Open innovation in the research and development: analysis of a cooperation net between companies from automotive sector and universities

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Abstract

The increasing demand for innovation and the necessity of reducing time and cost for the development of new products are modifying the automotive scenario in Brazil. From many years ago, it was characterized by a model of closed innovation mainly focused on the importing of technologies. The Flex Fuel technology has demonstrated to be a significant challenge to the companies, which is the main focus of this research. The main objective is to comprehend the process of open innovation in the content of the fuzzy front end, identifying the main motivations and bottle neck of its implementation. Aligned to that, it was evaluated a case study applied in a consortium containing nine companies and two universities. After the analysis of the documents and the execution of two interviews, questions were created and applied to all members of the consortium. The results are analyzed by the use of descriptive analysis, conjoint analysis and social net. An interesting aspect of this consortium is that the majority of the companies that constitutes are competitors. However the focus that the environment of knowledge is necessary to increase, they are sharing information and results. The main motivation factors identified for this consortium were the chance to reduce time for innovation and the collaborative development of technologies.

Keywords: open innovation, fuzzy front end, cooperation.

1 Introduction

The continuous evolution in the structured process of new product development favors the reduction of time-to-market, i.e. the time to introduce the product in the market (Tatikonda & Rosenthal, 2000). The increasing demand for innovation is directing the focus of the companies for the activities of fuzzy front end in the management process of innovation (Khurana & Rosenthal, 1997). "Fuzzy front end" cam be defined as the period between the idea generation and the moment that development starts (Kim & Wilemon, 2002).

The open innovation, term defined by Chesbrough represents the generation and use of ideas external to the organization, has become one important competitive tool for some sectors as Information Technology. However it has still low speed to other sectors (H. Chesbrough & Crowther, 2006; Dodgson, Gann, & Salter, 2006; Zien & Buckler, 1997).

The main objective of this work is to comprehend the process of open innovation in the context of fuzzy front end linked to the identification of the main motivation factors and bottle necks in its implementation. Then it was selected a longitudinal case study inside a consortium of research in the automotive sector, mixing the approaches of qualitative and quantitative research. Analysis applied consists on statistics and mapping techniques in the social nets to understand the relation between the actors.

2 Literature review

In the closed innovation model, the innovation process, since the concept of the idea, going for the development up to the commercialization, everything occurs inside the organization. One of the main advantages of the closed innovation is the profitability on the prize of price which is obtained by the introduction of innovation in the market.

In the open innovation model, the same process involves not only the internal environment of the organization, but also what is around, considering, for example, customers, suppliers, competitors and universities (H. W. Chesbrough, 2003a). In this context, Chesbrough concludes that management of the intellectual properties should follow the logic of the open innovation. It means that not only the ideas, but also the human resources and the acquired knowledge are not exclusive properties of the one that developed (Chesbrough, 2003b). The way that each organization uses the acquired knowledge and holds the best talents is what potentially makes the company different and improves its competitiveness. Open innovation favors the discovery of new ways of exploring the open innovation and incorporates the external innovation in the internal development (West & Gallagher, 2006).

It is important to highlight that in the same way of other typologies, the frontiers can be diffuse. Then it is possible to locate an organization in continuum, which extremes are the completely closed innovation or completely open (H. W. Chesbrough, 2003a). Important that of the companies to know well its inside before to join the open innovation model (Jacobides & Billinger, 2006).

The term fuzzy front end (FEE) can be understood as initial part and fuzzier of the innovation management once it refers to the phases of generation and selection of opportunities and innovative ideas. These activities in general have low structures and fuzzy in the organizations, while compared with the step of development itself. There are several distinctions between the FFE and the product development phase (Kim & Wilemon, 2002; Koen et al., 2001).

This is the very initial phase of the innovation process. The company should to search to a holistic view of this process because it is not enough to be aligned internally. It is necessary to maintain strong channels to follow up the environment changes regarding the monitoring of emergent technologies, new demands to customers and the competitor movements (Carvalho, 2009). In this way in the FFE the ideas are generated. For this work, it is explored the preparation of an environment to be able in supply the conditions to search new concepts for products given the transfer and/or generation of knowledge (Backman, Bo, & Setterberg, 2007).

From the cooperation perspective, there is the need in mention the fact that the organizations, independently on the different structures, are involved in social nets or networks (Powell, 1990). Social networks can be define groups of inter-organizations based on the systematic connections, formal or informal, of the companies (Freeman, 1991). It is an endogenous structure that depends on the individual choices of its actors (Eguíluz, Miguel, Zimmermenn, & Cela-Conde, 2001). Then its formation consists basically on knots and connections, where the knots are the actors and the connections represents the relation between the actors (McDonald, 2007).

The cooperation favors the access of the organizations to the information, resources, markets and technologies, in a way of combining competences and to increase their knowledge (Gulati, Nohria, & Zaheer, 2000). It also favors the expansion of the organization frontiers (Richardson, 1972).

There are many types of the connections that can occur between companies and universities: research partnership, research services, academic entrepreneurism, transfer of human resources, information interaction, commercialization of property rights, scientific publications (Perkmann & Walsh, 2007). The learn generated has been also the focus of previews researches (Gulati & Singh, 1998; Harrigan & Newman, 1990; Kogut, 1988). However it was given without the focus on the relations between companies and universities..

The analysis of the literature allows the identification of four types of relationships between the members of the company, customer or university, see Figure 1. The relations 1 and 2 are equivalent, they refers to

the interaction of the company to the university. This interaction can happen in different ways, including a simple relation of commercial service. On the other hand in the environment of the automotive industry, it is common the relation with the focus on the technology development before any commercial relation. The objective in this relation is the chance to collaborate to explore concepts of new technologies.

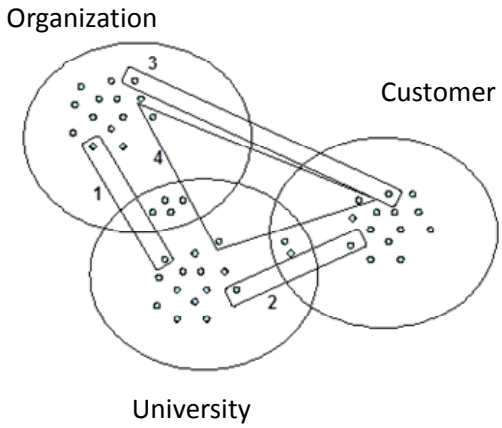

Figure 1 – Relations between the member of the company with its customer and university

This work focus in the relation indicated in the number 4 of the Figure 1, open and collaborative relation between company-customer-university (Janowicz-Panjaitan & Noorderhaven, 2009). Once the ideas are generated in the members enabled by the relations (Alegre & Chiva, 2008), all possible relationships are important as the basis to the open innovation. According to (Lorange et al., 1992), the main restrictions of these cooperative relations are: autonomy, the initial moment of the relation, focus in the external environment, politics, changes in the market, learn, people, poor communication and culture. In an evaluation between the different search methods for new concepts. Cooper and Edgett evaluate that the open innovation, specially the direct interaction with customers, is a very powerful tool. It is interesting related to the consortium under analysis of this paper (Cooper & Edgett, 2008).

3 Research Method

The research was based on the longitudinal study case taking the necessary recommendations this type of research as described by (Voss, Tsikriktsis, & Frohlich, 2002). The selected unit of analysis was a consortium involving nine companies and two universities with the focus on tribology and the mechanical impacts of the engine technology of the flex fueled internal combustion engines. In the period of two years (2010 e 2011), the researchers followed the formation of the consortium and the evolution along the time. There were also participation of monthly meetings and research seminars related to the consortium during the mentioned period.

The interviews allowed the identification of the main points to be explored in a closed questioner, with the objective to align the expectative of the members of the consortium and to measure the satisfaction of the institutions liked to the evolution of the partnership. These points were transformed in variables, which measure is one of the more remarking characteristics of the quantitative approach.

After the buildup of the questioner, it was sent to the 46 members and 11 answered. It is presented in Annex 1m the structure of the questioner. The questioner is composed by tree parts. In part I, it was evaluated variables related to the satisfaction of the member. It was used a score scale from 1 to 10 being subdivisions of half point. The approached topics were: satisfaction with the respect to the time schedule, satisfaction with the meeting agendas, satisfaction with the project management, satisfaction with the decisions taken in the project, satisfaction with the offered trainings, satisfaction with the involvement of different participating entities. For each topic, it was applied tree variables.

The second part was connected with the characterization of the sample. Some information applied were: gender, size of the company, previous experience in tribology project, previous experience in collaborative projects with other companies and/or universities, origin region of the company, motivator factors to entrance in the project. For the motivation factors, the participants were asked to select tree reasons from eleven options. The part III evaluated the degree of interaction between the companies and universities according to the scale: inexistent, weak, medium or strong.

4 Results

The evaluated consortium in this work counts with the involvement of 5 car builders, 2 auto-parts companies, one engineering service company and 1 oil and gas company. The table 1 presents the characterization of the members in the consortium.

Table 1 – Characterizations of the members of the consortium.

Institution	Type	Number of participants	Competence
Organization 1	Car builder	2 fixed + 2 not fixed	Leadership in larger engines
Organization 2	Car builder	1 fixed + 5 not fixed	Cost leadership / manufacturing
Organization 3	Car builder	1 fixed + 2 not fixed	Leadership in engines with lower fuel consumption
Organization 4	Car builder	1 not fixed	Beginning of project development 100% natural
Organization 5	Car builder	5 not fixed	Development platforms worldwide to flex engines
Organization 6	Auto-parts company	2 fixed + 8 not fixed	Specialist components of tribology
Organization 7	Auto-parts company	1 not fixed	Foundry
Organization 8	Engineering service company	2 not fixed	Combustion
Organization 9	Oil and gas	1 not fixed	Lubricants and lubricating systems
University 1	University	7 fixed + 5 not fixed	tribology, modeling and metallurgy / materials properties
University 2	University	1 fixed	Coatings

The Figure 2 illustrates the results related to the average of the eleven answered questioners for the eighteen variables. It is organized in the decreasing order of the average.

The topics with the highest scores were: satisfaction with the respect to the time schedule and satisfaction with the meeting agendas. It can demonstrate the applied efforts, which are being recognized by the participants.

The topics satisfaction with the project management, satisfaction with the decisions taken in the project and satisfaction with the involvement of different participating entities were evaluated with similar score level below to the two topics above. It may indicate that the sample of responses is not recognizing partly the efforts, which deserves higher attention and communication.

In the last appears the satisfaction with the offered trainings. The answers do not demonstrate the interest in the organization of trainings, but to get learn from the experience exchange of the participants.

The part of the characterization showed that 100% of the answers came from male participants. As information, the group is composed by 19 men and 5 women. Regarding the size of the companies, 10 answers were from big companies and 1 from small companies. It was expected once the main participation is given by auto builders and big universities.

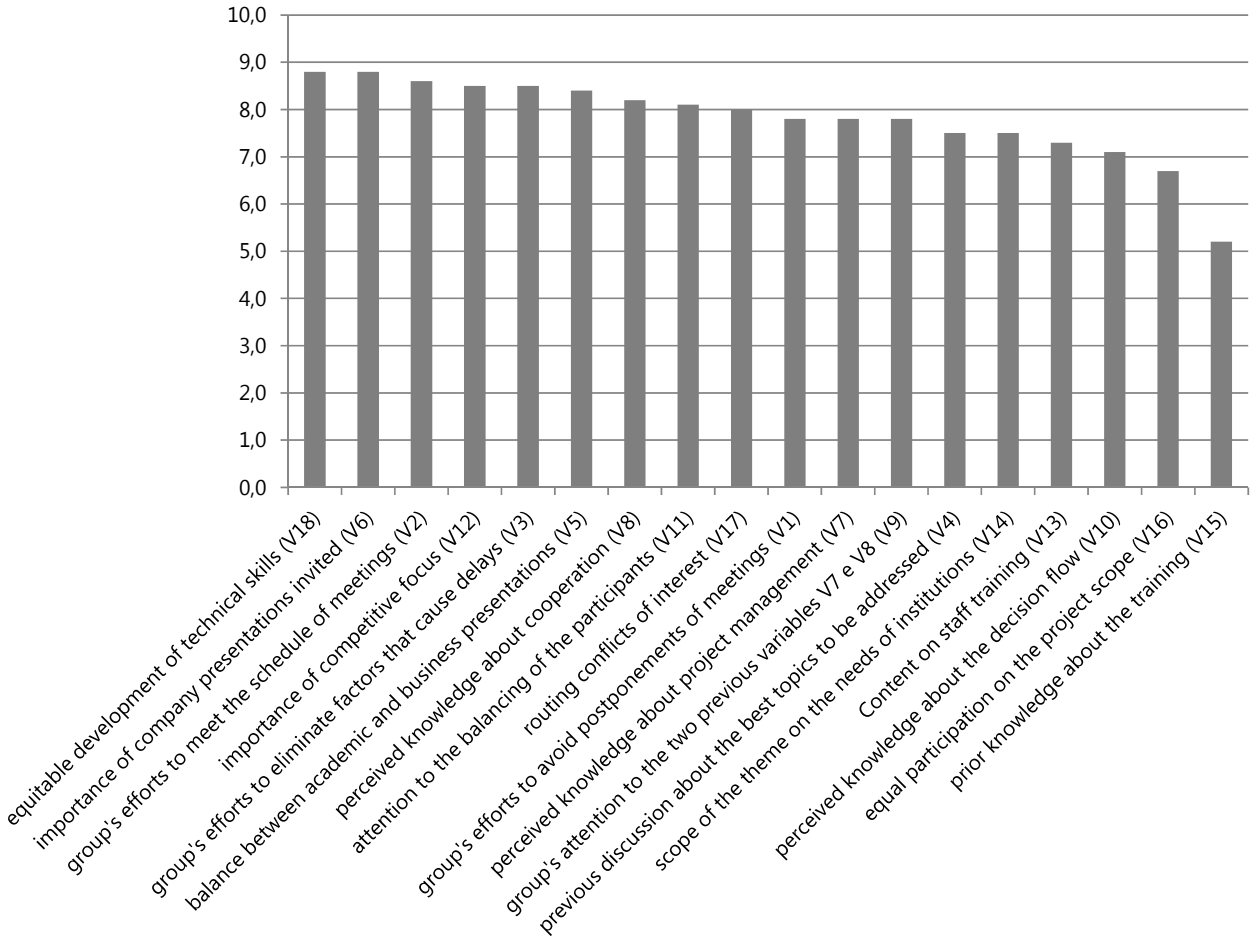

Figure 2 – Ranking of the eighteen variables, decreasing order of the evaluation.

Nine institutions, in front of two, have previews experience in tribology projects. From these 9, seven had these projects in collaboration with universities and/or companies. It is important to call attention to this result. The theme tribology in spite of being worked out by the majority of the participants is still understood as attractive. Notice that the consortium in evaluation has a pre-competitive focus. It is possible then to recognize the existent of significant vulnerability in the theme. And in this theme, the knowledge creation acts as key factor to the development of new products for the companies in the consortium.

The origin f the institutions presented in the following way: 3 in America, 5 in Mercosul and 3 in Europe. This point reinforce the importance and visibility of the subject not only in a local issue but also global.

The motivation factors to the entrance in the consortium, 3 were highlighted: reduce the time to innovation from learning, co-development of new technology and share complement technology.

Notice that it was confirmed the as described before in the literature review, the main motivation factor is the development and share of knowledge with the focus to reduce time-to-market on innovative products.

The net in the Figure 3 presents the results that indicate the interaction existent between the institutions.

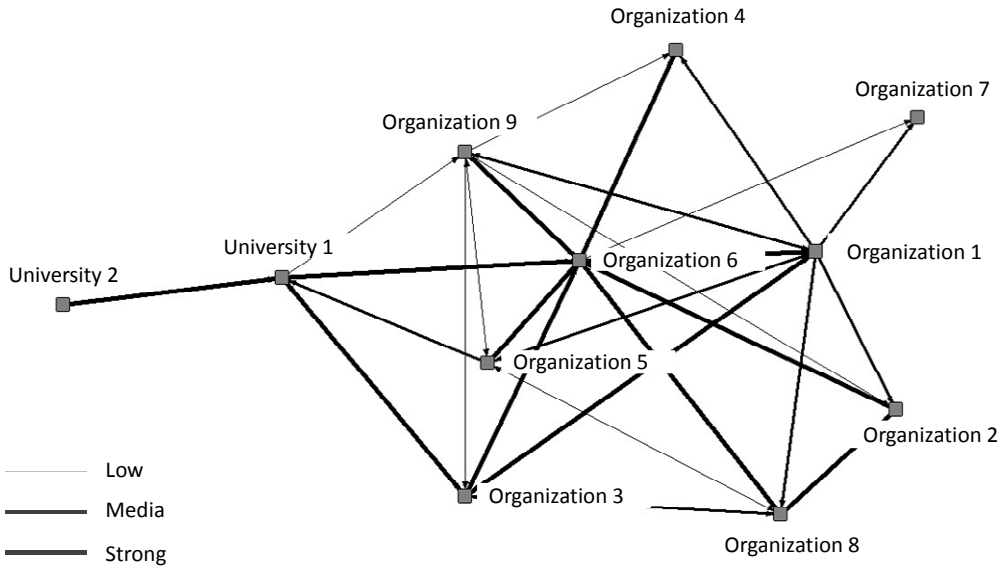

Figure 3 – Net for the interaction between the institutions.

It is verified that the company 6 is not only the most central of the net, but it also has the highest index of intermediation. Notice that many of the relations are characterized as weak or medium. It indicates the necessity of the institution to know better and to constitute the environment of thrust.

5 Conclusions

Besides the indication of the literature that the reductions of costs is one of the most important motivation factor to the entrance of companies in collaborative work with other institutions, in this project it was noticed the interest more focused on the development of knowledge given by the competence combination. Such knowledge focused on the reduction of risks and uncertainties related to the challenge of the flex fuel technology favors the reduction of the introduction time of the innovation to market.

Given the pre-competitive environment in the collaboration between companies and universities in the studied consortium, it is possible to indicate that the members from the companies act as boundary spanners. Their aim is in the search of ideas or the preparation of environment to reach new ideas. This is linked to the challenge to supply interesting concepts to the development funnel of the companies. Once it is a pre-competitive cooperation, it is not focused on the technology development or on the management of intellectual properties.

The fact of seven institutions to have previous experience in collaborative projects in tribology favors the degree of interaction and the degree of complementation between them. In this way, the interaction enables the development of thrust, which directly influences the internal mechanisms to enable the partnership.

In spite of the time schedule to be as predicted, the participation of the institutions are not being recognized to be happening in an homogenous way, which is against one of the objectives of the group. Another topic that requires improvement is related to the decisions take. It was noticed the need of improvement on the alignment of the objectives and the activities development up that moment. The authors intend to evaluate the next two years of the project in order to complement the analysis initiated in this research.

6 Annex 1 - Questionnaire

Part	Variables	Questions	Type of response
I	satisfaction with meeting the deadlines of the project	group's efforts to avoid postponements of meetings (V1)	scale of zero to ten, with intervals of 0.5
		group's efforts to meet the schedule of meetings (V2)	
		group's efforts to eliminate factors that cause delays (V3)	
	satisfaction with the agenda of the meetings	previous discussion about the best topics to be addressed (V4)	
		balance between academic and business presentations (V5)	
		importance of company presentations invited (V6)	
	satisfaction with the project management	perceived knowledge about project management (V7)	
		perceived knowledge about cooperation (V8)	
		group's attention to the two previous variables (V9)	
	satisfaction with the decisions taken in the project	perceived knowledge about the decision flow (V10)	
		attention to the balancing of the participants (V11)	
		importance of competitive focus (V12)	
	satisfaction with the training offered	Content on staff training (V13)	
		scope of the theme on the needs of institutions (V14)	
		prior knowledge about the training (V15)	
	satisfaction with the involvement of institutions	equal participation on the project scope (V16)	
		routing conflicts of interest (V17)	
		equitable development of technical skills (V18)	
II	gender		male / female
	size of the company		small / medium / large
	previous experience in projects of tribology		yes / no
	prior experience in collaborative projects with other companies and / or universities		
	continent of origin of the company		america / europe / asia / Mercosur
	motivating factors to enter into collaborative relationships	accessing new markets	choose three of eight
		share complementary technology	
		share productive advantages	
		jointly develop new technology	
		sharing costs and risks	
		reduce the time for innovation through learning	
		have access to new projects	
		having access to financial resources	
III	degree of interaction between institutions		absent / low / medium / strong

References

Alegre, J &, Chiva, R. (2008). Assessing the impact of organizational learning capability on product innovation performance: an empirical test. Technovation 28(6), 315–326.

Backman, M., Bo, S., & Setterberg, S. (2007). Working with concepts in the fuzzy front end: exploring the context for innovation for different types of concepts at Volvo Cars. R&D Management, 37(1), 17-28.

Carvalho, M.M. (2009). Inovação: Estratégias e comunidades de conhecimento. São Paulo: Atlas.

Chesbrough, H. W. (2003a). The Era of Open Innovation. MIT Sloan Management Review, 44(3), 35-41.

Chesbrough, H. (2003b). The logic of open innovation: Managing intellectual property. California Management Review 45(3), 33+.

Chesbrough, H., & Crowther, A. K. (2006). Beyond high tech: early adopters of open innovation in other industries. R&D Management, 36(3), 229-236.

Cooper, R., & Edgett, S. (2008). Ideation for Product Innovation: What are the best methods? Product Development Institute, 1, 12-16.

Dodgson, M., Gann, D., & 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.

Eguíluz, V. M., Miguel, M. S., Zimmermenn, M. G., & Cela-Conde, C. J. (2001). Cooperation and emergence of role differentiation in the dynamics of social networks. American Journal of Sociology, 110(4), 977-1008.

Freeman, C. (1991). Networks of innovators – A synthesis of research issues. Research Policy 20(5), 499-514.

Gulati, R., & Singh, H. (1998). The Architecture of Cooperation: Managing Coordination Costs and Appropriation Concerns in Strategic Alliances. Administrative Science Quarterly, 43(4), 781.

Gulati, R., Nohria, N., & Zaheer, A. (2000). Strategic networks. Strategic Management Journal, 21(3), 203-215.

Harrigan, K. R., & Newman, W. H. (1990). Bases of interorganization co-operation: Propensity, power, persistence. Journal of Management Studies, 27(4), 417-434.

Jacobides, M. G., & Billinger, S. (2006). Designing the Boundaries of the Firm: From "Make, Buy, or Ally" to the Dynamic Benefits of Vertical Architecture. Organization Science, 17(2), 249-261. doi:10.1287/orsc.1050.0167

Janowicz-Panjaitan, M., & Noorderhaven, N. G. (2009). Trust, Calculation, and Interorganizational Learning of Tacit Knowledge: An Organizational Roles Perspective. Organization Studies, 30(10), 1021-1044

Khurana, A., & Rosenthal, S. R. (1997). Integrating the Fuzzy Front End of New Product Development. Sloan Management Review, 38(2), 103-120.

Kim, J., & Wilemon, D. (2002). Focusing the fuzzy front-end in new product development. R&D Management, 32(4).

Koen, P., Ajamian, G., Burkart, R., Clamen, A., Davidson, J., Amore, R. D., Elkins, C., et al. (2001). Providing clarity and a common language to the "Fuzzy Front End." Research-Technology Management, 44(2), 46-55.

Kogut, B. (1988). Joint Ventures：Theoretical and Empirical Perspectives. Strategic Management Journal, 9(4), 319-332.

Lorange, P., Roos, J. & Bronn, P.S. (1992). Building successful strategic alliances. Long Range Planning 25(6), 10-17.

McDonald, D. B. (2007). Predicting fate from early connectivity in a social network. Proceedings of the National Academy of Sciences of the United States of America, 104(26).

Perkmann, M., & Walsh, K. (2007). University-industry relationships and open innovation：Towards a research agenda. International Journal of Management Reviews, 9(4), 259-280.

Powell, W. W. (1990). Neither Market nor Hierarchy: networks forms of organizations. Research in Organizational Behavior, 12, 295-336.

Richardson, G. B. (1972). The Organisation of Industry. The Economic Journal, 82(327), 883-896.

Tatikonda, M. V., & Rosenthal, S. R. (2000). Technology Novelty, Project Complexity, and Product Development Project Execution Success：A Deeper Look at Task Uncertainty in Product Innovation. IEEE Transactions on Engineering Management, 47(1), 74-87.

Voss, C., Tsikriktsis, N., & Frohlich, M. (2002). Case research in operations management. International Journal of Operations & Production Management, 22(2), 195-219.

West, J., & Gallagher, S. (2006). Challenges of Open Innovation：The Paradox of Firm Investment in Open Source Software. R&D Management, 36(3), 319-331.

Zien, K. A., & Buckler, S. A. (1997). From experience - Dreams to market: Crafting a culture of innovation. Journal of Product Innovation Management, 14(4), 274-287.