Science and Public Policy, volume 17, number 5, October 1990, pages 296-302, Beech Tree Publishing, 10 Watford Close, Guildford, Surrey, GU1 2EP, England.

Strategic partnership

New modes of international competition: the case of strategic partnering in R&D

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This paper addresses a number of issues surrounding the emergence, durability and importance of one form of strategic partnering activity — inter-firm co-operative agreements in research and development. These partnerships are distinguished from more traditional forms of joint venture and licensing arrangements by three main characteristics: a focus on knowledge production and sharing as opposed to a one-way transfer of technology — where knowledge is understood to include research and development, as well as design, engineering, marketing and management capabilities; their contractual nature with frequently little or no equity involvement by the participants; and a tendency to enter into such partnerships as part of the longer term planning activity of the firm rather than as an opportunistic response to short-term financial gain.[1]

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ARMS-LENGTH COLLABORATION in research and development (R&D) reverses a fairly long tradition of directly appropriating knowledge through in-house R&D. That tradition dates back to the development of science-based industries in the 19th century (Freeman, 1974; Mowery, 1983), and persisted well into the post-war years. In the period 1967-1970, US Multinational Corporations (MNCs) were reported to have spent 97.4% of their total R&D expenditure in the US, and almost all of it in-house (Michalet, 1976).

Much of the literature critical of MNCs in the 1960s and 1970s pointed to the negative consequences of the centralization of R&D activities in the parent corporation, particularly in countries such as Canada, Peru and Colombia where foreign investment was concentrated in many of the most dynamic industrial sectors (Britton and Gilmour, 1978; Hymer, 1976; Mytelka, 1979; Vaitsos, 1974).

Internationalization of R&D

As to the internationalization of R&D, traditionally direct foreign investment (DFI) involved little joint knowledge production and sharing, though one-way transfer in the form of licensing has been a feature of such activity since the 19th century. The Harvard MNC project (Curhan, Davidson and Suri, 1977) and the work of Stopford and Wells (1972), for example, make no reference to the internationalization of R&D activities by the ventures covered in their studies.

Similarly, in her study of 420 US overseas joint ventures in the manufacturing sector, created in the period 1974-1982, Hladik found that only 15% of the joint ventures engaged in R&D, although she broadly defined R&D to include minor product modifications as well as more collaborative R&D activities (Hladik, 1985, page 64).

Collaborative R&D thus remained uncommon in foreign joint venture subsidiaries throughout much of the 1970s. By the end of that decade, however, several new trends had appeared.

Research, for example, was being decentralized by some MNCs to a few of their overseas laboratories. This was particularly evident in the pharmaceutical industry[2] but it had spread to other industrial sectors as well. Thus high temperature superconductivity was demonstrated by a German and a Swiss scientist in the Swiss laboratory of a major US MNC while, in the automobile industry, Toyota relies on its design studios in Southern California.[3]

Takeovers of knowledge-based firms as a means to acquire a missing component in a wider knowledge-based system were also accelerating. This was particularly notable in the 'backward integration' of the electronics industry. Thomson, for example, purchased the US chip manufacturer Mostek, Philips purchased Signetics. In the 1980s, takeovers and mergers of this sort have also been evident in telecommunications, automobiles (Womack, 1988) and in biotechnology (Pisano *et al*, 1988).

Together these two trends are producing a spectacular growth in reverse transfers of technology from R&D facilities in overseas subsidiaries and affiliates (Behrman and Fisher, 1980). This phenomenon, moreover, is not restricted to the MNC giants that dominate many knowledge-intensive industries today. Rather, it has become an important factor in the internationalization of mid-size, high-growth companies such as Analog Devices, Cray Research, Dynatech, Sealed Air and Loctite (McKinsey and Co Inc, 1987).

Alongside the practice of directly appropriating knowledge through mergers and takeovers, firms began to develop innovative forms of decentralized networking through which knowledge is produced and shared. The number of such strategic partnerships has grown dramatically during the 1980s.

The LAREA/CEREM (1988), for example, examined a set of nearly 500 agreements between firms in which at least one of the partners was a European company. The agreements spanning four main sectors — information technologies, biotechnologies, materials technologies and aerospace technologies — were broken down by function into knowledge production, goods production, commercialization and global agreements. Over the five year period 1980-1985 covered by this study, the number of agreements involving either a knowledge-production or knowledge-sharing component increased from 11% in 1980 to 47% per year in 1985.

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Other studies confirm this trend. For the biotechnology and information technology sectors Hagedoorn and Schot (1988) found, that over the decade of the 1970s, a total of 68 technological co-operation agreements in biotechnology and 156 in information technology were signed. By 1985 nearly twice that number were being signed each year.[4]

There is no doubt that strategic partnering in R&D has thus accelerated in the 1980s. But could this simply be an epi-phenomenon, destined to disappear as quickly as it developed? To answer this question we need to know more about why strategic partnering activity came about in the first place, and what some of the forces are that now sustain it.

Emergence of strategic partnerships

Three factors seem particularly important in explaining the emergence of strategic partnering activity: the growing knowledge-intensity of production; shifts in demand world-wide; and the resultant rise in uncertainty with which both firms and states are forced to deal.

The growing knowledge-intensity of production is evident as much in agriculture, forestry, fishing and mining as it is across the span of manufacturing from textiles to telecommunications. At the macro level the evidence of this trend can be seen in OECD (Organization for Economic Co-operation and Development) data on the growing number of scientists and engineers engaged in R&D and on the rising share of R&D in gross domestic product (GDP) and in manufacturing value added.

Even more revealing, however, are data for the manufacturing sector that show that R&D expenditure has grown at three times the rate of tangible investment over the past two decades and that the share of non-material investment in the GDP of the major advanced industrial countries has been rising over the past ten years (OECD, 1987; Kaplan and Burcklen, 1986).

The growing knowledge-intensity of production has given rise to a set of contradictory dynamics which have increased the costs, risks and uncertainties of knowledge production and intensified competition across industries. On the production side, product life cycles in dynamic knowledge-intensive industries began to shorten as the very nature of the products, their uses and the manufacturing techniques required for their production differed substantially from one product generation to the next. With shortened product life cycles, firms were obliged to spend increasing amounts on R&D to remain at the technological frontier in their industries.

Rapid technological change not only increased the costs but also the risks in knowledge-intensive industries undergoing the change. This occurred because earlier strategies aimed at securing markets for products with high R&D costs did not work where the very conception of what might constitute the market for a new technology or product was unclear.

We are no longer on an incremental technological trajectory in many fields of research today. There are discontinuities and they are major ones. The growing inability to predict the shape of future markets has thus heightened uncertainty in the development and commercialization of new products and processes and reduced the effectiveness of long-term planning for firms.

Shifts in demand

The problems generated by rising costs, risks and uncertainties in knowledge-intensive industries have been exacerbated by shifts in demand growing out of the economic crisis of the 1970s and early 1980s, and by the slow pace of productivity growth that began in the late 1960s and led to a loss of competitiveness by firms in many of the advanced industrial countries (Aglietta, 1976; Baily and Chakrabarti, 1988). With slower growth in domestic purchasing power in the advanced industrial countries and crisis conditions in much of the third world persisting into the present, markets that depended upon the sale of consumer durables became saturated.

These changes undermined the strong linear relationship that had been established between a rapidly growing market, defined in terms of a range of goods, a heavily equipped manufacturing base that permitted economies of scale, and a set of R&D activities primarily oriented toward product differentiation. This relationship had given rise in the 1950s to a pattern of competition characterized by the setting of a big firm on a big market and the building of an oligopolistic position within it. In this way, market shares were stabilized and oligopoly rents were secured. Within such a competitive framework, new technology was developed primarily to penetrate a previously identified market.

Shifts in demand in the context of the growing potential for rapid technological change, in part through technology diffusion policies put in place by the state, undermined this type of competitive behaviour. Reduced growth prospects heightened competition. New products, combining both new manufacturing processes and new goods, stimulated the rise of new industries and brought new entrants into existing ones (including the arrival of the newly industrializing economies), thus shaking the position of established leaders while market segmentation placed new pressures on the model of mass consumption based on the manufacture of standardized goods.

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With markets under pressure, vertical integration linking the market to manufacturing and to R&D activities, once the formula for growth, now threatened to impair the ability of firms to adapt to change. Flexible response increasingly came to play a central role in the strategy of knowledge-intensive firms.

As a result of these changes, new competitive strategies designed to deal with the increased costs, risks and uncertainties of knowledge production were developed.

The new competitive strategies of the 1980s and 1990s share a number of common characteristics.

- they involve a shift away from competition solely or even primarily based on cost;
- they seek to exploit the systems properties of new technologies and of new products;
- they pay greater attention to economies of scope; and
- they stress efforts to reduce uncertainty through the development of new forms of inter- firm co-operative agreements in knowledge-production, goods production and commercialization.

The use of strategic partnering activity in R&D to create flexible, technology-based oligopolies in key technologies has thus become a complement to the more traditional practice of mergers and takeovers. Let us look at each of these briefly.

Current competitive conditions

For industry life cycle theorists such as Vernon (1966) or Abernathy and Utterback (1975), the primary form of innovation in the initial phase of the product cycle is product innovation. By being first on the market with a new product, innovators are able to reap the economic rents of monopoly pricing, thus recovering their R&D costs. As the industry matures and competitors appear, process innovation aimed at lowering costs would become the dominant form of R&D activity.

Under current competitive conditions, lead times in the introduction of new products, however, have shrunk (Mytelka, 1987). The intensification of new product development emphasizing design, quality and customization has thus increasingly been accompanied by attention to process changes.

This new form of competition based simultaneously on price and innovation has further undermined the validity of the mass market production strategy and it has accelerated the search for knowledge-based competitive advantages. This has taken two principal forms: exploiting the systems properties of new technologies — information technology and biotechnology — and new products — new materials, aircraft and the wired-house[5]— and exploiting economies of scope.

Exploiting systems properties

By combining generic technologies, often from hitherto distinct disciplines, the firm can position itself on a multitude of existing or potential markets. Yet even the largest firms cannot be everywhere — doing in-house R&D on all such potential generic links. Strategic partnering activity plays a central role in bringing clients, suppliers and firms with complementary technological assets together.

The European Programme for Research and Development on Information Technology (ESPRIT) is exemplary in this regard. Inspired by the Japanese experience with inter-firm research consortia, the ESPRIT programme has as its objectives:

- to promote intra-European industrial co-operations in R&D in five main information technology areas — advanced microelectronics, software technology, advanced information processing, office systems and computer integrated manufacture;
- to furnish European industry with the basic technologies that it needs to bolster its competitiveness through the 1990s; and
- to develop European standards (Commission (1987b, page 1).

A total of 750m ECU were committed to ESPRIT 1 which spanned the years 1983-88 and an additional 1600m ECU to ESPRIT 2 under which a first call for projects was made in 1988 (Commission 1987a, pages 0-22). A total of 225 projects involving at least two European firms from different European countries along with research organizations were undertaken through ESPRIT 1 and a further 153 were approved under ESPRIT 2.[6]

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Networking through the ESPRIT programme illustrates the way in which strategic partnering in R&D permits cross-disciplinary alliances in applications-specific markets, thus accelerating the development of new technologies and their diffusion. Siemens, for example, is a participant in 25 ESPRIT 1 and 28 ESPRIT 2 projects.

Through these 53 projects, Siemens has established links to firms in the aerospace industry (Aeritalia, SNIAS, Aerospatial), in chemicals and new materials (Hoechst, Akzo, Elf) in automobiles (BMW, Fiat, Peugeot, Renault, Volkswagen), in the machinery industry (Krupp, Bosch, Comau, Dornier, Robotiker). It also has links with those industries that comprise information technologies covered by the ESPRIT programme: software (Cap Sogeti, Logica, Mari), computers (IBM, Digital, Nixdorf, ICL, Bull), office machines (Olivetti, OCE) and telecommunications (CGE-Alcatel, Telettra, Racal, British Telecom, Telefonica, Bell Telephone).

A similar pattern of networking can be found for more specialized large firms such as Bull, France's pre-eminent computer manufacturer and for small firms. For both large and small firms, the R&D consortia created through the ESPRIT programme have considerably enhanced the scope of technological combinatory possibilities and the range of potential market applications.

In contrast to the assumption made by Schumpeter that the size of the firm is correlated with R&D performance, critical mass can thus be conceived quite differently today — in terms of the size of the 'system' needed to acquire the knowledge rather than the size of the firm itself. This has a host of consequences for supplier-client relations (Mowery, 1990), for the knowledge-accumulation possibilities of small firms through strategic partnering activity (Mytelka, 1990b) and for the ability of small and medium-sized firms to effect the transition from subcontractors to value-added firms in their own right.

While the forms may remain the same, the technological content of these relationships has thus changed and this potentially opens new opportunities for small firms in the advanced industrial and the newly industrializing economies.

Economies of scope

The 1970s were an important break-point in traditional technological trajectories and modes of competition. This occurred because of the way in which several changes came together simultaneously. Thus the growing knowledge-intensity of production and increased level of uncertainty were taking place within a context characterized by major shifts in the pattern of demand. It is this combination of factors that created a competitive advantage for firms practising flexibility both in the range of products and in the time needed to get a product to market.

Flexibility had already become a feature of the

Japanese system of production. Neither the decentralized conglomerate structure of Japanese firms nor their unique labour relations are easily imitated by US and European firms.[7] But strategic partnering activity does enable firms to combine to reduce the costs, risks and uncertainties of knowledge production in all phases of the production process and to do so without compromising the need for flexibility. Networking also complements modular production strategies and permits a more continuous flow of new products since innovations do not affect the process as a whole, resulting in extended periods of down-time for retooling.

Exploiting the possibilities for economies of scope through the development of flexible production systems, where production spans the process from conception to the market, may open new opportunities for knowledge accumulation by small firms and hence the survivability of such firms as independent centers of knowledge production and growth. There is some evidence for this from partnerships concluded within the ESPRIT programme (Mytelka, 1990b).

Though strategic partnerships may enable small firms to preserve their independence, it should be emphasized that networking is not the preferred strategy for large or medium-sized firms under all conditions. Internalization continues to be a fundamental strategic option in industries within which economies of scale remain important, particularly when technological change is not altering the parameters of the industry itself. Under these conditions, a return to earlier forms of oligopolistic market competition might be possible if the number of competitors were reduced. Hence, the target of takeovers and mergers are most frequently the large and medium-sized firms that are potential threats.

Within Europe, the shake-out in the information technology industry during the 1980s has thus been impressive. Thomson (France) and SGS (Italy) merged their microelectronics operations while in France, Ericsson (Sweden) and Matra (France) took over CGCT (France). In the United Kingdom, GEC (UK) and Siemens (Germany) took over Plessey (UK), STC (UK) took over ICL (UK) and Northern Telecom (Canada) bought into STC.

By acquiring ITTs European telecommunications activities, CGE secured major footholds in the Belgian, German and Spanish markets. In Germany, Siemens took over Nixdorf and in the Netherlands AT&T (US) formed a minority joint venture with Philips (Netherlands), APT, and subsequently took majority control.

Rapid and frequently discontinuous technological change, and a weakening of the boundaries delineating competitors and markets has in some industries begun to undermine the old bases for oligopolization

Flexible technology-based oligopolies

Despite the concentration apparent in many markets, it is likely that firms will continue to adhere to value-based practices, competing on the basis of innovation, quality and close ties to clients and suppliers. While the search for knowledge-based competitive advantages will thus require larger markets to amortize the increasing costs of knowledge production, earlier strategies of oligopolistic market competition and internalization aimed at securing markets for products with high R&D costs are proving less efficient in situations in which the definition of a market for a new technology or product has become unclear. This is particularly true where technological change has eroded the frontiers of old industries and where the recombination of generic technologies makes it possible to generate a wide variety of products for a multiplicity of markets.

Rapid and frequently discontinuous technological change, and a weakening of the boundaries delineating competitors and markets has in a number of industries begun to undermine the old bases for oligopolization (Chamberlain, 1965). In so doing, it has given rise to a need to participate in the shaping of future markets and not merely to respond to changes in them.

Strategic partnerships in knowledge production permit just such a windowing on the future shape of the market. In addition to providing access to potentially new technological components with recombinatory possibilities, participation in such partnerships enables dominant firms in a market to set the technological agenda for the future. Strategic partnering activity through the ESPRIT programme provides an excellent illustration of how this has been done.

The 12 European information technology (IT) 'Majors' — GEC, Thomson, Bull, Philips, Siemens, Olivetti, ICL, AEG, CGE, STET, Plessey and Nixdorf — collectively participate in nearly two thirds of all ESPRIT projects. An analysis of the partnering activity of these firms through ESPRIT reveals three distinct ways in which technological structuring is occurring.

First, through linkages among the big-12 firms, a European technology-based oligopoly is in formation. Whereas in ESPRIT 1 each of the European majors was intensively linked[8] to several other majors, in ESPRIT 2 a pattern of concentration has appeared that parallels the process of acquisition noted above. This pattern shows the big-12 differentiating into a core group composed of Thomson, Bull, Siemens, Philips and GEC within which intensive links are maintained, and a peripheral group whose members are intensively linked to only one or two of the core companies.

Second, setting the research agenda also results from the networking multiplier effect of participation in ESPRIT projects. Data on strategic partnering within ESPRIT 1 and 2 show an intensification of this process. Thus in ESPRIT 1, Bull, through its 32 projects, formed linkages to 63 other enterprises or a project/partner ratio of 1.96. In ESPRIT 2, Bull participated in 22 projects through which it established ties to 134 firms or a project/partner ratio of 6.09. Similar increases in the project/partner ratios have been calculated for Philips and Siemens.

Lastly, structuring occurs through projects that link a single European major to a number of small firms and research organizations in what is tantamount to the formation of a 'private' network. Philips, Olivetti, CGE and Thomson have been particularly active in pursuing this form of networking (Mytelka, 1990).

Conclusions

As the changes described above radically altered the relationship of knowledge to production, encouraged the re-organization of production along more flexible, decentralized lines, and gave rise to new forms of competition in the world economy, they also dramatically changed the parameters within which states could make economic policies that effectively enhanced the competitive advantage of domestic firms, and, by extension, the national economy as a whole.

This was particularly true in Europe where state intervention has traditionally been more pronounced. But its effects have been felt in the US and Japan as well. The consequence has been to stimulate a variety of new government policies aimed at promoting strategic partnering activity in R&D.

In Europe, the ESPRIT programme has been renewed for another five years and programmes for automobiles, biotechnology, telecommunications, materials and other sectors have also been developed. In Japan, the Key Technologies Research Promotion Center established in 1985 on the initiative of MITI and MPT is the latest institutional manifestation of the interactive behaviour through which firms and states co-operate to stimulate innovation and ensure a link between knowledge production and the market.

The Center provides equity for R&D companies comprised of private firms engaged in joint research, loans to private joint venture research firms and basic infrastructure to collect and diffuse scientific and technical information, to promote international research co-operation and to facilitate other forms of joint research (Levy and Samuels, 1990). In 1989, 30 new projects each of which was led by a major technology-based MNC were approved.

In the US Sematech was launched in 1987 with government funding, as was the HDTV (High Definition Television) project in 1988. NSF (National Science Foundation) funding is being used to promote University-Industry co-operation and the National Bureau of Standards has been transformed into a National Institute of Standards and Technology (Alic, 1990).

In sum, the emergence of strategic partnerships between firms and the encouragement they are currently receiving on the part of states reflects a number of fundamental changes in the process of production and in the form that competition now takes in the world economy. These changes are likely to keep strategic partnering activity alive as a vital component of the competitive strategies of firms.

Notes

1. For a longer discussions of strategic partnerships see L K Mytelka (1990a).
2. See the paper by J Howells in this issue.
3. Initially this process stopped at the frontiers of the advanced industrial countries — Canada, Europe — more recently it has spread to the newly industrializing economies (NIEs). Texas Instruments, for example, has established a software engineering laboratory in Bangalore, India.
4. See also Chesnais, 1988 and Mytelka, 1990a.
5. Bull, France's largest computer manufacturer, for example, advertises its products not as computers but as "solutions and services to customers". Thus it stresses that "with a combination of hardware platforms, software applications, networking and services and, now, [following its takeover of Zenith Data Systems] particular strengths in microcomputers, BULL provides complete information systems to its customers throughout the world. " Bull, Annual Report 1989, page 32;
6. Data on ESPRIT are drawn from a database that builds upon the European Communities' ESPRIT Project Synopses, complemented by interviews with participant firms. For further information see Mytelka, 1990b;
7. On R&D consortia in Japan see Levy and Samuels, 1990.
8. Intensity of the linkage between firms is measured in terms of participation in a minimum of five common projects.

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