery to the centre, and from one node on the periphery to another.

Given that technology transfer inside the firm is not significantly impeded by proprietary concerns, one would think that technology transfer and use inside the firm would be straightforward. However, this is definitely not the case. As Lew Platt, former CEO of Hewlett Packard (HP) once put it, “If only HP

know-how does not usually command significant value until it is embedded in products

knew what HP knows, we would be three times more productive!”⁵ The large size of many enterprises, their global reach, the importance of knowledge to competitiveness, the distributed nature of competence within the firm and the availability of tools to assist knowledge transfer has sharpened the competitive importance of accomplishing knowledge transfer inside the firm.

We know very little about how to transfer technology inside the firm. Economists and other social scientists frequently have a poor grasp of this topic, and are often content to assume that the transfer is cost free, when clearly it is not.⁶ Managers are not much better informed, although top management in many companies (such as British Petroleum and Hewlett Packard) has flagged the importance of knowledge transfer issues. Moreover, the knowledge that needs to be transferred is not simply technological. Knowledge about competitors, customers and suppliers is also a part of the mix. So is managerial experience. Such knowledge is often embedded in operating rules and practices, in customer, supplier and competitor databanks, and in the company’s own history. As mentioned earlier, there is also an important tacit dimension, which is difficult to transfer without the transfer of people.

In the information age, there is both the need and the opportunity to match information and knowledge requirements with availability in ways that have hitherto been impossible. Knowledge, which is trapped inside the minds of key employees, in file drawers and databases, is of little value if not supplied to the right people at the right time. Information ‘float’—the time lapse between knowledge discovery or creation and transfer and use—is extremely costly, at least in opportunity cost terms. Indeed, the technology leader could turn out to be viewed as the laggard in the marketplace if its competitors can transfer technology and manage information float better. As Gomory and Schmitt noted over a decade ago:

If one company has a 3-year [development and manufacturing] cycle and another has a 2-year cycle, the company with the shorter cycle will have its process and design into production and the product in the market one year before the other. The firm with the shorter cycle will appear to have newer products with new technologies. In fact, both companies will be working from the same storehouse of technology.⁷

Casually formed networks no longer suffice to diffuse best practice and new knowledge more generally. As Larry Prusak asks, if the coffee-pot was a fount of useful knowledge in the traditional firm, what constitutes a virtual one? How do we manage face-to-face time in a firm of tens of thousands? The requirement is to use (information) technology creatively. Corporate intranets and the Internet itself can help facilitate the flow of such information. However, as discussed below, infor-

Knowledge . . . is of little value if not supplied to the right people at the right time

mation itself rarely constitutes knowledge, so IT tools are never the entire solution. Moreover, knowledge and competence are often widely diffused in an organisation. Some of it may lie in R & D laboratories, some on the factory floor, and some in the executive suite. Often what is critical is the capacity to weave it all together. Firms cannot eschew the need for cross-functional and geographical integration without paying a heavy penalty in the marketplace.

While proprietary barriers to internal knowledge transfer are typically absent, within the firm transfer is not friction free and cost free, as noted above. Merely finding the person or group with the knowledge one needs is often quite difficult. In addition, issues such as absorptive capacity, rooted in education and experiences, social, professional and hierarchical contexts, also appear to be important. ‘Gatekeepers’, ‘translators’, ‘internal knowledge brokers’ and other specialists in technology transfer are often needed to effectuate transfer.⁸

External transfer—from one organisation to another—occurs either as a consequence of deliberate transfer (under learning and know-how agreements), of inadvertent transfer (for instance, spillovers in the context of alliances) or through the imitative activities of competitors. Clearly the external flow of that knowledge protected by intellectual property rights (such as trade secrets) is impeded (to the extent that intellectual property law is effective or deemed to be so), as compared with flows inside the firm. However, intellectual property law does not protect much knowledge, and in some cases proprietary concerns may be minimal. In such cases it may be correct, as Brown and Druid claim, that “knowledge often travels more easily between organisations than it does within them”.⁸ Their claim appears to derive from the observation that knowledge moves differently within communities than it does between them. “Within communities, knowledge is continuously embedded in practice, and thus circulates easily.”⁸ This is undoubtedly true, but as a general rule, internal transfer ought to be easier.^a

The external transfer of technology is frequently aided by licensing and technology transfer agreements. These not only remove intellectual property barriers, but they also frequently call for technology transfer assistance. The challenges associated with such external transfers are significantly softened (as compared with the internal challenge) by the frequent absence of a requirement for the subsequent transfer of updates and improvements. It is substantially easier to transfer a known technology for which there is operating and transfer experience than it is to constantly and continuously transfer state of the art technology.

Information management and knowledge management

Much of the excitement around knowledge management has

^a When its flow is impaired, it is frequently due to the poor design of incentives or to pure self-interest. The latter frequently stems from the unwillingness of individuals in our organisations to share information for fear of making themselves redundant.

Exhibit 1. Is information management masquerading as knowledge management?

There are three broad objectives frequently advanced by the 'knowledge' management movement:

- The creation of 'knowledge' repositories (data warehouses) for: (a) external information, particularly competitive intelligence and best practice; (b) internal information, such as internal research reports; and (c) informal internal knowledge-like discussion databases.
- The delivery of improved 'knowledge' access and hence reuse through the development of user-friendly analytical tools.
- The enhancement of the organisation's knowledge environment, including the willingness of individuals to freely share their knowledge and experiences.

been propelled by advances in information technology. However, information transfer is not knowledge transfer, and information management is not knowledge management, although the former can certainly assist the latter. Information technology alone will rarely be the source of sustained competitive advantage, in part because competitors can frequently replicate it.

Indeed, the very success of information technology in making information accessible at low cost itself highlights the difference between information and knowledge. Individuals and organisations now frequently suffer from information overload. Just as the winner of a national quiz show may never go on to do anything beyond the mediocre, so might a corporation with excellent IT systems have trouble competing. Knowledge is not primarily about facts and what we refer to as 'content'. Rather, it is more about 'context'. Knowledgeable people and organisations can frame problems and select, integrate and augment information to create understandings and answers. Knowing how to select, interpret and integrate information into a usable body of knowledge is a far more valuable individual and organisational skill than simply being able to give the answer to a discrete question or a series of questions. A Bloomberg or Reuters news feed is information. The opinion of the leading analysts and commentators, putting the news into context and enabling it to be used to create value, is more akin to knowledge.

Accordingly, data warehousing and data mining exercises are useless without other knowledge and other sense-making organisational processes.⁹ This is not surprising, given the tacit

nature of much organisational knowledge. Information technology assists in the storage, retrieval and transfer of codified knowledge, but unassisted by other organisational processes, the productivity benefit from information technology is likely to be limited. Accordingly, the view advanced here is that 'knowledge' management as it is frequently defined (see Exhibit 1) is too narrowly positioned to warrant the use of the term 'knowledge management'. Efficiently organised information is not knowledge. It is simply efficiently organised information—a helpful tool, but little more.

Nonetheless, the combination of information technology and co-aligned organisational processes can significantly enhance learning and competitive advantage. In addition, the conversion of tacit to codified or explicit knowledge assists in knowledge transfer and sharing, thereby possibly helping to make the firm more innovative and more productive. Once knowledge is made explicit, it is easier to store, reference, share, transfer, and hence re-deploy. Cutting the other way is the fact that once it is codified, it is sometimes harder to protect. Once data is held electronically, it can be sent almost anywhere in the world in seconds. In the wrong hands, it can 'leak out' comprehensively and quickly.^b However, the absence of strong intellectual property protection is usually not sufficient to warrant managerial strategies in favour of suppressing the conversion of tacit knowledge to explicit knowledge, as such suppression harms the owner's ability to use, reuse and combine such knowledge. Moreover, in most jurisdictions, there is some form of trade secret protection, thereby providing a means of protection against the misappropriation of explicit knowledge.¹¹

*Efficiently organised
information is not
knowledge*

Knowledge management and the design of firms

Structural issues

The migration of competitive advantage away from tangible assets towards intangible ones helps highlight some fundamental aspects of the business organisation. Firms are sometimes portrayed as organisations designed to protect specific physical, locational and human capital assets.¹² The protection of asset values from re-contracting hazards will be an enduring feature of the business enterprise. In the global economy we now confront, it is intangible capital which is pre-eminent; but in addition to protecting such capital against re-contracting hazards, one must also focus on generating, acquiring, transferring and combining such assets so as to meet customer needs.

In order to be successful in these activities, firms and their managements must be entrepreneurial. They must exhibit capabilities that I have labelled elsewhere as dynamic. Entrepreneurial firms are organised to be highly flexible and responsive.¹³ That in turn requires a set of attributes, which include:

- flexible boundaries—a presumption in favour of outsourcing and alliances;^c

^b Indeed, Edwin Mansfield's survey of almost two decades ago indicated that knowledge leaked out of firms with considerable speed even then.¹⁰

- high powered incentives—to encourage an aggressive response to competitive developments;
- non-bureaucratic decision-making—decentralised or possibly autocratic, self-managed where possible;
- shallow hierarchies—to facilitate both quick decision-making and rapid information flow from the market to the decision-makers;
- an innovative and entrepreneurial culture that favours rapid response and the nurturing of specialised knowledge.

As Charles Leadbeater¹⁴ points out, orthodoxy from both the left and the right does not always find the new emphasis on entrepreneurship agreeable. The left has demonised entrepreneurs as profit-hungry exploiters of the weak and the poor. On the other hand, many orthodox economists on the right have no place for the entrepreneur in their intellectual frameworks; in the perfectly competitive world of equilibrium economics, the entrepreneur is superfluous. It is mainly in the Austrian school that one finds a ready acceptance for the critical role of the entrepreneur in economic development. More recently, the role of entrepreneurship in management is beginning to be recognised.¹⁵

The modern corporation, as it accepts the challenges of the new knowledge economy, will need to evolve into a knowledge-generating, knowledge-integrating and knowledge-protecting organisation. While many companies have performed these functions with proficiency for decades, if not centuries, the global transformations taking place are quite radical in their implications for the management of many old line enterprises, requiring and enabling an entirely new level of proficiency in knowledge management. In the new economy, significant premiums are being placed on the entrepreneurial capacities of management, and on the capacities firms develop for building, protecting, transferring and integrating knowledge—both productive knowledge and customer knowledge. The ability of an organisation to exhibit dynamic capabilities is critical to its success. Without the organisational capacity to make sense of the evolving reality, the corporation will fall upon hard times. Entrepreneurial leaders must be able to make good decisions based on limited information. They must understand the evolving needs of customers in market contexts that are changing at high speed.

Compensation and employment issues

If hierarchy is antithetical to the performance of knowledge-based firms, how can one gain confidence that members of the organisation are working for the organisation, and not against it? The answer lies, in part, with performance pay and equity-based compensation systems. Providing clear performance-based metrics facilitates high autonomy; if well designed it also facilitates goal congruence. Equity provides a sense of membership and belonging.

^c The only situation where this presumption ought be overturned is innovation itself, as discussed above.

The use of equity pay to incentivise management at all levels is still largely a US phenomenon, and significant reliance on it tends to be mainly confined to high growth ‘Silicon Valley’ type companies. It has worked very well in a variety of diverse contexts. For the individual, it can provide spectacular returns if the company does well; for the company, it can facilitate a strong sense of ‘belonging’ when there may not be much else. It can also save on cash compensation, which may well be advantageous when cash is tight.

The use of equity-based compensation works better when there is good liquidity—a publicly traded security complemented by a publicly traded option, or at least the prospect of each. Indeed, in the US, the possibility of receiving stock in an entity is frequently a spur towards uncommon efforts and uncommon sacrifices, to the benefit of the enterprise, its members and shareholders.

Equity compensation ought not be limited to those traditionally thought of as ‘insiders’ or ‘employees’. Independent contractors and suppliers can, and should, be linked in where possible.^d Even customers can be included if the customer is accepting uncommonly high purchaser risk, as when a customer helps with early product adoption and testing, or when a customer places a large order upfront to help legitimise the company and its products.

Highly flexible Silicon Valley type firms, where there is a presumption in favour of outsourcing but where critical knowledge assets are built and protected internally, are likely to be a favourite organisational form in some sectors of the new knowledge economy.¹⁶ The corollary is that the employment relationship will continue to evolve, with distinctions between the ‘inside’ and ‘outside’ of the firm becoming increasingly blurred.

Successful companies will always have those with whom they collaborate, be they other firms, individuals or universities. When the sources of knowledge are widely dispersed, such collaboration is likely to be extensive. Networks are thus frequently critical to the knowledge-based firm. But while networks have been of growing importance for at least a couple of decades, one should not presume that this means that the integrated corporation is doomed. It is here to stay. As explained elsewhere,² the corporation cannot outsource its key systems integration capability where specialised knowledge assets are required for competitive advantage; these should be developed and practised internally. But it can outsource functions not critical to the firm’s core activities. Indeed, it will frequently find providers who specialise in such ‘routine’ support functions. Such firms can provide a level of service that the firm might not be able to provide for itself, possibly because of scale, or perhaps simply because the supplier has developed other relevant knowledge. Clearly, one is unlikely to be able to beat one’s competitors with respect to a function if one sources

^d In Silicon Valley it is not uncommon for consultants, headhunters, lawyers and even landlords to take a portion of their fees in options from newly formed pre-IPO businesses.

that function externally. But if one is behind, one can certainly catch up through outsourcing.

Industrial context

In this article, and in a series of articles over the past decade, this author has advanced the proposition that competitive advantage (superior profitability) at the enterprise level depends upon the creation and exploitation of difficult-to-replicate non-tradable assets, of which knowledge assets are the most important. While this proposition is advanced as having general applicability, its strength is likely to vary according to industrial context. Putting to one side sectors of the economy shielded from competition by government regulation (where political access and regulatory influence are key drivers of firm performance), it would appear that other aspects of the environment also impact the strength of the proposition and affect appropriate managerial responses. In this section, the underlying cost and demand dynamics and other factors that affect knowledge management and strategic management are explored.

At one level, it is self-evident that industrial context matters. There is clearly some difference between managing a pharmaceutical company, an Internet start-up and a professional services firm. However, the proposition advanced here is that in all three instances, managing knowledge assets and other intangibles (e.g. brands) is the key to building competitive advantage. The manner in which one can successfully manage each of the identifiable components of knowledge management—creation and building, transfer, protection, use—will be different. In part this is because there is variability in competitive dynamics as one looks across activities in the economy that employs knowledge assets. That is not to suggest that the knowledge economy is or will be confined to just a few activities or industries. All industries open to competition will be impacted. But the underlying cost/success drivers are different in different contexts. Understanding the relative role of knowledge assets, and dynamic capabilities, is obviously of some importance.

Perhaps one can begin by looking at extremes. Where is the new logic of organisation likely to have the greatest impact? Where is it likely to have the least impact? Identifying environments where there is already, or will soon be, a significant premium associated with the ownership and orchestration of knowledge assets is not difficult. Multimedia, web services, electronic banking and brokerage are just a few obvious examples. Less obvious, but equally important, are professional services and agriculture. Technology has always been critical to agricultural productivity, but new information technology coupled with satellite surveillance and active futures market participation is enabling more astute decision-making with respect to crop selection and harvesting. Biotechnology is meanwhile creating a more visible revolution with respect to plant and

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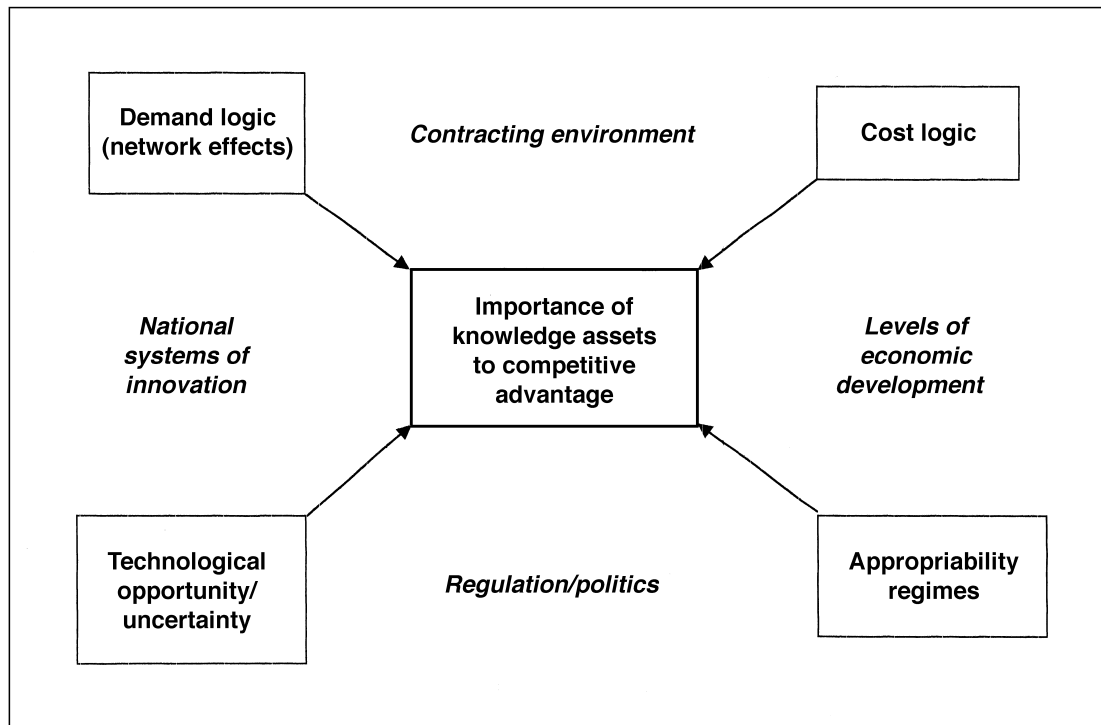


Figure 1. Factors impacting knowledge management

animal selection and growth. Ironically, education is one of the least impacted sectors, in part because of its public ownership and the limited competition that exists in many locales. Traditionally low-tech activities like retailing are meanwhile undergoing a revolution, enabled by information technology, and confronted by the Internet as an alternative and competitive distribution channel.

Physical assets will, however, remain important in many industries. Consumers will still need the output of steel mills and petroleum refineries, though these facilities will be run in quite different ways. Take the oil business: crude oil and many refined products are nowadays commodities, yielding only limited opportunities (for example, speciality products) for differentiation in the products themselves. Once the current wave of consolidation has levelled gross capacity utilisation differentials, the primary way in which industry participants can compete will be either through new ways of finding, transporting, refining or distributing oil, or through political influence (being better at winning in the political allocation of rights for the exploration, production and transportation of oil). Ownership of physical assets will not, however, provide a source of significant differentiation. Indeed, global competition and the expansion of intermediate product markets (including futures markets) means that one can compete downstream as a 'virtual' refiner, outsourcing supply whilst protecting oneself in financial markets from the risk thereby involved.

There is no easy metric for carving out sectors of the economy that might be insulated to some degree from the fundamental dynamics described earlier. One cannot do it based on R & D as a percentage of sales, because so much R & D is ‘outsourced’ in one way or another, and because R & D in one industry impacts on the competitive dynamics of others, as when biotechnology research impacts agriculture.^c Nor can one do it solely on the basis of the underlying cost dynamics that characterise the industry.

There is a need to categorise environments where knowledge management skills have high utility. Figure 1 is an attempt to do so. The taxonomy is by no means comprehensive, but it is offered as a preliminary and tentative typology to help the uninitiated think through particular real world situations and circumstances. Each factor that helps to define the relevant dimensions of industrial context is briefly described below.

Cost and demand logic

Increasing returns

In many industries today, and in particular in the information industries themselves, increasing returns are the norm. This is not just a matter of increasing returns to scale, as the phenomenon flows from both the demand and supply side considerations. (While these are dealt with together here, they are separately identified in Figure 1.) The effect is that whoever gains advantage, *ceteris paribus*, gains further advantage. Whoever loses advantage will tend to lose further advantage (for instance, Apple Computer in the early 1990s). Momentum lost is difficult, though not impossible, to regain, as Apple Computer is demonstrating.

There are at least three reasons for these phenomena. The first is cost: high-tech products involve large development costs—perhaps over \$250 million for the first disk of Microsoft Windows 95. The second disk could be created for almost nothing, and if distributed over the Internet could be distributed for next to nothing. While there are fixed upfront costs in many of the older industries (such as steel and automobiles), economies of scale would tend to become exhausted before industry demand was substantially satisfied. The second reason concerns demand-side factors: the bigger a network gets, the more utility associated with being on that network. This is because the product might well become a standard, actual or *de facto*. The third reason is the development of user knowledge, familiarity and skills with the product. One might become familiar with either WordPerfect or Microsoft Word, and so when upgrades are available, the user will stay with the product that builds on the user’s skills.

These demand and supply side factors work together to produce increasing returns. They also tend to make markets unstable in that there is an absence of smooth substitution possibilities amongst products or platforms. The market may tip one way, then another. There is a tendency for the market

^c Another good example is data services and telecommunications. Few service providers engage in R & D; most of the technological innovation is driven by equipment companies like Cisco and Lucent.

to 'lock-in' once one firm's product gets ahead, whether due to superior acumen, small chance events, clever strategies, government regulation or judicial blundering, but one should not think that whoever gets started first will necessarily win. Moreover, lock-ins may be quite weak and easily surmounted since switching costs are low. Like the presidential primaries in the United States, there is much that can happen between New Hampshire and California, although it typically does not hurt to win in New Hampshire. But even if one loses there, one can catch up through the use of complementary assets (such as advertising programmes), clever strategy, good luck and hard work. In product markets, one needs to focus on trying to get bandwagons rolling. Having a good product that is attractively priced helps immensely in contexts with increasing returns.

Industry position may well become established for a while, but certainly not for ever. Lotus 1-2-3 dominated spreadsheets for a while, Digital dominated minicomputers for a decade, and Microsoft may have DOS/Windows as the standard for the PC operating system for a few more years, but all eventually get overturned (unless government intervention moves in to freeze the *status quo*). It is not that competition stops once dominance^f is achieved: it simply takes on a new form. Once a standard is anointed by the market, competitors push for a new standard and may have to develop a radical new technology to make it happen. Monopoly power, if attained, is transient, not permanent. Competition in the market gets displaced by competition for the market.

When competition is of this kind, competitive strategies must adjust. The pay-off from market insight—figuring out where the market is heading and investing heavily to get there first—is high. The strategic challenge is therefore in part cognitive. However, even if an organisation is good at figuring out the future, to succeed one must also be good at responding quickly. Directed strategies, quickly and comprehensively implemented, are what is required—witness Gates' response at Microsoft in 1995 once he figured out the significance of the Internet. The ability to sense and then seize such opportunities is in part an organisational capability. Above, and elsewhere, it has been referred to as dynamic capability.^{17,18}

In environments with increasing returns, the challenge is to engineer products and services that can potentially become industry standards. Superior technology clearly matters, but it will not succeed alone. Not only does one need complementary assets, one needs the capacity to build a bandwagon effect, suggesting the importance of disseminating information about marketplace successes, the willingness to price low to build an installed base, and strong dynamic capabilities to sense and then seize opportunities. Virtual structures may well be ideal early on, when the pay-off from flexibility is high.

Once anointed as the flag bearer, a firm must keep innovating, as staying ahead is by no means inevitable. Failure to engineer the next generation of products satisfactorily could well

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^f I am using the term 'dominance' loosely. I do not mean to imply dominance in any legal sense.

unseat the incumbent. The incumbent is also confronted by competition for the market. The stakes escalate as the market grows. The main reason for technology transfer is not to keep the product on the frontier of technology, but to maintain the standard by licensing others (complements) to keep supporting and developing the established standard.

Constant returns

Large sectors of the economy are still characterised by constant returns to scale. Getting ahead is desirable, but it need not confer much advantage with respect to profit margins, even though total profits may expand. Professional services (such as accounting, consulting, law) may well fall into this category, together with scalable industries like food processing, book publishing, copiers, printers, paints, pharmaceuticals, adhesives and shoes. In these industries, the outcome of competitive battles depends on cost, quality and product and process innovation.

Knowledge management is important. The ability of firms to create new products that meet customers' needs requires a constant tuning of product offerings. Market share is gained in little bites, and dominance, if attained, is not protected through 'lock-in' effects or switching costs. While brands are likely to be important, competitive advantage is built in the old fashioned way (by keeping customers happy). Since competition is within the market, rather than for the market, the threat from inside the industry is relatively more important than the threat from outside. Learning is key to staying competitive, and licensing is critical to keeping technologies and products refreshed. Because technical expertise is of great importance in firms that compete in these contexts, the management of knowledge assets is critically important. The entrepreneurial factor is less significant. Innovation can be more 'routinised'. The techniques and tools of knowledge management must find their full expression here, if competition advantage is to be built and maintained. Constant return environments also offer opportunities for the global expansion of the business. There are no diseconomies associated with expansion.

Management consulting appears to exhibit constant returns to scale. Firms in this industry do not create new products through formal R & D activities, but create most new 'products' and services through on-the-job learning. In essence, their 'products' are usually methodologies or templates by which they tackle particular classes of problems. Increasingly, management consulting firms must pay attention to building, marketing and exploiting an organisational knowledge base that transcends the individuals in the firm. This knowledge base, resident as it is in the experiences of individuals in the firms, in reports, in slide presentations, and in databases and methodologies, must be accessible to all senior personnel. However, proprietary concerns will frequently get in the way as clients will not wish stu-

*Learning is key to
staying competitive*

dies that they have commissioned be made available outside the consulting engagement that generated it.

Consulting firms without good knowledge management systems and protocols will frequently end up duplicating for one client what they have already done for another, even in circumstances where there are no proprietary conditions surrounding sharing. However, one should not overplay the importance of knowledge management, as the diagnosis and solution of business problems is usually highly situational.

Diminishing returns

Diminishing returns imply that the enterprise confronts rising costs as it endeavours to expand. This is because of some fixed 'factor of production' which limits profitable growth. The Napa Valley vineyard, the local sole proprietor construction contractor and the small town real estate management firm are cases in point. While superior knowledge management can push back the effects of the 'fixed factor', they are unlikely to overcome it entirely.

With diminishing returns, knowledge management can be an important component of competitive strategy, as it will assist the firm in pushing the limits of its business model. Indeed it could become the very foundation of its competitive success, as it may enable customer capital (customer databases, for instance) to be leveraged more effectively. In general, however, knowledge management is unlikely to enable the firm to completely unshackle itself from the disabilities of diminishing returns. The Mauna Loa Macadamia Nut Company of Hawaii may be able to improve its performance, but if there are a limited number of places in which macadamia nuts can be cultivated, superior knowledge management is unlikely to completely remove these shackles.

Appropriability regimes

In a world of strong appropriability (that is, where patents or trade secrets and copyrights are an effective isolating mechanism), innovators can keep imitators and followers at bay, at least for a while. This gives the innovator the ability to line up complements and seek strategic partners, and do so from a position of relative bargaining strength. Lead-time in the market is more confidentially assured, and the chances of competitive success are higher if the firm astutely uses the intellectual property protection that it has. Dynamic capabilities are therefore less critical to success, because of the protection already available through intellectual property. The converse is also true. Dynamic capabilities will become more critical as the advantage from intellectual property weakens.

The advantage from intellectual property weakens if several firms have strong intellectual property rights in the same competitive space. Competitive advantage will then be eroded, although not destroyed. Cross-licensing amongst the owners of complementary intellectual properties will lead to at least the

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partial dissipation of rents, but firms which have not contributed to the technology in any way will have to pay a competitive licence fee. Competitive advantage might thus be somewhat preserved, inasmuch as the free riders will be excluded.¹⁹

Intellectual property protection is also likely to be specific to a particular jurisdiction. The level of protection available in the US is generally higher than available in Italy, Brazil, Turkey, Japan or China. Still, an intellectual property advantage in a key market like the US can sometimes enable the innovator to build sufficient scale and complementary assets to compete effectively where there is less intellectual property protection and possibly also in the period after the patent expires.

Compatibility standards

This is related to cost and demand logic, inasmuch as one of the reasons for increasing returns to scale, at least on the demand side, is the existence of compatibility standards. When such standards exist, some degree of customer 'lock-in' may exist, possibly resulting in significant switching costs for the consumer if the innovator is offering an incompatible standard.

If standards issues are not permanent, then battles over standards will not be a major strategic factor. The ability of the firm to compete by simply being better at the basics—including of course innovation—is likely. However, when incompatible standards are being advanced by significant contenders for a major market, the entrepreneurial and strategic capabilities of top management, and its ability to marshal the requisite resources, will become paramount.

In particular, the capabilities of the firm to sense and possibly shape the likely course of advancement will be of particular importance. In such circumstances there is high risk, and the rules of the game are by no means transparent. With such high uncertainty, failure is likely to be frequent. Still, superior sensing and calibrating of the opportunities—and hence superior decision-making—will be of great importance.

Technological opportunity

Knowledge assets and dynamic capabilities command a higher premium when rapid organic growth is enabled by new technologies. Some environments are likely to support much greater demand growth than others. Judging from the valuation of Internet IPOs, businesses that support or use the Internet are widely regarded, at least by investors, as providing significant opportunity. 3D graphics accelerator chips are likewise experiencing rapid growth as performance is provided at lower prices. Demand for caskets and coffins, on the other hand, is not predicted to grow much, as the death rate appears to be quite stable in advanced countries and there is little scope for selling more than one coffin for each deceased person. Accordingly, the mortuary and mortuary supply business is likely to be significantly more stable, and growth less robust, than web services, multimedia, 3D graphics and computers. While there

are frequently surprises with respect to traditional businesses, and an environment which has low opportunity in one epoch may have high opportunity in the next, the pay-off from astute knowledge management is likely to be higher when the technological opportunity is richer.

The role of political influence

Government regulation has been proven time and time again to stand in the way of innovation.⁸ Not only does regulation tend to limit market competition, it also diverts managerial effort away from competing on merits and towards competing by using the regulator and the regulatory process to limit the competitive activities of one's rivals.

Accordingly, when environments are characterised by circumstances where market forces are muted by regulation, the pay-off from good management—be it of knowledge assets or any other assets—is likely to be significantly compromised. However, if an environment is transitioning towards competition and away from regulation, then developing dynamic capabilities is likely to be both especially difficult and especially valuable. It will be especially difficult because the basic instincts and routines of a regulated enterprise are not going to be oriented towards embracing competition. It will be especially valuable because deregulation will bring about rapid change and the opening up of commercial opportunities which have been suppressed by regulation or government control.

Challenges to orthodoxy

The imperatives of the knowledge economy require new paradigms for management, and a revised understanding of the role of markets and firms. The following list summarises some of the key contentions developed in this article.

- Development, ownership, protection and astute utilisation of knowledge assets, not physical assets, provides the underpinnings for competitive advantage in the new economy.
- Because property rights have fuzzy boundaries, and because knowledge is not resident in some hypothetical book of blueprints inside the firm, figuring out how to protect and retain knowledge inside the firm is a key challenge for top management. It is not just an intellectual property issue that can be delegated to the law department.
- Today's competitive environment favours organisations (firms) able to protect knowledge assets from re-contracting hazards, but it also favours firms which can build, buy, combine, recombine, deploy and re-deploy knowledge assets according to changing customer needs and the changing competitive circumstances. Successful firms of the future will be 'high flex' and knowledge-based.

⁸ That is not to say that government R & D spending (for example, the National Institute of Health in the US) does not sometimes provide great assistance to innovation.

- It makes little sense to talk about 'labour markets' in isolation from the market for know-how. Much that is interesting about the former emerges from the study and understanding of the latter.
- The entrepreneurial function of firms in the new economy is more critical than the administrative one. Administrative functions can frequently be outsourced without loss of competitive advantage.
- The globalisation of financial markets and the narrowing of information asymmetries between borrowers and lenders are eroding access to capital as a major determinant of competitive advantage.
- Compensation structures need to be based more on equity. Rewards need to be geared towards individual and team outputs, not inputs.
- Virtual structures are frequently virtuous; the presumption should be to outsource all except the development and combination of knowledge assets and knowledge routines.
- Managing knowledge is not the same as human resource management. Besides human resource management, knowledge management involves managing intellectual property, and managing the development and transfer of industrial and organisational know-how. It is more multifaceted than simply managing people.
- The boundaries of the firm can no longer be defined with reference to equity stakes. Networks that do not involve equity are likely to be an integral part of the firm as a functioning entity.

Conclusion

The thesis advanced in this article is that competitive advantage flows from the creation, ownership, protection and use of difficult-to-imitate knowledge assets. That being so, superior performance depends on the ability of firms to innovate, to protect (intangible) knowledge assets and to use knowledge assets. Using knowledge assets obviously conceals complex processes surrounding: (i) the integration of intangibles with other intangibles, and with tangible assets; (ii) the transfer of intangibles inside the firm; and (iii) the astute external licensing of technology where appropriate. This set of activities requires management to refocus priorities, to build organisations that

have 'high flex' to accommodate such activity, and to display an uncommon level of entrepreneurial drive.

These challenges will obviously not simultaneously confront all firms at the same time in the same manner. Context is important. But the new norms required for success are already evident in many of the high-tech industries in the US, Europe and Japan. Those enterprises that are slow to recognise the paradigm shift, and respond appropriately, can expect to experience performance declines. Many of the new start-up firms being born in Silicon Valley and elsewhere understand the logic articulated here. Many incumbents are beginning to recognise the new logic, but have as yet failed to effectuate transformation. Clearly, such firms are at risk.

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References

1. D. Teece, The market for know-how and the efficient international transfer of technology, *The Annals of the Academy of Political and Social Science*, November, **458**, 81–96 (1981).
2. H. Chesbrough and D. Teece, When is virtual virtuous? Organising for innovation, *Harvard Business Review*, January–February, 65–73 (1996), republished in J. Brown (ed.), *Seeing Things Differently: Insights on Innovation*, pp. 105–119, Harvard Business School Press, Cambridge, MA (1997).
3. D. Teece, Economies of scale and scope of the enterprise, *Journal of Economic Behavior and Organisation* **1**(3), 223–247 (1980).
4. D. Teece, Towards an economic theory of the multi-product firm, *Journal of Economic Behavior and Organisation* **3**, 153–177 (1982).
5. R. Cole (ed.), Special Issue on Knowledge and the Firm, *California Management Review* **40**(3) (Spring) (1998).
6. D. Teece, *The Multinational Corporation and the Resource Cost of International Technology Transfer*, Ballinger, Cambridge, MA (1976).
7. R. Gomory and R. Schmitt, Science and product, *Science*, May, 1131 (1988).
8. J. Brown and P. Druid, Organizing knowledge, *California Management Review* **40**(3), 100–103 (1998).
9. T. Davenport, D. DeLong and M. Beers, Successful knowledge management projects, *Sloan Management Review*, Winter (1998).
10. E. Mansfield, How rapidly does new industrial technology leak out?, *The Journal of Industrial Economics* **34**(2), 217–223 (1985).
11. D. Teece, *Managing Intellectual Capital*, Oxford University Press, New York (forthcoming).
12. O. Williamson, *Economic Institutions of Capitalism*, Free Press, New York (1985).
13. D. Teece, Capturing value from knowledge assets: the new

economy, markets for know-how, and intangible assets, *California Management Review* 40(3), 55–78 (1998).

14. C. Leadbeater, Living on thin air: the new economy, draft (January) (1998).
15. D. Teece, Design issues for innovative firms: bureaucracy, incentives and industrial structure, in A. Chandler Jr., P. Hagstrom and O. Solvell (eds), *The Dynamic Firm: The Role of Technology, Strategy, Organisation, and Regions*, Oxford University Press, Oxford (1998).
16. D. Teece, Firm organisation, industrial structure, and technological innovation, *Journal of Economic Behavior and Organisation* 31, 193–224 (1996).
17. D. Teece and G. Pisano, The dynamic capabilities of firms: an introduction, *Industrial and Corporate Change* 3(3), 537–556 (1994).
18. D. Teece, G. Pisano and A. Shuen, Dynamic capabilities and strategic management, *Strategic Management Journal* 18(7), 509–533 (1997).
19. P. Grindley and D. Teece, Managing intellectual capital: licensing and cross-licensing in electronics, *California Management Review* 39(2), 1–34 (1997).