

Beyond high tech: early adopters of open innovation in other industries

Henry Chesbrough¹ and Adrienne Kardon Crowther²

¹Center for Open Innovation, Haas School of Business, UC Berkeley, CA, USA

²Analysis Group, Menlo Park, CA, USA

Companies have historically invested in large research and development departments to drive innovation and provide sustainable growth. This model, however, is eroding due to a number of factors. What is emerging is a more open model, where companies recognize that not all good ideas will come from inside the organization and not all good ideas created within the organization can be successfully marketed internally. To date, Open Innovation concepts have been regarded as relevant primarily to 'high-technology' industries, with examples that include Lucent, 3Com, IBM, Intel and Millenium Pharmaceuticals. In this article, we identify organizations in industries outside 'high technology' that are early adopters of the concept. Our findings demonstrate that many Open Innovation concepts are already in use in a wide range of industries. We document practices that appear to assist organizations adopting these concepts, and discover that Open Innovation is not ipso facto a recipe for outsourcing R&D. We conclude that Open Innovation has utility as a paradigm for industrial innovation beyond high tech to more traditional and mature industries.

1. Introduction

The book *Open Innovation* describes an innovation paradigm shift from a closed to an open model.¹ At the heart of this model is the recognition that today, competitive advantage often comes from *inbound open innovation*, which is the practice of leveraging the discoveries of others: companies need not and indeed should not rely exclusively on their own R&D. In addition, *outbound open innovation* suggests that rather than relying entirely on internal paths to market, companies can look for external organizations with business models that are better suited to commercialize a given technology. Open Innovation has taken on greater saliency in light of the debate about globalization and the potential for the R&D function itself to become outsourced, as the manufacturing function was 20 years earlier.²

Open Innovation follows a long tradition of studying the processes of innovation. Schumpeter

(1934) gave a powerful impetus to the study of innovation with his comparison of the entrepreneur and the entrenched incumbent firm. Business historians have documented the extensive markets for innovation that pre-dated the rise of the corporate R&D laboratory, and often pre-dated the enforcement of intellectual property law (Lamoreaux and Sokoloff, 2001). Historical accounts suggest that early R&D activities grew out of the need in many industries to maintain and improve production activities (Chandler, 1990). Because activities were frequently unique for each firm, investments in R&D were firm specific. Mowery (1983) documented the rise of the corporate R&D laboratory in American manufacturing, and attributed this rise to the costs of organizing innovation inside the firm, relative to the costs of organizing innovation through the market. From the technology base created by internal R&D, firms naturally moved to exploit their accumulated knowledge to develop

new products, thereby enhancing their economies of scope; in many industries large-scale dedicated R&D functions emerged, providing a barrier to entry through economies of scale (Chandler, 1990).

Another rich source of antecedents has been substantial prior work on the importance of external technology, at least when it was 'inbound' to the organization. Nelson and Winter (1982) modeled the firm's decision to search for new technology outside of its own organization. Cohen and Levinthal (1990) wrote about the importance of investing in internal research in order to be able to utilize external technology, an ability they termed, 'absorptive capacity.' Rosenberg (1994) asked the question, why do firms conduct basic research with their own money, and answered that this research enhanced the firm's ability to use external knowledge. Firms that fail to exploit such external R&D may be at a severe competitive disadvantage (Rosenberg and Steinmueller, 1988).

Other recent research has called attention to the rise of intermediate markets in particular industries (Arora et al., 2001). These intermediate markets alter the incentives for innovation, and also condition the mode of entry of new technologies and new firms into an industry (Gans et al., 2002). The presence of intermediate markets may interact with more networked structures to change the way in which innovation is organized.

Any model that claims to be a new paradigm for industrial innovation must account for anomalies that are not well explained in an earlier paradigm (Kuhn, 1962). *Open Innovation* identifies some anomalies in this vein. Corporate R&D organizations encountered difficulties when internal research generated spillovers that could not be internally commercialized. In some cases, such technology would be licensed to others, but in the majority of cases it 'sat on a shelf' waiting either for internal development or its research proponents to leave the firm and develop it on their own. This led to the Kuhnian anomaly of having the benefits of the innovation accrue *not* to the firm that financed its development, but instead to other firms who were able to capture the benefits of the innovation. The best known contemporary example of such spillovers is Xerox PARC (Smith and Alexander, 1988; Chesbrough, 2002). While these anomalies were documented, they were not adequately explained under the old model. They amounted to a regrettable but necessary cost of doing business.

A new paradigm must also explain evidence beyond its initial area of inquiry if it is to have external validity (Yin, 1988). In *Open Innovation*, the evidence adduced to support this model is taken almost exclusively from the so-called 'high-technology' industries, such as computers, information technology, and pharmaceuticals (Chesbrough, 2003a, b). A very recent study has found Open Innovation concepts relevant to explaining a technological transition from linear to digital stereophonic amplifiers (Christensen et al., 2004). Even if it is stipulated that Open Innovation accurately characterizes innovation processes in these industries (and therefore possesses some *prima facie* internal validity), these industries represent only a few of the many sectors in an advanced industrial economy. It remains an open question whether the concepts of Open Innovation apply to lower technology or more mature industries.

This question of external validity motivated our research project. To explore whether open innovation processes were operating outside the aforementioned industries, we sought to answer three questions:

1. Are companies across multiple industries (outside of 'high-technology') utilizing concepts consistent with the open innovation paradigm?
2. If so, what are the primary concepts being successfully employed, and what practices embody these concepts?
3. What Open Innovation adoption challenges have these adopting companies faced?

2. Our survey

Our methodology was intended to identify and qualitatively interview potential 'early adopters' of Open Innovation concepts. Our approach to finding appropriate companies to study began with multi-parameter, broad-based literature searches. We wanted to identify organizations that may have begun using either inbound and or outbound Open Innovation concepts, so we constructed search strings that seemed likely to turn up potential interview targets. We wanted to survey recent practices, and so we confined our search to articles in the past 24 months. Our search parameters which included both inbound and outbound open innovation strings, included; *open innovation*, *external innovation*, *sourcing innovation*, *innovation licensing*, *technology in-licensing*, *technology licensing*, and

technology out-licensing. These parameters led to over 1,000 citations in news sources over the past 2 years. By design, we were looking for companies that had adopted open innovation practices; therefore, our survey cannot make any claim to being statistically representative of the adoption of these practices in the overall economy.

Once we had compiled the citations, we then excluded all companies operating in the computer, information technology, and pharmaceutical industries. We also eliminated redundant articles on the same company and companies with headquarters outside the United States. Through our selection process, we generated a list of 40 potential companies in mature and/or asset intensive industries that were likely utilizing the concepts of Open Innovation. We then began phone contacts of the prospective organizations. If one of us had any prior industry knowledge about personnel within the identified organization, that criterion elevated the likelihood of making contact within that organization. We conducted in-depth qualitative interviews with senior business executives to understand common themes and trends regarding how each company adopted, deployed, and encouraged the concepts of Open Innovation within their organization. We emerged with 12 completed interviews, a response rate of 30% (12 out of the original 40 identified). We were not able to learn a great deal about the non-respondent firms, but these firms did not differ significantly from respondents in their size

or in the industries in which they operated. The surveyed companies are described in Exhibit A.³ Our semi-structured set of questions is shown in Exhibit B, responses to these questions led the interviewer to a set of detailed follow-up questions. We sought senior-level perspectives within the selected organizations. The interviews were held primarily with vice presidents of R&D or business unit executives. As shown in Exhibit A, the 12 companies we spoke with all represent mature and/or asset-intensive industries. Two of the companies are private; the remaining 10 have revenues greater than \$1 billion. Our sample is thus small in size, and skewed towards large enterprises. We found a range of industry settings, including aerospace, diversified chemicals, medical devices, bioscience tools and services, inks and coatings, thermoplastics, lubricants, assembly technology and fasteners, and consumer packaged goods.

Our research focused on understanding the practices being successfully deployed along four activities: Strategy and Goal Setting, Sourcing, Integration and/or Outsourcing Management, and Metrics and Organization. Within each activity we were able to develop a set of successful practices and useful learnings by comparing trends and patterns across respondent companies. We believe that this paper provides a foundation of empirical evidence that could be used to develop further qualitative benchmarking research on Open Innovation practices across all industries.

Exhibit A. Portrait of respondent companies

Revenues	Industry	Interview with
> \$5 billion	Chemicals	Managing director, ventures
> \$1 billion	Bioscience tools and services	CPG program manager (corporate business development)
> \$5 billion	Chemicals, diversified	Director, corporate technology partnerships department
> \$5 billion	Consumer packaged goods	VP, R&D; R&D strategic planner
NA (private)	Diversified	Director, R&D
NA (private)	Thermoplastics	Director, commercial development
\$1–\$5 billion	Medical devices	VP, corporate R&D
\$1–\$5 billion	Hardware, home improvement	President, business unit and EVP, corp R&D planning manager
> \$5 billion	Chemicals	Venture portfolio manager
\$1–\$5 billion	Inks & coatings	VP, R&D and new market development
\$1–\$5 billion	Lubricants	VP, business unit
> \$5 billion	Aerospace	Vice President, technology ventures manager, technology acquisition (IT) manager, Technology planning and acquisition principal process architect, technology planning

Exhibit B. First-level innovation questions

1. To what level of satisfaction are your technology needs met by your internal R&D? Explain.
2. Does your company make a practice of looking to bring in outside IP and technology? Is this done opportunistically or do you have a formal, systematic to doing so?
3. Is looking outside for technology that can be leveraged everyone's job—or is there a distinct group dedicated to doing this? What types of people fulfill this role?
4. What specific goals or objectives do you have regarding bringing in technology? What incentives are tied to these goals?
5. Where do you typically look for outside ideas and technology: e.g.: universities, start-ups, competitors, conferences, or companies in peripheral industries?
6. How would you characterize your efforts to bring in technology:
 - a. Would you say that typically when you bring-in or jointly develop an outside technology, it is to address an incremental product improvement or a breakthrough product?
 - b. Do you typically work with 'proven' technologies used in other applications, or are you trying to develop something entirely new?
 - c. Do you typically bring in technology that leverages core R&D capabilities, or does it feel more like outsourcing non-core needs?
7. How has bringing in outside technology helped your company? Has the impact been significant? What has the impact been?
8. How would you characterize your efforts to take out technology?
 - a. When something is developed internally that doesn't fit with your business model, do you have a practice of taking the IP or technology assets out to the marketplace?
 - b. When something that was initially developed internally is deemed 'dead,' are efforts made to find companies or partners that might be interested in it? Is this done opportunistically or is there a formal mechanism to do this?
9. Are there specific goals around when a technology asset can be taken out to the marketplace? Who or what group has responsibility for doing this? How are they incented?
10. What impact has taking IP or technologies you have chosen not to commercialize out to the market had on the company?

3. Findings

"In 2000, margins were declining and we knew it wasn't just the economy – our products were increasingly viewed as commodities. We needed to find innovations and create new markets where the potential to differentiate our products would be higher." (Senior VP, Research and New Market Development, Coatings Co.).

3.1. *Are companies across a broad set of industries utilizing Open Innovation?*

Our discussions confirmed the effectiveness of this approach to identifying potential adopters of Open Innovation. In each of the 12 companies that completed the interview process, we found at least some of the practices articulated in *Open Innovation* to be in actual use. All of the respondents we spoke with engage in some form of technology in-licensing, acquisition and joint development to bring in technology. A number also engage in outbound activities such as intellectual property or brand out-licensing.

We probed for the factors that motivated these organizations to adopt these practices. Respon-

dents identified a number of catalysts that drove the organization to accept a more open environment. The single most common reason offered is the belief that utilizing more technology from outside the firm is critical for profitable growth. Other influences include the need for external technologies to maintain or improve product margins and a perceived lack of ability to meet corporate growth objectives absent recourse to external technologies.⁴ A few of the 12 viewed open innovation as a way to monitor potentially 'disruptive technologies' that may threaten existing businesses.⁵ Increasing the company's speed to market for developing new products was also mentioned, while cost reduction appears to be a secondary driver.

3.2. *Which of the concepts are being successfully employed? What are the primary practices being used?*

As mentioned in the introduction, Open Innovation includes both inbound and outbound technology activities. Only a few of the companies in our sample had significant outbound open innovation efforts. We believe that this is a function of where we focused and not of the market in general, since every inbound tech-

Exhibit C. Inbound open innovation key success factors

	Key success factors		Key success factors	
Strategy/goals	Provide top-down direction and encouragement for Open Innovation (OI) practices Focus efforts and ensure alignment with business growth objectives	Integration and management	Assign business ownership and responsibility for success Do not create separate management systems – modify existing systems (unless a new business model is needed)	
Sourcing	Build deep networks in relevant areas Bring in innovations where R&D can still add value and have wins Obtain market exclusivity or purchase technology outright when core	Metrics and organization	Align metrics and incentives to encourage success whether in an open or closed environment Communicate OI link to strategy and business objectives, publicize wins	

Exhibit D



nology effort by one organization generates a reciprocal outbound effort from some other organization. As a result, the remainder of this article’s focus is on inbound technology practices.

Our research focused on understanding the practices being successfully deployed along four activities: Strategy and Goal Setting, Sourcing, Integration and Management, and Metrics and Organization. Against these activities, a number of success factors for incorporating inbound Open Innovation concepts were consistently articulated (see Exhibit C).

The companies we spoke with reported that embedding Open Innovation principles into their organization began with top-down direction and clear alignment between the need to meet business growth objectives and the desire to look outside for technology. While all agree on the need for

alignment, however, respondents use Open Innovation to address two very different growth objectives: those within the current business and those associated with a potential new business (see Exhibit D). When internal R&D cannot meet growth objectives, a growth gap ensues. To close the first growth gap requires strengthening or extending the current business by optimizing execution of the existing product pipeline. Closing the second business growth gap requires identifying potential new businesses in emerging technologies. This latter objective was perceived to require a longer time horizon before any results would be achieved.

The emergence of two types of growth challenges leads us to a fundamental question respondent companies deploying Open Innovation practices address: in an open environment, do we focus on optimizing incremental development execution or do we look to create step-change growth options—or both?

3.3. Successful practice: leveraging inbound open innovation to optimize development execution

“Once a business group has identified a new product innovation or market segment it wants to pursue, it is often faster and cheaper to look outside for the associated technology than to develop it in-house” (Director, Consumer R&D, Diversified Mfg Co.).

Using open innovation to extend or defend one's core business requires a company to address an ongoing development issue: for technology opportunities already in the development pipeline, what is the best way to capture commercial value? Respondents indicated that once a business or market need is defined and a technical challenge is determined, external scanning can help to determine if an external technology can get offerings to market faster.

We found that when companies look outside for technologies to extend or defend their core business, they minimize risk by investing in technology that is often proven in other applications (as opposed to 'new to the world' technologies). These are economies of scope, in Chandler's (1990) parlance, or could also be conceived of as recombinations of technology (Fleming and Sorensen, 2001). In addition, respondent companies tend to seek agreements with entrepreneurs and smaller companies so that market exclusivity can be obtained. Bringing in outside technology requires internal 'champions' who can interact effectively with others in many different functions across the enterprise. Such champions are reminiscent of the 'heavyweight' managers that figured prominently in research on new platforms in the automotive industry (Wheelwright and Clark, 1992). These champions are viewed as important to support the effort needed to integrate the external technology into an existing product development phase-gate process.

Companies using open innovation to extend their enterprise do not create new processes and metrics; instead they layer an open innovation perspective onto existing processes. In general, open innovation is considered a means to an end or a tool to achieve growth goals. As such, specific metrics around open innovation are not employed; instead, clear growth goals, such as percent of revenue from new products, are used to induce open innovation activities. In sum, adopters perceive that the key to success is providing focus and clear top down direction, requiring business ownership of new technology (whatever its provenance), and heavily involving R&D in due diligence and integration.

3.4. *Successful practice: leveraging inbound open innovation to create step change growth*

"We need to identify technologies that may result in breakout businesses for our parent

company – generating \$200 to \$500 million in five years" (Venture Portfolio Manager, Diversified Mfg Co.).

Using open innovation to generate new growth in revenues requires a company to address a different issue: How to avoid over-funding incremental business projects and inadvertently under-funding potentially higher growth, longer-term options? We found that companies looking for emerging and breakout technologies start by defining a set of target areas that they anticipate will drive next generation growth. This tends to be a high-level, top-down exercise, often tied to the strategic planning process. Examples of target areas include nanotechnology, advanced composites, environmental technologies, and information technology.⁶ While these areas are broad, companies scanning for breakout technologies tend to focus efforts in sub-areas that are perceived as most relevant to their existing businesses.

Unlike searching for opportunities to fill existing product gaps, these opportunities are higher risk. To manage the risk, companies we spoke with place a series of small bets on early stage, unproven technology where commercial viability is unclear. In some cases, companies also go beyond investment and seek board involvement or provide access to internal resources for joint development. In two cases, our respondents created an internal group to provide a small amount of corporate investment to external ventures, which was run like a venture capital firm. These groups and these amounts are not large. The multi-billion dollar companies doing this employ only five or six individuals, and invested between five and 15 million dollars per annum. The objective is not primarily capital appreciation from the investment, but instead the evaluation of these ventures' technologies for applicability inside the parent company.

3.5. *What adoption challenges have these companies faced? How were challenges overcome?*

Adopting Open Innovation concepts within an organization appears to require practices that are highly focused and aligned with overall business objectives. Effective adoption, however, typically requires overcoming two critical challenges. The first is the not invented here (NIH) syndrome, well known within the R&D community (Katz

and Allen, 1985). Companies we spoke with have overcome NIH by clearly articulating the growth gap and explaining why internal efforts are insufficient to meet objectives, thereby building greater organizational alignment and commitment to an Open Innovation approach. Further commitment is gained when organizations involve R&D early (instead of bypassing it) as well as when organizations identify external technologies where internal R&D can be leveraged to add further value.

The second adoption challenge for Open Innovation concepts involves sustaining internal commitment over sufficient time to realize benefits from adopting the concepts. To address this issue, companies have ensured senior management support and funding at the outset of the initiative, created open innovation champions to manage the processes that incorporate the technologies in the business, and revised internal processes, metrics, and incentives to induce adoption. In sum, our research identified that moving from a set of *ad hoc* processes to clearly defined Open Innovation practices, systems, roles, and responsibilities can help to ensure successful adoption across the organization.

4. Conclusion

Our interviews suggest that certain Open Innovation concepts are finding application in companies operating outside the 'high-technology' industries that comprise the bulk of the evidence in *Open Innovation*. Participants in these other industries are not innovating differently for innovation's sake; rather, the data suggest that the search for growth, in revenues and in new products, is the primary driver leading to the adoption of these concepts.

For the responding firms, Open Innovation concepts are not employed primarily as a rationale for cost reduction or outsourcing of the R&D function. Indeed, there is preliminary evidence that internal R&D spending is maintained or increased in these organizations. Thus, the concepts of Open Innovation ought not to be interpreted to imply the outsourcing of the entire R&D function. Leveraging external research may function more as a complement than as a substitute in the performance of internal R&D activities.

We did not find every Open Innovation concept to be in widespread use. Even in a sample delib-

erately constructed to identify 'early adopters' of Open Innovation, we found that many of the outbound-oriented concepts in the book have not been adopted yet. At one level this is odd, since one company bringing in an external technology is obtaining it through some other organization's outplacement of that technology. One explanation may be that certain types of organizations, such as universities, are donors of research and technology (and bring in little or no external technology). A broader sample of a more diverse range of organizations may have identified these 'donors,' and recorded more outbound innovation practices.⁷ Within the firms we did survey, there may be certain environmental conditions required for these practices to diffuse, such as liquid private equity markets, or markets for intellectual property. In other cases, it may be simply that the sources of inertia that impair organizational change in other R&D contexts apply here as well. And it may be that these outbound activities are already occurring, but are less salient in the minds of our respondents.

We believe that the evidence reported here belies the claim that *Open Innovation* is just for 'high-technology industries.' While adoption of the concepts is at an early stage in many of the industries we studied, we did find adoption across a wide range of industries that were not previously considered in the book. We believe this suggests that *Open Innovation* may indeed have broader applicability, a crucial prerequisite if this concept is to supplant the current paradigm of industrial R&D.

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Notes

1. Henry Chesbrough (2003a), *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Press.)
2. For an alarmist assessment of the trend, see Forrester Research, which estimates that 3.3 million R&D jobs will move offshore over the next 12 years (<http://www.nytimes.com/2003/10/05/business/05ECON.html?ntemail0>). For a more hopeful assessment, see the McKinsey Global Research Institute, <http://www.mckinsey.com/knowledge/mgi/offshore/>, which estimates that the United States will capture 78% of the value created from offshore R&D employment.
3. As part of our screening process, we promised confidentiality to all organizations who complied with our requests for interviews. For this reason, we do not identify the surveyed organizations by name. Respondent organizations were also offered a copy of the survey results.
4. This was most commonly mentioned as a 'growth gap.' The respondents noted that their core markets were growing at one rate, while their top management had set financial expectations of a higher rate of growth. Interestingly, this growth gap appeared in the two privately held firms as well as in the nine publicly traded firms, so this is not a phenomenon confined to dealing with the external capital markets.
5. The respondents used this term themselves, usually referencing the pathbreaking book by Clayton Christensen, *The Innovator's Dilemma* (Christensen, 1997). It is interesting to note that this is a 'home grown' response to the problem of how to respond to disruptive technologies. Christensen makes no mention of utilizing external technologies within the company's current business as an appropriate response to disruptive technologies. Whether such a response is in fact effective is outside the scope of this paper.
6. While we consciously selected non-high tech industries, we found that these areas were also highly interested in new technology, including so-called high technology. This is another reason why the concepts of *Open Innovation* may have greater applicability beyond the industries explored in the book.
7. Chesbrough (2003b) identifies a number of organizational types, including those that generate innovation, those that fund innovation, and those that commercialize innovation.