

# Open R&D and open innovation: exploring the phenomenon

Ellen Enkel<sup>1</sup>, Oliver Gassmann<sup>2</sup> and Henry Chesbrough<sup>3</sup>

<sup>1</sup>Dr. Manfred Bischoff Institute of Innovation Management of EADS, Zeppelin University, Am Seemoser Horn 20, D-88045 Friedrichshafen, Germany. ellen.enkel@zeppelin-university.de

<sup>2</sup>Institute of Technology Management, University of St. Gallen, Dufourstrasse 40a, CH-9000 St. Gallen, Switzerland. oliver.gassmann@unisg.ch

<sup>3</sup>Center for Open Innovation, Haas School of Business, Faculty Wing, F402, University of California, Berkeley, Berkeley, CA 94720-1930, USA. chesbrou@haas.berkeley.edu

**There is currently a broad awareness of open innovation and its relevance to corporate R&D. The implications and trends that underpin open innovation are actively discussed in terms of strategic, organizational, behavioral, knowledge, legal and business perspectives, and its economic implications. This special issue aims to advance the R&D, innovation, and technology management perspective by building on past and present studies in the field and providing future directions. Recent research, including the papers in this special issue, demonstrates an increasing range of situations where the concept is regarded as applicable. Most research to date has followed the outside-in process of open innovation, while the inside-out process remains less explored. A third coupled process of open innovation is also attracting significant research attention. These different processes show why it is necessary to have a full understanding of how and where open innovation can add value in knowledge-intensive processes. There may be a need for a creative interpretation and adaptation of the value propositions, or business models, in each situation. In other words, there are important implications for new and emerging methods of R&D management.**

## 1. Opening up R&D and innovation

The advantages of cooperation are increasing in the open innovation era. As the focus shifted from purely internal R&D activities, the academic community started emphasizing that the firms should be open to outside innovation (e.g., Rigby and Zook, 2002; Christensen et al., 2005). 'Not all the smart people work for us. We need to work with smart people inside *and* outside our company' (Chesbrough, 2003). This networking imperative, which is present in many high-tech industries, is described by Saint-Paul (2003, p. 3): 'In an industry with, say, 10 firms similar in

output and investment in R&D, each member of a nine-firm technology cartel [or network] can expect to obtain immediate access to nine times the number of innovations that the remaining enterprise can anticipate on the average.' Once the notion of interorganizational innovation collaboration has entered an industry, everyone who does not participate will cope with serious competitive disadvantages. Even worse, Koschatzky (2001, p. 6) found that 'firms which do not cooperate and which do not exchange knowledge reduce their knowledge base on a long-term basis and lose the ability to enter into exchange relations with other firms and organizations'. There-

fore, cooperation with externals is core to increase innovativeness and reduce time to market.

Although the era of open innovation has begun for many firms, we still lack a clear understanding of the mechanisms, inside and outside of the organization, when and how to fully profit from the concept. Procter and Gamble announced that they were able to increase their product success rate by 50% and the efficiency of their R&D by 60% by introducing the open innovation concept to the organization. Philips has a well-established open innovation environment, while Siemens started a huge corporate open innovation program in 2009. However, only first approaches of measurement systems and key performance indicators are known, which makes it hard to evaluate open versus closed innovation approaches.

At the same time, companies investing in open innovation activities face risks and barriers that hinder them from profiting from their initiatives. Our study with 107 companies, equally European SMEs and large enterprises, undertaken in 2008, showed that risks such as loss of knowledge (48%), higher coordination costs (48%), as well as loss of control and higher complexity (both 41%) are mentioned as frequent risks connected to open innovation activities. In addition, there are significant internal barriers, such as the difficulty in finding the right partner (43%), imbalance between open innovation activities and daily business (36%), and insufficient time and financial resources for open innovation activities.

Today's business reality is not based on pure open innovation but on companies that invest simultaneously in closed as well as open innovation activities. Too much openness can negatively impact companies' long-term innovation success, because it could lead to loss of control and core competences. Moreover, a closed innovation approach does not serve the increasing demands of shorter innovation cycles and reduced time to market. The future lies in an appropriate balance of the open innovation approach, where the company or the institution uses every available tool to create successful products and services faster than their competitor and at the same time fosters the building of core competencies and protects their intellectual property. This demand creates an increasing urge for identifying the cause-and-effect relationship of open and closed innovation activities, finding the appropriate contributors and integration mechanisms, and exploring non-economic approaches to enrich companies' portfolios. This special issue will solve some of these future challenges and advance the field of open innovation.

## 2. Contributions in the field of open innovation

There are many ways to categorize theoretical developments in the field of open innovation, such as schools of thought (Gassmann, 2006), actors, or processes (Chesbrough et al., 2007; Gassmann and Enkel, 2004; Prahalad and Ramaswamy, 2004). By using a firm's process perspective, we can discuss the new developments in open innovation and illustrate their relevance in practice through illustrative figures. Three core processes can be differentiated in open innovation.

These are (1) the *outside-in process*: enriching the company's own knowledge base through the integration of suppliers, customers, and external knowledge sourcing. This process can increase a company's innovativeness (Laursen and Salter, 2006; Lettl et al., 2006; Piller and Walcher, 2006). The outside-in process reflects companies' experience that the locus of knowledge creation does not necessarily equal the locus of innovation. Our study (Enkel and Gassmann, 2008) with 144 companies in 2008 revealed that knowledge sources are mostly clients (78%), suppliers (61%), and competitors (49%), as well as public and commercial research institutions (21%). Consultancies are used to a lesser degree. A surprisingly large body of other sources was used (65%), namely non-customers, non-suppliers, and partners from other industries. Within this process, we can see an increasing awareness of the importance of innovation networks (Dittrich and Duysters, 2007; Chesbrough and Prencipe, 2008; Enkel, 2010), new forms of customer integration, such as crowdsourcing (Howe, 2008), mass customization, and customer community integration (Piller and Fredberg, 2009), as well as the use of innovation intermediaries, such as Innocentive, NineSigma, or yet2.com (Lakhani, 2008; Piller, 2009).

(2) The *inside-out process* refers to earning profits by bringing ideas to market, selling IP, and multiplying technology by transferring ideas to the outside environment. Companies that establish the inside-out process as key, focus on externalizing their knowledge and innovation in order to bring ideas to market faster than they could through internal development. The decision to shift the locus of exploitation outside the company's boundaries means generating profits by licensing IP and/or multiplying technology, thus transferring ideas to other companies. The firm no longer restricts itself to the markets it serves directly. Instead, it participates in other

segments using licensing fees, joint ventures, spin-offs, etc. These different streams of income create more overall revenue from the innovation (Gassmann and Enkel, 2004; Lichtenthaler and Ernst, 2007). In our study, 43% of the sample companies have an in-licensing policy in place, while only 36% use an out-licensing policy to externally commercialize their technologies (Enkel and Gassmann, 2008). Overall, faster and medium clockspeed companies (see Fine, 1998 for the definition of clockspeed) actively use the inside-out process, although to a much lesser degree than they use the outside-in process. In a comparison between company sizes, it is clear that only large multinationals have an active out-licensing strategy to which they allocate substantial resources. Within this process, we can see an increasing awareness of corporate venturing activities (Vanhaverbeke et al., 2008), new business models, such as new ventures and spin-offs (Chesbrough, 2007b), and the commercialization of own technologies in new markets called cross-industry innovation (Enkel and Gassmann, 2010).

(3) The *coupled process* refers to co-creation with (mainly) complementary partners through alliances, cooperation, and joint ventures during which give and take are crucial for success. Companies that establish the coupled process as key combine the outside-in process (to gain external knowledge) with the inside-out process (to bring ideas to market) and, in doing so, jointly develop and commercialize innovation. Co-creation is widely studied in the open innovation management literature. Derived from open source project development (Von Hippel and von Krogh, 2006), open innovation strongly focuses on peer-production through communities (Lakhani et al., 2008; Reichwald and Piller, 2009), consumers (Hienert, 2006; Lettl et al., 2006), lead users (Franke et al., 2006), universities or research organizations (Perkmann and Walsh, 2007), and partners from other industries (Enkel and Gassmann, 2009). Our study's results show that the companies integrated externals in 35% of all R&D projects (Enkel and Gassmann, 2008). The number differs considerably across the various clockspeed categories. In the fast clockspeed category, especially within the electrical, electronic, IT, and other high-tech industries, the number of joint R&D projects comprises almost 50% of all R&D projects within a company. In the slow clockspeed category, the number of joint projects is 20% or less, especially in the leather, wood, and printing industries. When company

size is taken into account, the coupled process is popular in companies of all sizes that have substantial resource allocation. Our study reveals that the participating companies use possible external partners in different ways. While 83% mainly link with non-competing market and technology leaders, 79% partner world-class universities and 61% local ones.

### 3. Papers in this issue

This special issue of *R&D Management* brings together some of the most active authors in this field, who have developed a further understanding of open R&D and open innovation in recent years. The large body of valuable submissions for this special issue required a rigorous approach to the selection and referee process and necessitated two issues of the journal to publish the resulting papers. The second issue will be published in 2010 and available in online early from December 2009 (Enkel and Gassmann, 2010).

While most researchers focus on the outside-in process, theory lacks of a clear understanding of the inside-out or outbound activities, as Lichtenthaler terms them. To close this gap, he addresses the relationship between outbound open innovation strategies and firm performance by analyzing 136 industrial firms. The results show that the degree of technological turbulence, the transaction rate in technology markets, as well as the competitive intensity in technology markets have a positive effect on firm performance.

Keupp and Gassmann focus on how and why firms differ regarding their extent of open innovation activities. By analyzing a large-scale sample, they are able to explain the externalization of firms as a result of firm-internal weaknesses in innovation. Four archetypes of firms were identified that differ significantly regarding their breadth and depth of open innovation activities and the importance of their impediments.

Ebner, Leimeister, and Krcmar discuss the important topic of community engineering for innovation. They describe how one of the leading software companies, SAP, tries to systematically address its user group of 60,000 highly educated people for the purpose of idea generation and innovation development. This leads to a concept of launching IT-supported idea competitions in virtual communities to leverage the potential of crowds.

A different perspective on communities is given by Fichter, who uses case studies to develop a concept of promoter networks. In this concept, the quality of interaction between innovation communities is evaluated through the promoter theory, which helps to explore the role of promoters and networks of promoters for open innovation. As transformational leaders who closely and informally cooperate across functional and organizational boundaries, promoters play a key role in open innovation.

Müller-Seitz and Reger undertook a comparative case study of two non-profit project networks that attempt to operate in line with the OSS phenomenon: Wikipedia, the online encyclopedia, and the development of an automobile, OScar. They compare a non-software-related project with open source principles e.g. regarding the aspirations of individual contributors or their supportive conditions, in order to evaluate whether OSS can be used outside the software industry.

Raasch, Herstatt, and Balka present their case study-based findings about open source development of tangible goods, the so-called open design. Their analysis reveals that open design is already being implemented in a substantial variety of projects with different organizational and institutional structures.

While most open innovation literature focused on economic issues in open innovation, Holmes and Smart studied eight voluntary partnerships between corporate and non-profit organizations. They could distinguish two generic approaches to open innovation: first, a more exploratory approach resulting in an emergent innovation process. The second approach is a focused and predetermined search activity to exploit the non-profit partner's resources. Driven by the need to address societal and social issues, they could demonstrate the value of an open innovation approach.

By applying a social systems perspective, Neyer, Bullinger, and Mösslein studied 15 medium-sized firms, analyzing the kind of innovators they integrate and the integration practices they use. They propose that a company can only fully profit from the knowledge of the integrator when they use a suitable integration practice.

Changing from non-profit and medium-sized firms to an established enterprise, Rohrbeck, Hölzle, and Gemünden studied the open innovation activities of an incumbent telecommunication operator. Opening up their innovation process led Deutsche Telecom to enhance its innovation capacity and embrace external creativity and knowledge resources.

#### 4. Opening silos

Developments in internet technology and social-networking technologies will allow companies to interact with numerous sources and predict an unprecedented level of richness. Companies will be able to draw their customers, suppliers, or other partners in the heart of their product development e.g. through online idea management or community participation in product development (Chesbrough and Prencipe, 2008). One important source of innovation will be companies from other industries, because we know that most innovation is based on a recombination of existing knowledge, concepts, and technology. Established solutions from other industries will enrich corporate product development while reducing the related risks through reducing uncertainty. The corporate silos in R&D and innovation functions will be more open to external leverages.

In addition, novel open innovation-based business models create further opportunities for user and additional treats for companies (Chesbrough, 2007a). Known from the software sector, where users develop open source platforms through co-creation, users are increasingly able to co-create all sorts of good. Nowadays, users can buy customized furniture over the internet, where it will be built by an online furniture shop for a fraction of the price a local carpenter would charge (Piller, 2009). Users will be more empowered in all sorts of industry sectors, creating their own goods, which meet their demands better, not only as inventors but also as manufacturers. Therefore, companies will not only face competition from other peers but from the empowered user himself (Baldwin et al., 2006).

Although practice and theory seem to indicate that the open innovation approach is beneficial for companies as well as users (Dodgson et al., 2006; Laursen and Salter, 2006), innovation measurement is still looking for an appropriate metrics system that monitors the investments and impact of open versus closed innovation approaches in order to help companies to find their right balance (Enkel and Lenz, 2009).

Intellectual property issues will raise research attention under the open innovation paradigm (Chesbrough, 2006). Cooperative innovation processes require different IP management systems than closed innovation systems. Therefore, new forms of IP evaluation, monitoring, and management will emerge (Fauchart and von Hippel, 2008).

Some of these challenges will be targeted in the second special issue on open R&D and open innovation available online later this year.

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## References

- Baldwin, C.Y., Hienert, C. and von Hippel, E. (2006) How user innovations become commercial products: a theoretical investigation and case study. *Research Policy*, **35**, 9, 1291–1313.
- Chesbrough, H.W. (2003) *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Cambridge, MA: Harvard Business School Publishing.
- Chesbrough, H.W. (2006) *Open Business Models: How to Thrive in the New Innovation Landscape*. Cambridge, MA: Harvard Business School Publishing.
- Chesbrough, H.W. (2007a) The market for innovation: implications for corporate strategy. *California Management Review*, **49**, 3, 45–66.
- Chesbrough, H.W. (2007b) Why companies should have open business models. *MIT Sloan Management Review*, **48**, 2, 22–28.
- Chesbrough, H.W. and Prencipe, A. (2008) Networks of innovation and modularity: a dynamic perspective. *International Journal of Technology Management*, **42**, 4, 414–425.
- Chesbrough, H.W., Vanhaverbeke, W. and West, J. (eds), (2007) *Open Innovation. Researching a New Paradigm*. Oxford: University Press.
- Christensen, J.F., Olesen M, H. and Kjær J, S. (2005) The industrial dynamics of open innovation – evidence from the transformation of consumer electronics. *Research Policy*, **34**, 10, 1533–1549.
- Dittrich, K. and Duysters, G. (2007) Networking as a means to strategy change: the case of open innovation in mobile telephony. *Journal of Product Innovation Management*, **24**, 6, 510–521.
- Dodgson, M., Gann, D. and Salter, A. (2006) The role of technology in the shift towards open innovation: the case of Procter & Gamble. *R&D Management*, **36**, 3, 333–346.
- Enkel, E. (2010) Attributes required for profiting from open innovation in networks. *International Journal of Technology Management* (in press).
- Enkel, E. and Gassmann, O. (2008) Driving open innovation in the front end. The IBM case. Working Paper University of St. Gallen and Zeppelin University, St. Gallen and Friedrichshafen.
- Enkel, E. and Gassmann, O. (2010) Creative imitation: exploring the case of cross-industry innovation. (in press).
- Enkel, E. and Lenz, A. (2009) Open innovation metrics system. Proceedings of the R&D Management Conference, Vienna, Austria, June 21–24.
- Fauchart, E. and von Hippel, E. (2008) Norms-based intellectual property systems: the case of French Chefs. *Organization Science*, **19**, 2, 187–201.
- Fine, C.H. (1998) *Clockspeed: Winning Industry Control in the Age of Temporary Advantage*. Reading, MA: Perseus Books.
- Franke, N., von Hippel, E. and Schreier, M. (2006) Finding commercially attractive user innovations: a test of lead-user theory. *Journal of Product Innovation Management*, **23**, 4, 301–315.
- Gassmann, O. (2006) Opening up the innovation process: towards an agenda. *R&D Management*, **36**, 3, 223–226.
- Gassmann, O. and Enkel, E. (2004) Towards a theory of open innovation: three core process archetypes. Proceedings of the R&D Management Conference, Lisbon, Portugal, July 6–9.
- Hienert, C. (2006) The commercialization of user innovations: the development of the rodeo kayak industry. *R&D Management*, **36**, 3, 273–294.
- Howe, J. (2008) *Crowdsourcing: Why the Power of the Crowd is Driving the Future of Business*. New York: Crown Publishing Group.
- Koschatzky, K. (2001) Networks in innovation research and innovation policy – an introduction. In: Koschatzky, K., Kulicke, M. and Zenker, A. (eds), *Innovation Networks: Concepts and Challenges in the European Perspective*. Heidelberg: Physica Verlag.
- Lakhani, K.R. (2008) InnoCentive.com (A). *Harvard Business School Case*, No. 608–170.
- Lakhani, K.R., Jeppesen, L.B., Lohse, P.A. and Pannetta, J.A. (2008) The value of openness in scientific problem solving. Harvard Business School Working Paper No. 07-050.
- Laursen, K. and Salter, A. (2006) Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal*, **27**, 2, 131–150.
- Lettl, C., Herstatt, C. and Gemuenden, H.G. (2006) ‘Users’ contributions to radical innovation: evidence from four cases in the field of medical equipment technology. *R&D Management*, **36**, 3, 251–272.
- Lichtenthaler, U. and Ernst, H. (2007) External technology commercialization in large firms: results of a quantitative benchmarking study. *R&D Management*, **37**, 5, 383–397.
- Perkmann, M. and Walsh, K. (2007) University-industry relationships and open innovation: towards a research agenda. *International Journal of Management Reviews*, **9**, 4, 259–280.

- Piller, F. (2009) The future of open innovation. Proceedings of The R&D Management Conference, Vienna, Austria, June 21–24.
- Piller, F. and Fredberg, T. (2009) The paradox of strong and weak ties. Working Paper RWTH Aachen University and Chalmers University, Aachen and Gothenburg.
- Piller, F.T. and Walcher, D. (2006) Toolkits for idea competitions: a novel method to integrate users in new product development. *R&D Management*, **36**, 3, 307–318.
- Prahalad, C.K. and Ramaswamy, V. (2004) *The Future of Competition: Co-Creating Value with Customers*. Boston, MA: Harvard Business School Press.
- Reichwald, P. and Piller, F. (2009) *Interaktive Wertschöpfung: Open Innovation, Individualisierung und neue Formen der Arbeitsteilung*, 2nd edn. Wiesbaden: Gabler.
- Rigby, D. and Zook, D. (2002) Open-market innovation. *Harvard Business Review*, **80**, 10, 80–89.
- Saint-Paul, G. (2003) Information sharing and cumulative innovation in business networks. Discussion Paper Series, Centre for Economic Policy Research, London.
- Vanhaverbeke, W., Van de Vrade, V. and Chesbrough, H.W. (2008) Understanding the advantages of open innovation practices in corporate venturing in terms of real options. *Creativity and Innovation Management*, **17**, 4, 251–258.
- von Hippel, E. and von Krogh, E. (2006) Free revealing and the private-collective model for innovation incentives. *R&D Management*, **36**, 3, 295–306.

**Ellen Enkel** is Professor of innovation management and Director of the Dr. Manfred Bischoff Institute of Innovation Management of EADS at the Zeppelin University in Friedrichshafen, Germany. Before, she was heading the competence center Open Innovation at the Institute of Technology Management at the University of St. Gallen (Switzerland). Her research interests focus on cooperative innovation processes like open and cross-industry innovation, innovation networks within and across companies as well as innovation metrics systems. She has broad industry experience working with companies like Daimler, Unilever, IBM, BASF, Alcan and Hen-

kel, has published 4 books and several academic articles in the area of innovation and technology management.

**Oliver Gassmann** is Professor of Technology and Innovation Management at the University of St. Gallen, Switzerland and Director of the Institute of Technology Management. After completing his PhD, he was leading corporate research of Schindler Corporation worldwide. Gassmann published in leading journals such as *Research Policy*, *R&D Management*, *Journal of Management*, *Journal of World Business*, *International Journal of Technology Management*, *IEEE Transactions on Engineering Management*, *Harvard Business Manager*. At the core of his research is the pervading question of how companies innovate and profit from innovation. He has been consulting several Fortune 500 firms in innovation strategy.

**Henry Chesbrough** is Executive Director of the Center for Open Innovation at the Haas School of Business at UC Berkeley. His research focuses on managing technology and innovation. His book, *Open Innovation* (Harvard Business School Press, 2003), articulates a new paradigm for organizing and managing R&D. A more academic version of open innovation, *Open Innovation: Researching a New Paradigm*, with Wim Vanhaverbeke and Joel West, was published in 2006 by Oxford University Press. His most recent book, *Open Business Models* (Harvard Business School Press, 2006), extends his analysis of innovation to business models, intellectual property management, and markets for innovation. His academic work has been published in *Harvard Business Review*, *California Management Review*, *Sloan Management Review*, *Research Policy*, *Industrial and Corporate Change*, *Research-Technology Management*, *Business History Review*, and the *Journal of Evolutionary Economics*. He is a member of the Editorial Board of *Research Policy* and the *California Management Review*.