Peer-to-Peer Systems Consubstantiating the *Ba* Concept

Fábio Luís Accorsi and João Paulo Costa
University of Coimbra and INESC, Coimbra, Portugal
fabioaccorsi@gmail.com
jpaulo@fe.uc.pt

Abstract: The conceptual evolution of Knowledge Management (KM) has been supported by the use of flexible processes and several computational tools. The sophistication of these tools, incorporating the KM concepts, has been growing with time, creating functions better suited to knowledge creation processes. However, centralized Knowledge Management Systems (KMS) present some inconveniences, such as inflexible knowledge codification structures and centralised control. These may diminish the flexibility and the availability of knowledge through processes that standardize knowledge and information and remove them from the context. The suggestion of peer-to-peer (P2P) systems seems to promise to overcome these inconveniences by supporting interaction and knowledge sharing in simultaneous different contexts. The P2P systems provide real benefits to the interchange of knowledge among its peers/collaborators, but they are far from being a guarantee of interaction. We argue that the notion of *ba* is the design basis to obtain P2P systems closer to theoretical KM concepts. Peers can be encouraged to freely share knowledge without the constraints imposed by hierarchies or other organisational limitations. Interaction through P2P systems, supported by the *ba* concept, can make better use of autonomy to access and share personal knowledge without a centralized codification. P2P systems consubstantiate the *ba* concept thereby creating a new entity which we call *"connecting ba"*. We believe that the *"connecting ba"* can give different visions and energy to the utilization of P2P systems. *"Connecting ba"* can also provide stimulation for virtual participation and for knowledge creation processes. Probably the most important implication of *"connecting ba"* is the possibility to incorporate peers within the spirit of *ba,* promoting collaboration for knowledge creation. The characteristics and the concept relations of these notions are enumerated and justified throughout the text.

Keywords: knowledge management; knowledge creation; concept of *ba*; knowledge management systems; peer-to-peer systems; interaction

1. Introduction

The systematic evolution and conceptual widening of Knowledge Management (KM) in the last ten years has been quite clear. Likewise, the sophistication of tools and technology has provided support for KM needs, acting as facilitators or enablers. One of the most used technological constructions specifically designed for KM proposes is the centralized Knowledge Management System (KMS). However, some points such as knowledge codification and centralized control standardise knowledge and information, removing them from context. Moreover, a KMS usually turns out to be an expensive structure demanding a huge organisational effort in order to make it effective. On the other hand, the suggestion of peer-to-peer (P2P) systems can make a direct connection between individuals feasible, supporting knowledge exchange with more than just one (omnipresent) codification process. Personal interaction and the search for contextualized knowledge fit the conceptual perspective of KM. However, autonomy in search processes, knowledge availability and even interaction, may suffer some inconveniences such as inaction or retention of private knowledge. This paper focuses on the search for solutions or incentives in order to optimise the utilization of P2P systems, aiming to facilitate the KM processes and to integrate their actors.

We present a conceptual perspective of KM and its processes of knowledge creation, especially the *ba* concept. We briefly analyze some conceptual aspects of centralized KMS and P2P systems and we indicate some of its main characteristics. We propose to integrate *ba* and P2P systems, aiming to promote an effective participation of collaborators/peers. Ahead of this fusion we present *"connecting ba"* – a new entity involving associations of issues and concepts as a new approach to stimulate virtual work.

"Connecting ba" sets out to implement the *ba* concept with collaborators/peers in dispersed geographical locations, who use P2P systems in their regular work with other collaborators. It effectively includes and involves them in knowledge creation processes. *"Connecting ba"* aims to use the benefits provided by P2P systems, mainly when dealing with knowledge, and to stimulate actors through the *ba* concept.

2. Knowledge management and *ba* concept

Considering that knowledge is created through interaction Nonaka and Takeuchi (1995) developed a knowledge conversion model for tacit knowledge (abilities, intuitions, judgements, insights, etc) and explicit knowledge (all the facts and abilities that can be registered). This model is divided into four actions defined as Socialisation (tacit – tacit), Externalisation (tacit – explicit), Combination (explicit – explicit) and

Reference this paper as:
Accorsi, F. L. and Costa, J. P. "Peer-to-Peer Systems Consubstantiating the Ba Concept." *The Electronic Journal of Knowledge Management* Volume 6 Issue 1 2008 pp 1 - 12, available online at www.ejkm.com

Internalisation (explicit – tacit). The spiral association of these four conversion modes allows knowledge creation in organisations. In addition, the management of explicit or tacit knowledge consists of performing one or several of the knowledge processes such as transferring, creating, interacting, combining and using knowledge (Bechina and Bommen 2006). This proposal involves high degree of interaction between all collaborators of an organisation.

According to Nonaka, Toyama and Konno (2000) "knowledge creation is a continuous, self-transcending process through which one transcends the boundary of the old self into a new self by acquiring a new context, a new view of the world, and new knowledge". Knowledge is created through interaction between individuals or individuals and their environment. They proposed a model of knowledge creation, combining three elements: 1) The SECI (Socialisation – Externalisation – Combination – Internalisation) process; 2) The emergence of *ba* (a context to share knowledge); and 3) knowledge assets (inputs, outputs, and a moderator of the knowledge-creating process). The authors believe these elements must interact with each other organically and dynamically.

Probably it was through searching for the right context for the SECI process that the Japanese concept *ba* (adapted by Nonaka and Konno 1998) was found, to stimulate the development of the conditions necessary for knowledge creation. According to the authors "*ba* can be thought of as a shared space for emerging relationships. This space can be physical (e.g., office, dispersed business space), virtual (e.g., e-mail, teleconference), mental (e.g., shared experiences, ideas, ideals), or any combination of them". *Ba* should be regarded as a special base where we can use conditions allowing for the emergence of new knowledge.

Von Krogh, Ichijo and Nonaka (2000) identified five knowledge "enablers": 1) install the knowledge vision, 2) manage talks, 3) mobilise knowledge activists, 4) create suitable context and 5) globalize local knowledge. It is in the first and fourth points, that the *ba* concept can be understood more clearly, because it is revealed through an environment (organisational context) that provides positive synergies.

Nonaka, Toyama and Konno (2000) presented four types of *ba*: *originating ba, dialoguing ba, systemising ba, and exercising ba*, defined by two dimensions. The first dimension is the interaction type, i.e., whether the interaction occurs individually or collectively. The second refers to the media used in such interactions, i.e., interactions through personal contact or virtual media, such as books, handbooks, memos, e-mails or teleconferencing. The description of the characteristics of each type of *ba* is exemplified (Nonaka, Toyama and Konno 2000):

- *Originating ba* is defined as the individual and face-to-face interactions, where the individuals share experiences, feelings, emotions and mental models. It offers a context for socialisation: the only way to capture the full range of physical senses and psycho-emotional reactions, such as ease or discomfort, which are important elements in sharing tacit knowledge. It is an environment where such feelings as care, love, trust and commitment, emerge, forming the basis for knowledge conversion among individuals.
- *Dialoguing ba is* defined as collective and face-to-face interaction, where individuals' mental models and abilities are shared and converted into common terms and concepts. It offers a context for externalisation, where individuals' tacit knowledge is shared and articulated through dialogues amongst participants. The articulated knowledge is also brought back into each individual, and further articulation occurs through self-reflection. This type of *ba* is more consciously constructed than *originating ba*.
- *Systemising ba is* defined as collective and virtual interactions. It offers a context for the combination of existing explicit knowledge, as explicit knowledge can be relatively easy to transmit to a large number of people in written form. Information technology, through such things as on-line networks, groupware, documentation and databanks, offer a virtual collaborative environment for the creation of *systemising ba*.
- *Exercising ba* is defined as individual and virtual interactions; overall, it offers a context for internalisation. Here, individuals embody explicit knowledge that is communicated through virtual media, such as written manuals or simulation programs. *Exercising ba* synthesises the transcendence and reflection through action.

To Nonaka, Toyama and Konno (2000) "*ba* must be energized to offer energy and quality to the SECI process". For this, knowledge producers have to provide the necessary conditions, such as: 1) *Autonomy* – increases the possibilities of finding valuable information and gives motivation to the organisation's members to create new knowledge. Not only does self-organisation increase the commitment of individuals, but it can

also be a source of unexpected knowledge; 2) *Love, care, trust and commitment* – are feelings needed among organisational members to stimulate and give form to knowledge creation foundation. These feelings make it easier to share knowledge (especially tacit knowledge); 3) *Redundancy* – refers to the intentional overlapping of information about organisational activities, management responsibilities and about the company as a whole. It speeds the knowledge creation process in two manners. Firstly, sharing redundant information promotes tacit knowledge sharing, because individuals can detect what the others are trying to articulate. Secondly, helps the organisational members to understand their role, which in turn functions to control their thoughts and actions path; 4) *Creative chaos* – stimulates the interaction between an organisation and the external environment. It is different from complete disorder; it is intentionally introduced in the organisation by its leaders to evoke a crisis sense amongst its members by proposing challenging goals or ambiguous visions. It helps to focus members' attention and motivate them to transcend existing boundaries, by defining a problem and solving it. There is another element called *Requisite variety* that works with *Creative chaos* to maintain the balance between order and chaos. It can be seen as a part of *Creative chaos*.

Table 1: Modes and environment for knowledge creation

Knowledge conversion Nonaka and Tacheuchi (1995)	Types of *ba* Nonaka *et al.* (2000)
Socialisation (tacit – tacit)	*Originating ba* (individual and face-to-face interactions)
Externalisation (tacit – explicit)	*Dialoguing ba* (collective and face-to-face interactions)
Combination (explicit – explicit)	*Systemising ba* (collective and virtual interactions)
Internalisation (explicit – tacit)	*Exercising ba* (individual and virtual interactions)

3. Knowledge management systems

3.1 Centralized KMSs

It is perceived in the literature that several technological solutions have been presented to facilitate the KM processes. Nowadays KMSs are broadly defined. KMSs can be considered as artefacts that use extensive domain-specific and context knowledge to solve problems and support decision processes. KMSs also refer to a class of information systems applied to managing organisational knowledge (Halawi, Aronson and McCarthy 2005). Centralized KMSs have been cyclically proposed, showing significant evolutions in terms of the functionalities they embrace. According to Maier and Sametinger (2004) "A KMS provides intelligence to analyse these documents, links, employees' interests and behaviour, offers support for personalized access to the knowledge base as well as advanced functions for knowledge sharing and collaborations". For Maier (2004) a centralized KMS provides a powerful instrument to consolidate the organisational knowledge base that is so often fragmented. Its application requires advanced machines, optimized systems, and a lot of effort to search through a large quantity of data and sources of existing knowledge. Establishing a KMS with a centralized architecture is an expensive approach. Susarla, Lui and Whinston (2003) report that many organisations have tried to build centralized KMSs, but the effort required to codify and create mechanisms to transfer knowledge meant that it became a Herculean task. Moreover, with those conventional KMS efforts, the process of discovering knowledge can only deduce information already encoded as opposed to providing a tool helping to discover tacit knowledge.

According to Yang and Ho (2007) the centralized KMS creates a large, homogeneous Organisational Memory (OM), in which knowledge is explicitly incorporated, collected, represented, and organized in a uniform manner. Centralization brings some advantages in terms of scope, control and organisation. On the other hand, they note that an objectivist view of the world is assumed, in a centralized KMS, i.e., the meaning of the world objects is assumed to be univocal. This takes for granted that the entire context, social and subjective knowledge aspects can be eliminated to have only one objective and general codification. However, knowledge is the result of different perspectives and partial interpretations of "small worlds", which are generated by individuals or groups through social interactions. Subjectivity and sociability are proposed to be intrinsic dimensions of knowledge.

Yang and Ho (2007) believe that the greatest obstacle is that knowledge workers hesitate to transfer the knowledge under their control when they have to resign autonomy and embrace anonymity. Consequently, organisations fail to establish a centralized OM. Maier (2004) observes that a centralized KMS often only marginally satisfies the requirements of integration in personal workspaces.

Without ordering by relevance and probably not being exhaustive, in conclusion, the problems of centralized KMSs can be summarised as: 1) the cost of implementation is high, 2) too much effort must be put in its construction and integration, 3) the knowledge codification remove its context, 4) they only marginally satisfy integration requirements, 5) they are inefficient at capturing tacit knowledge, and 6) they only retain the encoded knowledge certified by the "organisation".

3.2 P2P KMS

According to Liu and Zhuge (2006) a P2P system consists of a large number of nodes through which it is possible to exchange data and services, in a decentralized and distributed manner. Peers are autonomous, dynamic and heterogeneous. In P2P systems, the resources are distributed in multiple autonomous sites. Each site has equal functionalities and can play the role of both client and server. A P2P system has the characteristics of local data control, dynamic addition and exclusion of peers, local knowledge and data schemes, self-organisation and self-optimization.

Yang and Ho (2007) affirm that "distributed KM is a different epistemological paradigm that keeps subjectivity and sociality aspects of knowledge, which are viewed as a potential source of value, rather than a problem to overcome. Distributed KM would be based on the principle that multiplicity (and heterogeneity) of perspectives within complex organisations should not be viewed as an obstacle to knowledge exploitation, but rather as an opportunity that can foster innovation and creativity". As far as the authors are concerned, P2P architecture is appropriated to develop a virtual community and to facilitate resources sharing, collaboration and "content management". They observe that through the amplification of a P2P computing paradigm to the whole area of KM, interaction between the peers can be "naturally" extended beyond the organisational boundaries, without relying on a corporate infrastructure. In a "pure" P2P, the peer's nodes are really autonomous and not centrally indexed to a knowledge store, and they support key processes of KM (e.g., search, codification, distribution). Thus, they may be seen as a natural extension of the KM practices from the individual to the group level. The freedom of interaction provides a particular flexibility to knowledge exchange among their peers.

However there are some issues investigated (Susarla, Lui and Whinston 2003) and later organized by Maier (2004, p 285) that point out some problems of a P2P infra-structure: 1) *participation issue* – there must be incentives to actively participate in order to foster information sharing and to avoid the free ride issue; 2) *trust issue* – security and reliability have to be believable for the participants if the system has to be used as the sole, personal knowledge workspace; 3) *coordination issue* – structure and quality management of the knowledge contained in a P2P network have to be supported in order to avoid information overload.

The main characteristic of P2P KMSs is that collaborators can use tools and systems accommodated in a distributed environment without centralized control. As an example, the Instant Message Manager, which is basically a P2P function, provides an instant communication with other peers without the need to connect to a central system. Anyway, documents, graphics, photos, audio/video, etc., can be manipulated and shared without going through or being stored in a centralized repository. Those knowledge pieces can make part of a repository belonging to peers that interact in a collaborative work, or even peers that are just interested in the subject and want to share knowledge.

4. Interaction advantages of peers

The P2P system provides significant advantages for its users who are dealing with knowledge. Among them it is possible to emphasize that when a user needs to know about a process or tries to access specific organisational resources, s/he can send a query to other nodes, which in turn can ensure that search results are relevant and up-to-date (Susarla, Lui and Whinston 2003). There is, thus, an interactive aspect of knowledge search in the P2P environment so that the search technology can be complemented by human intelligence components. A database search can only reveal encoded knowledge; P2P mechanisms can reveal the knowledge residing at user nodes and thus can help in the discovery of 'hidden' knowledge (not yet encoded).

During the dynamic process of people's interactions, there is some background, contextual, information which can provide very valuable tacit knowledge (Yang and Ho 2007). Consequently, individuals can voluntarily explain and supply necessary information. Such autonomy would facilitate the tacit knowledge capture and transfer. According to the authors, a "pure" P2P KMS can effectively supplement shared knowledge in virtual communities. For them the great challenge is how to maintain the knowledge multiplicity and sharing autonomy principle and simultaneously also deal with knowledge as a valuable resource to an organisation.

The advantages of P2P KMSs suggested by Benger (2003, *vide* Maier 2004, p 284) are: 1) *autonomy* – semi-autonomous organisational units can easily create and share knowledge, 2) *direct communication* – knowledge is exchanged directly without central units that often act as an unwanted filter (barrier) to knowledge, 3) *flexibility* – P2P KMSs allow the configuration of temporary, dynamic networks of knowledge workers, 4) *acceptance* – local storage together with an efficient management of access privileges reduces the barriers to providing knowledge that some central KMS solutions experience. In addition, other advantages of P2P KMSs are noted by Milojicic, Kalogeraki, Lukose, Nagaraja, Pruyne, Richard, Rollins and Xu (2003): 1) improving scalability by avoiding dependency on centralized points, 2) eliminating the need for costly infrastructure by enabling direct communication among clients, and 3) enabling resource aggregation.

The P2P metaphor promises to solve some of the shortcomings of centralized KMSs. Examples are (Maier 2004, p 284): 1) to reduce the substantial costs of the design, implementation and maintenance of centralized KM suites, in terms of hardware, standard software as well as the often underestimated cost of designing, structuring and organizing a centralized knowledge server and the management of users and privileges. This is due to the fact that simple local KMSs are often already in place. Compared to a central KMS, additional investments are minimal. 2) To reduce the barriers that prevent individual knowledge workers from actively participating and sharing benefits of a KMS, e.g., by reducing the psychological barrier to disclosing knowledge elements to an unknown target group by giving the user full control over the access privileges to his/her knowledge elements. 3) To overcome the limitations of a KMS that (almost) exclusively focuses on organisational-internal knowledge whereas many knowledge processes cross organisational boundaries, because workspaces can easily be extended to knowledge workers from partner organisations. 4) To include individual messaging objects, e.g., emails, instant messaging objects, into the knowledge workspace that are rarely supported by centralized KMS. 5) To seamlessly integrate the shared knowledge workspace with an individual knowledge worker's personal knowledge workspace.

However, there are still serious challenges that have to be overcome in P2P computing in general. These challenges concern (Barkai 2001, *vide* Maier 2004, p 285): 1) *connectivity*, e.g., locating peers that do not have public IP addresses and mechanisms for communicating through firewalls; 2) *security and privacy*, especially the risk of spreading viruses, unauthorized access to confidential and private information and the installation of unwanted applications; 3) *fault-tolerance and availability*, e.g., finding the required resources when they are needed; 4) *scalability*, especially concerning the naming scheme and searches in the flat structure of the distributed search domain; 5) *self-managed systems* that are administered by users with limited experience and; 6) *interoperability*, i.e., current P2P installations sometimes cannot connect to each other due to e.g., a variety of computing models, a variety of network settings and a wide range of applications types.

5. Peer-to-peer systems consubstantiate the *ba* concept: *connecting ba*

It was observed that P2P systems have considerable advantages in relation to traditional centralized KMS. Providing a "direct" connection between individuals, making possible the exchange of knowledge without needing to go through a re-codification process, is probably the main attribute. Supported in this point is the viability of interaction between individuals in the search for contextualized knowledge. Nevertheless, autonomy in the search process, knowledge availability, and even interaction, can suffer some inconveniences. However, most of inconveniences reported in the literature can be considerably reduced if P2P systems support the *ba* concept. It can be observed that these issues stem from a lack of incentive or culture related to the KM. An enabling context, or *ba,* must be developed with the aim of reducing the disadvantages related to interaction and to stimulate a common involvement.

Interaction and collaboration offer access to the biggest portal of contextualized knowledge that can be conceived, its scope depends on the dimension of involvement achieved by its actors. Such dimension is related to certain feelings of transcendence, such as the satisfaction of knowing and showing knowledge without any imposition. Nevertheless, individuals have to have a real notion about the KM processes and

they must realise that it is possible to create new knowledge and achieve self development through them. There cannot be a suitable P2P KMS without its peers understanding the common sharing benefits of knowledge and the possibilities generated by these exchanges. Peers must be stimulated by the differentiated context that involves the individuals supported by *ba*. This conceptual approach can be seen in Table 2.

Consequently P2P KMSs can support people's integration in their workspaces. The distributed knowledge in each peer can be a source of unexpected connections' re-generating structures, associations and stimulating meetings. It must be perceived that the nodes of a system only exist because there are other nodes, and behind each node there is a person who will not be restricted to computational interactions to reach his/her objectives. Thus, a P2P KMS can be seen as an evolution bringing considerable benefits especially if the *ba* concept is involved.

Table 2: Approach of the issues and advantages of P2P and energizing *ba*

Issues that have to be considered Susarla *et al.* (2003)	P2P KMS advantages Benger (2003)	Energizing *ba* Nonaka *et al.* (2000)
Participation issue (there must be incentives to actively participate in order to foster information sharing and to avoid the free ride issue)	*Autonomy* (semi-autonomous organisational units can easily create and share knowledge with the help of those tools and those ontologies that fit their domain)	*Autonomy* (optimizes the search for valuable information, motivates and commits the collaborators to creating knowledge - becoming an unexpected source of knowledge)
Trust issue (security and reliability have to be believable for the participants)	*Direct communication* (knowledge is exchanged directly without central units that often act as an unwanted filter (barrier) to knowledge)	*Love, care, trust and commitment* (fostering these feelings amongst organisational members is important as it forms the foundation of knowledge creation - especially tacit knowledge)
Coordination issue (structure and quality management of the knowledge contained in a P2P network have to be supported in order to avoid information overload)	*Flexibility* (P2P KMSs allow the configuration of temporary, dynamic networks of knowledge workers)	*Redundancy* (it is an intentional overlapping of organisational information - it provides a self-control mechanism for achieving a certain direction and consistency)
	Acceptance (local storage with an efficient management of access privileges reduces the barriers to provide knowledge that some central KMS solutions experience)	*Creative chaos* (it evokes a crisis sense - helps to focus members' attention and motivate them to transcend existing boundaries, defining a problem and solving it)

5.1 "Connecting ba"

We propose to consubstantiate the *ba* concept in P2P systems. We call this fusion *"connecting ba"*. The *"connecting ba"* is a sequence of relations, interaction and connections established through P2P systems by actors supported by the *ba* concept. It is a guide to travelling, via P2P systems, through a virtual environment where the conditions for knowledge creation and the stages of the SECI process are intended to exist. The *"connecting ba"* stimulates the inclusion of geographically dispersed collaborators/peers to virtually interact, simulating face-to-face relationships and other types of association, aiming to facilitate knowledge conversion and creation.

First of all, to achieve their objectives collaborators must understand the theory underpinning the subject. Interacting in these processes, looking to share tacit and explicit knowledge, is a learning exercise that involves commitment and trust, especially if using a virtual medium. In order to use P2P systems for KM the effective ascension of the *ba* concept becomes fundamental. *"Connecting ba"* can support the collaborator who, geographically remote, acts to establish efficient and effective ways of interaction and knowledge creation. Figure 1 represents the *"connecting ba"* concept. The triangle represents a physical organisation – the organisational culture is the basis of KM which supports the *ba* concept involving all the collaborators/peers (small circles). They are connected through P2P systems to act in the SECI process promoting a new Knowledge. The circle represents the environment of the *"connecting ba"*.

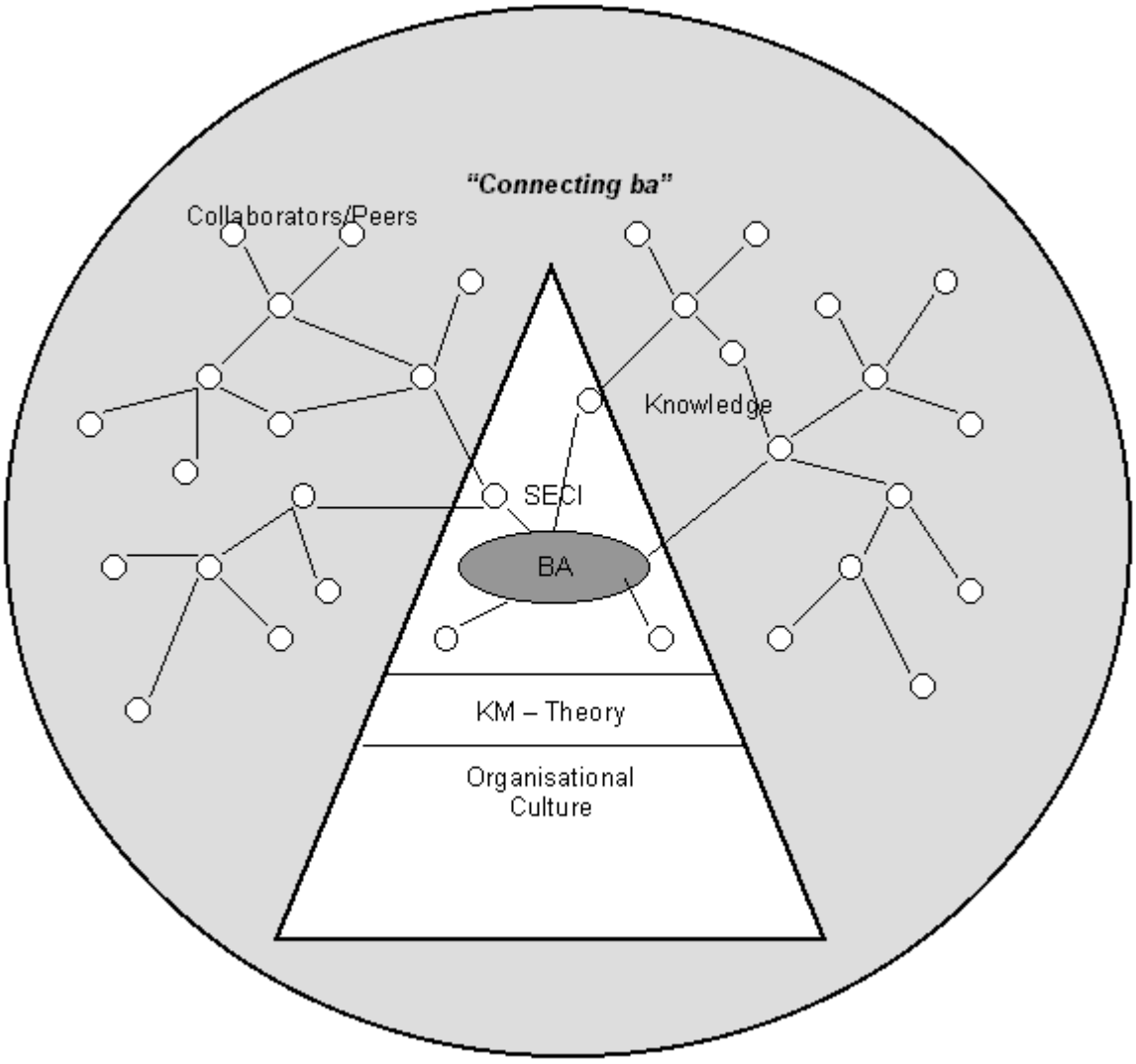

Figure 1: Peer-to-peer knowledge management system – *"Connecting ba"*.

Dispersed collaborators can participate in knowledge creation – the dispersion does not remove them from the four types of *ba* (see section 3). Even if the *originating ba* claims face-to-face interaction, a way must be found (through P2P systems) to provide it with comprehension of feelings, experiences and mental models. Considering that this type of *ba* is connected to socialisation – without wanting to substitute face-to-face interaction, but out of necessity – P2P systems can contribute to tacit knowledge sharing. As explained in section 4, behind each node there is a person. *Originating ba* is an environment where a sequence of feelings emerges - this background can be simulated by *"connecting ba"* considering that human components are part of a P2P net.

In relation to *dialoguing ba* where face-to-face interactions are articulated and explicit, *"connecting ba"* must try, through P2P systems, to provide support to perceive the experiences and abilities of the collaborators converting them into common terms and concepts, even if with different codification structures. The context offered by *dialoguing ba* to the externalisation process (tacit – explicit) can be supported by *"connecting ba"* in the search for tools to promote virtual dialogues and also to support the conversion process. *"Connecting*

ba" can involve selected collaborators in meetings or projects to facilitate the generation of knowledge creation in *dialoguing ba*.

"Connecting ba" can help *Systemising ba* (collective and virtual interactions) with tools that facilitate combination. The explicit knowledge already in place in the organisation and with the peers can be combined to generate new explicit knowledge. Through *"connecting ba"* the collaborators can interact by using heterogeneous tools and systems, generating the collaborative virtual environment aimed by *systemising ba*.

Exercising ba supports the internalisation phase, where there are individual and virtual interactions. Here, there is a transformation of explicit knowledge (virtually communicated) to tacit knowledge. *"Connecting ba"* can help as a dissemination medium through collaborator interaction, resulting in tacit knowledge. This knowledge turns into a new formal knowledge and into actions supported and transmitted via *"connecting ba"*.

Considering these connections, it can be seen that *"connecting ba"* is an energized movement where collaborators can, above all, use their own P2P systems appropriately. *"Connecting ba"* approaches the four types of *ba*. It can find solutions to issues (see section 3.2) that precede the implantation and development of a P2P infrastructure in an organisation. These issues can be supported by the same conditions (section 2) that are needed to energize *ba* and thus offer energy and quality to P2P systems users.

The *participation issue* can be stimulated through the *ba* concept to form a sort of movement. In this way, *"connecting ba"* can be the biggest incentive to autonomous participation in the search for contextualized knowledge. *Autonomy* (section 2) facilitates the voluntary search for information and peer movement. In addition, the contextualized knowledge, existent in each peer, provokes peer's interaction.

The *trust issue* can be stimulated by *"connecting ba"*, because peers that virtually interact, involved by *ba*, reduce the uncertainties with regard to relationships. The *love, care and commitment* (section 2) are established by the theme, project or knowledge affinities. The P2P infrastructure will then provide autonomy of action and, with this, it will stimulate interaction. The safety and trust are established by a sharing relation, which gains power if involved by the *ba* concept.

Coordination opposes *redundancy* (section 2): the first is concerned with the KM structure and quality - in a P2P network it must be supported to avoid information overload; and the second is concerned with intentional overlapping of organisational information – in a P2P net it will be naturally expected. In both cases *"connecting ba"* can provide a dynamic interactivity that will make it possible to easily expand the number of peers and consequently information redundancy which, if contextualized and coordinated, can generate new knowledge.

The *creative chaos* (section 2): *"connecting ba"* can easily offer support to it, supporting the creation of a collaborators' movement, to facilitate spreading 'chaos' and finding new ways of defining problems and solutions to overcome them.

Under this view *"connecting ba"* can support and present solutions to design and implement a P2P infrastructure, because it is in tune with the necessary conditions that energize *ba*. In this way, *"connecting ba"* can be more than a concept supported by *ba* and P2P systems: it can be a route to multiple solutions to the benefit of interaction and knowledge creation.

5.2 Challenges of *"connecting ba"*

First of all, it is the *organisation* and its *culture* that provide a work guide, styles of behavior, interaction and collaboration. The "adjusted" organisational culture is one that allows flexibility in the understanding and adaptation of new contexts, facilitating thinking and acting dynamically. Organisational culture provides freedom to break barriers in the search for an organisation's objectives and values. However the *organisational culture* must also provide ways to manage and control those organization's objectives – this duality is a challenge for the structure of contemporary organisations.

A theory is needed to support knowing how to deal with knowledge search and share, enriching Intellectual Capital, and, in particular, creating new knowledge. Attention to tacit knowledge is important because expertise relies on it, and because it is a source of competitive advantage, as well as being critical to daily management activities (Baumard 1999). The biggest problem is that tacit knowledge is hard to articulate, stabilize, formulate and transmit, and sometimes it cannot be done (Nonaka and Takeuchi 1995; Baumard

1999). Consequently, working with and taking advantage of tacit and explicit knowledge are great challenges for any researcher or organisation involved in KM.

The *ba* concept is presented here as a vital element for the constitution of *"connecting ba"*. *Ba* is related to the *right* context – which foments new relationships in micro communities, between the groups' boundaries, throughout an organisation, promoting the necessary initiatives to release the tacit knowledge (von Krogh, Ichijo and Nonaka 2000). "*Ba* can emerge in individuals, working groups, project teams, informal circles, temporary meetings, virtual space such as e-mail groups, and the front-line contact with the customer" (Nonaka and Toyama 2007, p 23). An environment created and supported by *ba* can reach a "state of spirit" suitable for interaction and collaboration through P2P systems. *"Connecting ba"* consubstantiates *ba* in P2P systems. Autonomy and feelings like love, care, trust and commitment are essential elements to energize *ba* and for *"connecting ba"*. Involved in this environment, groups can evolve through P2P systems. Doing more than simply carrying out a task, groups can profit from the knowledge that inhabits each peer. This would stimulate interaction and virtual collaboration in the search for a common element, and furthermore it would create interest in transforming definitive virtual interactions into face-to-face ones.

SECI is a dynamic process for converting knowledge (tacit and explicit), but while it offers the possibility of disseminating it, principally it creates knowledge through the interaction between the stages of the process and people. *"Connecting ba"* can operate with "any" kind of knowledge, but explicit knowledge (electronic) is easier to transmit through P2P KMSs than tacit knowledge. Explicit knowledge depends on how accomplished people are at expressing their tacit knowledge in a perceptive way to others. The individual internal process of converting knowledge (tacit to explicit) can not be replaced by technology but technology can support the process. Technology is a communication and collaboration facilitator, mainly for dispersed people. *"Connecting ba"* enables collaborators to actively share knowledge because they are embedded in *ba*, and have a flexible and objective environment to support it.

Working on the SECI process with *"connecting ba"*:

- *Socialization* (tacit – tacit): Can be accomplished by videoconference (Nonaka, Reinmöller and Toyama 2001). Systems for multipoint videoconferencing can be used to extend almost any point-to-point video conferencing systems with minimal increase in complexity and no additional hardware requirement (Civanlar, Özkasap and Çelebi 2005). Image and sound can provide an environment that simulates f2f meetings, making the exchange of tacit knowledge and the transfer of part of the context possible. Immediate feedback can trigger socialization. Chat and instant messaging systems, though poorer, can also be a useful communication environment.
- *Externalization* (tacit – explicit): knowledge can be externalized, i.e. documented, contextualized and stored as explicit in peers' individual knowledge bases (Maier 2004). This can be facilitated through, e.g., collaborative text editing tools, instant messaging, chats, etc.
- *Combination* (explicit – explicit): knowledge from several peers can, semi-automatically or manually, be brought together and stored as part of one, many or all the knowledge bases of the peers involved in the combination (Maier 2004). This stage provides knowledge *search* and *share* (objects such as documents, pictures/graphs, and video/audio) between peers.
- *Internalization* (explicit – tacit): can be facilitated by, e.g., digitalized manuals, videos, on-line group discussion, on-line narrative tools and networking technologies (Nonaka, Reinmöller and Toyama 2001).

The "spiral of knowledge creation", suggested by Nonaka, is hard to accomplish because it can be a stressful process if followed step by step, but it is easier for persons interested and involved by *ba*. This can occur if their relationships improve through this process. *"Connecting ba"* can engender "the strength of weak ties" (SWT) (Granovetter 1973) using all social network advantages through the bridge each peer can provide. This wider sociological theory that involves the forces of connections between people in social networks provides a deeper vision of and reflection on the linking of micro and macro levels of relationships. To Granovetter (1983, p 299) "weak ties are asserted to be important because their likelihood of being bridges is greater than (and that of strong ties less than) would be expected from their numbers alone. This does not preclude the possibility that most weak ties have no such function". In SWT the author suggested "that for a community to have many weak ties which bridge, there must be several distinct ways or contexts in which people may form them". *"Connecting ba"* is a tool leading the ties to the "complex roles sets and the need for cognitive flexibility" (Granovetter 1983, p 204). The peers can strengthen their ties through *"connecting ba"*. It can also reduce the inconveniences or difficulties found for "digital immigrants" (who were not born into the digital world) making them more like "digital natives" (like "native speakers" of digital

language of computers, internet, etc.) (Prensky 2001). This can be accomplished through *ba*, which provides feelings such as security and reliability for the participants in a P2P system. In this way, "digital immigrants" can use this environment to take advantage of the use of P2P systems. However, *"connecting ba"* establish facilities mainly for dispersed collaborators working "together" in the SECI process of knowledge creation.

Knowledge is the objective to be pursued, shared and created by the collaborators/peers. *"Connecting ba"* provides ways to reach contextualized knowledge resident in each peer, and stimulates an interactive and collaborative behavior between peers. The availability of knowledge (explicit and tacit) supplied by each peer is directly linked to the impact of KM on organisational culture, specifically the organisational involvement in the *ba* concept.

6. Conclusions

In this paper we have discussed the dynamic process of knowledge creation and its connection with the *ba* concept. We have noted the main characteristics of centralized KMS and P2P systems, confirmed the advantages of P2P systems and their benefits to KM practices. P2P systems offer more freedom of interaction and provide more flexibility in the exchange of knowledge between peers. The provision of a "direct" connection between collaborators/peers makes it possible to access knowledge without going through a re-codification process. Hence, it becomes the best way to reach contextualized knowledge and to approach the conceptual perspective of KM.

We have proposed a new concept called *"connecting ba"*, consubstantiating *ba* in P2P systems. We believe that *"connecting ba"* can give a different view of and energy to the utilization of P2P systems. Therefore, *"connecting ba"* can also provide stimulation for virtual participation and also for knowledge creation processes. Probably the most important implication of *"connecting ba"* is the possibility of including peers in the spirit of *ba,* promoting collaboration for knowledge creation.

Acknowledgements:

This work was supported by the FCT and FEDER, project POCI/EGE/58828/2004 and by the AlBan Programme, the European Union Programme of High Level Scholarships of Latin America, scholarship no. E04D07158BR. The authors thank Eliana Giacomini for her help with the English.

References

Barkai, D. (2001) Peer-to-peer Computing. Technologies for Sharing and Collaborating on the Net, Hillsboro (OR), USA.

Baumard, P. (1999) Tacit Knowledge in Organisations, Sage, London.

Bechina, A, A. and Bommen, T. (2006) "Knowledge Sharing Practices: Analysis of a Global Scandinavian Consulting Company", The Electronic Journal of Knowledge Management Vol 4, Issue 2, pp109-116, available online at www.elkm.com

Benger, A. (2003) "Dezentrales, Selbstorganisierends Wissensmanagement", in: Gronau, N. (ed.): Wissensmanagement: Potenziale – Konzepte – Werkzeuge, Proceesings of the 4 Oldenburg Conference on Knowledge Management, University of Oldenburg, June 11-12, Berlin, pp155-170.

Civanlar, M.R., Özkasap, Ö. and Çelebi, T. (2005) "Peer-to-peer Multipoint Videoconferencing on the Internet", Signal Processing: Image Communication, 20, pp743-754.

Granovetter, M. S. (1973) "The Strenght of Weak Ties", American Journal of Sociology, Vol 78, No. 6, pp1360-1380.

Granovetter, M. S. (1983) "The Strength of Weak Ties: A Network Theory Revisited", Sociological Theory, Vol 1, pp201-233.

Halawi, L., Aronson, J. and McCarthy, R. (2005) "Resource-Based View of Knowledge Management for Competitive Advantage", The Electronic Journal of Knowledge Management, Vol 3, Issue 2, pp75-86, available online at www.elkm.com

Liu, J. and Zhuge, H. (2006) "A semantic-based P2P resource organisation model R-Chord", The Journal of Systems and Software, No. 79, pp1619-1631.

Maier, R. (2004) Knowledge Management Systems: Information and communication Technologies for Knowledge Management. Springer-Verlag, Berlin, Heidelberg.

Maier, R. and Sametinger, J. (2004) "Peer-to-peer Information Workspace in Infotop", International Journal of Software Engineering and Knowledge Engineering, Vol 4, No. 1, pp79-102.

Milojicic, D., Kalogeraki, V., Lukose, R., Nagaraja, K., Pruyne, J., Richard, B., Rollins, S. and Xu, Z. (2003) Peer-to-Peer Computing, HPL-2002-57 (R.1), Hewlett-Packard Company, Palo-Alto.

Nonaka, I. and Konno, N. (1998) "The Concept of "Ba": Building a Foundation for Knowledge Creation", California Management Review, Vol 40, No. 3, spring, pp40-54.

Nonaka, I., Reinmöller, P. and Senoo, D. (1998) "Management Focus the 'ART' of Knowledge: Systems to Capitalize on Market Knowledge", European Management Journal, Vol 16, No. 3, pp673-684.

Nonaka, I., Reinmöller, P. and Toyama, R. (2001) “Integrated Information Technology Systems for Knowledge Creation”, Chapter 37 in: Dierkes, M., Antal, A. B., Child, J. and Nonaka. I. (Eds.), Organisational Learning and Knowledge, Oxford University Press, New York, pp827-848.
Nonaka, I. and Takeuchi, H. (1995) The Knowledge Creating Company. Oxford University Press, New York.
Nonaka, I., Toyama, R. and Konno, N. (2000) “SECI, Ba and Leadership: a Unified Model of Dynamic Knowledge Creation”, Long Range Planning, Vol 33, No. 1, February, pp5-34.
Nonaka, I. and Toyama, R. (2007) “Why Do Firms Differ? The Theory of Knowledge-Creating Firm”, Chapter 1 in: Ichijo, K. and Nonaka, I. (Eds.). Knowledge Creation and Management: New Challengers for Managers, New York, Oxford University Press.
Yang, H-L. and Ho, H-C. (2007) “Emergent Standard of Knowledge Management: Hybrid Peer-to-Peer Knowledge Management”, Computer Standards & Interfaces, No. 29, pp413-422.
Susarla, A., Lui, D. and Whinston, A. B. (2003) “Peer-to-Peer Knowledge Management”, Handbook on Knowledge Management 2 – Knowledge Directions. Springer-Verlag, Berlin, Heidelberg, pp129-139.
Prensky, M. (2001) “Digital Natives, Digital Immigrants”, [online] Flexiblearning, http://pre2005.flexiblelearning.net.au/projects/resources/Digital_Natives_Digital_Immigrants.pdf
Von Krogh, G, Ichijo, K. and Nonaka, I. (2000) Enabling Knowledge Creation. Oxford University Press, New York.

