Decision Making Challenges in 'Co-opetitive Learning and Knowledge Exchange Networks'

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Abstract

This primarily conceptual paper introduces 'Co-opetitive Learning and Knowledge Exchange Networks' (CoLKENs) as a specific context for decision making. CoLKENs play a pivotal role within our global, increasingly knowledge based society and shape knowledge sharing processes among their members and organizations. The inherent balancing act between cooperation and competition requires designing and implementing specific management processes to enable economic value maximization for individuals and firms. CoLKENs, their components and generic structure are described. A first taxonomy is suggested. Two specific CoLKENs in open source type environments, SourceForge and CodeX (Xerox) are explored. Finally, future research lines are identified.

Keywords

Knowledge management, learning, knowledge exchange, co-opetition, taxonomy, open source, decision making

1. INTRODUCTION

Decision making and knowledge management under co-opetition has been discussed in the fields of management and information systems for several years (e.g. Loebbecke et al. 1999; McGaughey 2002). The concept of 'Co-opetitive Learning and Knowledge Exchange Networks' (CoLKENs) has been introduced more recently by Loebbecke et al (2003a, 2003b).

In the resource-based theory of the firm, corporate knowledge is considered a crucial determinant of sustainable competitiveness (Stalk et al. 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 simultaneously cooperate and compete with their counterparts (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, acquired, shared and disseminated. Under competition, knowledge serves as a critical resource or asset to achieve competitive advantage and above normal rents.

This balancing act between collaboration and competition within a community, here within CoLKENs, suggests the need for special competencies and decision making models that enable actors (individuals and organizational units) to reap the benefits of temporary synergy while avoiding the risks associated with making knowledge available to external partners.

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-firm relationships such as joint development agreements, strategic alliances, equity joint ventures, licensing agreements, cross-licensing and technology sharing, customer-supplier partnerships, and R&D contracts (Bardaracco 1991; Doz 1996; Mowery et al. 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 of the network while preventing an unwanted transfer of core competencies to partners (Hamel et al. 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 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 and decision processes 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; Matusik, Hill 1998; Spender 1996). 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'. The management literature provides us with an ongoing debate as to who are appropriate knowledge agents: Who is intellectually empowered, the organization or its individual employees? Does knowledge reside at the level of the individual and at the organizational level? Among others, Drucker (1993) and Grant (1996) stress the predominant importance of individuals. A different body of management literature (Nonaka, Takeuchi 1995; Spender 1996; Boisot 1998; Lane, Lubatkin 1998; Matusik, Hill 1998; Crossan et al. 1999; Inkpen 2000) considers organizational cognition or organizations as cognitive entities to be a suitable unit of analysis. A third school of scholars is found in the organization science literature, where organizational learning is a central tenet and is believed to be conducive to competitive advantage (Senge 1990; Moingeon, Edmondson 1996). For these authors, both the individual and the organization are capable of learning and processing knowledge although both place more emphasis on the importance of knowledge processing at the level of the individual employee.

The third 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 (e.g. Powell 1996).

'Knowledge', 'Agents', and 'Networks' provide the basic pillars of inter-organizational learning and knowledge exchange networks in the context of cooperation and competition. The CoLKEN challenge is to balance both aspects by designing and implementing active decision making and knowledge management processes in order to create and extract the maximum economic value (see Figure 1).

[1] The authors offer an extensive literature review on the theoretical underpinnings of CoLKENs and their main components in Loebbecke, Angehrn (2003a).

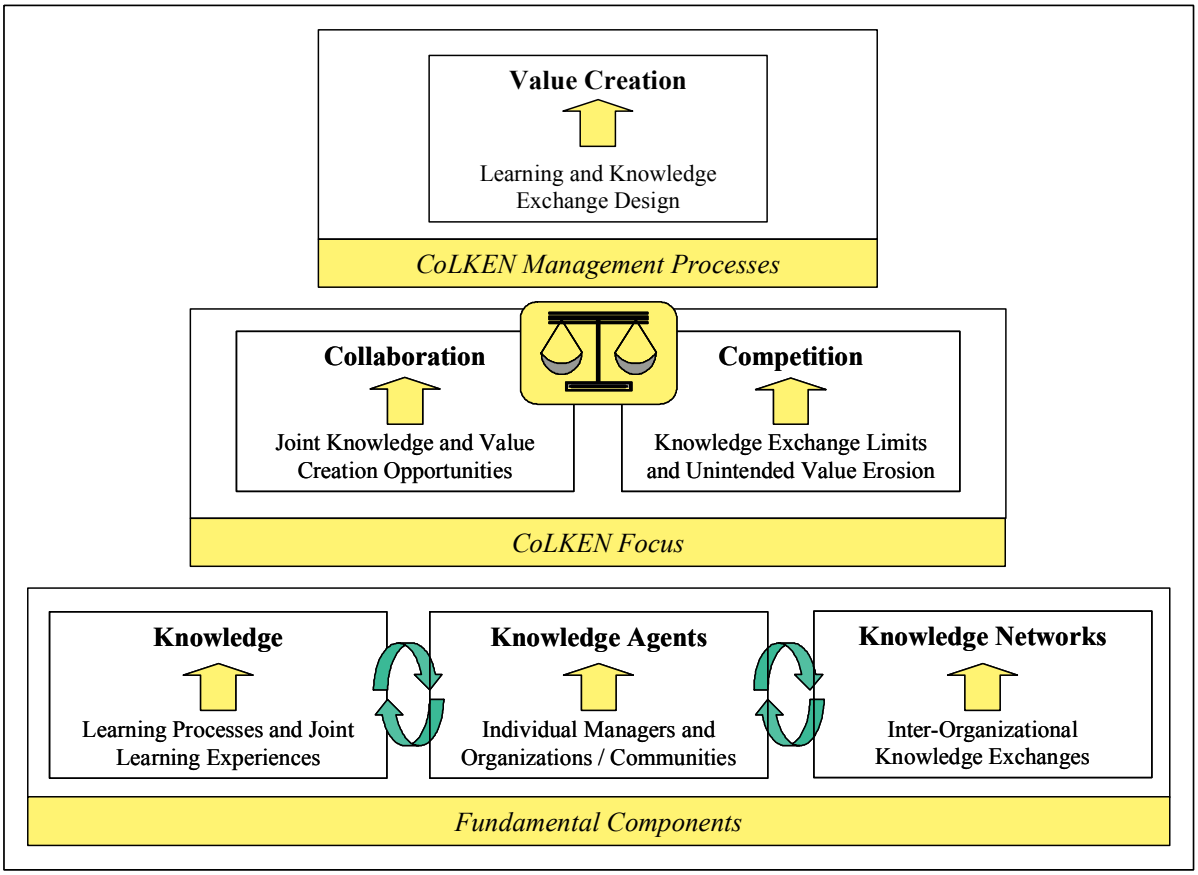

Figure 1: Balancing Collaboration and Competition at the Focus CoLKENs (Source: Loebbecke et al. 2003a and 2003b)

3. TOWARDS A COLKEN TAXONOMY

CoLKENs come in various shapes. Possible dimensions for differentiating CoLKENs are 'size', 'growth pattern', 'composition', and 'internal competition'. While all of these are important, we choose two other dimensions for developing a first CoLKEN taxonomy (see Figure 2). We distinguish CoLKENs based on their information, communication and media technology (ICMT) usage and their intra-organizational versus inter-organizational governance focus. While our basic assumption of co-opetition among organizational units requires some degree of 'inter'-organizational networking, the horizontal axis takes into account the more or less overriding legal structures that may emphasize the 'intra'-setting for competing sub-units.

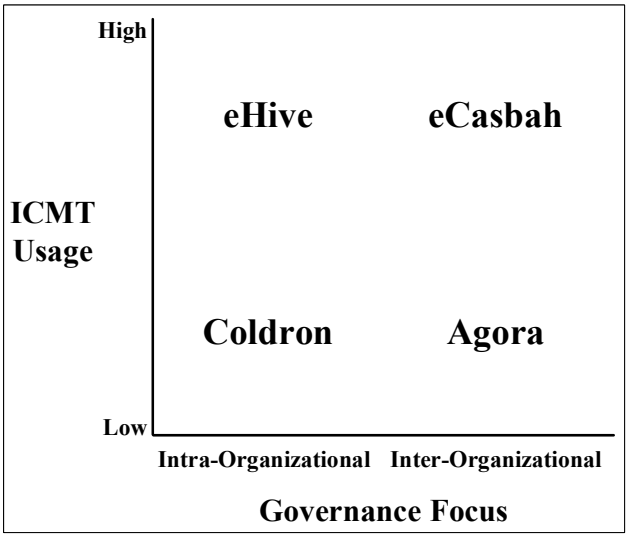

Figure 2: CoLKEN Taxonomy

Various CoLKEN examples have been investigated in a case study series conducted by the authors since September 2002. In the context of this paper, we briefly report on our findings with regard to two technology-driven CoLKENs which both operate on an open source based ICMT platform.

4. COLKENS IN OPEN SOURCE TYPE ENVIRONMENTS

4.1 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. As of March 2004, Linux and the platform 'SourceForge' are probably the most 'visible' examples.

The open source rationale is to represent a virtual space for knowledge sharing and development where organizational units operate in a distributed fashion (e.g. Bessen 2002; for an extensive coverage of open source related issues including access to numerous working papers, see opensource.mit.edu). Infrastructure allows employees to interact remotely (Osterloh, Frey 2000; Weber 2003). New organizational forms emerge that translate the advantages of electronic communications into flexible modes for organizing work (DeSanctis, Fulk 1999) and allow for user-driven innovation (von Hippel 2002). Quasi-organizational entities emerge. Members contribute interactively to a coherent performance that individual organizations could not achieve (Goldman 1997; Harhoff et al. 2000).

4.2 Collaboration and Competition in Open Source Based CoLKENs: A Brief Literature Review

4.2.1 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 of learning 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 (2002) found that, especially in high tech sectors, open source can result in a substantial lowering of externalities.

However, what motivates people to collaborate 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 et al. (2000) and 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[2]. However, there also seems to be a noticeable turn towards financial motivations amongst participants in the community, as self-employed professionals must earn a living, and employees must convince their superiors that working on open source projects during work time is valuable (Markus et al. 2000). Also for companies, financial benefits seem to be the main driver (Loebbecke, Angehrn 2003). Besides direct return on investments, these can be shaping a specific product market or gaining market dominance over competitors.

4.2.2 Competition and its Management

The most well functioning open source groups operate a combination of the following four coordination mechanisms in order to take care of potential competition based inefficiencies: managed membership, rules and institutions, monitoring and sanction, and reputation (e.g. Markus et al. 2000). 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 (von Hippel, von Krogh 2002).

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[2] These findings were further confirmed in a study of more than 600 open source participants by BCG (2002). Among respondents to a survey - 70% of whom were volunteers and 30% of whom were paid - the most common reasons to participate included intellectual stimulation (44.9%), improved skills (41.3%), work functionality (33.8%), and the belief that code should be free and open (33.1%)s.

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 (e.g. Lorenzino, Lipparini 1999; Williamson 1991; Ahuja 2000; Birnberg 1998). In order to balance the issues of cooperation and competition, the literature identifies four main mechanisms - structural, procedural, interpersonal, and 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.

5. TWO EXPLORATORY CASE STUDIES

As research methodology we apply an inductive case study approach with cross-case analysis. Here we report on two CoLKENs operating on an open source platform, an 'eHive' and an 'eCasbah' (see Figure 2). The approach of multiple case studies (Yin 1994) was chosen to arrive at an in-depth understanding of how to initiate, manage, and sustain economic knowledge exchange in CoLKENs. Our overall work is based on a multi-stage, nested design (Eisenhardt 1989; Burgelman 1994; Yin 1994). The data is comprised of one-to-one online and off-line interviews and online 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.

5.1 Xerox' Open Source Initiative: 'CodeX'[3] – an 'eHive'

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, Xerox embarked on the open source initiative 'Code eXchange', short 'CodeX' 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. 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. In June 2003, it involved 1,400 users and 250 hosted projects from all countries and Xerox organizations (e.g. Reese et al. 2003).

'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 USD 3,000,000 per year[4] already since 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.

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

[4] The savings of USD 3,000,000 resulted from USD 1 million savings in infrastructure, software licences, and administrative time, and USD 2 million stemming from personal productivity improvements (see Reese et al. 2003).

5.2 SourceForge – an 'eCasbah'

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 'Open Source Development Network, Inc.' ('OSDN'), the 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 March 2004, more than 810,000 active users were registered to work on one or more of the almost 79,000 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 where knowledge sharing takes place through mailing lists, forums and via sharing documentation between previous versions of the product, (3) the public oriented space (http://www.SFnet/project), and (4) the 'foundries'.

5.3 Comparative Case Analysis

Table 1 summarizes the measures taken to manage co-opetition at the 'eHive' and the 'eCasbah' CoLKENs, 'Sourceforge' and 'CodeX'.

	CodeX ('eHive')	**SourceForge ('ecasbah')**
Management of collaboration including knowledge creation, sharing and management, as well as learning and innovation	- Easy to use and access (entirely web-based) - Ubiquity and uniformity (exact same project environment anywhere, anytime on Intranet) - Continuous feedback collection from the field - Easy transition between projects - Experts quickly identifiable (color management, network protocols) - Semi-voluntary participation, encouraging culture change - Participation encouraged by company-wide communication campaign - Acting as magnet within Xerox - Sharing 'attitude' and values	- Complex interaction mode for specialization and redundancy - Learning by active participation in development communities - Guidance from experts - KM tools (boards, forums) - Free visibility of source code - Shared normative and causal beliefs - Shared notions of validity - Voluntary participation
Management of competition including coordination and control	- Clear distinction between sharing intellectual capital and business practices ('Free access' does not mean 'Free of charge') - De-emphasis of hierarchical structures (leadership without coercion) - Environment favoring 'cross-breeding' (Darwinian approach to software sharing and re-use) - CodeX team bridging gap between product teams and customer organizations in charge of integration and services	- Opportunistic behavior curbed through screening of active members before acceptance to participate - Well structured administration & hierarchy (approval rules) - Project initiators assuming leadership - Vigilant self-governance - User 'rating'

	- Predefined, published rules for re-use and sharing	- Technology support for fast and efficient communication

Table 1: Managing Co-opetition in 'eHive'- and 'eCasbah'-CoLKENs - Cases of CodeX and SourceForge

5.3.1 Management of Collaboration

CodeX and SourceForge 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 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, offers continuous feedback collection from the field, and enables easy transition between projects. Experts are easily identified. Motivation to collaborate 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 attitudes and values.

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. As participation is strictly voluntary at SourceForge, the high level of expertise, perceived by developers as a 'paradise', is a strong motivator for joining the collaborative community.

5.3.2 Management of 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'.

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.

CodeX and SourceForge have developed specific responses to their need for empowering or de-emphasizing leadership. Due to their individual nature as 'eHive' and 'eCasbah', they have developed different member management strategies and procedures to soften upcoming issues of moral hazard.

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

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

6. TOWARDS DECISION SUPPORT TOOLS AND PROCESSES IN COLKEN CONTEXTS

While knowledge management under co-opetition has been discussed recently on the strategic level in CoLKEN contexts including open source communities, the underlying decision support in open source contexts is still a relatively unexplored area and handled rather primitively in practice (e.g. http://bb-opensource.org/advisorygroup.html). Additional concepts and subsequently tools are needed for decision support in CoLKEN contexts to support effectively (see also Crowston, Scozzi 2002; Gallivan 2001): (1) network governance processes (strategy building, membership management), and (2) value creation processes (emergence and selection of initiatives, resource allocation, knowledge management).

Certainly, the different CoLKEN for exhibited in Figure 2, 'eHives', 'eCasbahs', 'Coldrons' and 'Agoras' might have slightly different needs in terms of decision support, so that different tools might hence be employed.

To effectively support the needs of 'eHives' and 'eCasbahs', the two CoLKEN types discussed in this paper, in which the vast majority of decisions have to be taken by distributed teams, various decision support tools could and should be adapted or extended. For instance, Ventana has offered a new Internet-based version of 'Groupsystems', called 'Cognito', since October 2003 (http://www.groupsystems.com/solutions/index.htm). As 'Cognito' is geared towards strategic planning, business planning, focus groups, requirements negotiations, and risk management, such a tool (platform) could be beneficial in CoLKEN contexts, particularly to help potential conflicts emerge and being addressed systematically.

7. SUMMARY AND OUTLOOK

CoLKENs are a growing phenomenon, which provide an interesting decision setting when collaborating amongst potential competitors. This paper has provided a first CoLKEN taxonomy and has detailed some of the 'co-opetition' strategies adopted by two very specific open source CoLKENs, although the open source principle lends itself to cooperation. The examples analyzed in this paper are 'CodeX', an intra-organizational platform of the Xerox Corporation established to facilitate software production and innovation, and 'SourceForge', the world's largest open source software development web site.

In general, open source CoLKENs seem to be very much 'learning by doing' decision settings; differences between the eHive 'CodeX' and the eCasbah 'SourceForge' appeared due to the intra-organizational versus inter-organizational open source governance focus.

With the CoLKEN concept, we have identified a relevant application domain for advanced distributed decision support and aim at analyzing in more detail which decision support tools and mechanisms might help CoLKENs in better addressing the 'collaboration-competition dilemmas' emerging in these contexts. We also suggest the development of a research framework for integrating context specific decision routines that take into account the advantages of collaboration against the potential downsides of competition.

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