

# »The Winning products«



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## OPEN INNOVATION IN SMES THAT CREATE VALUE WITH OPEN SOURCE SOFTWARE

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### Abstract

*Open source software (OSS), as part of corporate open innovation is still a recent phenomenon. However, OSS has already the potential to fill the gap between innovation and product, and represents a great way for SME companies to create value in their target market. In a first instance, this paper reveals the major reasons and barriers for the adoption of open innovation in SMEs. Secondly it analyzes the use of open source software as an example of open innovation and presents the major pro- and anti-innovative features of OSS.*

**Keywords:** *Open innovation, Open source, SME, Open standards, Software industry*

### 1 Introduction

Globalization increasingly affects how companies operate, compete and innovate, both at national and international markets. Companies now face an environment in which competition is global, the knowledge is spread more widely, the R&D investments are increasing and the product life cycles are shortening. To meet these new challenges, companies need to adopt new approaches to innovation processes, organizational models, finance and decision making.

Innovation has become a key to succeeding in the competitive struggle for market share and a prerequisite for sustainable development in a globalized world. We can typically consider that there are two kinds of innovation approaches: closed innovation and open innovation. The major differences between these two concepts of innovation are illustrated in Table 1.

For a long time, closed innovation has been a very successful way used by companies to sustain a competitive advantage in their different businesses. However, the innovation landscape has changed considerably: good ideas are widely distributed with no firm having a monopoly, venture capital is abundant nowadays and the acceleration of the product life cycle has turned intellectual property (IP) into an increasingly perishable asset. As a result, a growing number of companies have been moving from an internally focused innovation process to one that is more “open”. In this new era of open innovation, firms use both internal and external pathways to exploit technologies and, currently, they scout different external sources of technology that can

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accelerate their innovation process (Chesbrough, 2003). In addition to internal R&D, established companies need to get access to external knowledge, such as startups, universities, suppliers, or even competitors to stay competitive in the long run (Vrande, 2008).

<b>Closed Innovation</b>	<b>Open Innovation</b>
The smart people in the field work for us.	We need to work with smart people inside and outside the company.
To profit from R&D, we must discover it, develop it, and ship it ourselves.	External R&D can create significant value: internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to the market first.	We don't have to originate the research to profit from it.
The company that gets an innovation to the market first will win.	Building a better business model is better than getting to the market first.
If we create the most and the best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win.
We should control our Intellectual Property (IP), so that our competitors don't profit from our ideas.	We should profit from others' use of our IP, and we should buy others' IP whenever it advances our business model.

*Table 1: Differences between closed innovation and open innovation (Chesbrough, 2003)*

## 2 Innovation in Small and Medium-Sized Companies

European Commission defines SMEs as “enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million” (EC, 2003). However, as far as the size-component is concerned, there is no single, universally accepted definition of what constitutes the “right”, numerically measurable size of a SME (Tiwari, 2007).

Despite the difference in their nuances, all definitions of SMEs companies inherently imply that SMEs have lesser human and financial resources at their disposal than large companies. Contrasted against some large corporate firms that generate billions of euros in annual sales and employ thousands of workers, SMEs are, per definition, equipped with much lesser resources. Many SMEs neglect the subject innovation because they lack skilled personnel and they have shortfalls in capacity and financing. Market chances are not persecuted and often there is no innovation strategy available (Scozzi, 2005).

The SMEs in Europe count for 23 million enterprises which provide around 75 million jobs, generate more than two thirds of the EU's Gross Domestic Product (GDP) and account for up to 80 percent of employment in some industrial sectors (Bardi, 2007). Therefore, there is a high potential for SMEs companies to play a prominent role in contemporary open innovation landscape.

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## 2.1 Motives for Open Innovation in SMEs

In November of 2008, the Erasmus Research Institute for Management (ERIM) and the Research Institute EIM Business and Policy Research conducted a study to analyze the reasons that drive companies to get involved in open innovation practices, namely: outsourcing of R&D, setting up new ventures, participation in new or existing firms, involvement of external partners, involvement of users and involvement of non-R&D employees. The different answers were coded in the following categories: control, focus, renewal, knowledge, costs, capacity, market, utilization, policy and motivation.

Consecutively, the authors of the research study classified all answers into the previous considered categories. These results are presented in Table 2.

Motives (%)	Type of open innovation					
	Outsourcing (R&D)	Venturing	Participation in other firms	Network usage	Customer involvement	Employee involvement
Control	1	1	3	1	1	9
Focus	3	8	0	1	0	-
Renewal	8	23	24	21	19	-
Knowledge	44	4	6	35	5	-
Costs	9	13	11	2	2	-
Capacity	13	0	5	7	3	-
Market	14	31	36	22	61	13
Utilization	-	-	-	-	-	30
Policy	-	-	-	-	-	15
Motivation	-	-	-	-	-	22
Other	8	19	14	11	10	11
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Table 2: Motives for different types of open innovation (Vrande, 2008)

The Table 2 shows that for almost all open innovation practices pursued by SMEs, the most important motives are market-related ones. For the majority of respondents, using new innovation methods is regarded as a way to keep up with market developments and to meet customer demand, which should eventually result in increased growth, better results, or a bigger market share. Another important reason for companies to engage in open innovation is the pursuit of corporate renewal. Corporate renewal refers to motives related to process innovation, the desire to develop products faster and more effectively, or to incorporate new technologies in current products.

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## 2.2 Barriers to Open Innovation in SMEs

Barriers to innovation in SMEs have been the object of investigation in a large body of international studies. A few are mentioned here: Acs and Audretsch (1990) worked on this topic in US, Mohnen and Rosa (1999) as well as Baldwin and Gellatly (2004) researched on them in Canada, Friedrich E. Stiftung in Germany (2004), and also Rammer et al. in Germany (2005 and 2006). The dominant problems they found are listed in Table 3.

Barriers to innovation in SMEs	Studies (amongst others)
Financial bottlenecks due to difficulties in accessing to external finance, high innovation costs and high economic risks	Acs and Audretsch (1990), Baldwin and Gellatly (2004), Rammer et al. (2006)
Shortage of and hindered access to qualified personal	FES (2004), Rammer et al. (2005), Rammer et al. (2006)
Limited internal know-how to manage the innovation process effectively and efficiently	Mohnen and Rosa (1999), Rammer et al. (2005)
Missing market know-how to meet customers' needs and to enter in foreign markets	FES (2004)
Bureaucratic hurdles due to long administrative procedures, and restrictive laws and regulations	Acs and Audretsch (1990), Rammer et al. (2006)
Lack of intellectual property rights	Baldwin and Gellatly (2004)

*Table 3: Major studies on barriers to innovation in SMEs (Tiwari, 2007)*

More recently, the ERIM and the Research Institute EIM Business and Policy Research also analyzed the major open innovation barriers, which were coded in the following categories: administration, finance, knowledge, marketing, organization, resources, property rights, quality of partners, user acceptance, customer demand, competent employees, commitment and ideas management.

Consecutively, the authors of the research study classified all answers into the previous considered categories. These results are presented in Table 4. This table didn't consider outsourcing of R&D, because this future motivation could only appear when it have occurred a previous internal effort in terms of innovation.

Table 4 shows that organization and corporate culture-related issues, which typically emerge when two or more companies are working together, are clearly the most important barrier that firms face when they engage in venturing, participation in other firms, and the involvement of external parties and users. The availability of time and resources is another barrier, which affects almost all types of open innovation practices. Administration-related problems occur fundamentally when a company is cooperating with governmental or other non-profit institution.

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Motives (%)	Type of open innovation				
	Venturing	Participation in others firms	Network usage	Customer involvement	Employee involvement
Administration	28	13	10	-	-
Finance	10	0	5	-	-
Knowledge	5	5	-	-	-
Marketing	10	5	-	-	-
Organization	35	75	48	30	-
Resources	5	0	7	10	17
Property rights	-	-	5	10	-
Quality of partners	-	-	24	-	-
User acceptance	-	-	-	13	-
Customer demand	-	-	-	28	-
Employees competence	-	-	-	-	24
Commitment	-	-	-	-	51
Idea Management	-	-	-	-	8
Other	8	3	-	8	-
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Table 4: Barriers to different types of open innovation (Vrande, 2008)

## 3 Open Innovation and Open Source

Open innovation is a great way to acquire and share innovations with others. Yet, turning an innovation into a product requires a lot of additional functionality, as well as development and integration effort. Most of this functionality is being implemented in software and, as a result, the amount of software in products has risen dramatically in the past years. However, it is becoming harder and harder for companies to develop all this software in-house, or even to buy this software from third-party software firms. Therefore, open source software can be seen as the right software methodology to fill the gap between innovation and product (Engelfriet, 2007).

### 3.1 Development Model of Open Source Software

The basic idea behind Open Source software is very simple. When programmers can read, modify, and redistribute the software's source code, it evolves. Programmers all over the world can improve the program, adapt it to their personal needs and fix bugs. The experiences of the past years show that this can happen at a much faster speed, compared to the pace of traditional software development. People who are familiar with Open Source software have learned that this rapid evolutionary process produces better software than the conventional closed model, in which only the original programmers can see the source code and everybody else must use a so-called "black box" of bits (Hecker, 1999). Because of the independent peer review and continuous evolutionary improvement and selection, Open Source software can reach levels of reliability,

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power and general maturity in short time frames that closed products will find hard to attain (Kenwood, 2001).

Several attempts have been made to explain this phenomenon. One of the first and most popular studies in this field was Eric Raymond's "Cathedral and the Bazaar" published in 1998 (Raymond, 2001), where the concept of "Cathedral" development model is associated to proprietary software and the concept of "Bazaar" is associated to Open Source software. The principal concepts associated with Cathedral and Bazaar development models are presented in Table 5.

Cathedral	Bazaar
Small groups of individuals work in isolation developing software	Open environment, almost any person can participate
A "beta" version is not released before a program has been tested	Programs are released early
Debuggers and Coders work on source code that is often kept secret	Programmers and Coders consist of OSS developers world wide
Small discussions within the project team	Discussion of new features, bug fixes, user problems, etc. in the Open Source community

*Table 5: Differences between cathedral and bazaar approaches (Raymond, 2001)*

## 3.2 Open Source Licenses

Under the open source development model the source code of a computer program is made publicly available under a license that gives users the right to modify and redistribute the program. This right often comes with an obligation for licenses to make their modifications and improvements freely available in turn to others. The license ensures that all participants can benefit equally from the development. It creates a common field in which multiple companies, groups and individuals can work together to create the best software platforms for their respective innovations.

At the present time, there are nearly sixty different free and open source licenses. These licenses can be categorized based on the extent to which a license requires a derivate work to use the same license as the code commons from which the work is derived (SUN, 2006). The open source licenses can be categorized in three categories, as is shown in Table 6.

Typically, companies that use open source often make a purely black or white decision: either a product is open source or it is not. Much greater benefits can be obtained by using a more subtle approach. A company can use open source for certain features and use closed, in-house developed or commercially licensed software for other features if all license implications are

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properly managed. The ultimate goal must be to ensure the product or service offers the most value to the company. Value can be obtained through different strategies: a feature can serve to differentiate the product over competing products; alternatively, the feature can be licensed to others for a royalty fee, for example, as a software library or a chip with embedded software. Patents related to the feature can be licensed royalty-bearing as well (Engelfriet, 2007).

	Category A	Category B	Category C
Base license	Unrestricted, non-copyleft	File-based copyleft	Project-based copyleft
Consequence	Create any work	Files derived from commons must use same license	All files in project must use the same license as the commons if any one file from the commons is used in the project
Derivative work	No restriction on licensing	Files added may use any license	Code added to the project must also use the same license as the commons
Goal	Marketplace-creating	Community-fostering	Commons-protecting

Table 6: Categories of open source software licenses (SUN, 2006)

## 3.3 Creation of Open Standards

Information technology standards have historically been either fully proprietary or fully free. The use of open source software incentives the appearance of open source standards, enabling people and companies to compete in a structured way. Open source standards pose an interesting challenge, because restrict the freedom of their users even while providing them with extremely low-cost and reliable technology.

Open source standards should attend some principles. Firstly, all users should be free to implement open standards in both proprietary and open source software. Secondly, open standards should be developed using a collaborative, balanced, and consensus-based approach process. Thirdly, open standards should be made available under reasonable reciprocal licenses that assume all parties to have equal opportunity to use and benefit from the standard (Rosen, 2005).

There are many technical, social and ethical reasons for the adoption and use of open standards. The main reasons are listed below:

- Innovation/competitiveness – open standards create a level playing field that ensures greater competition between large and small, and local and foreign companies, resulting in innovative products and services (Chesbrough, 2006);
- Greater interoperability – open standards ensure an ubiquity experience by allowing different devices and products to interoperate seamlessly;

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- Customer autonomy – open standards also empower consumers and transform them into co-creators. They also prevent the vendor lock-in by ensuring that the customer is able to shift easily from one product or service provider to another without significant efforts or costs;
  - Reduced cost – open standards eliminate patent fees, resulting in a reduction of total cost of ownership (TCO);
  - Privacy – open standards enable the citizen to examine communications between personal and state-controlled devices and networks.

## 3.4 Pro and Anti-Innovative Features of Open Source Software

The innovation process of OSS has several pro-innovative features compared with the innovation procedures of commercial enterprises, namely:

- High number of programmers and knowledge spillovers – the huge number of programmers is partly a result of the fact that the source code is open and available for free. For example, universities often use OSS products in their classes for programming training because of the availability of the code. Besides that, the source code contains both the product and the information of how the product is constructed, huge opportunities for learning and knowledge spillovers (West, 2004);
- Motivation effect – the nature of voluntarism implies that programmers only work on projects that they enjoy working on. Another reason for high motivation is signaling as the result of one's programming work being published, and the authors' name stated;
- Boundless cooperation – because commercial exploitation of the newly developed software is not intended, there is no need to keep new ideas secret and therefore barriers against cooperation do not emerge;
- Disciplining forking-threat – Forking and branching describes the splitting up of OSS projects into rival and competing development streams. The right to modify and distribute as OSS a splintered version of an existing project puts every programmer in the position to leave the community and set up a new project, further developing a derived version in an possible improved and better direction (Bitzer, 2005);
- Zero-costs effect – In the decision process between two technological alternatives, costs are not a decisive criterion. Therefore, technologically superior but not economically profitable software solutions can be realized in an OSS environment.

Beside these advantages in the innovation process of OSS, there are also some disadvantages in particular in comparison to commercial development of software. The key problems can be summarized as follows:

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- Development redundance – due to the freedom within the various OSS communities, there are a huge number of redundant developments, which from an economic point of view can be considered a waste of resources;
  - Undirected process – the development of particular software components is not guaranteed by the respective OSS communities. For example, certain drivers may not exist for Linux, and Linux users have no influence, apart from suggesting the driver or getting it programmed for pay, on the decision of programmers to develop the driver. Furthermore, because of the absence of a liable coordinating institution, it can neither be guaranteed that existing hardware or software is supported by the operating system in later versions;
  - Unhealthy forking – the process of splitting the code base can appear in different uncontrolled moments of the project. This could originate incompatible versions between the two forked versions and might conduce to a fragmentation of the network effects provided by the OSS community (Bitzer, 2005);
  - Code reuse problems – the extensive code reuse embedded in the production process of OSS may, to some extent, create a barrier to innovation.

## 4 Conclusions

Small and medium sized firms play an important role in the innovation paradigm. The concept of Open Innovation is becoming increasingly popular among SMEs, because small firms often lack resources to develop and commercialize new products in-house and, as result, they are more often inclined to collaborate with other entities such as large firms, universities and R&D centres.

Open innovation is a great way to acquire and share innovation with others. One popular example of open innovation has been open source software, which involves collaboration between firms, suppliers, customers and developers. Open source software also stimulates the appearance of open source standards, which allow the companies to reduce dependence on software vendors and lower the costs of software development.

The open source software contains some characteristics that can be considered as pro- and anti-innovative features. The most important pro-innovative features of OSS development are based on the huge number of programmers involved, and the high knowledge diffusion and motivation among programmers. Anti-innovative OSS features, on the other hand, are the potentially high development redundance and the problems associated with an undirected innovation process as well as the occurrence of forks and breaches in OSS projects. These anti-innovative features of OSS should be considered and mitigated by companies that intend to create value with open source software, but typically OSS software represents a great way for SME companies to succeed and improve their position in the market.

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## References

1. Bardi, A. et al (2007), *Open Innovation for Small and Medium Sized Enterprises*. Fraunhofer-Institute for Industrial Engineering, Stuttgart, Germany.
2. Bitzer, J., Schroder, P. (2005), "The Impact of Entry Competition by Open Source on Innovation Activity". *Industrial Organization*, 0512001, EconWPA.
3. Chesbrough, H. (2003), *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Press, Boston, MA.
4. Chesbrough, H. et al (2006), *Open Innovation: Researching New Paradigm*. Oxford University Press, London, UK.
5. EC (2003), "SME Definition: Commission Recommendation of 06 May 2003". *Official Journal of the European Union*, L 124/36.
6. Engelfriet, A. (2007), "Open Innovation and Open Source". *Proceedings of the LinuxWorld Open Solution Summit*, Stockholm, Sweden.
7. Hecker, F. (1999), "Setting up Shop: The Business of Open-Source Software". *IEEE Software*, Vol. 16, No. 1.
8. Kenwood, C. (2001), *A Business Case Study of Open Source Software*. MITRE Corporation, Bedford, MA.
9. Raymond, E. (2001), *The Cathedral and the Bazaar*. O'Reilly Editions, Sebastopol, CA.
10. Rosen, L. (2005), "Defining Open Standards". Available at <http://www.rosenlaw.com/VANCOUVERpresentation.pdf>.
11. Scozzi, B., Garavelli, C., Crowston, K. (2005), "Methods for Modeling and Supporting Innovation Processes in SMEs". *European Journal of Innovation Management*, Vol. 8, No. 1.
12. SUN (2006), *Free and Open Source Licensing*. Sun Microsystems White Papers, Santa Clara, CA.
13. Tiwari, R., Buse, S. (2007), "Barriers to Innovation in SMEs: Can the Internationalization of R&D Mitigate their Effects". *Proceedings of the First European Conference on Knowledge for Growth*, Seville, Spain.
14. Vrande, V. et al (2008), *Open Innovation in SMEs: Trends, Motives and Management Challenges*. Scientific Analysis of Entrepreneurship and SMEs, Zoetermeer, Netherlands.
15. West, J., Gallagher, S. (2006), "Challenges of Open Innovation: The Paradox of Firms Investment in Open Source Software". *R&D Management*, Vol. 36, No. 3.