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Innovation and Antitrust Enforcement

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In evaluating markets with relatively homogeneous products and a fixed or slowly evolving technological base, the Antitrust Division of the Department of Justice (DoJ) often focuses on the price effects of potentially anticompetitive behavior. In dynamic industries, however, technological change and innovation receive particular attention. Innovation affects not only the prices that consumers pay for given products but, more important, the quality of products available in the marketplace. Moreover, the force of the innovation process can lead to dramatically higher-quality products being offered at lower prices to consumers in the future. An understanding of the particulars of competition in dynamic industries is, consequently, a vital part of a sound antitrust policy.¹

Some observers have questioned whether the antitrust laws are adequate to handle the complexities associated with rapidly innovating industries. The antitrust laws, of course, were passed initially to confront issues in “smokestack” industries in which rates of innovation were slow. However, the statutory standard set by Congress is a flexible standard that can be and has been applied to dynamic industries. The specifics of how that standard is to be applied remain open for serious debate. We are of the view that in dynamic innovative industries antitrust enforcement should be forward-looking as much as possible and that accelerated antitrust enforcement must be given serious consideration before the path of innovative activity is set in stone. We believe that this view has been borne out by antitrust activity at the Antitrust Division in recent years.

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¹ See the discussion in the second section. See also Federal Trade Commission (1996: 11–24) for a discussion of new and improved products.
The number of matters under investigation at the Antitrust Division in which innovation has been a significant issue has been growing rapidly. The division has responded by delving deeply into innovation questions. This effort is especially appropriate in light of the fact that the losses in economic efficiency that can result from the reduced incentives of firms to innovate can easily dwarf the more traditional static efficiency losses often considered by the division.

THE ANALYSIS OF INNOVATION ISSUES
AT THE ANTITRUST DIVISION

The treatment of innovation issues by the antitrust authorities is not new. A close reading of the working documents of the competition authorities shows that innovation is taken into account in both the Antitrust Guidelines for the Licensing of Intellectual Property (IPG) and the Horizontal Merger Guidelines (HMG). In the following two subsections, we describe the treatment of innovation in each.

The Intellectual Property Guidelines

In the 1995 Intellectual Property Guidelines there is a single unifying theme: the enforcement agencies apply "the same general antitrust principles to conduct involving intellectual property that they apply to conduct involving any other form of tangible or intangible property" (IPG 2.1). While the division appreciates the fact that patents may confer market power, the division does not presume that they do, any more than property rights in mines, trademarks, or taxicab medallions (IPG 2.2).²

Even where antitrust issues do arise, the division is sensitive to the need to preserve the procompetitive benefits of licensing. These include the quick and efficient commercialization of new products, and enhanced incentives to invest in R&D resulting from broader opportunities to appropriate the rewards of innovation (IPG 2.3).³

Nevertheless, antitrust issues do arise, typically in relation to licensing restraints. While once again being sensitive to the need to preserve the

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³ According to Katz and Ordoñez (1990: 139), "The inability to appropriate all the gains from ex post sharing of R&D results [from imperfect intellectual property rights] has two negative effects on a firm's incentive to conduct R&D: (1) it reduces the expected return to innovation; and (2) since a firm can gain from the R&D conducted by its rivals, it reduces the firm's potential loss from failing to conduct its own R&D." However, Cohen (1995: 229) cautions, "Despite a growing body of evidence on inter-industry differences in appropriability conditions, there is no clear empirical consensus about whether greater appropriability encourages innovative activity."
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procompetitive benefits of these restraints, \footnote{Ordover and Baumol (1988: 22) offer a list of intellectual property benefits that suggests a restricted role for antitrust enforcement: “As usual, our view is that the licensing process ought to be relatively free of antitrust scrutiny. The bases for this view are as follows: (1) To the extent that private firms already have inadequate incentives to engage in \textit{ex post} dissemination, policies that interfere with dissemination may only exacerbate the problem; (2) To the extent that contracting for the sale and purchase of information through licensing is fraught with significant transactional difficulties, a good deal of latitude should be granted to licensors, who must protect themselves against free riding and uncompensated disclosure; (3) To the extent that price and non-price vertical restraints improve vertical efficiency, when those restraints are applied to the sale of information they are even more likely to be conducive to social efficiency; (4) To the extent that revenues from licensing add to the innovator’s profit, they enhance entrepreneurial incentives to invest in the production of information and knowledge; (5) To the extent that licensing improves dissemination and adds to the effective stock of knowledge, it can reduce wasteful duplication of R&D efforts and can redirect R&D funds toward less imitative pursuits.”} the division is also aware that firms may use licensing restraints as the basis for cartel behavior\footnote{According to Katz and Ordover (1990: 143), “The biggest [antitrust] concern is that firms will use licensing contracts as a means to subvert competition in markets for downstream products.” As an example, Gilbert and Shapiro (1997: 315) cite the Justice Department’s complaint against the Pilkington Company alleging that Pilkington’s licenses sustained a worldwide cartel in the manufacture and sale of flat glass. Of particular interest is their claim in a footnote that “the cartelmmeister theory enunciated in the Pilkington case by the Justice Department could not support PPG’s private claim that Pilkington excluded PPG from the market with worthless trade secrets. Under the cartel theory, a firm that is not a member of the cartel would benefit from its formation.” However, this overlooks the fact that a cartel beneficiary like PPG may develop its own superior technology, decide to market the technology outside its cartel-assigned territory (even if this causes the cartel to collapse), and be deterred by sham trade secret litigation. According to the Government’s Complaint in \textit{United States v. Pilkington} (1994: para. 25), “Pilkington’s license agreements provided a framework for a worldwide cartel, created and controlled by Pilkington, for float glass technology and the design and construction of float glass plants.” As the Competitive Impact Statement (1994: I:B) explained, “Pilkington has routinely used litigation, and threats of litigation, to enforce its anticompetitive license restrictions. . . . In a 1985 arbitration concluded in 1992 . . . arbitrators determined that, while much of Pilkington’s alleged secret know-how was publicly known by 1985, PPG had failed to prove that 45 specific items were publicly known. The arbitrators did not consider the question of whether any of those items were valid trade secrets.”} or to achieve vertical foreclosure.\footnote{Segal and Whinston (1996: 19) show “that when an incumbent firm can make discriminatory offers of exclusive contracts to buyers, it need not rely on buyers’ disorganization to successfully exclude. Rather, by exploiting the externalities present among buyers, an incumbent firm can profitably exclude potential rivals. The ability to make offers to buyers over time further strengthens the possibilities for profitable exclusion, and in many cases can allow the incumbent to exclude for free.” Cf. Rasmusen, Ramsever, and Wiley (1991) and Hoven (1987).} According to the guidelines, harm to competition from a restraint may occur if it anticompetitively forecloses access to, or increases competitors’ costs of obtaining, important inputs, or
facilitates coordination to raise price or restrict output. The risk of anticompetitively foreclosing access or increasing competitors' costs is related to the proportion of the markets affected by the licensing restraint; other characteristics of the relevant markets, such as concentration, difficulty of entry, and the responsiveness of supply and demand to changes in price in the relevant markets; and the duration of the restraints. (IPG 4.1.1)\(^7\)

Licensing issues also arise in the context of settlement negotiations after the division has made the decision to challenge a proposed merger. Occasionally, the parties will propose that a new competitor be created through the licensing of one or both of the merging firms' intellectual property. This could, in principle, be more desirable than a divestiture remedy to a competitive problem because it brings new assets into the market. It is certainly possible that a prospective licensee may have all of the necessary complementary assets to commercialize the product, but that licensee would not have entered the market if it needed to develop the intellectual property on its own. The crucial question is whether this new licensee-entrant is an adequate replacement for an established incumbent.

Licensing solutions to competitive problems created by mergers create a number of difficult, but potentially significant, practical issues that the division takes into account:

- The grant of rights. Does the license grant include the results of unsuccessful designs and experiments? Does the grant include access to ancillary technology licensed from third parties? Does it impose territorial or customer restraints that expose the licensee to a higher risk of trade secret litigation (because the licensee cannot easily demonstrate that its sales to the restricted territories or customers do not use the licensed know-how) or to a higher risk of business failure?
- The transfer of know-how. Is the extent of the know-how transfer specifically delineated?\(^8\) Will the licensee be given all manuals,\(^7\) Gilbert and Shapiro (1997: 333) offer a helpful list of additional indicia of anticompetitive impact: “The dangers of exclusive dealing provisions in licenses are most pronounced when the following conditions are present: (1) the licensor has a first-mover advantage, signing contracts before other potential innovators are themselves in a position to negotiate with licensees, as often occurs when one firm succeeds in innovating before its rivals; (2) there are multiple licensees who find it difficult to coordinate, so that each alone gives up little in agreeing to deal exclusively with the dominant firm, but collectively the cost is large; (3) there are scale economies and the incumbent licensor employs long-term, staggered licenses with exclusivity provisions; and (4) there are strong network effects in the market.”

\(^8\) According to Simpson (1995: 249), “The extent of a know-how transfer must be specifically delineated. Know-how does not involve a statutorily created and defined right such as a patent or copyright. A patent is the right to exclude others from making, using,
instructions, and development tools that the merging parties give their own engineers? Whose responsibility is it to make sure that the licensed technology works? Does the agreement include a timetable for transfer of the know-how, and some agreement as to what happens if someone fails to adhere to the timetable?

- The protection of intellectual property. Does the agreement describe the licensed know-how with enough specificity to ensure a common understanding of what information is claimed to be a trade secret and what is not?

- The termination of an agreement. Does the agreement include termination dates for the licensor’s obligation to provide technical assistance, the licensee’s right to use the licensed technology, and the licensee’s obligation to maintain confidentiality of the licensor’s proprietary know-how?

- Production and marketing. Does the agreement include a supply agreement, or a requirement to divulge preferred sources of essential materials?

**The Horizontal Merger Guidelines**

When mergers are being evaluated, reference to the 1997 *Horizontal Merger Guidelines* suffices for the treatment of most common offering to sell, selling or importing the claimed invention or a product made by a claimed process for the life of the patent in that country. . . However, for know-how, there is no such careful definition of the extent of the intellectual property in time, in technical area, or in type of recorded medium.” Cf. Goldscheider (1996: 39): “A mere general statement relating to ‘all trade secrets used by the company in relation to a particular product or persons’ will not do.” Byrne (1994: 119) offers a model clause that suggests the appropriate degree of specificity for know-how.


11 According to Goldscheider (1996: 336), “legal protection of the legitimate interests of innovating firms in trade secret information by prohibition of use or disclosure by former employees should be denied unless, in most cases, the firm notified the departing employee what information the firm claims to be trade secrets.” Cf. Robison (1983: 393).

12 Byrne (1994: 212) argues persuasively for no time limit on the licensee’s right to use the licensed technology: “Either party to a licensing agreement may suffer serious consequences if the right to use confidential know-how expires or terminates with the agreement. If at all possible, the common law courts will not allow a business to be devastated in that way. Subject to an express contrary intention, as a general rule know-how transferred under a technology licensing agreement is given for all time and may be used freely by the recipient after termination of the agreement.”

13 To put a definite end to the risk of sham trade secret litigation, confidentiality agreements should have a fixed termination date, especially for technology that becomes obsolete quickly: “Confidentiality agreements are important and should have a time limit. Don’t be inflexible but realistic. Limit them to what is really needed, both ways” (Manfroy, Paterson, and Stockman 1996: 398). Cf. Goldscheider (1996: 328).

innovation issues. The Antitrust Division encounters innovation questions in its analysis of product market definition, the identification of firms that participate in the relevant market, market concentration, entry, and the analysis of anticompetitive effects.

Product Market Definition

When competitive interactions take place mainly through innovations in product quality and features, the division looks for evidence that buyers shift purchases between products in response to relative changes in those competitive variables. (An interesting special case described in the Intellectual Property Guidelines is the "technology market" where rights to intellectual property are the relevant product market.)

The Identification of Firms That Participate in the Relevant Market

In general, the guidelines' preferred approach is to define discrete product markets, and to include as market participants any firm that "has existing assets that likely would be shifted or extended into production and sale of the relevant product within one year, and without incurring significant sunk costs of entry and exit, in response to a 'small but significant and nontransitory' increase in price for only the relevant product." However, "if production substitution among a group of products is nearly universal among the firms selling one or more of those products... the Agency may use an aggregate description of those markets as a matter of convenience" (HMG 1.321). In particular, if production substitution is determined by core competence in a particular technology (and all firms with this technology have the ability to market

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15 "In considering the likely reaction of buyers to a price increase, the Agency will take into account all relevant evidence, including, but not limited to, the following: (1) evidence that buyers have shifted or have considered shifting purchases between products in response to relative changes in price or other competitive variables; (2) evidence that sellers base business decisions on the prospect of buyer substitution between products in response to relative changes in price or other competitive variables; (3) the influence of downstream competition faced by buyers in their output markets; and (4) the timing and costs of switching products" (HMG 1.11).

16 "Technology markets consist of the intellectual property that is licensed (the "licensed technology") and its close substitutes — that is, the technologies or goods that are close enough substitutes significantly to constrain the exercise of market power with respect to the intellectual property that is licensed. When rights to intellectual property are marketed separately from the products in which they are used, the Agencies may rely on technology markets to analyze the competitive effects of a licensing agreement.

"To identify a technology's close substitutes and thus to delineate the relevant technology market, the Agencies will, if the data permit, identify the smallest group of technologies and goods over which a hypothetical monopolist of those technologies and goods likely would exercise market power — for example, by imposing a small but significant and nontransitory price increase" (IPG 3.2.2)."
the products that emerge from it), the division may use an aggregate description of those products (i.e., the products generated by that technology) for convenience and clarity. (This differs from the concept of "technology markets" in the Intellectual Property Guidelines because the focus is not on a developing technology, but rather on a relatively stable technology that generates a cluster of new products.)

**Market Concentration**

The division takes into account the reasonably predictable effects of innovation trends on market concentration and the market shares of particular firms. As the Horizontal Merger Guidelines state,

Market concentration and market share data of necessity are based on historical evidence. However, recent or ongoing changes in the market may indicate that the current market share of a particular firm either understates or overstates the firm's future competitive significance. For example, if a new technology that is important to long-term competitive viability is available to other firms in the market, but is not available to a particular firm, the Agency may conclude that the historical market share of that firm overstates its future competitive significance. The Agency will consider reasonably predictable effects of recent or ongoing changes in market conditions in interpreting market concentration and market share data. (*HMG* 1.521)

**Entry**

The division takes into account reasonably predictable effects of innovation on the likelihood of entry. Occasionally, the division encounters markets where competitive interactions occur through innovation on a very long time scale. In these settings, even if entry takes more than two years, the division considers entry to be timely so long as it would deter or counteract the competitive effects of concern within the two-year period and subsequently.

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17 Dussauge, Hart, and Ramanantsoa (1992) refer to this product cluster as a "technology cluster." According to the authors, "Porter defines an industry as 'a group of firms which manufacture substitutable products.' However . . . firms which grow as technology clusters do not compete in one specific industry, but in all the industries where their technological potential can provide them with an advantage" (p. 111). A firm that competes in the technology cluster needs "the capacity to develop rapidly a wide range of applications, in the form of many different products to be sold in a large number of markets" (p. 106) and the ability to "assess the competitive advantage its technology could create, and evaluate whether this advantage offsets its lack of familiarity with a particular market (distribution networks, customer behavior, behavior of firms already in the market, etc.)" (p. 111).

18 "In order to deter or counteract the competitive effects of concern, entrants quickly must achieve a significant impact on price in the relevant market. The Agency generally will
Anticompetitive Effects

The Horizontal Merger Guidelines recognize that "Sellers with market power also may lessen competition on dimensions other than price, such as product quality, service, or innovation" (HMG 0.1, n. 6). As Gilbert and Sunshine (1995) explain, coordinated effects are not usually a major focus when innovation questions arise (although anticompetitive coordination of innovative activities can be accomplished through market allocation). Unilateral effects in either of two forms are more likely in innovation cases. The first is where the merging firms compete more directly with each other than with other firms. (One would have to demonstrate in a particular case that the incentive to innovate would be reduced by the loss of competition.) The second unilateral effect is the loss of diversity because the number of independent innovators has been reduced by one; in particular, there is a considerable body of anecdotal evidence that diversity is particularly important for major technological advances, and that pathbreaking technological breakthroughs have often been made by niche players or by leading firms working outside their main areas of specialization.

On occasion, a different analytical framework is needed to demonstrate that a merger will lead to higher prices and reduced output. One example is the division's use of innovation markets, defined as the research and development activities of competitors. Consider a market of two firms, each producing a product with a 40% market share. Suppose that the merging firms wish to introduce a new product that will reduce their competitors' market share from 40% to 30%. The merging firms may be able to achieve this by reducing their competitors' R&D spending and by making their own R&D efforts more efficient. The merging firms may also be able to achieve this by making their competitors' products less desirable or by making their own products more desirable.

19 "The conditions required to sustain a collusive agreement... are particularly difficult to satisfy when the coordinated activity is research and development. Firms are likely to benefit in different ways from a successful R&D program and agreement over the "spoils" of coordinated R&D activity is likely to be difficult. Monitoring will also be difficult since R&D typically involves private information. A firm that succeeds in an R&D program gains a substantial advantage over its competitors and retaliation by its unsuccessful rivals may be difficult or even impossible. In addition, when R&D does not require specialized assets, any collusive agreement to suppress R&D will be vulnerable to entry from innovators who are not members of the agreement." Gilbert and Sunshine (1995: 591).

20 "In some markets the products are differentiated, so that products sold by different participants in the market are not perfect substitutes for one another. Moreover, different products in the market may vary in the degree of their substitutability for one another. In this setting, competition may be non-uniform (i.e., localized), so that individual sellers compete more directly with those rivals selling closer substitutes" (HMG 2.21).
development directed to particular new or improved goods or processes, and the close substitutes for that research and development.\textsuperscript{21} The first division challenge of a merger on innovation market grounds occurred in 1993, when the division investigated the proposed acquisition by ZF Friedrichshafen of General Motors' Allison Division.\textsuperscript{22} Allison and ZF together produced 85 percent of the world output of heavy-duty automatic transmissions for trucks and buses, but they actually competed in few markets. Nonetheless, the division concluded that even regional markets whose concentration would be unaffected by the merger would be harmed by the merged entity's reduced incentive to develop new designs and products.

\textit{Joint Ventures}

While there is clearly a tension between intellectual property protection and competition policy (one enhances rewards to the innovator, whereas the other constrains it), the two policy areas have a common goal: to enhance economic performance and consumer welfare. This balancing between innovation incentives and competition has been recognized in the National Cooperative Research and Production Act, which provides a limited safe harbor from antitrust enforcement for qualifying R&D joint ventures. (In fiscal year 1998, thirty-seven such joint ventures were registered with the Department of Justice.) It has also been recognized by the Antitrust Division in a number of its business review letters. For example, the 1997 MPEG-2 Business Review Letter (Klein 1997) provides support (under appropriate assumptions) for a patent pooling of intellectual property for the provision of advanced video compression technology into a single license, which, when granted, would be done on a nondiscriminatory basis.

\textsuperscript{21} "A licensing arrangement may have competitive effects on innovation that cannot be adequately addressed through the analysis of goods or technology markets. For example, the arrangement may affect the development of goods that do not yet exist. Alternatively, the arrangement may affect the development of new or improved goods or processes in geographic markets where there is no actual or likely potential competition in the relevant goods.

"An innovation market consists of the research and development directed to particular new or improved goods or processes, and the close substitutes for that research and development. The close substitutes are research and development efforts, technologies, and goods that significantly constrain the exercise of market power with respect to the relevant research and development, for example by limiting the ability and incentive of a hypothetical monopolist to retard the pace of research and development. The Agencies will delineate an innovation market only when the capabilities to engage in the relevant research and development can be associated with specialized assets or characteristics of specific firms" (IPG 3.2.3). Cf. Gilbert and Sunshine (1995).

\textsuperscript{22} Complaint, \textit{United States v. General Motors et al.} (Nov. 16, 1993).
The importance of joint ventures for innovation and competition policy was the subject of Federal Trade Commission (FTC) hearings in 1998. In April 2000, the FTC and the DoJ issued draft Antitrust Guidelines for Collaborations among Competitors. Although the new guidelines raise innovation issues, they do not offer a new analytical framework. Rather, the "Collaborations Guidelines" put forward a general competitor collaboration policy that relies heavily on the Intellectual Property and Horizontal Merger Guidelines.

ACCOUNTING FOR INNOVATION: INTELLECTUAL THEMES

In its analysis of innovation issues, the Antitrust Division makes an effort to keep abreast of developments in the academic literature on the economics of innovation. In this section, we briefly characterize several themes in that literature that have particular importance for antitrust enforcement.

Schumpeterian Competition

At the core of antitrust analysis is the question of how market structure and firm size affect innovative effort. Traditional innovation–market structure analysis views innovation as a manufacturing process in which R&D spending is the input, innovation is the output, and firms are virtually identical except for market share (Tisdell 1995: 30). In this paradigm, a principal innovation focus in a merger investigation is the determination of the merger's impact on incentives to invest in R&D. While the effect of a particular merger on innovative activity can be very significant, the general relationship between market structure and innovation is an unsettled issue in the literature. For example, in his review of the empirical literature Symeonides (1996: para. 44) emphasizes the inconclusiveness of the R&D–market concentration relationship, and Cohen and Levin (1989: 1078) concur: "These results leave little support for the view that industrial concentration is an independent, significant, and important determinant of innovative behavior and performance."

Empirical studies on innovation and firm size are somewhat more definitive, finding that smaller firms (beyond a minimum threshold) are

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23 For example: “Having defined the innovation market, an analysis of a merger involving R&D must consider whether the merged firm's share of R&D is sufficient to affect the total level of R&D in that market.” Gilbert and Sunshine (1995: 596).

24 "First, there is little evidence of a positive relationship between R&D intensity and concentration in general, although there may be circumstances where such a relationship exists. Second, there is even less evidence of a positive relationship between innovative output and market structure. Third, industry characteristics such as technological opportunity explain much more of the variance in R&D intensity or innovation than market structure." Symeonides (1996: para. 44).
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as research-intensive as larger firms and more productive. However, the contribution of small firms to innovation is known to vary greatly by industry. For example, researchers at the U.K. Science Policy Research Unit noted that the industries in which small enterprises contribute a large share of innovations are those in which they also contribute a large share of output – typically, industries in which capital intensity or innovation costs are lower (Freeman and Soete 1997: 236–37). Audretsch (1995) found that small enterprises enjoy a relative innovative advantage in industries that are highly innovative, and Dorfman (1987) found from her study of computer and semiconductor industries that innovative small firms tend to be start-ups: "Innovations have generally been initiated by either large established companies or relatively new ones. The small mature firm was almost conspicuous by its absence among innovators" (Dorfman 1987: 10).

There is also a substantial body of evidence that leading incumbents prefer a different path of innovation than challengers. According to Dorfman (1987), "Leading companies ... generally use technology as a means of reinforcing their position without changing the fundamental rules of the game. ... Because it may disrupt the nature of competition in a given industry, a new technology which modifies the key factors for success tends to be perceived as a strategic opportunity by marginal competitors, and as a threat by the leading competitors, even if they are the ones which developed the new technology." As a consequence, path-breaking technological breakthroughs have often been made, not by leading incumbents but by small start-ups or by major firms working outside their main area of specialization. One policy implication for antitrust is the need to preserve a larger number of firms in industries where the best innovation strategy is unpredictable. (This was an important consideration, for example, in the division’s challenge to the

25 Cohen (1995: 189) concludes, "Thus, the robust empirical patterns relating R&D and innovation to firm size are that R&D increases monotonically – and typically proportionately – with firm size among R&D performers within industries, the number of innovations tends to increase less than proportionately than firm size, and R&D productivity tends to decline with firm size." See also Symeonides (1996: para. 29). Cohen and Klepper (1992) offer an alternative interpretation of the apparent productivity advantage of small firms, arguing that large firms have an advantage in appropriating the rewards of innovation and so are willing to pursue R&D projects with a lower probability of success.

26 Dussauge et al. (1992: 14, 61). Tushman and Anderson (1986) distinguish competence-destroying and competence-enhancing innovations. Christensen (1997) says that established firms find it extremely difficult to pursue a rapidly evolving "disruptive technology" that isn't mature enough yet to serve their current customers.

27 Swann and Gill (1993: 211). See also Metcalfe (1995) for an evolutionary perspective on the importance of variety (differences in R&D strengths and strategies) and selection (allowing particular R&D strengths and strategies to survive or die).
proposed Lockheed-Northrop merger.) Another implication is Scherer and Ross's (1990: 654) observation that "Technical progress thrives best in an environment that nurtures a diversity of sizes and, perhaps especially, that keeps barriers to entry by technologically innovative newcomers low." (Again, a concern in the proposed Lockheed-Northrop merger was that the merged entity would foster an industry-wide trend to keep innovative activities within vertically integrated chains rather than collaborate with outsiders.) A third implication is the awareness that dominant firms may have an incentive to act so as to deter innovative activities that threaten the dominant position (as, for example, with Pilkington's trade secret licensing restraints, which were challenged by the division).

**Innovation Management and Evolution**

Important inferences for merger analysis can also be drawn from the innovation management and evolutionary literature. These paradigms depart from the Schumpeterian tradition by emphasizing distinctive firm competencies and strategies, and the cross-fertilization of information among firms that know different things. For example, Dorfman (1987) emphasizes the importance associated with having a rich exchange of ideas among differently situated firms:

There are, thus, complementary roles for large established firms and small, new enterprises in advancing technology, a complementarity that is augmented by a mutual dependence in gaining technical knowledge and know-how. This was manifest by a tendency for established firms to obtain expertise by acquiring newer firms at the same time that other new firms transferred technology and know-how from the research laboratories and production facilities of established firms. These observations lead us back to the conclusions of Jewkes and his collaborators that were cited in the very first chapter of this book: "It may well be that there is no optimum size of firm but merely an optimum pattern for an industry, such a distribution of firms by size, character and outlook as to guarantee the most effective gathering together and commercially perfecting of the flow of new ideas." (Dorfman 1987: 244)

Similarly, Rothwell (1994) observes:

There is considerable evidence to show that innovation today has become significantly more of a networking process. During the 1980s the number of horizontal strategic alliances and collaborative R&D consortia have increased dramatically, vertical relationships, especially at the supplier interface, have become more intimate and strategic in nature and innovative SMEs [small- and medium-sized enterprises] are forging a variety of external relationships with both large and small firms. (Rothwell 1994: 43)
The innovation management view is anchored in a literature that builds on the view that because of trade secrets and tacit know-how\(^{28}\), knowledge varies among firms, with innovation being driven by a flow of ideas among partners and rivals, not just by R&D spending. These ideas define core competencies that give firms a sustainable competitive advantage over rivals that do not have the same know-how. In fact, as Hamel (1991: 83) argues, "It is possible to conceive of a firm as a portfolio of core competencies on one hand, and encompassing disciplines on the other, rather than as a portfolio of product-market entities."\(^{29}\) In this view, innovation competition is a race to learn: "Conceiving of the firm as a portfolio of core competencies and disciplines suggests that inter-firm competition, as opposed to inter-product competition, is essentially concerned with the acquisition of skills. . . . The traditional 'competitive strategy' paradigm, with its focus on product-market positioning, focuses on only the last few hundred yards of what may be a skill-building marathon" (Hamel 1991: 83).

According to this view, innovating firms approach their dealings with teammates and subcontractors as opportunities to learn. For example, Hamel, Doz, and Prahalad (1989) assert that "Successful companies view each alliance as a window on their partners' broad capabilities. They use the alliance to build skills in areas outside the formal agreement and systematically diffuse new knowledge throughout their organizations" (Hamel et al. 1989: 134).

Although learning is an unambiguous social benefit, it is not clear whether these spillovers have a positive or negative effect on incentives to invest in R&D. On the one hand, firms have a greater incentive to invest in R&D when they can appropriate most of the rewards for themselves.\(^{30}\) On the other hand, spillovers also generate incentives to invest in R&D, either to develop learning capacity ("absorptive capacity") to capture others' spillovers\(^{31}\) or because spillovers raise the marginal

\(^{28}\) "Following Michael Polanyi (1967), tacitness refers to those elements of knowledge, insight, and so on that individuals have which are ill-defined, uncodified, unpublished, which they themselves cannot fully express and which differ from person to person, but which may to some significant degree be shared by collaborators and colleagues who have a common experience." Dosi (1988: 1126).

\(^{29}\) See also Prahalad and Hamel (1990) and Teece, Pisano, and Shuen (1994: 14–15): "The very essence of capabilities/competences is that they cannot be readily assembled through markets. . . . [They] cannot be bought and sold short of buying the firm itself, or one or more of its subunits."

\(^{30}\) "Know-how leakage and other spillovers impair incentives to innovate by redistributing benefits to others, particularly competitors and users." Jorde and Teece (1992: 52).

\(^{31}\) Cohen and Levinthal (1989: 569) show that "contrary to the traditional result, intra-industry spillovers may encourage equilibrium industry R&D investment." Howells
product of other firms' R&D.\textsuperscript{32} Cohen's (1995: 229) survey of the literature concludes that “The empirical findings to date do not establish whether the net effect of appropriability on R&D incentives is positive or negative, nor do we yet know the extent to which the net effect varies across industries.”

Firms adopt a variety of strategies to maximize the private benefits of these spillovers. They try to be good learners and bad teachers (Hamel et al. 1989; Hamel 1991), they choose alliances that promise more incoming spillovers than outgoing spillovers (Cassiman and Veaglers 1998), they avoid collaborating with competitors (Cassiman and Veaglers 1998: 20; Tidd, Bessant, and Pavitt 1997: 20), and they acquire prospective partners rather than collaborate.\textsuperscript{33} Firms may also forgo the benefits of collaboration and rely on internal capabilities, even if collaboration would yield higher quality and lower cost. According to Hobday (1994: 164–65),

While the network system may be suited to fast innovation, it is unsuitable for building corporate competences over the long term. . . . Large firms are unlikely to distribute their core capabilities within a network for economic, technological and strategic reasons. To do so would expose them to predatory behaviour from other large firms and risk their long-term investments in human and physical capital. Where large firms do participate in dynamic networks, the boundaries of its participation are likely to end where its core assets and advantages begin.

Similarly, the Defense Science Board Task Force on Vertical Integration and Supplier Decisions warns that “To develop their internal businesses, prime contractors may favor their new in-house capabilities over external suppliers in new weapon systems bids. . . . Firms might also ‘cherry

(1997: 2) notes that “The internal R&D process is changing, it is no longer the sole generator of a firm’s innovation stream; it now has an important technological scanning role and as a purchaser and adapter of other organisations’ technology.”

\textsuperscript{32} “The more capable firms there are in the economy, the more potential spillovers will be created and, therefore, the more potential spillovers each capable firm will have access to. Increasing the volume of spillovers in this way will, of course, have an effect on the relationship between R&D input and innovative output analogous to increasing returns to scale. . . . Under the circumstances, there is something to be said for the view that public policy makers might try to maximize spillovers rather than try to minimize them.” Geroski (1995: 92).

\textsuperscript{33} Merger greatly enhances the incentives and opportunities for a flow of ideas between the previously separate entities, but it may also create negative synergies: “To the extent that a company’s knowledge and capabilities depend on its culture and spirit, a merger threatens to destroy the very thing that it was intended to secure. [Also,] an acquisition makes little sense when a company is interested in learning only one of the many capabilities of another organization or when markets or technology may change quickly. Tomorrow’s needs may differ from today’s, and an acquisition may become an albatross around a company’s neck.” Badaracco (1991: 104).
pick' the highest value, most sophisticated work for their in-house suppliers to build corporate skills, leaving routine, lower-margin areas for external suppliers.\textsuperscript{34}

To summarize, this literature emphasizes that firms know different things, innovation is driven in part by a flow of ideas among partners and rivals, spillovers are not unambiguously negative as some authors suggest, and firms have incentives to exercise an "in-house bias" that constrains this flow of ideas. All of this gives rise to a possible anticompetitive harm from vertical mergers. The risk is that innovation may be impaired because the flow of ideas becomes narrowly confined within vertically integrated firms, without the stimulus of suppliers and producers interacting with a variety of partners and serving as a conduit of ideas from one firm to another. This risk is especially evident in defense industries, for two reasons. First, key defense technologies are sometimes very market-specific, with only a few knowledgeable producers and suppliers. Second, U.S. defense strategy is predicated on being technologically far superior to potential adversaries, so unpredictable innovations triggered by an unexpected convergence of ideas are of paramount importance. These innovation-related risks were given serious consideration in the analysis of vertical issues of the proposed Lockheed-Northrop merger.

The analytical work undertaken by the Antitrust Division builds on the work of the many contributors to the rich academic literature on innovation. Of course, actual merger investigations often present interesting issues relating to market structure and conduct.

\textit{Network Effects}

With network goods, the value to either consumers or producers increases with the breadth of use of others. As a result, when network effects are present, there may be substantial efficiencies on either the demand or the supply side that lead to the creation of firm dominance in a market. Many network industries are dynamic, in which case the market is a moving target, evolving as technology changes in response to innovation. Antitrust analysis must occasionally focus, therefore, not

\textsuperscript{34} Defense Science Board (1997: 21–22). The report identifies "Firm's desire to capture or keep leading technology or product position in key areas" (p. 24) as one of the pressures encouraging harmful effects from vertical integration. Additional motives listed for in-house bias include "desire to have a larger base for overhead cost absorption" (p. 24) and divisional incentives that don't perfectly match those of the corporation: "Systems integration divisions seek 'best value' supplier selections while supplier divisions pursue their own financial goals. Corporate leaders may have a policy to make fully competed supplier choices, but their subordinate divisions may act on local economic incentives" (p. 26).
only on static competition within the market as it is currently constituted, but also on dynamic competition for the market of the future, that is, competition to control the next market standard (if there is one).  

There are a number of aspects of markets with network effects that make the relationship between innovation and antitrust especially complex and subtle. First, because of network effects small firms can become dominant very rapidly; in loose parlance, the market can rapidly “tip” toward monopoly. In such a case, incentives to innovate are often determined at an early stage when competition for the market is most severe; at a late stage the path of innovation may already to a large extent be determined. Second, in network industries, the literature makes it clear that the forces that drive the winner to be the most efficient may not be as reliable as they would be in non-network markets. The process by which firms and industries move from one standard to another are also a subject of study, especially in light of the possibility that lock-in effects can make it difficult to change a standard, and the social cost of changing the standard may exceed the benefit of changing. Even ascertaining the rate at which particular innovations are made in network industries is itself a complex undertaking. There remains substantial debate, therefore, as to whether the best product will necessarily become the standard. If an “inferior” good gets a decisive advantage by creating an early installed base of users, the switching costs may be sufficient to discourage existing customers from moving to the superior standard. Further, new customers may find that with substantial network effects generated by the dominant firm, price or design advantages may not be sufficient to encourage a switch.

Switching costs can also discourage innovative efforts that might otherwise lead firms to enter markets, especially if the new products to be designed cannot interconnect with those already in the market. In other words, the potential stability of network-dominant firms can reduce the incentives of those firms to introduce innovative products and service offerings.

Third, network effects can create complex vertical issues. A dominant network firm may have an advantage in selling complementary goods

35 Rubinfeld (1998) discusses the relationship between networking and antitrust enforcement in high-technology industries.
36 Network effects are not necessary for tipping; tipping can occur in any market with substantial scale-related economies, whether on the demand or the supply side.
37 Katz and Shapiro (1994) suggest that path dependency and timing are likely to be less significant in a strategic setting because a dominant firm can and will act to tip the market in its preferred direction.
38 Farrell and Katz (1998) analyze how the degree of compatibility affects the nature of competition in network markets.
that allow it to extend its dominance from one market to another. One means of accomplishing this is to condition the sale of the tied product on the purchase of the distinct tying product. Another is to technologically tie the products together so that the option to purchase the two products separately is not readily available. As in the previous cases, the advantages to an incumbent dominant firm are not necessarily anticompetitive. It is quite possible that a dominant provider of a complementary good may be able to take advantage of economies of scale and/or scope to become the most efficient provider. Distinguishing such pro-competitive behavior from the anticompetitive aspects of tying and other practices that link vertical markets is a substantial challenge for antitrust law and policy.

RECENT ANTITRUST INNOVATION CASES AT THE ANTITRUST DIVISION

In the past year, innovation has come into even greater prominence at the division. In each of the following four subsections we describe some recent innovation cases. The first three are treated briefly, and the fourth, Lockheed-Martin, is considered in more extensive detail.

The Halliburton-Dresser Merger

Innovation has had a major impact on oil production in recent years, letting oil drillers extract large amounts of previously uneconomical oil without any increase in the cost per barrel. Logging-while-drilling (LWD) tools are the subsurface sensors of this new drilling technology. From their position directly behind the drill bit, they transmit to the surface real-time data about the type of formation (e.g., limestone vs. sand), whether the formation contains oil, and how porous the formation is. LWD services are important in the exploration of oil and gas because they allow the producer to obtain data from the well bore without interrupting the drilling process, particularly in offshore drilling applications, where daily rig rental costs are substantial, and the ability to obtain downhole information in this manner is important for cost-efficient exploration.

LWD innovation has been led by four firms that design and test the cutting-edge technologies, staying always a few years ahead of lesser competitors who imitate and improve once the technologies are well understood. These four industry leaders command a large share of the LWD market and are, of course, the only suppliers of the more advanced

For an explanation of why tying can be an effective device for raising rivals' costs and thereby strategically foreclosing competition, see Mathewson and Winter (1997). See also Whinston (1990).
tools. Halliburton Company and Dresser Industries, Inc., are two of the "Big Four." The Antitrust Division challenged their proposed merger on September 29, 1998, because of anticompetitive effects on price and innovation.

The principal focus of the innovation inquiry was to understand what drives innovation in this particular industry. Does the initiative come from customers, from component suppliers, from collaborations? Do the Big Four all play similar roles, or do some lead and others follow quickly with major improvements? Are the merging firms important players? These market-specific, firm-specific inquiries elicited the facts that supported the merger challenge. The division concluded that important innovations in LWD services had come solely from the Big Four; and that fringe players tended to play follow-the-leader, offering last-generation products that had already been superseded by the next generation of innovations. Interestingly, a number of important customers were more concerned about innovation effects than price effects.

The investigation’s emphasis on innovation dictated the scope of the divestiture ordered by the consent decree. The divestiture remedy included virtually all of Halliburton’s LWD tools, plus the following, needed to ensure a viable innovative business entity: worldwide, royalty-free, irrevocable, nonexclusive intellectual property licenses, and sublicenses covering the use of third-party technology; R&D equipment and records, including the results of unsuccessful designs; manufacturing, testing, and repair equipment and facilities; all assignable contracts and customer lists worldwide; an inventory of measurement-while-drilling (MWD) tools (used in combination with LWD tools); and the right to hire Halliburton employees as the purchaser requires to operate the business.

**The Visa–MasterCard Investigation**

On October 7, 1998, the Department of Justice filed a Section 1 Sherman Act action against Visa and MasterCard, alleging that the overlapping ownership and governance of these two associations by the same major banks had anticompetitive effects, particularly with respect to innovation at the credit card network level. To understand the nature of the issues raised in the current suit, some background is useful.

Network effects are predominant in the credit card industry. As use and acceptance of a credit card increase, the card becomes more valuable for both businesses and consumers. In analyzing the competitive issues associated with the credit card industry, two related markets are

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40 At the time this article went to press, the Visa complaint had been amended and expanded to some extent, but the case was still in litigation.
of particular interest. Consumers and merchants deal primarily with the
market for card issuance and card acceptance services. In this market,
the individual banks and other institutions that issue cards compete for
customers on the basis of interest rates, annual fees, payment terms, cus-
tomer service, and other enhancements and bonuses. The same issuing
institutions provide card acceptance services to merchants on the basis
of various fees and services. The suit filed by the Department of Justice
relates directly to the second market, the market for the underlying card
networks. Those networks provide services to card issuers, including
implementation of systems and technologies for card use and clearance,
development of card products, promotion of the card brand, and setting
fees for use and participation in the card network.

To the extent that many institutions can join a credit card network
and issue cards, competition for consumers of general credit card ser-
dices and for merchants requiring acceptance services will be substan-
tial. However, competition at the network level is more complex and
more difficult. Establishing brand name, developing processing and
information systems, and building a base of merchants and card users is
slow and expensive. Entry is difficult because a new entrant must enter
the market at two levels: the issuance and acceptance-services market as
well as the network-services level. In fact, only one new network has suc-
cessfully entered the market in the past thirty years.

Visa and MasterCard began as separate, competing networks that
were owned and governed by their card-issuing members. Each eventually
accepted the other’s members onto its network as participating
owners, and the two networks now have substantially overlapping own-
ership and governance. The Department of Justice is concerned in its
case about the innovation-reducing consequences of the Visa–Master-
Card arrangement. In its suit, the department alleges that the governance
arrangements have the effect of stopping both networks from introduc-
ing new products and services because improvements in one network
would shift profits from the other. Because Visa and MasterCard have a
75 percent share of the credit card market by volume of transactions, the
joint governance arrangement creates little incentive to implement new
initiatives in the systems jointly. The particular innovations that were
allegedly delayed include the decision by MasterCard to withhold intro-
duction of “smart card” technology, which involves the use of integrated
circuits in the cards to store more data, perform a greater array of func-
tions, and better monitor fraud and credit risk. According to the com-
plaint, when Visa did not want to introduce smart cards, MasterCard’s
board refused to continue its planned development. The department’s
case also challenges Visa and MasterCard rules that make entry or
expansion by smaller networks more difficult.
The Microsoft Investigation

The Justice Department has also challenged what it alleges are a series of anticompetitive practices by Microsoft whose purpose is to maintain its monopoly power in the market for desktop operating systems for personal computers (PC).\(^1\) This power, according to the Antitrust Division, was threatened by Netscape’s Internet browser – a software package that provided a means of access to the Internet that had the potential to provide an alternative “platform” that would support any operating system, not solely Microsoft’s Windows operating systems.\(^2\) Central to the monopoly power argument is the view that the necessity of producing a range of successful applications along with an operating system (which controls and allocates the hardware resources of the computer and allows the computer to run applications) creates an “applications barrier to entry.” Further, the tendency for a single firm to become dominant in the operating systems market flows in part from the fact that operating systems are subject to substantial network effects – the greater the number of programs that are developed to be compatible with popular operating systems, the more popular those systems are to consumers who naturally desire increased options for complementary programs. The result of the network effects and the applications barrier to entry is a market for operating systems that is “tippy,” with the consequence that a single operating system type will tend to dominate the market, and entry by potential competitors will be difficult. Currently, the “Windows” operating system, including Windows 95 and Windows 98, dominates the PC desktop market, and Microsoft is alleged by the division to have monopoly power in the Intel-based desktop operating systems market.

The Department of Justice claims, among other charges, that Microsoft has misused its dominance in the market for operating systems in an effort to gain dominance in the complementary market for browsers and maintain its current dominance of the personal computer operating system market. According to the division, Microsoft has required computer manufacturers to agree, as a condition of receiving licenses for installation of Windows, not to remove Microsoft’s browser from the computer or to allow the more prominent display of a rival browser. Because consumers demand Windows pre-loaded by manufac-

\(^1\) At the time this article went to press District Court Judge Jackson’s ruling in favor of the Department of Justice had just been appealed.

\(^2\) Netscape’s Navigator web-browsing software is a particular threat to Microsoft because it serves as a mechanism for the distribution of Sun Java, a software program that is cross-platform – programs written in Sun Java can in principle be run on any operating system.
turers onto their PCs, manufacturers have no real choice but to accept these terms. Similarly, the department claims that Microsoft has refused to list Internet service providers (ISPs) in the Windows display screen (or in its ISP referral service) unless the ISPs agree in turn to withhold information about non-Microsoft browsers to their subscribers and to adopt proprietary standards that make their services work better in conjunction with Microsoft's browser than with others. Microsoft is also alleged to have contractually limited the ability of some ISPs to ship non-Microsoft browsers even in response to an explicit customer request for that browser. Microsoft has responded that the integration of its Internet Explorer browser with the Windows operating system expands the functionality of the operating system as well as increasing the features and functionality of programs written for use with the Windows operating system, which ultimately increases consumer welfare. Microsoft also claims that the contractual arrangements with ISPs are cross-promotional agreements that are common within the computer industry.

The department's case reflects an effort to protect competition in Internet markets and to maintain incentives for the development of innovative software by preventing anticompetitive actions against successful products. The challenge for competition policy makers in this context is to preserve competitive opportunities without punishing successful competitors. At issue is where to draw a line: on one side of that line is a successful company's legitimate use of aggressive, competitive tactics, regulation of which might reduce future innovation incentives and consumer welfare; on the other side of that line is the misuse of market power to engage in predatory, exclusionary conduct that forecloses competition and innovation to the ultimate detriment of consumers. Striking the right balance is essential for promoting innovation and protecting consumer welfare in the fast-moving environment of network competition.

The Proposed Lockheed-Northrop Merger

The department's challenge to Lockheed Martin's proposed acquisition of Northrop Grumman—the largest proposed challenge to a merger at the time—illustrates a broad spectrum of the innovation-related issues that we have been discussing. Lockheed and Northrop were two of the leading suppliers of aircraft and electronic systems in the United States. The complaint (filed March 23, 1998) alleged that the acquisition would have tended substantially to lessen competition in numerous product markets, giving the merged entity a monopoly in airborne early-warning radar, electro-optical missile warning, fiber optic-towed decoys, directed infrared countermeasures, and the SQS-89 integrated
antisubmarine warfare combat system, reducing the number of competi-
tors from three to two in high-performance fixed-wing military airplanes,
on-board radio-frequency countermeasures, stealth technology, and
remote mine-hunting systems, and creating vertical anticompetitive
effects in numerous products— for example, through the combination of
Lockheed Martin's airframes and Northrop Grumman's fire control
radar. Although the complaint alleged substantial price effects, the
cornerstone of the challenge was concern that the acquisition would
substantially lessen innovation in various products and services for
defense applications. In the subsections that follow, we highlight a
number of significant economic issues that were raised by the proposed
acquisition, including issues in which innovation played a significant
role.

Market Definition
The division found that Lockheed and Northrop both participate in the
same relevant market for airborne early warning radar even though they
make somewhat different products for that market. Their inclusion in the
same market was based in part on the companies' shared core compe-
tence. At trial, the division expected to prove that Lockheed and
Northrop were the only two competitors in this particular market, with
the obvious implication that the two-to-one acquisition would be
anticompetitive.

Another relevant market was for the development and application of
stealth technology. The development of stealth technology is a technol-
ogy market in the sense of the Intellectual Property Guidelines, and the
application of stealth technology is a technology market in the sense of
a cluster of products generated by a core technology.\(^43\) This technology
is critically important for the next generation of warships as well as air-
planes, and the consolidation of this market from three independent
innovators to two was viewed with great concern.\(^44\) This is an important
example of the need to preserve a larger number of firms in industries
working at the frontiers of innovation where the best innovation stra-
gy is unpredictable.

\(^43\) An alternative approach would have been to regard stealth as an important capability
in the market for high-performance fixed-wing military aircraft, but the division con-
cluded that it was sufficiently distinctive to warrant independent standing as a relevant
market.

\(^44\) Northrop Grumman was a surprising entrant into the competition for the arsenal ship,
and a survivor of the first round of cuts before the program was eliminated. A success-
ful experience in that competition would have positioned it as a prospective bidder for
the DD21 class of stealth destroyers.
Market Participants and Ease of Entry

Two issues come up over and over again in identifying the relevant competitors for defense markets. One is the time scale for innovation. In Lockheed-Northrop, the division was concerned about anticompetitive impacts five, ten, or twenty years out. That is clearly a long time to peer into the future, and a long lead time for potential entrants. The division generally takes into account the uncertainties associated with long lead times by being appropriately cautious before concluding that there exist barriers to entry. Nevertheless, the division concluded that the barriers to entry were very high in all of the markets challenged in the Lockheed-Northrop merger. Moreover, although the Department of Defense (DoD) can and does routinely sponsor new entry into particular markets, this is normally done as part of a carefully considered long-term procurement strategy. As an ad hoc response to a Lockheed-Northrop merger, the division in consultation with DoD determined that the possibility of DoD-sponsored entry was not sufficient to deter the expected anticompetitive effects of the proposed merger, that it was not an appropriate response to an otherwise desirable merger, and that the additional cost burden on DoD was properly regarded as an anticompetitive effect.

The second issue is a particular entry barrier, the core competency required to be a “system prime contractor.” This is the firm that contracts directly with DoD to produce a weapons system (e.g., a fighter airplane), accepts responsibility for integrating all the needed subsystems, and decides who will supply each of the subsystems (in particular, which subsystems will be produced in-house and what will be offered to outsiders). The requisite competency varies from market to market and is difficult to define. System prime contractors may need to understand what the customer wants but did not specify, they may need in-depth expertise in one or more key technologies, and they probably need a working knowledge of several distinct technologies that have to work together. Note that all of these emphasize institutional know-how. (For example, Northrop can be a system prime for high-performance fixed-wing military aircraft even though it has not won a prime bid in years, and a system prime for the next generation of destroyers even though it has never built a ship.) Physical assets (as emphasized in the traditional industrial organization literature) are sometimes important, too, but know-how (as emphasized in the recent innovation literature) seems always to be a critical entry barrier in rapidly innovating industries.

Horizontal Innovation Effects

If no one knows the correct path of innovation, or if what everyone knows for sure is not so, then innovation is not just a matter of how much
R&D money gets spent. Two aspects of diversity are important: the number of independent innovators, and the opportunity for entry by innovators who have a fresh outlook. Frequently in the history of military aircraft, major pathbreaking advances have been made not by the leading incumbents but by niche firms or by major firms working outside their main areas of specialization.

In the Lockheed-Northrop market for high-performance fixed-wing aircraft, the issue was not whether a consolidation from three airframe manufacturers to two would reduce the intensity of innovative effort. The published literature does not yield a clear conclusion on that, especially because a large share of R&D spending is funded by DoD. Rather, the issue was that the number of independent innovators will be reduced by one, and the literature makes clear that this reduction matters. Moreover, one of the hot prospects for innovation in this market is unmanned aircraft – and that is precisely the kind of competency-destroying innovation that the division believed leading incumbents like Lockheed and Boeing are less likely to encourage.

Vertical Innovation Effects
Vertical innovation effects occur because firms exercise a preference for keeping transactions in-house rather than dealing with outsiders. Taken to an extreme, this becomes an outright refusal to deal (vertical foreclosure), a concern expressed by the Defense Science Board (1997: 22; cf. 3, 16): “Vertically integrated primes may deny competing primes access to key products or technologies they formerly supplied, or may give them access to a lower performance or higher cost product.” This was indeed a concern in the Lockheed-Northrop investigation, particularly as regards technologies that defense contractors consider their “crown jewels” – the so-called strategic discriminators that help them win lucrative, strategically important contracts as a system prime rather than a subservient role as subcontractor. For example, Northrop Grumman has an outstanding reputation in composite materials (a critical technology for stealthy airplanes), but it clearly prefers selling stealth B-2 bombers, where they enjoy the profits and decision-making authority of a system prime, rather than act as a subcontractor of composite technology to Lockheed or Boeing. With Northrop as an independent bidder, Boeing has a better chance to obtain access to its composite technology, either because Northrop decides to enter a teaming arrangement with Boeing, or because Northrop happens to lose out in the first round of bidding as a system prime and then tries to get a piece of the action as a composite supplier. Either of these eventualities would be less likely following a merger of Northrop with Lockheed.
These outright refusals to deal, however, are exceptional in the defense industry. Teaming arrangements are commonplace, even among direct competitors. The primary reason is that even direct competitors have complementary capabilities, and teaming can enhance their chances of winning a bid. On the other hand, as discussed earlier, there are also strong incentives favoring reliance on internal capabilities. So defense contractors face a difficult tradeoff. Teaming with an outsider may improve a firm's chances of winning this bid, but keeping the work in-house may position that firm better for the next bid. A Lockheed-Northrop merger would have tilted this decision in favor of keeping the work in-house. In particular, consider the combination of Lockheed's airframes with Northrop's fire control radar. Currently, there are three airframe suppliers (Lockheed, Boeing, and Northrop) and two suppliers of fire control radar (Northrop and Raytheon-Hughes), and teaming arrangements vary from contract to contract. Postmerger, Northrop would become Lockheed's preferred supplier of fire control radar, and a reluctant supplier to Boeing. Raytheon-Hughes would become Boeing's preferred supplier, and a reluctant supplier to Lockheed. As a result, the division expected a tendency toward Lockheed-Northrop competing consistently against a vertical alliance of Boeing with Raytheon-Hughes.

Why is that anticompetitive? One valid but complex argument is that DoD is less likely to get the combination of the best airframe and the best radar after the merger. For example, suppose Lockheed is clearly superior to Boeing in airframes, and Northrop is clearly superior to Raytheon-Hughes in fire control radar. Then a Lockheed-Northrop team creates the best possible combination, but they can win by submitting a bid that is only marginally better than the hypothesized worst possible combination, Boeing-Hughes (Farrell, Monroe, and Saloner 1998). Two considerations argue against this outcome. One is that there is so much uncertainty and so much at stake that Lockheed-Northrop won't take the risk of losing. (But we have already encountered that argument in the context of in-house bias. Defense contractors do trade off the chances of winning a bid against other ways to enhance their profits.) A second

45 Exclusive teaming arrangements have nonetheless become more common, and DoD has had to intervene in significant procurements to ensure that critical competencies were not denied to competing teams.

46 Defense Science Board (1997: 21–22) observes that "To develop their internal businesses, prime contractors may favor their new in-house capabilities over external suppliers in new weapon systems bids... Firms might also 'cherry pick' the highest value, most sophisticated work for their in-house suppliers to build corporate skills, leaving routine, lower-margin areas for external suppliers."
and more compelling consideration is that, absent the merger with Lockheed, Northrop can bid to be the supplier of fire control radar to both Lockheed and Boeing. In fact, for the Joint Strike Fighter, Northrop competed aggressively to become Boeing's radar supplier at the same time that it was already teamed with Lockheed. Taking all this into account, the mix-and-match scenario presents a valid competitive concern, but a factually and analytically difficult one that may be a challenging subject for further research.

A second effect of in-house bias is the lessening of collaborative learning opportunities. If Lockheed works with Northrop this time and Hughes next time (or both simultaneously), it can learn radar ideas from one and teach the other. Northrop and Hughes, of course, view this with mixed emotions (as do Lockheed and Boeing, when it is their airframe ideas getting funneled through Northrop and Hughes). But from the broader perspective of fostering breakthrough technologies in radar and airframes, a vertical merger that restrains the cross-fertilization of ideas in airframes and radar is a serious concern.

Clearly, the recent innovation literature was enormously helpful to the division's analysis of the proposed Lockheed-Northrop merger, focusing attention on firm-specific core competencies, on know-how as a critical entry barrier, on the flow of ideas between firms as an important contributor to innovation, on the importance of challengers for industry-transforming innovations, on the importance of the predictability of innovation as an industry variable for antitrust analysis, and on the need to preserve a larger number of firms in industries where the path of innovation is especially unpredictable.

CONCLUDING COMMENTS

This chapter has, we hope, made it clear that the Antitrust Division has taken an active role in thinking about innovation issues in recent years. In the process we hope to have made it clear that the current antitrust laws should offer sufficient flexibility so that innovation issues can be properly treated in both merger and non-merger investigations. This is not to say, of course, that all policy issues have been resolved. To the contrary, many interesting and difficult issues remain for antitrust enforcers, economists, and legal scholars to sort out. We hope that this chapter has provided some background and perspective that will aid in that inquiry.

As the chapter has also made clear, there remain a number of difficult and significant policy issues that are likely to continue to be the subject of debate and discussion in the academic and policy arenas for years to come. The Antitrust Division has been, and we expect that it will continue to be, an active participant in those debates.
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