

Technological Collaboration and Innovation

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In: Dodgson, M. and Rothwell, R., (eds.), “The Handbook of Industrial Innovation”,
Edward Elgar, 1994

I. Introduction

p. 285 Innovation is such a complex and uncertain activity it commonly requires the combination of inputs from a multiplicity of sources. In order to retain some element of management control over these inputs, firms’ relationships with external organizations are often formalized into “collaborations”. Here, a broad *definition of collaboration is used which includes any activity where two or more partners contribute differential resources and know – how to agreed complementary aims.*

It is important to distinguish between *vertical* collaboration which occurs throughout the chain of production for particular products, from the provision of raw materials, through the manufacture and assembly of parts, components and systems, to their distribution and servicing, and *horizontal* collaboration which occurs between partners at the same level in the production process.

Collaboration between firms can take a variety of forms. It may take the form of R&D contracts or technology exchange agreements whereby firms’ shared objectives involve the interchange of research findings or technological know – how. Where such relationships abound among groups of firms they are sometimes described as “innovation networks”.

p. 286 Although collaboration occurs in many different forms, and may reflect different motives, a number of generalizable assumptions underpin them.

First, is the belief that collaboration can lead to *positive sum gains* in internal activities. That is, partners can together obtain mutual benefits, which they could not achieve independently. Such benefits may include:

- *Increased scale and scope of activities*: The outcomes of collaboration may be applicable to all partners’ markets, and thus may expand individual firm’s

customer bases. Synergies between firms' different technological competences may produce better, more widely applicable products.

- *Shared cost and risk*: Collaboration can share the often very high costs, and therefore risks, of innovation (although it also naturally shares future income streams).
- *Improved ability to deal with complexity*: Innovation is increasingly complicated and closer strategic and technological integration between firms is a means for dealing with the complexity of multiple sources and forms of technology.

A second assumption regarding collaboration concerns the way it is believed to assist with *environmental uncertainty*. Increasingly sophisticated and demanding customers, growing competition in and internationalisation of markets, and rapidly changing and disruptive technologies place pressures on firms to exist with, and attempt to control, these uncertainties confronting them. This is believed to be achieved more easily in collaboration than in isolation. A number of analyses of collaboration link it with uncertainties in the generation and early diffusion of new technologies¹. The product life – cycle of Abernathy and Utterback (1975), for example, implies a cyclical role for collaboration based on uncertainty.

p. 287 A third set of assumptions underlying collaboration is one that considers it offers *flexibility* and *efficiencies* compared to its alternatives. Much technological knowledge is tacit and firm – specific. It is, therefore, difficult to transfer easily or quickly, or even impossible. Collaboration potentially provides a mechanism whereby close linkages among different organizations allow sympathetic systems, procedures and vocabulary to develop, which may encourage the effective transfer of technology. It may also allow partners to “unbundled” discrete technological assets for transfer².

Examining whether the potentials of collaboration are in practice being realized is difficult as data on its extent and outcomes is often piecemeal and frequently contradictory. Furthermore, whereas the bulk of evidence suggests an increasing role for collaboration in industry, the majority of studies point to the very considerable difficulties in gaining mutually satisfactory outcomes amongst the partners.

¹ Freeman, C., 1991

² Mowery, D., 1988

Collaboration has a long history. Most modern analyses of collaboration assume that it has increased in its frequency over the past decade or so. There are, nevertheless, major questions concerning the quality of these databases in their coverage and accuracy, and major uncertainties remain in important questions such as the trends of vertical as compared to horizontal collaborations.

p. 288 Fourth, there are two more reasons as to why collaboration may be increasing. These are the changing corporate strategies of firms, which are increasingly outward in their vision, and a perceived increase in the internationalisation of technology. Thus, collaboration may be seen as a strategic tool used by firms to assist their increasing technological diversification³. An element of these corporate strategies is believed to be increased internationalisation, or “globalisation”, as firms attempt to link into, and exert influence over, the multinational sources of, and markets for, technology⁴.

Discussions of the likely future increase in collaboration from both a corporate and public policy perspective emphasize its “positive” aspects and often discount or underemphasize its “negative” implications. These can be seen in the way in which collaboration can be used as a tool of corporate strategy or government policy to exclude competitors. Thus, alliances between firms may be formed to isolate competitors or raise barriers to new entrants. The majority of international collaborations are within and between the “Triad” of W. Europe, the USA and Japan, thereby excluding other nations. Many collaborative programmes within the Triad are also developed by one trading bloc in order to exclude the other two⁵.

Collaboration can be seen as a means by which large multinational firms can indirectly receive government assistance for R&D, thereby further distorting competition. Furthermore, shared technological development may be argued to produce a technology to a standard of the lowest common denominator, rather than the objectively best achievable.

It might additionally be speculated that if collaboration is associated with the early stages of a technology’s development and diffusion, then the greater maturity of that technology (as arguably is being seen in IT) might lead to reduced collaborations.

³ Grandstrand, O. et al., 1992

⁴ Soete, L., 1991

⁵ Dodgson, M., 1992a

p. 289 Another “negative” aspect of collaboration is seen in the growing body of research which point to the difficulties firms encounter in trying to use it.

There are, therefore, a variety of reasons why the *rate in increase in the numbers of collaborations being formed during the ‘80s may slow in the future. At the same time, however, experience of collaboration may point to a corresponding increase in their quality inasmuch as relationships between partners may be closer and more intimate.* A number of reasons can be suggested as to why this might be so:

- *Increased understanding of the real role of collaboration:* Joint technological development cannot in any sustainable way be anything but a supplement rather than an alternative to firms’ core method of technology development: internal R&D. Firms need differential proprietary competences with which to trade in collaborations. These can most effectively be achieved by means of internal R&D. Technology is such a key element of corporate competitiveness that there are obvious pressures to internalize it.
- *Shared cost:* This may be seen as particularly important in the more expensive, speculative and risky projects in a firm’s R&D portfolio.
- *The continuing complexity of science and technology:* the heterogeneity of potential sources of technology, with the possibilities of specialist inputs and complementary knowledge from other firms, will ensure continuing uncertainty in industrial innovation. There will remain an enormous multiplicity of sources of technology. The opportunities and threats of environment issues will further stimulate collaboration.

p. 290

- *Enhanced learning abilities:* With continuous and rapid market and technology change there are pressures on firms to improve their learning capacities so as to identify future opportunities and threats and to be able to respond effectively to them. Collaboration can provide possibilities not only of learning about new technologies, but learning about methods of creating future technologies and of the ways those technologies might affect the existing business. It can teach companies new ways of doing things not only technologically, but also organizationally and managerially, and can conceivably alter the nature of the business.

Two major factors which can be identified as having a major bearing on the way collaboration is used to support innovation in the future are the use of Information Technology and the management skills utilized.

Whereas the innovation process has always involved close interaction between firms in clusters – and regional networks of customers and suppliers, and interacting competitors and collaborators – this is the first period in which IT can cement and intensify these linkages.

The effective use of electronic media depends, of course, as with all aspects of successful collaboration, on its managements. Research into the management of technological collaboration points to a number of important issues for its conduct. One issue of central significance is: what is success and failure? There may be advantages in taking the wider view of the contribution of collaboration and, instead of evaluating its success or failure in terms of *outputs* or readily identifiable products, it should examine *outcomes* more broadly defined. These include enhancements of the firm's knowledge base, and any technological or organizational learning the firm may have accumulated (including learning by failing, hopefully not to be replicated). The expectations of managers, in consequence, need not be too rigidly or restrictedly defined.

p. 291 Firms often enter collaborations on the basis not of what technologies they currently possess, but of what they are capable of producing in the future. The management of collaboration needs, therefore, to exist within a strategic framework.

One of the most important aspects of the collaborative process is the nature of the relationship between partners. The strategic adhesion and complementarity of companies, the exchange of often valuable technological know – how, and the need for effective and open communications so as to equitably exchange resources, is often predicated on the existence of high – trust relationships. Partners trust one another to be honest, capable and committed to joint aims. Perhaps the greatest challenge to management is to produce such trust – based relationships in firm's potentially more contentious horizontal collaborations.

If, in future, collaborations are characterized more widely by high – trust relationships this will have important implications not only for strategic management but also for our understanding of theories of the firm. The cooperative rather than universally competitive model of inter – firm relationships, in areas of such commercial importance as technological innovation, has implications for those

theories that reduce all firm transactions to cost and price considerations without regard to the potentially mutually valuable synergies achievable through the sharing of competences and knowledge.

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