View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by AIS Electronic Library (AISeL)

Association for Information Systems
AIS Electronic Library (AISeL)

ECIS 2003 Proceedings

European Conference on Information Systems (ECIS)

2003

Open Source Platforms Under Co-opetition: A Comparative Analysis of SourceForge and 'CodeX' (Xerox) as Two 'Co-opetitive Learning and Knowledge Exchange Networks' (CoLKENs)

Claudia Loebbecke
University of Cologne, claudia.loebbecke@uni-koeln.de

Albert A. Angehrn
INSEAD, albert.angelhrm@insead.edu

Follow this and additional works at: http://aisel.aisnet.org/ecis2003

Recommended Citation
Loebbecke, Claudia and Angehrn, Albert A., "Open Source Platforms Under Co-opetition: A Comparative Analysis of SourceForge and 'CodeX' (Xerox) as Two 'Co-opetitive Learning and Knowledge Exchange Networks' (CoLKENs)" (2003). *ECIS 2003 Proceedings*. 89.
http://aisel.aisnet.org/ecis2003/89

This material is brought to you by the European Conference on Information Systems (ECIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in ECIS 2003 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

Open Source Platforms Under Co-opetition: A Comparative Analysis of SourceForge and 'CodeX' (Xerox) as Two 'Co-opetitive Learning and Knowledge Exchange Networks'(CoLKENs)

Claudia Loebbecke*
University of Cologne
Dept. of Business Administration and Media Management
Pohligstr. 1, 50969 Koeln, Germany
Tel: +49 (221) 470 5364 - Fax: +49 (221) 470 5300
claudia.loebbecke@uni-koeln.de
www.mm.uni-koeln.de

Albert A. Angehrn**
INSEAD
Center for Advanced Learning Technologies (CALT)
Boulevard de Constance, 77305 Fontainebleau, France
Tel: +33 1 60 72 43 61 - Fax: +33 1 60 74 55 45
albert.angehrn@insead.edu
www.insead.edu/calt

Abstract

This paper investigates 'Co-opetitive Learning and Knowledge Exchange Networks' (CoLKENs) deploying open source platforms. The balancing act between cooperation and competition which CoLKENs must execute when engaging in collaboration with eventual competitors is heightened within an open source environment. This requires the designing and implementing of specific management processes to enable economic value maximization for participating individuals and firms. The authors first describe the concept of CoLKENs, their components and their generic structure. Relevant dimensions to examine when investigating CoLKENs are then identified. Specific characteristics of open source CoLKENs are reviewed and two cases, SourceForge and CodeX (Xerox) are analyzed. Findings indicate varying motivations for participation, diverse methods of leadership and governance, several specifically tailored tools for managing collaboration and primarily hidden coordination and control mechanisms for dealing with competition. Finally, the authors identify the need for future research, especially in the area of evaluating and managing the element of competition.

---

* My thanks go to my hosts at INSEAD's Technology Management Department (Sept. – Dec. 2002) as well as to the EU funded 'eFactors' project (IST-2001-34868).

** My thanks go to the dedicated researchers involved in the EU funded 'Knowlaboration' project, and in particular to Katerina Nicolopoulou and Michael Gibbert, Karen Askov and Lynn Selhat.

Keywords

Knowledge Management, Co-opetition, Open Source, Collaboration, Competition, CoLKEN

1. Introduction

In the resource-based theory of the firm, corporate knowledge is considered a crucial determinant of sustainable competitiveness (Stalk, Evans, & Shulman 1992, Wernerfelt 1984). This seems to contrast with resource-leveraging strategies that emphasize inter-firm collaboration and knowledge flows *across* firm boundaries. 'Co-opetition' describes the phenomenon in which firms engage in a virtual form of interaction whereby they cooperate *and* compete with their counterparts simultaneously (Brandenburger & Nalebuff 1996). *Cooperation* forms the basis for any knowledge exchange process between organizations as it stands for the learning processes through which knowledge is created and acquired as well as shared and disseminated. In *competition*, knowledge serves as a critical resource or asset to achieve competitive advantage and above normal rents. There seems to be a contradiction in the fact that partners are supposed to share knowledge (collaboration) which is at the same time a key determinant of their competitive advantage (Loebbecke, v. Fenema, & Powell 1999). This balancing act suggests the need for special competencies that enable companies to reap the benefits of temporary synergy while avoiding the risks associated with making knowledge available to external partners. In this context, this paper investigates 'Co-opetitive Learning and Knowledge Exchange Networks' (CoLKENs) deploying open source platforms.

2. The Concept of CoLKENs[1]

2.1 Background

Implications of the knowledge-based and resource-based theory of the firm lead to the area of *inter-organizational collaboration* which broadly refers to a variety of inter-organizational relationships such as joint development agreements, equity joint ventures, licensing agreements, cross-licensing and technology sharing, customer-supplier partnerships, and R&D contracts (Bardaracco 1991, Mowery, Oxley & Silverman 1996).

At the same time, knowledge management has been increasingly considered as a key managerial function necessary for achieving competitive advantage (Grant 1996, Tsang 2002). Economic thinking leaves no doubt that scarcity is a precondition for property and thus for the commercial value of any resource. This puts at least a question mark behind the desirability of generously sharing knowledge in an economic context.

Hence, inter-organizational knowledge sharing processes revolve around a formidable balancing act between borrowing knowledge assets from partners, while protecting one's own assets (Loebbecke et al 1999). The challenge is to share enough skills to learn and create advantage vis-à-vis organizational units outside the network, while preventing an unwanted transfer of core

1 The authors have offered an extensive literature review on the theoretical underpinnings and the main components of CoLKENs in a separate paper (Loebbecke, &Angehrn 2003). These are therefore discussed in abbreviated form in this paper.

competencies to partners (Hamel, Doz, & Prahalad 1989). This challenge is exacerbated when some members in the network are competitors. In such constellations, the danger of becoming 'hollowed out' by 'predatory' partners (Hamel et al 1989, Kogut & Zander 1992) seems particularly evident, suggesting that appropriate steps be taken to ensure that only mutually beneficial sharing occurs. Nevertheless, many of the skills that migrate between organizational units are not covered in the formal terms of a knowledge exchange (Loebbecke & v. Fenema 2000). Often, what gets traded - i.e. what is shared and learned - is determined by the day-to-day interaction of engineers, marketers, and product developers (Hamel et al 1989).

2.2 CoLKEN Components

The first fundamental CoLKEN component is 'Knowledge'. Knowledge is a complex concept to define, exhibiting a number of dimensions which need to be distinguished (Polanyi 1966, Spender 1996, Matusik & Hill 1998). Knowledge assets have their foundation not only in data and information, but also in collaborative learning processes. Knowledge may increase in value the more it is used, with investment in knowledge and knowledge-creating capabilities characterized by increasing returns (e.g. Teece 1998). However, that makes it less amenable to management (e. g. Polanyi 1966, Nonaka 1994, Boisot 1995).

The second of the CoLKEN components are 'Knowledge Agents'. Both individuals and organizations are considered to be knowledge agents, capable of owning and processing knowledge (Senge 1990, Drucker 1993).

The last of the CoLKEN components are 'Knowledge Networks' which are commonly defined as formally set up mechanisms, structures, and behavioral patterns that connect knowledge agents who were not previously connected because of (a) functional, (b) hierarchical, or (c) legal boundaries between organizations.

'Knowledge', 'Knowledge Agents', and 'Knowledge Networks' lay the foundation for investigating inter-organizational learning and knowledge exchange networks in the context of cooperation and competition. In order to create and extract the maximum economic value, the challenge is to balance both aspects by designing and implementing management processes (see Figure 1).

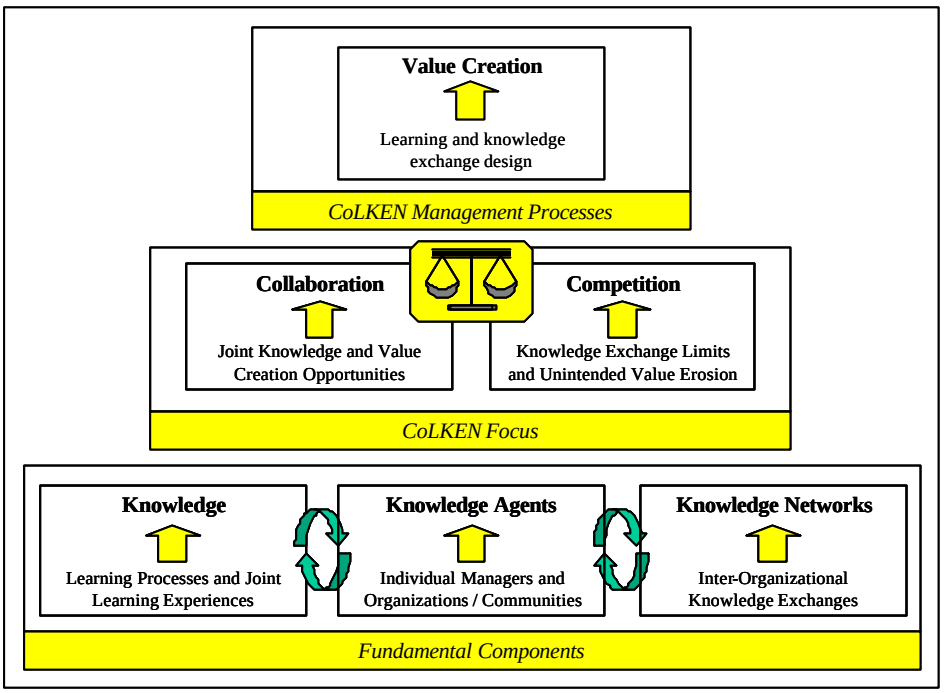

Figure 1: CoLKEN Pyramid

2.3 Relevant Dimensions for Investigating CoLKENs

The main dimensions adopted for investigating CoLKENs in this paper are

(1) the motivation for individuals and for companies to participate in the CoLKEN,

(2) issues of leadership, governance and decision making,

(3) the management of collaboration including knowledge creation, sharing and management as well as learning and innovation, and finally

(4) the management of the competition dimension including coordination and control.

Of these four dimensions, the first two primarily represent the inputs which members and management bring into a CoLKEN. These are the 'raw materials' for managing co-opetition. The latter two dimensions, the management of collaboration and competition, i.e. the balancing collaboration and competition issues, represent the main focus of CoLKENs. They are depicted in layer '2' of the CoLKEN Pyramid (see Figure '1') and primarily represent the outputs which must be balanced to optimize value creation.

3. CoLKENS in Open Source Type Environments

3.1 Open Source Type Environments

The open source initiative started in the late 1960s when Ken Thomson and Dennis Ritchie worked on the Unix operating system. In the late 1990s, it gained public attention with Raymond's (1999)

'The Church and the Bazaar' and with Netscape making the open source code of its Navigator publicly available. Currently, Linux and the platform 'SourceForge' are probably the most 'visible' examples.

A central characteristic of open source environments is their ability to represent a virtual space for development where organizational units operate in a distributed fashion. Infrastructure allows employees to interact remotely. New organizational forms emerge that translate the advantages of electronic communications into flexible modes for organizing work (DeSanctis & Fulk 1999). Members contribute interactively to a coherent performance that individual organizations could not achieve (Goldman 1997).

An investigation of open source CoLKENs sets the stage for an encounter between collaboration and competition issues. This encounter is inevitable since in such environments which are first and foremost communities for collaboration, contributors work for competing units.

3.2 Managing Open Source-Based CoLKENs: Selected Insights from the Literature

Table 1 summarizes the main measures and principles for managing and operating CoLKENs in open source environments from the literature.

Motivation to Participate

What motivates people to participate in faceless, anonymous networks like open source communities where people are seemingly less accountable for their actions? According to Lakhani and von Hippel (2000), Markus, Manville and Agres (2000) as well as von Hippel (2001) basic motivators include a) a user's direct need for the software and its improvement, b) the fun of the work, and c) the visibility and reputation that accompanies participation. Open source volunteers express the importance of 'altruism' as well as other intangible social values including ideology (BCG 2002). However, there also seems to be a noticeable turn towards financial motivations amongst participants in the community. Markus et al (2000: 18) say, "Self-employed professionals must earn a living, and employed professionals must convince their superiors that working on open source projects during company time is valuable". For companies, financial benefits seem to be the main driver. Besides direct return on investments, these can be shaping a specific product market or gaining market dominance over competitors.

	Measures Suggested in Literature
Motivation to participate	• Individuals o Need for software o Fun / voluntarism o Visibility / reputation o Altruism o Financial rewards • Organizations o Financial rewards / ROI o Shaping product markets o Dominance over competitors
Leadership, governance and decision making	• Leadership o Senior developers with initiative as leaders o Varying leadership style (including authoritative style) o Volunteers, elected officers, committee members • Four governance / decision making mechanisms o Managing membership o Procedures and institutions o Monitoring and sanctions o Reputation
Management of collaboration including knowledge creation, sharing and management, as well as learning and innovation	• Fostering situated learning o Interaction o Community management o Learning by doing o Support for sharing tacit knowledge
Management of competition including coordination and control	• Coordination and control mechanisms o Structural o Procedural o Interpersonal o Technical

Table 1: Measures and Principles for Managing CoLKENs in Open Source Environments (e.g. Markus et al 2000, Wenger & Snyder 2000, Loebbecke & v. Fenema 2000, v. Hippel 2002)

Leadership, Governance and Decision Making

Open source groups may be managed by a potentially large workforce of volunteers ranging from persons acting during a probationary period to 'elected' officials who then appoint committee members. Leaders often have initiated their projects by creating the first working version (Edwards 2000, Markus et al 2000), which is then viewed as part of the vision for directing production in an open source environment. Strong, and even authoritative leadership style, as that exhibited by Linus Torvalds, is primarily accepted because of a person's particular status, even if it sometimes produces harsh language and behavior (Edwards 2000).

Most well functioning open source groups operate a combination of the following four coordination mechanisms (Markus et al 2000): managed membership, rules and institutions, monitoring and

sanction, and reputation. Managing membership addresses not only the question of who can get involved, but also of who may assume a position of responsibility. Rules and institutions cover any 'official' licensing agreements as well as discussion and particularly voting procedures. Monitoring activities and sanctions are usually rather efficient as open source community members pay attention to reputation. Many open source models apply member performance 'ratings' as a powerful tool. Indeed, in organizations where membership is free and making money (directly) is not an explicit goal, one's reputation is a valued commodity.

Collaboration and its Management

The basic aim for collaboration is joint and synergetic learning and resulting innovation. Open source-based CoLKENs foster collaborative, situated *learning* which happens outside the heads of individuals through interactions with people in a community (Senge 1990, Brown & Duguid 1991, 1998). The original nature of 'teacher to student' becomes a many-to-many relationship when participants are both knowledgeable and in need to learn from each other. Basic processes include 'learning by exercising', 'verifying', 'solidifying' and 'improving' mental models through discussions and information sharing (Alavi 1994). Sharing and acquiring tacit knowledge also plays a prominent role in open source CoLKENs. Beyond being a carrier of knowledge creation, CoLKENs are meant to drive innovation. Similarly, Lecocq and Demil (2000) found that, especially in high tech sectors, open source can result in substantial lowering of externalities.

Competition and its Management

Given the complexities of the simultaneous presence of individual and organizational cooperation and competition, many CoLKENs operate with pre-set, mutually dependent *coordination* and *control* mechanisms[2] (e.g. Williamson 1991, Birnberg 1998, Lorenzino & Lipparini 1999, Ahuja 2000). In order to balance the issues of cooperation and competition, the literature identifies four main mechanisms - *structural, procedural, interpersonal, or technical* as part of inter-firm governance (Lorenzoni & Lipparini 1999). In each CoLKEN, either the leader or a central node (which may or may not be the leader), applies a combination of these coordination and control mechanisms, be it visibly to all members or in a rather intuitive, perhaps even hidden manner.

4. Research Questions and Methodology

In this section of a larger research initiative, we focus on two CoLKENs operating in an open source environment. One is truly inter-organizational (the case of 'SourceForge') and one operates between the units of a large, multinational corporation ('Xerox'). We have purposefully selected these two cases for the ECIS conference as they both heavily depend on ICMT usage. They both represent the 'hi-tech' end of the 'hi-touch versus hi-tech' spectrum'. In both cases, this work investigates how these particular CoLKENs are managed along the four dimensions listed in section 2.3. More explicitly, we address the following questions mentioned above:

(1) What are motivations for individuals and organizations to participate?

2 These go beyond the governance / decision making mechanisms mentioned in section '3.2', which aim at fostering collaboration and general operation.

(2) What mechanisms of leaderships and governance and decision making are implemented?

(3) How is the collaboration dimension managed by the different CoLKEN members?

(4) How is the competition dimension managed by the different CoLKEN members? What mechanisms of coordination and control are implemented?

We analyze these issues along the trajectories of 'who', (people), 'what' (topics), and 'how' (processes).

As *research methodology* we apply an *inductive case study approach* with cross-case analysis of two different CoLKENs operating on an open source platform. The multiple case study (Yin 1994) was chosen to arrive at an in-depth understanding of how to initiate, manage, and sustain economic knowledge exchange in CoLKENs. Our work is based on a *multi-stage, nested design* (Eisenhardt 1989, Burgelman 1994, Yin 1994). The data collection comprised one-to-one as well as expert interviews and participant observation. Data were analyzed using the *grounded-theorizing approach* (Glaser & Strauss 1967), which refers to inductively gaining theoretical insights by comparative analysis of two or more cases in an iterative mode. We examined the case evidence, revised theoretical propositions, and then iteratively examined the evidence once again from an adapted perspective. The issue of external validity was approached by systematically comparing the data across cases (Eisenhardt 1989) in order to highlight inter-case differences and to make sure that patterns discussed were not idiosyncratic to one setting. In the remainder of this paper, we report on two of the case studies, namely 'SourceForge' and 'Xerox'.

5. Two Case Studies

5.1 Case of SourceForge

SourceForge (SF.net) is the world's largest open source software development web site, providing free hosting to tens of thousands of projects. It is also among the largest repositories of open source code and applications available on the Internet. The mission of SourceForge is to enrich the open source community by providing a centralized place for open source developers to control and manage open source software development. SF.net is owned by 'Opensource Development Network, Inc.' ('OSDN'), a leading news, collaboration and distribution community for IT and open source development, implementation and innovation. Each month, more than five million IT professionals, developers and systems administrators visit OSDN destinations - delivering more than 110 million page views per month. OSDN sites offer IT news, development tools, distribution and discussion channels, cutting-edge editorial, and ongoing education and evangelism among the IT and open source community. The SF.net site runs the SF collaborative software development platform, which provides developers with development and project management tools, and integrated support management capabilities. As of December 2002, more than 520,000 active users were registered to work on one or more of the almost 52,000 open source software development sites hosted. Six categories of users are distinguished: 'project creators', 'developers', 'end users', 'moderators', 'anyone', and ' 'experts'. The latter gather in the 'foundries' (expert knowledge sharing repositories), moderating discussions in, for example, Java or Open systems development or other expert topics. The SourceForge community consists of four active spaces (1) the Concurrent Versioning Space

(CVS) for creating concurrent versions of one product, (2) the development-oriented space[3], (3) the public oriented space (http://www.SFnet/project), and (4) the 'foundries'.

5.2 Case of Xerox' Opensouce Initiative 'CodeX'[4]

Xerox has more than 70,000 employees in five continents and approximately 4,000 software developers scattered around the globe producing more than seven million lines of software each year. In January 2001, to better identify, access and leverage the expertise available within its own software development environment which is dispersed across teams of developers, internal organizations, and geographies, Xerox embarked on the open source initiative 'Code eXchange', short 'CodeX'. The main objectives have been to enable Xerox' software developers to know who is developing what and where, to identify experts, to share globally within Xerox, to harmonize day-to-day software development practices and to avoid third party licensing if in-house software is available, i.e. to produce more pertinent software faster and to combine software components for new projects and innovation. From its official launch in January 2001 through October 2002, CodeX grew, on average, at 5 % per month to involve 1,300 users and 200 hosted projects from all countries and Xerox organizations.

'CodeX' describes an internal initiative to 'port' the open source tools, methods and culture into the Xerox corporate environment. The guiding principles are similar to those of open source software: one can freely copy and redistribute; one has the right to access the source code; one has the right to make improvements to the software; and the community has the right to benefit from anyone's modifications to the code. "Good programmers know how to write. Great ones know how to rewrite and reuse" (Juillard 2002a). Besides being an initiative to propagate open source methods and culture within Xerox, CodeX is also a Xerox internal website containing company software code. It presents a world-wide infrastructure to guide development projects and a series of tools to facilitate software development.

CodeX has caused a sizeable challenge to change the Xerox culture, a culture which originally - since its invention of xerography - was based on secrecy. More critical projects are migrating from work-group level tools to CodeX. The ubiquitous risk of personal optimization against group level success has hence become an incentive management problem. To alleviate developers' fears, the CodeX team has taken several measures: They maintain private projects for highly sensitive expertise, and track software access and downloads permitting developers to know who else uses their software and when.

Xerox has realized major benefits such as faster development, improved quality and features of software, diffusion of best practices, and substantial, quantified cost savings (estimated at US $3,000,000 in 2001) as software developers increasingly support CodeX. The initiative has also triggered a growing sense of community, making individuals and groups of developers realize that they are not the only ones to develop a particular kind of software. Successful impact is further substantiated by user satisfaction rates above 90 percent for almost all CodeX services.

---

3 In this space, knowledge sharing takes place through mailing lists, forums and via sharing documentation between previous versions of the product.

4 For the information on CodeX see Juillard, Stidd (2001) and Juillard (2002 a & b).

5.3 Comparative Case Analysis

Table 2 shows a comparative analysis of the main measures and principles for managing CoLKEN operations within the open source environments of SourceForge and CodeX.

Motivation to Participate

At *SourceForge*, where participation is strictly voluntary, the high level of expertise, perceived by developers as a 'paradise', is a strong motivator.

Motivation within *CodeX*, although semi-voluntary, is supported by Xerox-wide communication campaigns encouraging cultural change. The platform acts as a magnet for Xerox' staff developers who begin to share 'attitude' and values.

Leadership, Governance and Decision Making

SourceForge and *CodeX* have developed specific responses to their need for empowering or de-emphasizing leadership. Due to their individual nature, they have developed different member management strategies and procedures.

Governance and decision making procedures within *SourceForge* are exemplified through the way projects are initiated: People interested in initiating a project first have to go through the approval of the SourceForge staff in order to be allocated space on the server for the particular project. Once the project creator gets the OK from the SourceForge staff to start developing, he can become administrator and take the initiative to propose developers. From then on, decision making starts scaling down. The development and management of tasks is decentralized and characterized by vigilant self-governance, including user 'ratings'. But decisions concerning admission of new developers remain constantly centralized.

Choice of governance tools within *CodeX* is driven by the desire to encourage cultural innovation. The platform de-emphasizes hierarchical structures and favors 'cross-breeding' (Darwinian approach to software sharing and re-use). CodeX teams are enabled to bridge gaps between product teams and customer organizations in charge of integration and services. Importantly, these innovations occur within a predefined, published set of rules for product re-use and sharing. For example, project creators do serve as first project administrators and retain the power to 'bless' members (who then acquire read and write rights to project code).

Management of Collaboration including Knowledge Creation, Sharing and Management as well as Learning and Innovation

SourceForge and CodeX both exercise a series of specially tailored interaction modes and technology-based tools to foster situated learning in order to support their goals and assist community management.

Collaboration on particular tasks within *SourceForge* is based on the 'learning by doing' principle (von Hippel & Tyre 1995), i.e. the active participation of developers in all communities. SourceForge provides expert guidance and standard tools such as knowledge management boards and forums, facilitating a complex interaction mode for specialization and redundancy.

Further collaboration measures and tools include the freezing of software code whilst producing a new release and automatic linkage to other documents in the versioning space (CVS). This offers an easy way of creating new product versions, connecting them to their developers and comparing the contributions on a platform. Free visibility of source code, shared normative and causal beliefs and shared notions of validity amongst community members facilitate the collaborative environment.

Collaboration management within *CodeX* is facilitated by an easy to use and accessible (entirely web-based) system. This ubiquitous and uniform tool provides the exact same project environment anywhere, anytime via the Xerox Intranet and enables easy transition between projects.

Actively Managing Competition

Managing competition requires the 'balancing of social and individual needs while providing specific participation and activity structures for social learning, collaboration, communication and knowledge building' (Topper 1995).

At *SourceForge*, anyone can see the source code, but, as previously stated, centralized approval is necessary to actually exchange knowledge as a developer. This encourages the avoidance of opportunistic behavior.

Concerning the *CodeX* platform, Xerox makes a clear distinction between sharing intellectual capital and business practices.

The literature suggests the need for open source CoLKENs to develop clear coordination and control mechanisms (structural, procedural, interpersonal and technical). These points, however, do not explicitly emerge from the empirical results of the study. If they are at work within the cases profiled, they are for the most part hidden mechanisms.

	SourceForge	'CodeX'
Motivation to participate	• Voluntary • Highly expertise oriented (developers' paradise)	• Semi-voluntary, encouraging culture change • Sharing attitude and values • Acting as magnet within Xerox • Xerox staff developers • Company-wide communication campaign • Increase in perceived personal productivity
Leadership, governance and decision making	• Project initiators assuming leadership • Decentralized development after project approval • Vigilant self-governance • Well structured administration & hierarchy (approval rules) • Technology support for fast and efficient communication • User 'rating'	• De-emphasis of hierarchical structures (leadership w/out coercion) • Predefined, published rules for re-use and sharing • Based on driving cultural innovation • CodeX team bridging gap between product teams and customer organizations in charge of integration and services • Environment favoring 'cross-breeding' (Darwinian approach to software sharing and re-use)
Management of collaboration including knowledge creation, sharing and management, as well as learning and innovation	• Complex interaction mode for specialization and redundancy • Guidance from experts • Common policy enterprise • Learning by active participation in development communities • KM tools (boards, forums) • Free visibility of source code • Shared normative and causal beliefs • Shared notions of validity	• Easy to use and access (entirely web-based) • Ubiquity and uniformity - (exact same project environment anywhere, anytime on Intranet) • Easy transition between projects • Experts quickly identifiable (color management, network protocols) • Continuous feedback collection from the field
Management of competition including coordination and control	• Opportunistic behavior curbed through screening of active members before acceptance to participate	• Clear distinction between sharing intellectual capital and business practices ('Free access' does not mean 'Free of charge')

Table 2: Comparative analysis of management principles within 'SourceForge' and 'CodeX'

6. Summary and Outlook

'Open source CoLKENs' are a growing phenomenon which provide an interesting model for collaboration amongst competitors. This paper has detailed some of the 'co-opetition' strategies adopted by two different open source CoLKENs: SourceForge, the world's largest open source software development web site, and CodeX, an intra-organizational platform of the Xerox Corporation established to facilitate software production and innovation.

When examining the empirical results along the four management dimensions outlined in this study, some differences appear due to the diverging nature of the two cases. As a corporate endeavor, motivation to participate is strictly voluntary at SourceForge whereas it is semi-voluntary in CodeX. Leadership, governance and decision making issues bear many similarities, however, at SourceForge the main, centralized leadership intervention occurs at the moment actively participating developers are accepted. Within CodeX, participating developers are, per se, already on the job within Xerox. In the case of SourceForge, individual leadership style may vary depending on the project hosted. CodeX actively encourages flat hierarchical structures across the board. Both cases have addressed the need to manage collaboration and have instated a series of measures, some different, some similar, to support knowledge creation, sharing, learning and innovation. For each case, these measures have been adapted to their individual governance guidelines. The management of competition appears to be the most difficult of the four dimensions to seize. SourceForge's only apparent tool to influence fair competition occurs at the moment when a developer is accepted into a team and deemed able to avoid opportunistic behavior. CodeX, faced 'only' with the issue of internal competition, has nonetheless deemed it necessary to create protected zones for the optimal functioning of certain, critical projects.

Open source CoLKENs are, themselves, very much 'learning by doing' endeavors. However, further study of 'best practices' for identifying collaboration tools and mechanisms, geared to individual open source CoLKENs' specific needs, provides an area for further research. Further, although the open source principle lends itself, par excellence, to cooperation, the development of a research framework for weighing off the advantages of collaboration against the potential downside of competition remains to be developed.

References

Ahuja, G (2000), 'The Duality of Collaboration", *Strategic Management Journal*, vol. 21, no. 3, pp. 317-343.

Alavi, M (1994), 'Computer Mediated Collaborative Learning: An Empirical Evaluation", *MIS Quarterly*, vol. 18, no. 2, pp. 159-174.

Bardaracco, J (1991), *The knowledge link: How firms compete through strategic alliances*, Harvard Business School Press, Boston, MA.

Birnberg J (1998), 'Control in Inter-firm Co-operative Relationships', *Journal of Management Studies*, vol. 35, no. 4, pp. 421-428.

Boisot, M (1995), *Information space: A framework for learning in organizations, institutions and cultures*, Routledge, London.

BCG (2002), 'The Boston Consulting Group Hacker Survey', viewed 24 July 2002, <http://www.osdn.com/bcg>.

Brandenburger, AM, Nalebuff, BJ (1996), *Co-opetition*, Doubleday, New York.

Brown, J, Duguid, P (1991), 'Organisational Learning and Communities-of-Practice: Toward a Unified View of Working, Learning and Innovation', *Organisation Science*, vol. 2, no. 1, pp. 40-57.

Brown, JS, Duguid, P (1998), 'Organizing Knowledge', *California Management Review*, vol. 40, no. 3, pp. 90-111.

Burgelman, R (1994), 'Fading memories: A process theory of strategic business exit in dynamic environments', *Administrative Science Quarterly* vol. 39, no. 1, pp. 24-56.

DeSanctis, G, Fulk, J (1999), *Shaping organizational form: communication, connection, and community*, Sage, Newbury Park, CA.

Drucker, P (1993), *The Effective Executive*, Harper Business, New York.

Edwards, K (2000), 'When beggars become choosers', *First Monday*, vol. 5, no. 10, October.

Eisenhardt, K (1989), 'Building theories from case study research', *Academy of Management Review*, vol. 14, no. 4, pp. 532-550.

Glaser, B, Strauss, A (1967), *The discovery of grounded theory*, Aldine Press, Chicago.

Goldman, A (1997), 'Science, Publicity, and Consciousness', *Philosophy of Science*, vol. 64, pp. 525-545.

Grant, R (1996), 'Toward a Knowledge-Based Theory of the Firm', *Strategic Management Journal*, vol. 17 (Winter Special Issue), pp. 109-122.

Hamel, G, Doz, YL, & Prahalad, CK (1989), 'Collaborate with your Competitors - and Win', *Harvard Business Review*, vol. 67, no. 1, pp. 133-139.

Juillard, L, Stidd, J (2001), 'CodeX - Introduction and Tutorial - Breaking down the Barriers to Code Sharing inside Xerox', *International Workshop at INSEAD, Fontainebleau, France*, October 26, 2002.

Juillard, L (2002a), CodeX - 'Enterprise-wise software sharing and Re-Use', *International workshop at INSEAD, Fontainebleau, France*, on October 26.

Juillard, L (2002b), Coded telephone interview with authors on November 5, 2002.

Kogut, B, Zander, U (1992), 'Knowledge of the Firm, Combinative Capabilities and the Replication of Technology', *Organisation Science*, vol. 3, no. 3, pp. 383-397.

Lakhani, K, von Hippel, E (2000), 'How open source software works: 'free' user-to-user assistance', *MIT Sloan School of Management Working Paper 4117*.

Lecocq, X, Demil, B (2002), 'Open Standard: Role of externalities and impact on the industry structure', 11 Nov. 2002, <opensource.mit.edu/papers/lecocqdemil.pdf>.

Loebbecke, C, v. Fenema, PC & Powell, P (1999), 'Co-opetition and Knowledge Transfer', *The Data Base for Advances in Information Systems (*DATABASE), vol. 30, no. 2, pp. 14-25.

Loebbecke, C, v. Fenema, P (2000), 'Virtual Organizations that Cooperate and Compete: Managing the Risks of Knowledge Exchange' in *Knowledge Management and Virtual Organizations*, ed. Y. Malhotra, BRINT, Idea Group Publishing, Hershey, PA, pp. 162-180.

Loebbecke, C, Angehrn, A (2003), 'Investigating Coopetitive Learning and Knowledge Exchange Networks (CoLKENs) as Emerging Concept in Management Literature and Practice' in *Proceedings of the Fourth Conference on Organizational Knowledge, Learning and Capabilities* (OKLC) Barcelona, Spain, April.

Lorenzoni, G, Lipparini, A (1999), 'The Leverage of Interfirm Relationships as a Distinct Organizational Capability', *Strategic Management Journal*, vol. 20, no. 4, pp. 317-338.

Markus, ML, Manville, B & Agres, C (2000), 'What Makes a Virtual Organization Work? Lessons from the Open-Source World', *Sloan Management Review*, Fall, vol. 42, no. 1, pp. 13-26.

Matusik, S, Hill, C (1998), 'The utilization of contingent work, knowledge creation, and competitive advantage', *Academy of Management Review*, vol. 23, no. 4, pp. 680-697.

Mowery, D, Oxley, J, & Silverman, B (1996), 'Strategic alliances and interfirm knowledge transfer', *Strategic Management Journal*, vol. 17, Winter Issue, pp. 77-91.

Nonaka, I (1994), 'A Dynamic Theory of Organisational Knowledge Creation', *Organisation Science*, vol. 5, no. 1, pp. 14-37.

Raymond, E (1999*), The Cathedral and the Bazaar*, O'Reilly & Associates, Sebastopol, CA.

Senge, P (1990), *The fifth discipline: the art and practice of the learning organization*, Sage, London.

Spender, J-C (1996), 'Making Knowledge the Basis of a Dynamic Theory of the Firm', *Strategic Management Journal*, vol. 17 (Winter Special Issue), pp. 45-62.

Stalk, G, Evans, P & Shulman, LE (1992), *Competing on Capabilities*, Harvard Business Review, vol. 70, no. 2, pp. 57-69.

Tsang, E (2002), 'Acquiring knowledge by foreign partners from international joint ventures in a transition economy: Learning-by-doing and learning myopia', *Strategic Management Journal*, vol. 23, no. 9, pp. 835-854.

Teece, DJ (1998), 'Research Directions for Knowledge Management', *California Management Review*, vol. 40, no. 3, pp. 289-292.

von Hippel, E, Tyre, M. (1995), 'How 'Learning by Doing' is Done: Problem Identification in Novel Process Equipment', *Research Policy*, vol. 24, no. 1, pp. 1-12.

von Hippel, E (2001), 'Innovation by user communities: Learning from open-source software', *MIT Sloan Management Review*, Cambridge; Summer 2001, vol. 42, no. 4, pp. 82-86.

von Hippel, E (2002), 'Open Source Projects as Horizontal Innovation Networks - by and for Users', *MIT Sloan School of Management Working Paper No. 4366-02*, June.

Wenger, EC, Snyder, WM (2000), 'Communities of practice: the organizational frontier', *Harvard Business Review*, vol. 78, no. 1, pp. 139-146.

Wernerfelt, B (1984), 'A Resource-Based Theory of the Firm', *Strategic Management Journal*, vol. 5, no. 2, pp. 171-180.

Williamson, O (1991), 'Comparative Economic Organisation: The Analysis of Discrete Structural Alternatives', *Administrative Science Quarterly*, vol. 36, no. 4, pp. 269-296.

Yin, R (1994), *Case study research: Design and methods*, Sage, London.