

Absorptive Capacity

Draft version, September 2013.

Citation

Kwanghui Lim and Michael R. Falk (2013). Absorptive Capacity. In Mie Augier and David J. Teece (Eds.), *The Palgrave Encyclopedia of Strategic Management*. Palgrave Macmillan Publishers Ltd, forthcoming.

Authors

Kwanghui Lim and Michael R. Falk.

Melbourne Business School, 200 Leicester St, Carlton, VIC 3053, Australia.

Definition

Absorptive capacity is the ability of a firm to recognize the value of external knowledge, assimilate it and commercialize it (Cohen and Levinthal, 1989, 1990). Cohen and Levinthal viewed this ability as a function of firm-specific investments, most notably the firm's prior relevant R&D. Over time, scholars have elaborated upon the capabilities involved, and linked absorptive capacity to a broader range of factors including the firm's social networks, complementary organizational search routines, and incentive structures within the firm.

Abstract

Absorptive capacity is an organizational ability to evaluate, assimilate and commercialize knowledge that originates outside the firm. Cohen and Levinthal popularized the concept with their model describing the dual roles of R&D; as a source of innovation and as a means of enhancing the firm's ability to learn. In the large literature that developed, many studies follow this logic to link absorptive capacity to other factors that shape the firm's incentive to learn and invest in R&D, including knowledge flows and social networks. Other studies emphasise the firm's routine behaviors and the link to performance outcomes in the context of such firm-level activities as technology sourcing, alliances, innovation and strategic renewal.

Opening

Absorptive capacity in the context of research on knowledge flows across organizations was popularized by Cohen and Levinthal (1989, 1990). Prior authors acknowledge the importance of knowledge absorption (for antecedents see Lane, Koka and Parthak, 2002: 836). The term itself has prior use in development economics referring to issues around foreign capital inflow (see Adler, 1965; Rosenstein-Rodan, 1943). But it was Cohen and Levinthal who elaborated upon its underlying logic at the organizational level and conducted the first comprehensive empirical tests for the effects of absorptive capacity. Based on both economic logic (1989) and cognitive factors (1990) they argue that a firm's prior related knowledge is a major determinant of its ability to learn. It is important to recognize that although absorptive capacity may sound like it is motivated by individual level considerations, it is posited to be an organizational level construct (1990: 131); one that is shaped by the firm's communications structures and organizational routines. Another important insight is that absorptive capacity is cumulative and path dependent, as such it is sometimes considered to be a source of competitive advantage.

Cohen and Levinthal's seminal work has spawned a large literature, with over 20,000 citations on Google Scholar as of August, 2013. Part of its appeal is that it presents an alternative to the conception by Nelson (1959) and Arrow (1962) that knowledge once produced is a public good that flows freely across organizations. Absorptive capacity evokes a view that knowledge flows are somewhat more circumscribed, requiring a firm to exert its own effort to acquire external knowledge, this effort contingent upon technological, social and economic factors (see 'The Determinants of R&D' below).

While absorptive capacity offers a valuable conceptual building block to scholars of innovation, several criticisms have been raised in the literature. First, the concept is broadly construed and used in inconsistent ways by various authors (Zahra and George, 2002). Second, studies rarely employ longitudinal research methods or process models, and understate the importance of feedback loops in the learning process (Todorova and Durisin, 2007). Third, the concept of absorptive capacity itself has gone through little theoretical development. Conceptual contributions include Lane and Lubatkin's (1998) idea of relative absorptive capacity, Zahra and George's (2002) distinction between potential and realized capacity, and Lim's (2010) three types of absorptive capacity which exist depend upon the type of knowledge absorbed and stage of industry evolution. Yet, given the size of the accompanying empirical literature, there has been surprisingly little conceptual development.

On the empirical front, a large literature has emerged making use of the absorptive capacity construct in empirical tests. Many firm-specific or industry-specific studies suggest the importance of absorptive capacity, linking it to firm performance, firm-level activity and interfirm networks. With such heterogeneity a unified view remains an elusive target for empirical scholars. Lane et al. (2006: 841) critique absorptive capacity as having become 'taken-for-granted', or 'reified', with 80% of citing papers making superficial use of the concept with no discussion of its foundations.

Despite these concerns, absorptive capacity remains an important and widely used concept, appearing in the full text of over 4000 academic papers during the first eight months of 2013. The concept features in 110 of those papers' titles, as it does in 168 titles published during the previous year.

The Determinants of R&D

Cohen and Levinthal's original papers (1989, 1990) were major contributions to areas of strategy and economics concerned with how firms exploit external R&D. Many subsequent studies have depicted the dual roles of R&D, as a source of innovation and means of enhancing the firm's ability to learn. Though absorptive capacity is hard to observe empirically, scholars have devised ways to test for its effects and extend its implications using proxy measures – commonly, R&D expenditures and R&D intensity (the ratio of R&D expenditures to firm size).

A central stream of research follows Cohen and Levinthal in upholding the centrality of factors classically ascribed as the key determinants of R&D – technological opportunity, appropriability conditions, intraorganizational spillovers and patterns of demand. The effects of these industry characteristics on R&D are shown to be moderated by the firm's own knowledge stocks and competences (Cohen and Levinthal, 1989; Rothaermel and Alexandre, 2009; Arbussa and Coenders, 2007).

Absorptive capacity studies have contributed to new insights into the dynamics and determinants of innovation. While many studies are at the level of the firm, contributions also focus on indigenous research

effort and infrastructure (Kim and Dahlman, 1992), 'learning-by-exporting' or importing (Liu and Buck, 2007), and the evolution of national innovation systems (Mowery and Oxley, 1995; Castellacci and Nateri, 2013). In fact, one of the earliest microeconomic studies of absorptive capacity was on cultural constraints in international technology transfer (Kedia and Bhagat, 1988). Broadly, these contributions support a movement among scholars influenced by evolutionary economics, away from a linear view of innovation towards a more integrated model (Kline and Rosenberg, 1986). Where the post-War economic paradigm counseled firms to be strongly self-reliant, the now prevailing counter-view depicts technological progress as the outcome of complex interactions between knowledge producers, users and brokers.

Economic governance and competition is increasingly characterised by how organizations respond to competence-destroying technical change and flows of intangible capital. Since the early 1990s, invention and information have become more broadly distributed such that no single organization has the internal capabilities necessary to exploit novel developments (Veugelers, 1997). Absorptive capacity has been an important element linked to a range of emergent organizational practices. In international business, firms have moved from traditional resource-sharing alliances towards learning-centered partnerships (Lane and Lubatkin, 1998) and collaborative R&D. Open learning enables firms to formulate new technical standards (Mowery, Oxley and Silverman, 1996) and to spread the risks in innovation, such as when entering new markets (Fu, Diez and Schiller, 2013). Absorptive capacity serves as a crucial factor explaining how firms behave in alliance relationships (Mowery et al., 1996) and technology markets (Arora and Gambardella 1994).

Absorptive capacity and the flow of knowledge

R&D investment within an industry is shaped by firms' absorptive capacity (Cohen and Levinthal, 1989) because it exerts a positive marginal effect on the firm's incentive to learn. This effect however depends on underlying scientific or technological characteristics of the domain in which a firm looks to innovate. Firms in 'difficult learning environments' must draw on external science that is less targeted to commercial ends, more complex and better protected. Under these conditions, in-house basic research becomes relatively more important in permitting the firm to recognise, assimilate and exploit valuable knowledge (Rosenberg 1990; Dyer and Singh 1998).

From the mid 1990s, these insights motivated research into the diffusion of scientific knowledge. The pharmaceutical and biotechnology industries, as settings for research, have facilitated examination of how science links with technology (Foray, 2004: 55) and how incumbent firms respond to radical technological change. Investing in basic science is the price firms pay to 'plug into the outside information network' (Rosenberg, 1990) and exploit outside scientific findings (Pavitt 1991). Research on biotechnology emphasised the effect of a firm's external connections on inventive performance outcomes (Powell, Koput and Smith-Doerr, 1996). Cockburn and Henderson (1998) explored how firms develop scientific capabilities. They show that large US pharmaceutical firms relied on a complex set of activities for knowledge absorption, including 'pro-publication' policies and promotions based on scientific reputations. When understood in terms of firm's 'connectedness' with basic science, absorptive capacity helps explain variability among firms and how they co-evolve with their environment. Specifically, the concept can help explain the differential rates at which firms adopt a superior capability (Cockburn, Henderson and Stern, 2000).

Cohen and Levinthal conceived absorptive capacity as path dependent and contingent upon the partner. Firms in knowledge-intensive industries (e.g., biopharmaceuticals) depend upon scientific capabilities to guide the development of new products and processes (Gambardella, 1992). Search efficiency is increased

by collaboration with university scientists: it increases the speed at which firms exploit existing knowledge to generate inventions, and this effect is more pronounced for firms that develop absorptive capacity via internal basic research (Fabrizio, 2009). While recognizing that the value of scientific capabilities varies at different stages of industry maturity, the flow of scientific knowledge opens up opportunities for novelty and facilitates change in organizational processes and technological orientation (Pisano, 1994).

Lane et al. suggested that the problem of reification can be addressed only by investigating absorptive capacity's 'building blocks' and diverse applications. This impulse links two disparate strands of the literature – studies on knowledge flows (this section) with research that describes absorptive capacity in organizational processes (next section). The middle path may be a view that absorptive capacity is relative, founded in relationships that enable learning, but also in organizational processes that drive convergent and divergent development between firms within fields of innovation. Thus, Lane and Lubatkin's (1998) idea of relative absorptive capacity highlights the structural and operational similarities between organizations that facilitate knowledge transfer. That study evokes empirical findings by Mowery et al. (1997) that the ability of firms to share capabilities through strategic alliance depends on extant overlaps in their technological portfolios.

Another nuanced view emerges in studies that differentiate forms of absorptive capacity; some based within high-level cognitive relationships and practices, others functionally determined by dynamics of the technology market. Firms use a diverse range of activities to build strategic orientation and flexibility into the organizational resource base. In low technology sectors (e.g., services), the ability of firms to scan the market for valuable technologies relies on knowledge of business trends and technologies at a user level (Arbussa and Coenders, 2007). They build on Cassiman and Veugelers' (2000) argument that absorptive capacity has two dimensions: recognising the value of new technologies constitutes a separate capacity to integrating complex knowledge. Lim (2009), by contrast, clarifies the 'many faces' of absorptive capacity. In a high technology setting (semiconductors), different capacities may develop to reflect the strategic choices of individual firms. Technological maturation and market position can lead a firm to invest in the absorption of knowledge encoded in tools, artefacts and processes, leaving others to invest in disciplinary or domain-centered expertise.

Organizational antecedents and other uses of absorptive capacity

The modern theory of the firm has engendered intensive research on the firm's decision to 'make' or 'buy' intermediate inputs (Coase, 1937; Simon, 1951). These choices are sometimes complementary (Veugelers, 1998; Veugelers and Cassiman, 1999). Firms may tap external knowledge sources through M&A activities, licensing or by hiring researchers with relevant knowledge (Arora and Gambardella, 1990). In research that goes right to questions about the nature and boundaries of the firm, absorptive capacity has been used by scholars to link internal and external sourcing.

Absorptive capacity is framed in many studies as a dynamic capability. In this literature, the firm's decision to collaborate is viewed as a variant of the make-or-buy decision. This reflects a broader position about the origins of competitive advantage: organizational processes should support the continued endowment of firms with superior routines and new knowledge as environments change (Teece, Shuen and Pisano, 1997). That is, absorptive capacity can have a direct impact on performance and adaptation. At its deepest level, it is part of a system of a system of organizational practices by which firms "build, integrate and reconfigure organizational resources and competences" (Adner and Helfat, 2003). Companies enact unique configurations of routines oriented to the exploitation and exploration of internal and external knowledge. For

example, firms may readily imitate 3M's well-described policy that 15% of employees' time remains unaccounted for in the hope of fostering experimentation, but fail to replicate crucial unobserved social mechanisms by which that policy succeeds (Lewin, Massini and Peeters, 2011). The absorptive capacity concept has gained additional traction with the development of a 'knowledge-based view of the firm' (Grant and Baden-Fuller, 1995; Conner and Prahalad, 1996).

The work on capabilities presents a different view on absorptive capacity than in earlier work. Thus, over the past decade, a series of articles have called for a theory that focuses on the organizational antecedents of absorptive capacity (Jansen, Van den Bosch and Volberda, 2005; Lane et al., 2002; Volberda, Foss and Lyles, 2010). One attempt is Zahra and George's (2002) model which differentiates two forms of absorptive capacity – that which is 'realised' in the form of new products, processes or services, and that which remains latent in the firm's resource base. Knowledge acquisition and assimilation routines may be deployed in the interests of strategic flexibility. As Todorova and Durisin note, Cohen and Levinthal's original model held that absorptive capacity moderates the effect of appropriability over R&D investment. By contrast, Zahra and George depict a more direct relationship between absorptive capacity and its consequences (Todorova and Durisin, 2007).

Beyond R&D, absorptive capacity is also now being used in many other streams of innovation research. This includes studies on entrepreneurship (George and Prabhu, 2003), open learning systems (Jensen and Webster, 2009; Robertson, Casali and Jacobson, 2010), and influence networks such as China's Guanxi system (Fu et al., 2013). The managerial cognition literature is a promising area of development, highlighting the processes by which managers translate their interpretations of change into strategic choice, including into R&D strategies (Kor, 2006). Eggers and Kaplan (2009) build on this, and investigate the degree to which cognitive effects interact with organizational orientation in processes of strategic renewal. In combination with managerial cognition, absorptive capacity is shown to be important in allowing the firm to overcome structural and cognitive barriers.

Signature

Kwanghui Lim and Michael R. Falk.

Bibliography

Adler, J. H. 1965. Absorptive capacity: the concept and its determinants. Brookings Staff Paper. Washington DC: The Brookings Institute.

Adner, R. and Helfat, C. E. 2003. Corporate effects and dynamic managerial capabilities. *Strategic Management Journal* 24, 1011–1025.

Arbussa, A. and Coenders, G. 2007. Innovation activities, use of appropriation instruments and absorptive capacity: evidence from Spanish firms. *Research Policy* 37, 1545–1558.

Arora, A., Gambardella, A. 1990. Complementary and external linkages: the strategies of the large firms in biotechnology. *The Journal of Industrial Economics* XXXVIII (4), 361–379.

Arora, A., Gambardella, A. 1994. Evaluating technological information and utilizing it: scientific knowledge, technological capability, and external linkages in biotechnology. *Journal of Economic Behavior and Organization* 24, 91–114.

Arrow, K. J. 1962. Economic welfare and the allocation of resources to invention'. In *The Rate and Direction of Inventive Activity: Economic and Social Factors*, ed. R.R. Nelson. Princeton MA: Princeton University Press.

Castellacci, F. and Natera, J. M. 2013. The dynamics of national innovation systems: a panel cointegration analysis of the coevolution between innovative capability and absorptive capacity. *Research Policy* 42, 579–542.

Coase, R. H. 1937. The nature of the firm. *Economica* N.S., 386–405. Reprinted in *The Nature of the Firm: Origins, Evolution, Development*, ed. O. E. Williamson and S. Winter. 1991. New York: Oxford University Press.

Cockburn, I. M. and Henderson, R. M. 1998. Absorptive capacity, coauthoring behavior and the organization of research in drug discovery. *Journal of Industrial Economics* XLVI (2), 157–182.

Cockburn, I. M., Henderson, R. M. and Stern, S. 2000. Untangling the origins of competitive advantage. *Strategic Management Journal* 21, 1123–1145.

Cohen, W. M. and Levinthal, D. A. 1989. Innovation and learning: the two faces of R&D. *The Economic Journal* 99 (397), 569–596.

Cohen, W. M. and Levinthal, D. A. 1990. Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly* 35 (1), 128–152.

Conner, K. and Prahalad, C. K. 1996. A resource-based theory of the firm: knowledge versus opportunism. *Organization Science* 7 (5), 477–501.

- Dyer, J. H. & Singh, H. 1998. The relational view: cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review* 23 (4), 660–679.
- Eggers, J. P. and Kaplan, S. 2009. Cognition and renewal: comparing CEO and organizational effects of incumbent adaptation to technical change. *Organization Science* 20 (2), 461–477.
- Fabrizio, K. R. 2009. Absorptive capacity and the search for innovation. *Research Policy* 38, 255–267.
- Foray, D. 2004. *The Economics of Knowledge*. Cambridge MA: The MIT Press.
- Fu, W., Diez, J. R. and Schiller D. 2013. Interactive learning, informal networks and innovation: evidence from electronics firm survey in the Pearl River Delta, China. *Research Policy* 42, 635–646.
- Gambardella, A. 1992. Competitive advantages from in-house scientific research: the US pharmaceutical industry in the 1980s. *Research Policy* 21, 391–407.
- George, G. and Prabhu, G. N. 2004. Developmental financial institutions as technology policy instruments: implications for innovation and entrepreneurship in emerging economies. *Research Policy* 32, 89–108.
- Grant, R. M. and Baden-Fuller, C. 1995. A knowledge-based theory of inter-firm collaboration. *Best Paper Proceedings, Academy of Management*, 17-21.
- Jansen, J. P., Van den Bosch, F. A. J. and Volberda, H. W. 2005. Managing potential and realized absorptive capacity: how do organizational antecedents matter? *Academy of Management Journal* 49 (6), 999–1015.
- Jensen, P. H. and Webster, E. W. 2009. Knowledge management: does capture impede creation? *Industrial and Corporate Change* 18 (4), 701–727.
- Kedia, B. L. and Bhagat, R. S. 1988. Cultural constraints on transfer of technology across nations: implications for research in international and comparative management. *Academy of Management Review* 13 (4), 559–571.
- Kim, L. and Dahlman, C. J. 1992. Technology policy for industrialization: an integrative framework and Korea's perspective. *Research Policy* 21, 437–452.
- Kline, S. J. and Rosenberg, N. 1986. An Overview of Innovation. In *The Positive Sum Strategy: Harnessing Technology for Economic Growth*, ed. Landau, R. and Rosenberg, N. Washington DC: National Academy Press.
- Kor, Y. Y. 2006. Direct and interaction effects of top management team and board compositions on R&D investment strategy. *Strategic Management Journal* 27, 1081–1099.
- Lane, P. J. and Lubatkin, M. 1998. Relative absorptive capacity and interorganizational learning. *Strategic Management Journal* 19, 461-477.
- Lane, P. J., Koka, B. R., and Pathak, S. 2006. The reification of absorptive capacity: a critical review and rejuvenation of the construct. *Academy of Management Review*, 31 (4), 833–863.

- Lewin, A. Y., Massini, S. and Peeters, C. 2011. Microfoundations of internal and external absorptive capacity routines. *Organization Science* 22 (1), 81–98.
- Lim, K. 2009. The many faces of absorptive capacity: spillovers of copper interconnect technology for semiconductor chips. *Industrial and Corporate Change* 18 (6), 1249–1284.
- Liu, X. and Buck, T. 2007. Innovation performance and channels for international technology spillovers: evidence from Chinese high-tech industries. *Research Policy* 36, 355–366.
- Mowery, D. C. and Oxley, J. E. 1995. Inward technology transfer and competitiveness: the role of national innovation systems. *Cambridge Journal of Economics* 19, 67–93.
- Mowery, D. C., Oxley, J. E. and Silverman, B. S. 1996. Strategic alliances and interfirm knowledge transfer. *Strategic Management Journal* 17 (Winter Special Issue), 77–91.
- Mowery, D. C., Oxley, J. E. and Silverman, B. S. 1998. Technological overlap and interfirm cooperation: implications for the resource-based view of the firm. *Research Policy* 27, 507–523.
- Nelson, R. R. 1959. The simple economics of basic scientific research. *Journal of Political Economy* 67 (3), 297–306.
- Pavitt, K. 1991. What makes basic research economically useful, *Research Policy* 20 (1991) IOY-119.
- Pisano, G. P. 1994. Knowledge, integration, and the locus of learning: an empirical analysis of process development. *Strategic Management Journal* 15, 85–100.
- Powell, W. W., Koput, K. W. and Smith-Doerr, L. 1996. Interorganizational collaboration and the locus of innovation: networks of learning in biotechnology. *Administrative Science Quarterly* 41, 116–145.
- Robertson, P. L., Casali, G. L. and Jacobson, D. 2010. Managing open incremental process innovation: absorptive capacity and distributed learning. *Research Policy* 41, 822–832.
- Simon, H. 1951. A formal theory of the employment relationship. *Econometrica* 79 (3), 293–305.
- Teece, D. J., Pisano, A. and Shuen, A. 1997. Dynamic capabilities and strategic management. *Strategic Management Journal* 18 (7), 509–533.
- Todorova, G. Durisin, B. 2007. Absorptive capacity: valuing a reconceptualization. *Academy of Management Review* 32 (3), 774–786.
- Rosenberg, N. 1990. Why do firms do basic research (with their own money)? *Research Policy* 19, 165–174.
- Rosenstein-Rodan, P. N. 1943. Problems of industrialisation of Eastern and South-Eastern Europe. *The Economic Journal* 53 (210/211), 202–211
- Todorova, G. and Durisin, B. 2007. Absorptive capacity: valuing a reconceptualization. *Academy of Management Review* 32 (3), 774–786.

Veugelers, R. 1997. Internal R&D expenditures and external technology sourcing. *Research Policy* 26, 303–315.

Veugelers, R., Cassiman, B. 1999. Make and buy in innovation strategies: evidence from Belgian manufacturing firms. *Research Policy* 28, 63–80.

Volberda, H. W., Foss, N. J. and Lyles, M. A. 2010. Absorbing the concept of absorptive capacity: how to realize its potential in the organization field. *Organization Science* 21 (4), 931–951.

Zahra, S. and George, G. 2002. Absorptive capacity: a review, reconceptualization, and extension. *Academy of Management Review* 27 (2), 185–203.

Suggested Cross-References

dynamic capabilities
path dependence in technologies and organizations
knowledge based view
complementarities
R&D alliances
R&D investment
resource based view
appropriability regime
Arrow, Kenneth
basic research
biotechnology industry
pharmaceutical industry
co-evolution of dynamic capabilities
cognition and strategy
competitive advantages
evolutionary-theories of innovation
lock-in effects
incentives
inter-organizational learning
knowledge sourcing
knowledge networks
knowledge spillovers
learning and adaptation
Levinthal, Daniel
make-or-buy decision
managerial cognition
markets for technology
Nelson, Richard
organizational knowledge

Rosenberg, Nathan
science and innovation
search (and strategy)