

## Strategic alliances: an introductory framework

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So far strategic alliances have generally been defined in the academic literature to refer to relationships that allow an organization to access the strengths and capabilities of other organizations. The type of organization often focused on is the firm. The strategy behind such an alliance is for each firm in the alliance to draw on the core competencies of the other firm(s) with the goal of facilitating the growth and development of each member within the alliance.

Strategic alliances have long been studied from several micro perspectives including factors that bring about the alliance, alternative forms of relationships that shape the structure of the alliance, efficiency gains from the alliance, and the life cycle of the alliance. A major shift in the analysis occurred in the last years. The strategic alliances that are now being observed more and more frequently – and studied less frequently than firm-with-firm alliances – are those that involve partners other than firms. In many advanced nations, strategic alliances are subsidized by the public sector in the belief that they advance economic growth. One form of such a public/private partnership involves universities as the public partner; another form involves a government agency(ies) as the public partner; and a third form involves both.

This shift in the focus of the analysis of strategic alliances reflects the recent advances of the economics of knowledge and opens a new chapter in the literature (Antonelli and Link 2015). Following the Arrovian insights about the properties of knowledge as an economic good, the economic literature paid much attention to the consequences of the limited appropriability of knowledge, both in positive and normative terms. Because of the limited appropriability of knowledge agents would miss the incentives to invest in the generation of new technological knowledge and market systems would risk the systematic undersupply of knowledge.

In order to contrast the undersupply of technological knowledge, at the country level, public policy should elaborate interventions aimed at: i) increasing the appropriability of knowledge through the implementation and enforcement of intellectual property rights; ii) providing incentives to the allocation of resources supportive to the generation of new technological knowledge by firms; iii) supporting directly the generation of new technological knowledge with the creation of a public research infrastructure (Antonelli, Link, Metcalfe 2009).

At the firm level, the implementation of strategic alliances has been regarded and practiced as a major tool to increase knowledge appropriability and the opportunity for knowledge exploitation. A large literature has systematically explored the mechanisms by means of which firms could use strategic alliances to reduce the risks of uncontrolled

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knowledge dissipation, stretch the duration of lead times and delay imitation. By means of strategic alliances with firms located in other geographic markets, firms that had been able to generate new technological knowledge could implement timely global exploitation strategies, reducing costs of international hierarchies. By means of strategic alliances with firms active in adjacent product markets, firms could take advantage of new serendipitous technological knowledge, limiting costs of product diversification. By means of strategic alliances, innovative firms could sell disembodied technological knowledge to third parties, using direct equity in a new venture as an effective hostage that would prevent the opportunistic behavior of the licensee (Mowery, Oxley, Silverman 1966).

The Schumpeterian flavor of this literature – based upon the legacy of *Capitalism Socialism and Democracy* – is evident: strategic alliances are basically aimed at increasing the height of barriers to entry and hence to imitation and at stretching the duration of transient monopolistic market power (Schumpeter 1942). The increased levels of appropriation have direct positive effects of increasing the incentives to perform and fund research and development activities and hence to reduce the risks of knowledge undersupply. This line of investigation has been most successful in the exploration of strategic alliances among firms.

The new economics of knowledge has now shifted the emphasis from knowledge appropriation and exploitation to knowledge generation. The attention of the literature is now focused on the implications of the economic properties of knowledge on its own generation process (Crépon, Duguet, Mairesse 1998). Technological knowledge is more and more regarded as an output of a dedicated economic activity that firms undertake intentionally in order to support the introduction of technological innovations. The generation of technological knowledge is necessary to introduce innovations. New properties of knowledge, such as non-exhaustibility, cumulability and complementarity, and most importantly the dual character of knowledge as both an input and an output, are identified and the attention now focuses their implications on the generation of knowledge (Link and Antonelli 2014).

This new exploration has been marked first by the discovery of the other side of the appropriability coin. Limited knowledge appropriability has negative effects on ‘inventors’ as much as positive ones. Knowledge spillovers provide access to knowledge generated by third parties. Knowledge externalities reduce costs of knowledge generation. The appreciation of absorption costs has marked the second step. Knowledge, spilling in the atmosphere, can be actually used only after many dedicated efforts. Technological knowledge differs from information: it has a strong tacit component and it is intrinsically sticky: dedicated interactions between knowledge holders and knowledge users associated to market transactions within or also between vertical value chains, are necessary to actually access it. Major screening, un-coding, and absorption activities are necessary in order to use knowledge spillovers. Knowledge externalities are pecuniary rather than pure. Even if knowledge cannot be fully appropriated by the ‘inventor’ as it spills, external knowledge is not a free good and it does not fall like manna from heaven. Its – secondary – use, as an input, has a cost: when pecuniary knowledge externalities are at work however the cost of knowledge is below its social value.

The increasing awareness of the limits of public research infrastructure in delivering a correct amount and composition of knowledge actually necessary to the economic system makes a major contribution. The understanding of the intrinsic heterogeneity of knowledge calls attention on the economic efficiency of public research infrastructure put in place to support the generation of technological knowledge and contrasts its undersupply by the market system. The standard built up of imposing public research infrastructure is aimed

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to support the performance of basic research and the generation of scientific knowledge to contribute its eventual transformation into technological knowledge by the business sector unable to fund and perform the appropriate amount of research by the lack of incentives and the excess risks associated with the generation of knowledge. The lack of an effective price mechanism and the experienced limits of all attempts to forecast the direction of scientific advances impedes the implementation of an effective mechanism to direct the disciplinary allocation of public resources assigned to the public research infrastructure. Public research centers and the academic system are left without guidance about the types of knowledge that they should generate. This leads to increasing risks of mismatches between the types of knowledge provided by the public research infrastructure and the types of knowledge actually useful to the economic system to feed the innovation process. The public research infrastructure risks producing types of knowledge that the business sector is unable to use and convert into technological knowledge and eventual innovations. Closer interactions between the supply of scientific knowledge by the public research infrastructure and its demand by the business sector seem more and more necessary to increase economic efficiency of the public resources invested in the generation of scientific knowledge (Chesbrough, 2003; Antonelli and Fassio 2016a).

The identification of the recombinant character of the knowledge generation process contributes radically the new thinking about the role of scientific knowledge as an input into the generation of new technological knowledge (Weitzman 1996). The generation of new technological knowledge consists in the recombination of existing knowledge items. The understanding of the recombinant character of the knowledge generation process calls attention on the role of the existing stocks of knowledge within the boundaries of the firm and outside it. The access to external knowledge is strictly necessary as no agent can command all the existing knowledge. Without the access to the existing stocks of knowledge, including those possessed by third parties, the generation of new knowledge is actually impossible. External and internal knowledge enter the recombinant knowledge generation process as complementary inputs of an O-ring production process. (Antonelli and Colombelli 2015a).

These advances in the economics of knowledge parallel and reflect the radical changes in the organization of research and development activities within corporations. Internal research laboratories have been gradually substituted and integrated by new knowledge outsourcing. In the recent past, corporations experienced the decline of the efficiency of management of the large 'intramural' R&D laboratories that had characterized their growth in the second part of the XX century. The failure of incumbent corporations to participate in the flow of radical innovations in informatics and biotechnology together with the increasing costs of internal research personnel pushed firms to elaborate a new model of R&D management based upon the systematic access to external sources of technological knowledge and their eventual recombination with internal knowledge. The process favored the emergence of markets for technology where corporations are active on the demand side and specialized knowledge-intensive firms provide the supply of knowledge embodied in research services. The take-over of new successful small public companies, brought to the financial markets by venture capitalism, provides access to external knowledge that has already been screened and implemented so as to become an integral component of the organization of the knowledge generation process by large corporations. Systematic partnership with academic research centers enables corporations to take advantage of highly qualified research capabilities without supporting the huge long-term costs of their implementation. The open innovation model of R&D management progressively reduces the tight vertical integration of research activities within corporations and increases the role of

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external sources of knowledge as complementary inputs into the new knowledge generation process. Strategic alliances between corporations and the public research infrastructure play a crucial role in the new open innovation approach, as they help reducing the heavy transaction costs that characterize the markets of technology. They also provide a framework into which flows of knowledge and talented personnel can take place with reduced risks of opportunistic behavior (Antonelli and Fassio 2016b).

Here the understanding of new properties of knowledge comes into play. Technological knowledge is at the same time the output of a dedicated activity and an essential input. Technological knowledge exhibits low levels of exhaustibility as it can be used and used again with little 'wear and tear'. It is characterized by substantial indivisibility and hence diachronic cumulability and synchronic complementarity. In the recombinant knowledge generation process, external knowledge is an essential input, strictly complementary to other internal ones, such as the competence acquired by means of learning processes, research and development activities, and the stock of existing knowledge. The access to external knowledge is indispensable. Its conditions play a central role in the actual capability of each agent to generate new technological knowledge. The knowledge generation process can yield an output only if all inputs, including specifically external knowledge, have a positive value. Because external knowledge can be substituted only to a limited extent, large costs of access to external knowledge imply large costs of the knowledge output (Antonelli and Colombelli 2015b).

The generation of technological knowledge and the introduction of technological innovations are typical emerging system properties where individual undertaking is complementary with the system properties. Vibrant entrepreneurship in systems endowed with low levels of connectivity and poor conditions of access to and use of the existing stock of technological knowledge, dispersed and fragmented in a variety of firms and research institutions, is deemed to fail, as much as systems with high levels of organized complexity but low levels of entrepreneurship.

The knowledge connectivity of the system becomes a central property: firms are able to generate new technological knowledge only if and when they are able to implement qualified knowledge interactions that make the access to external knowledge possible and effective. The costs of knowledge are low only if external knowledge can be accessed and used at low cost. Strategic alliances are an indispensable tool to access and use external knowledge and to reduce its costs. In this new approach, strategic alliances are hybrid forms of inter-organizational coordination aimed at the creation and quasi-internalization of pecuniary knowledge externalities. The goal of new strategic alliances is to organize and make operational knowledge interactions between agents that possess complementary bits of knowledge.

The effects of the reappraisal of the Schumpeterian legacy based upon the new appreciation of his late essay "The creative response in economic history" are evident (Schumpeter 1947). The introduction of innovations is now regarded as a creative response to unexpected changes in product and factor markets that is possible only when positive pecuniary knowledge externalities are available and can actually support the generation of new technological knowledge at low costs. In order to implement a creative reaction to cope with unexpected events by means of the introduction of technological innovations, firms need to search and access external knowledge at costs below its social value. The new strategic alliances of firms with the public research infrastructure enable the systematic access to relevant knowledge directly from its academic sources and its use as an input into the recombinant generation of new technological knowledge. As such the new strategic alliances are a major organizational innovation that enables the introduction of technological innovations.

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Strategic alliances aimed at the generation of technological knowledge differ substantially from strategic alliances aimed at increasing knowledge appropriation and exploitation. Strategic alliances aimed at the generation of technological knowledge have much a wider scope of action. They are not limited to firms. They are characterized by the inclusion of public agencies and generally by the systematic partnership between firms and components of the public research infrastructure.

The new strategic alliances provide the contractual framework that is necessary to the implementing the knowledge interactions that enable to access and share the tacit components of technological knowledge. The new strategic alliances enable to improve the quality of knowledge interactions as they put them in a structured context. The effects are beneficial for both parties: i) firms have direct and systematic access to the research activities in progress within the research institutions and can contribute them with their own competence and experience; ii) research institutions can better select the directions of their research programs and take advantage of the bottom up accumulation of competence of firms.

The ultimate effects of strategic alliances are the timely and effective access to external knowledge reducing absorption costs, higher levels of division of labor in the knowledge generation process and, consequently, its increased efficiency of the knowledge generation process with the ultimate reduction of cost of knowledge. Firms able to implement strategic alliances aimed at the generation of new technological knowledge, in fact, can more and more substitute internal R&D activities with the research carried on by competent third parties and can access scientific breakthroughs much earlier. The new strategic alliances enable to reduce drastically knowledge absorption costs and to internalize substantial pecuniary knowledge externalities. The quasi-internalization of pecuniary knowledge externalities enables to generate more technological knowledge with a given research budget and to reduce the costs of knowledge that are necessary to innovate. The lower the knowledge costs the faster is likely to be the pace of introduction of innovations (Antonelli and Link 2015).

The new strategic alliances are a major organizational innovation that has powerful effects at the system level in terms of increased levels of knowledge connectivity. The new strategic alliances are an important component of the array of tools and procedures that qualify the knowledge governance of a system. Their introduction, in fact, increases the levels of cooperation between crucial components of the system and helps increasing its levels of coordination in the distributed generation and use of scientific and technological knowledge.

The collection of papers in this timely volume transcends the traditional approach to a strategic alliance and dwells systematically on the new focus of the economics of knowledge: the generation of knowledge and the implications of its recombinant character in terms of the indispensable access and use of external knowledge as an input in order to generate new technological knowledge as an output. The papers herein focus on alliances that fall broadly under the rubric of a public/private partnership. To place the research in this special issue in context, the lead article by Vonortas and Zirulia (“Strategic technology alliances and networks”) overviews the extant academic literature – economics literature as well as management literature – in which a strategic alliance is defined as an agreement whereby two or more partners share the commitment to reach a common goal by sharing their resources together and coordinating their activities. Such alliances are enhanced through networks. This opening paper grounds the reader in “what has been.” It also underscores the importance of the remaining papers in the sense that it is void of any discussion about public/private partnerships, especially those that involve a university, within the

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context of strategic alliances is in itself grounds the remaining papers as being foundational and motivates the profession to devote more attention in that direction. However, the methodologies discussed by these authors are applicable to public/private partnerships in general.

Boardman and Bozeman (“Academic faculty as intellectual property in university-industry research alliances”) provide an overview of industry/university strategic alliances with an eye toward the strategy of each type of partner. Their paper artfully integrates the economic literature with the management science literature on this topic. They focus on property rights issues that arrive from such alliances and how those issues can be effectively managed with an eye toward economic gain.

Toole, Czarnitzki, and Rammer (“University research alliances, absorptive capacity, and the contribution of startups to employment growth”) argue that university startups represent a strategic alliance between the university and its faculty. They focus explicitly on the employment growth benefits of university startups, thus providing a methodological template for not only how one might think of spillover benefits from alliances in general but also for how similar studies might be structured.

Chandran, Hayter, and Strong (“Personal strategic alliances: enhancing the scientific and technological contributions of university faculty in Malaysia”) built on the theme of universities as key partners in a strategic alliance. The motivating force behind the alliance that they examine is the Malaysian government. Their analysis has important policy implications; they conclude that human capital investments may only be realized by simultaneously strengthening and supporting personal strategic alliances with communities outside of academia (i.e., networks in the Vonortas and Zirulia sense).

O’Connor, Link, Downs, and Hillier (“The impact of public investment in medical imaging technology: an interagency collaboration in evaluation”) also examine the net social benefits of a public/private partnership, but the partnership examined involves public funding of university research. They employ a traditional evaluation model to the quantification of the net social benefits associated with publicly-sported university research in medical imaging technology.

Hall (“Public investments in sustainable technology: an evaluation of North Carolina’s Green Business Fund”) is more structured than the previous three papers that focus on the benefits of strategic alliances. His strategic alliance involved state government as a partner with state firms to further economic growth of a green industry. He formulates a theoretical model which facilitates the quantification of the net social benefits of such a public/private partnership, and implements the model with data from one state program.

Scott and Scott (“Standards and innovation: US public/private partnerships to support technology-based economic growth”) address strategic alliances to create and use standards that affect economic growth and development. Their model is applied to U.S. Corporate Average Fuel Economy (CAFE) standards. Their analysis offers a theoretical foundation for how policy makers should think about the implications of standards, in general, for economic advancement.

Finally, the international comparative evidence of Antonelli and Gehringer (“The cost of knowledge and productivity dynamics. An empirical investigation on a panel of OECD countries”) confirms the large variance across countries in terms of cost of knowledge and provides a macroeconomic framework to test the basic hypothesis that the low cost of technological knowledge enable the creative reaction of firms and their capability to introduce technological innovations. Countries able to implement the connectivity of their national innovation systems can generate new technological knowledge at lower costs and experience faster rates of introduction of technological innovations and hence faster

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increase of total factor productivity growth. The cost of knowledge depends upon the conditions of access and use of the external knowledge that is a necessary and indispensable complementary input in the recombinant generation of new knowledge. When the access to the external knowledge occurs at costs below the social value of knowledge, firms benefit from pecuniary knowledge externalities and are actually able to react creatively to un-expected changes in product and factor markets and introduce productivity enhancing innovations. The empirical evidence on 20 OECD countries confirms that the growth of total factor productivity is negatively associated with the costs of knowledge. Total factor productivity thus increases faster where and when the costs of knowledge are lower.

The cost of knowledge reflects and measures the capability of its agents to implement its connectivity and enables the reaction of firms to unexpected changes in product and factor markets to be creative, as opposed to adaptive. Firms and countries that are able to generate technological knowledge at low costs are also able to increase the rate of introduction of technological and organization innovations and hence of total factor productivity.

This collection represents the locus of observational points making up a new frontier that defines the scope of research conducted under the rubric of “strategic alliances.”

### References

- Antonelli, C., and A. Colombelli. (2015a). “External and internal knowledge in the knowledge generation function.” *Industry and Innovation* 22, 273–298.
- Antonelli, C., and A. Colombelli. (2015b). “The cost of knowledge.” *International Journal of Production Economics* 168, 290–302.
- Antonelli, C., and C. Fassio. (2016a). “Academic knowledge and economic growth: Are scientific fields all alike?” *Socioeconomic Review*, forthcoming.
- Antonelli, C., and C. Fassio. (2016b). “The role of external knowledge(s) in the introduction of product and process innovations.” *R&D Management*, forthcoming.
- Antonelli, C., A. N. Link, and J. S. Metcalfe (eds.). (2009). *Technology Infrastructure*. London: Routledge.
- Antonelli, C., and A. N. Link (eds.). (2015). *Handbook on the Economics of Knowledge*. London: Routledge.
- Chesbrough, H. (2003). *Open innovation. The new imperative for creating and profiting from technology*. Boston: Harvard Business School Press.
- Crépon, B., E. Duguet, and J. Mairesse. (1998). “Research and development, innovation and productivity: An econometric analysis at the firm level.” *Economics of Innovation and New Technology* 7, 115–158.
- Link, A. N., and C. Antonelli (eds.). (2014). *Recent Developments in the Economics of Science and Innovation*. Cheltenham: Edward Elgar.
- Mowery, D. C., J. E. Oxley, and B. S. Silverman. (1966). “Strategic alliances and interfirm knowledge transfer.” *Strategic Management Journal* 17, 77–91.
- Schumpeter, J. A. (1942). *Capitalism, Socialism and Democracy*. New York: Harper and Brothers.
- Schumpeter, J. A. (1947). “The creative response in economic history.” *Journal of Economic History* 7, 149–159.
- Weitzman, M. L. (1996). “Hybridizing growth theory.” *American Economic Review* 86, 207–212.