# THE IMPACT OF COMMUNITIES OF PRACTICE (CoP) ON INTER-FIRM ALLIANCE RESEARCH TEAMS.

by

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## Summary

The need for faster, more flexible and less risky ways for organisations to expand their capabilities and competencies increasingly lead to the formation and proliferation of networking strategies and partners. Understanding the potential contribution that CoP membership can provide within these teams is a step towards developing and refining a strategy to support and enhance the speedy progression of the team towards a productive phase.

The study shows that membership of researchers to the same or similar CoPs have some impact on the norming stage, and assist in reaching the performing / productive stage faster in team development. The survey in particular has indicated that similar standards, practices, terminology, ethics, standards, peer recognition, trust and a sense of belonging have more of an impact on the productive phase of team forming, than on the norming phase. The hard factors such as terminology, standards and similar practices have a strong correlation with the softer factors such as a sense of belonging and trust.

This information should be utilised in both the socialisation processes in academic institutions as part of the education of professionals, as well as organisational approaches to Research and Development (R&D), information sharing and development of the researchers.

The paper also highlights emerging organisational and strategic Best Practices currently prevalent in R&D teams and collaborative projects. It is clear that research collaborations cuts across the whole spectrum of business and management areas - from strategy, across intellectual property issues, finance, strategic human resource management, R&D management and innovation, knowledge management, organisational values and culture, and many more. To support innovation and R&D on a strategic level, both internally and on inter-firm collaborations, requires a review of the total organisational strategy, culture and norms in an organisation. Innovation and R&D support should be a holistic approach, with strategic and pro-active risk management supported by appropriate strategic human resources management and systems.

Literature on CoPs, teams, social capital (SC), knowledge management (KM), intellectual capital (IC), intellectual property (IP), strategy and governance provide theoretical grounding.

## Key Terms

Communities of Practice (CoP); Social networks; Social Capital; Inter-firm Collaboration; Knowledge Management; Team development; Intellectual property; Research and Development strategic management; Risk management; Innovation.

## List of Abbreviations used regularly in the text.

| | | | |
|---|---|---|---|
| Community of Practice | CoP | Research and Development | R&D |
| Community of Interest | CoI | Social Capital | SC |
| Intellectual capital | IC | | |
| Intellectual property | IP | | |
| Information technology | IT | | |

# Acknowledgements

*Thou didst give a wide place for my steps under me,*
*and my feet did not slip.*
*Psalms 18:36*

My interest in this particular subject was inspired by a good friend who wishes to remain anonymous. A researcher himself, the internet enabled him to obtain input on problematic cases from colleagues all over the world within a short space of time. It was interesting to note that for my friend the focus of the discussion was on the technology that made this networking possible. The fact that there was this network of researchers out there that he knew and trusted professionally, and who willing shared their expertise, was almost taken for granted. I would like to express my appreciation for all his subsequent input and support as well.

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# Chapter 1 Introduction

## 1.1 Introduction

Today's dynamic market place requires various organisational strategies and tools to cope and stay competitive. Intangible resources are seen as the primary providers of competitive advantage. Intangible resources consist of assets that are not material or physical, such as the goodwill of a firm, intellectual capital, knowledge creation and expertise. Thus concepts such as knowledge creation and intellectual capital are being explored as sources and enablers of innovation.

Such a dynamic environment requires flexibility in capabilities and competencies, which is difficult for an organisation to accomplish through in-house resources alone. In many instances mergers and acquisitions proved to be too slow, cumbersome, expensive and risky partly due to integration problems. The need for a faster, more flexible and less risky way for organisations to expand their capabilities and competencies increasingly lead to the formation and proliferation of networking strategies and partnerships. Wolcott (2002) developed a topology to illustrate the motivation behind the forming of networks.

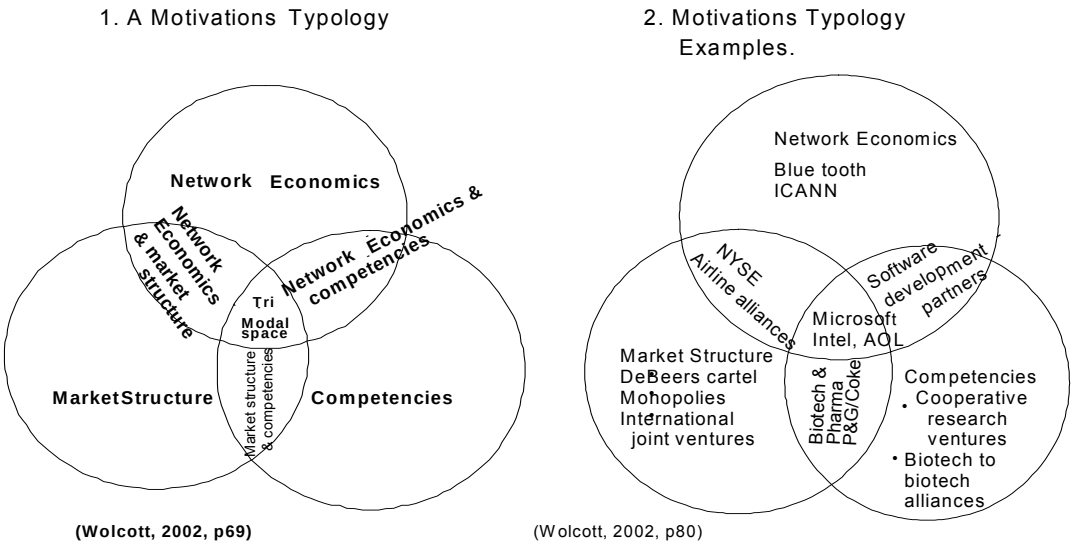



**Diagram 1: Wolcott's Motivational Typology**

This topology identifies three motivations behind the forming of networks, namely market structure, networks economics and competencies. According to this topology the cooperative research ventures resort under the latter group – competencies. Competencies are a set of behaviours that encompasses skills, knowledge, abilities, and personal attributes, that taken together, are critical to successful work

accomplishment (State of Texas HR Workforce Glossary, no date).

The chemical, engineering, pharmaceutical and biotech ventures are market related networks. The biotech industry is composed of firms operating in a variety of sectors: health care, crop production and protection, chemical feedstock production and processing, food processing, waste management, aquaculture, forestry and the environment (Liebeskind, Olive, Zucker & Bruwer, 1996; Cumby and Conrod, 2001).

However, the sensitive and competitive nature of innovation and knowledge creation limits the extent to which such collaborative inter-firm alliances can take place. Both Skandia and Ernst & Young (in Sveiby, 1998) emphasise the *static* properties of knowledge, such as inventions, ideas and patents as Intellectual Capital (IC). In contrast knowledge creation and Knowledge Management (KM) is *active* (Sveiby, 1998). According Nonaka & Takeuchi (1995), knowledge creation is a spiralling process of interactions between explicit and tacit knowledge. Van Beveren (2002: 18) claims that knowledge cannot exist outside the human brain, and that any expression of the knowledge requires it to be transformed (back) into information to be communicated outside the brain. Innovation can be defined as the creation and exploitation of new ideas. The process moves products and services, processes or devices beyond their current boundaries and capabilities (University of Salford, no date).

It would seem that cross-organisational collaboration on knowledge creation and innovation is often limited to the initial research phases (Liebeskind, *et al*.; 1996; Muller and Välikangas, 2002). After the point where an academic-like openness to basic research is no longer essential, research into new products or processes becomes highly proprietary. Researchers become much less willing to share information, patents are *de rigueur* and intellectual property strategy restricts information flow between researchers. This not only applies to research conducted in for-profit settings, but extends to include many academic settings as well (Wolcott, 2002).

The research environment became much more complicated with the move into:

- Genomics - the study of genes and their function (genomes) which includes genome mapping and gene sequencing;
- Proteomics - the branch of genetics that studies the full set of proteins encoded by a genome, the analysis of complete complements of proteins; and
- The broader fields of bioinformatics and nanotechnology;
- The aerospace industry, which includes as diverse areas as aircraft and rocket development, engines for the aircraft and rockets, 3-D modelling, simulation and virtual reality tools, command, control and tracking capabilities, etc.

The amount of information to be researched in genomic, proteomic and nanotechnology research areas is vast, requiring so many resources and information technology (IT) capacity that it resulted in world-wide collaboration – thereby eliminating wasted resources duplicating the same work, and improving efficiency by sharing technology and research capacity and skills. New large-scale collaborative efforts, such as the genomics and proteomics research have made it almost impossible to keep up through internal efforts alone (Liebeskind, *et al*., 1996; Quinn, 2000; Wolcott, 2002). The same is true for the aerospace industry, where the prohibitive cost of research and development resulted in the industry being built around collaboration (Lundberg, 2005, personal interview).

This world-wide collaboration further highlighted the conflict between proprietary ownership of knowledge (intellectual property issues) in a highly competitive environment, and cooperation with potential competitors for the common good (Wolcott, 2002). Linnarson and Werr (2004) also refer to inherent tension between the logic of alliances and the logic of innovation. Innovation is generally argued to require flexibility, political protection and extensive communication; whereas the commonly mentioned key characteristics of alliances are detailed contractual regulation, political struggles and limited information exchange.

For large companies, outsourcing to universities, institutes and government laboratories has long provided fundamental research knowledge for new product streams. In the 1950's Hoffman La Roche, through the La Roche Institute, was among the first to formalise such relationships, giving researchers support, independence and facilities that few universities or independent laboratories could equal.

The drug development process in the pharmaceutical industry provides an excellent example of the knowledge requirements and related issues facing knowledge-based industries.

**The drug research and development process**

The competitive advantages of the pharmaceutical companies are based upon the company's ability to generate new knowledge which can produce patents and new medicines that are turned into marketable profit-generating products. The industry is noted for its technological intensity, and studies suggest that research and development (R&D) forms an important source of competitive advantage (Yeoh and Roth, 1999, in Styhre and Sundgren, 2003) to the extent in which the R&D result in marketable profit-generating products.

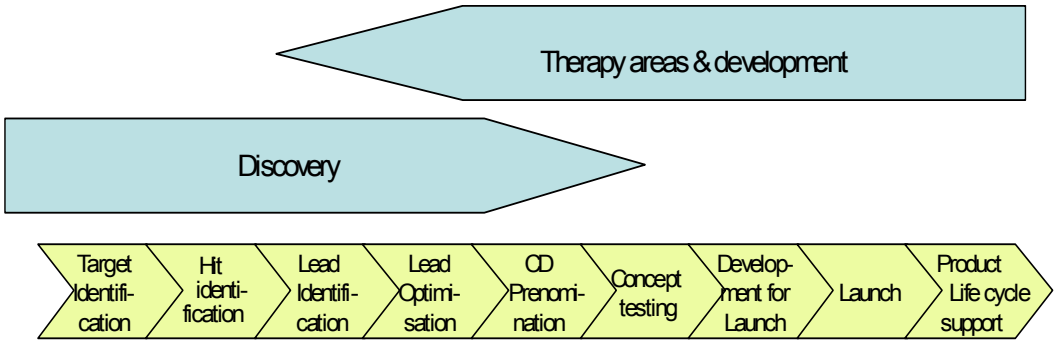
For those sectors involved in scientific discovery aimed at the creation of new health care products, the process is long and arduous. According to Cumby and Conrod

(2001), discovery and preclinical studies are followed by three stages of clinical trials on humans to gain necessary government regulatory approval. "At any step of the way, the drug might fail because it's not safe or just doesn't work; depending on the kind of drug, the failure rate for a product in clinical trials is typically in the 80 per cent to 90 per cent range. Even if a drug is approved, success in a competitive market is another challenge" (Chidley, 2000, in Cumby and Conrod, 2001: 49).

In the case of discovery pharmaceutical research, the outcome is a new chemical entity (NCE), a new chemical compound that serves as the basis for a new candidate drug (CD). In the case of development there are two aspects:

- First, the research outcome is a formulation (i.e. formulation or drug delivery device) well suited for administration of the compound, etc.;
- Second, the product containing the candidate drug is tested in clinical research activities. If it is proven to be successful in terms of benefits for the patients and without severe undesirable side effects, the product is approved by the authorities and launched in the market. (Styhre and Sundgren, 2003).

The following diagram illustrates a typical drug development process.




*Styhre & Sundgren (2003).*

**Diagram 2: Overview of a typical drug research and development process**

To document the effects of a new drug is very resource demanding and time consuming, and only a fraction of the molecules (i.e. the active substance of the drug) which are tested are finally launched in the market. The pharmaceutical industry has perhaps the longest development times of all industries and is investing between 9 and 50 per cent of its sales profit in research and development. Bringing new drug to market requires upwards of 5-15 years from concept to the point of generating revenue. Even after a new therapeutic enters clinical trials the likelihood of the drug reaching the market remains low. As a consequence, the success of big pharma firms requires a deep and diverse pipeline of new drugs. The expansion of collaborative relationships in the pharmaceutical industry illustrates the recognition by pharma

leadership that collaborative arrangements represent an important mechanism with which to broaden and deepen product pipelines (Quinn, 2000; Wolcott, 2002).

The recent maiden flight of the world's largest passenger plane, the Airbus A380, presents a similar example of the timelines and collaboration in the aerospace industry.

1991 - Airbus begins talks with major international carriers about requirements for a super-large passenger aircraft. Its member partners work on individual schemes which later lead to the A3XX project.

June 1993 **-** After Boeing opts instead for smaller "jumbos", Airbus partners set up A3XX team to focus on the "super-jumbo" project.

2002 - Work begins on manufacturing key components, including the wings in Filton, near Bristol, and at Broughton, north Wales.

February 2004 **-** The first Airbus engines are delivered by Rolls-Royce to the Airbus factory in Toulouse, southern France, while two months later the first wing rolls off the north Wales production line.

April 2004 **-** Major redevelopment work begins at London's Heathrow airport to accommodate the new giant.

May 2004 **-** Assembly begins in the giant £240m factory.

April 2005 **-** The first test-flight was completed, which will be followed by more than a year of flight-testing and certification-programme work.
http://news.bbc.co.uk/2/hi/business/4488361.stm)

## 1.2 Purpose of the Research

This paper looks at the knowledge creation approach by means of inter-firm alliances. It looks in particular at the researchers involved in cooperative research projects, as well as the strategy and management issues involved with information sharing and collaboration. While there are a number of studies on the economic performance and dynamics of alliances in the pharma and biotech industry, there seems to be little work done on the actual inter-firm alliance research teams involved in the creation of knowledge through their research, particularly regarding membership to Communities of Practice (CoPs) and any potential impact from the social network on the team development.

A literature search showed a lot of ongoing debate concerning the measurement of team output and performance (Flitman, 2003; Senior and Swailes, 2004), which becomes even more of an issue when it comes to the complex area of innovation or research teams (Aird, 1993 in Hirons, Simon & Simon, 1998; Boaden and Cilliers, 2001; Cumby and Conrod, 2001; Hoegl and Gemuenden, 2001).

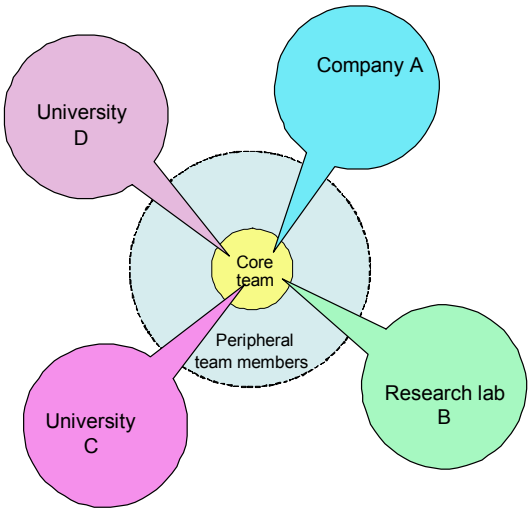
Too often top executives spend more time screening potential partners in financial terms than managing the partnership in human terms. They tout the future benefits of the alliance to their shareholders but do not help their managers create those benefits. They worry more about controlling the relationship than about nurturing it. In short, they fail to develop their company's collaborative advantage and thereby neglect a key resource (Kanter, 1997, 224).

Such inter-firm alliances teams have to function within complex matrix reporting structures, diverse company cultures, values, practices and priorities. This is aggravated even more when these scientists come from institutions and firms with different priorities in terms of freedom of research, pressure to publish or not, pressure to produce, funding and remuneration. Literature in this regard states:

- The core task of both firms and networks is to access sources of knowledge rapidly and turn the partial, situated insights of individuals and communities into tangible products (Brown and Duguid, 1991).
- These new innovations are inherently fragile because they are premised on obtaining deeper engagement and participation from "core" employees and more collaboration and mutual involvement among ostensible competitors. Employees toil in a context of greater labour market volatility; and inter-firm cooperation coexists with rivalry among competing networks (Powell, 2001:35-6).
- Stark (2001: 75) characterised these complex networks of intersecting alliances as "heterarchies" or "complex adaptive systems" that interweave a big variety of organising principles to adjust to multiple environments.
- Operational and cultural differences emerge after collaboration is under way. These differences often come as a surprise to those who created the alliance. That failure could reflect blind spots on the part of the legal and financial analysts who dominate the engagement period. Differences in authority, reporting, and decision-making styles become notable at this stage in the new alliance: which people get involved in decisions; how quickly decisions are made; how much reporting and documentation are expected; what authority comes with a position; and which functions work together (Kanter, 1997:236).
- According to Gunasekaran (1998) the major problems with international R&D project management include higher coordination costs, cultural problems, problems with language skills and communication problems.

- According to Clemons and Hitt (2004: 90) the increased use and sharing of information assets in a contractual exchange can lead to a set of risks different from those that have been previously considered in work in transaction costs economics, incomplete contract theory or other theories of contracting and governance.
- Barley and Orr (1997: 7) refer to work groups that specialise in technically skilled, project-based work as "communities of practice" (CoPs), signalling that loyalty to a professional or technical community may be stronger than attachment to a firm.

To demonstrate the complexity of the environment in which these teams have to function, consider an alliance between a commercial company that is very much profit driven, and various academic and research institutions that are more research driven, all of which may be geographically dispersed all over the world.




The research question being asked involves the *impact of "communities of practice"* in such inter-firm research teams.

**Diagram 3: Potential inter-firm alliance**

### 1.2.1 Research question

The research question asks:

To what extent does the "*community of practice"* to which the members a *particular core research team, comprising of researchers from a number of companies,* belong, contribute to:

- Enhancing the team forming process through a pre-existing relationship, to become productive faster;
- The productivity of the team by providing common ground through the CoP's own culture, values, shared meanings, shared practices and terminology that is not necessarily linked to any of the parent companies in the alliance?

And secondly:

What are the R&D management strategy requirements for managing collaborative teams in this information and knowledge era?

The unit of research is:

- The core research team;
- Consisting of researchers of a number of companies; with
- The researchers belonging to the same or a similar CoP.

## 1.3 Importance of the research

In the U.S. and Europe the advances in biotechnology were competence-destroying for the established pharmaceutical firms as the skills and knowledge base required to operate the core technology shifted. New biotechnology firms were founded to exploit the new technology and capitalised on the gap in knowledge between the new techniques and that of the established firms (Liebeskind, *et al*., 1996; Lynskey, 2001).

Even as pharma firms acquire new development capabilities in-house, the diversity of research at university and government labs, government funded initiatives and small biotechnology firms will continue to compel competitive pharma firms to go beyond their boundaries in search of new knowledge (Wolcott 2002: 171).

**Table 1: Alliance activity of the three top Genomics firms on record as of June 7, 2001**

| Firm | Market capitalisation | Number of alliances |
|---|---|---|
| Human Genome Science | US$ 9.3billion | 24 |
| Millennium Pharmaceuticals | US$ 8.7billion | 57 |
| Celera Genomics | US$ 3.0billion | 21 |

*Source: Recombinant Capital, in Wolcott 2002: 141.*

Strategic alliances provide access to resources, knowledge, skills and capabilities with a view to compliment existing in-house resource. This alliance forming approach provides flexibility and capacity enabling the organisation to adapt to changing markets in terms of innovation as well as production.

### 1.3.1 Alliances as Financial Indicators

The number and quality of inter-firm alliances in the biotech and pharmaceutical industry serve as one of the indicators financial analysts use to evaluate the market capitalisation of a company's shares.

**Table 2: Alliance used as financial indicators**

| | |
|---|---|
| Powell (1996). | Powell found that biotech industry analysts explicitly examine the alliances of individual firms and ascribe market value based on the quality and quantity of those relationships. Firms with a higher quality constellation of alliances generally enjoyed higher market evaluations, a reflection of the market's belief that they will perform better in the long run. |
| Goldman Sachs (2000). | All the Goldman Sachs analyst reports on biotechnology firms devote time to exploring alliances, and Goldman publishes a comprehensive annotated listing of biotech alliances as of 2000. |

*Adapted from Wolcott, 2002.*

### 1.3.2 Research and Development (R&D) and Intellectual Capital (IC)

The best documented and most widely researched area of IC is the area of R&D.

**Table 3: Intellectual Capital (IC)**

| | |
|---|---|
| Aboody and Lev (2000). | They show that one dollar invested in chemical R&D increases, on average, current and future operating income by two dollars. |
| Hirschley and Weygandt, 1985; Bublitz and Ettredge, 1989. | Econometric studies relating R&D intensities to corporate market value of book-to-market ratios yield consistently positive and statistically positive association estimates. |
| Lev, 2001. | Whereas the areas of R&D and organisational capital have been empirically researched, other areas of intangibles have received substantially less research attention. |
| Bassi *et al*. (1999). | Examined financial reports of forty large public organisations, and found no relevant, quantitative information about human resources, although these firms frequently reported that employees are their most valuable assets. |

*Adapted from Marr, Gray & Neely (2003).*

In knowledge-based firms it is those specialised employees – the technologists, researchers and engineers – that provide the competitive advantage by generating the new knowledge which raises the market value of firms. Knowledge-based firms establish competitive advantages by utilising the knowledge accumulated in the firm and its resources to produce innovative products and services.

Hildreth, a partner at Ernst & Young, says that whether it's explicit or not, there's has to be pressure felt by the bench scientists to really come up with great ideas. About 20% of a drug company's profit is derived from its manufacturing operations, and 20% to 30% from sales and marketing, but the majority emanates from R&D (Warner, 2003).

### 1.3.3 Literature on Communities of Practice (CoPs)

The literature on CoPs confirms the positive role and contribution of communities of practice in knowledge creation and the sharing and expansion of intellectual capital (IC) (see Addendum B for more detail on the literature studies).

The case study done by Markus, *et al.* (2000), on the development of open source software presents compelling evidence of the shared culture, meanings, structured processes and procedures to be found in a CoP. It also confirms the success of the peer review and monitoring mechanisms operating in CoPs. The reputation building opportunities provides important motivational value since peer recognition is much sought after in scientific circles.

The literature indicates that CoPs cannot be managed in the same way teams or business units are managed (Brown & Duguid, 1991; Wenger and Snyder, 2000; Swan, *et al.,* 2002; Schwen & Hara, 2003). Managers dealing with CoPs are advised to create an environment that supports the activities of the CoP. There are already indicators in some of the case studies of clashes between the management approach of control with a time and bottom-line perspective, and the scientific approaches of research methodologies and ethics (Styhre & Sundgren, 2003; Park, *et al.,* 2003).

### 1.3.4 Importance of the Research

The literature and evidence seems to suggest that alliances and collaborative teams are the way to go in the dynamic market place today. Similarly, this inter-firm alliance approach to knowledge creation and intellectual capital expansion is seen as the value creating mechanism.

There are a number of studies on the economic performance and dynamics of alliances in particularly the pharmaceutical industry. However, there seems to be little work done on the actual inter-firm alliance research teams that are involved in the creation of knowledge through their research. There also seems to be limited research done on the management strategy requirements regarding R&D collaborative teams in this knowledge era.

When one considers the size of these alliances and the money involved in these inter-firm collaborations, the long time period from research to actual marketable product,

and the number of new ideas required filling the pipeline, the productivity of these teams will always be of paramount importance. This indicates a need for organisations to understand the contribution of CoPs to the value creation process especially in inter-firm collaborative teams. Such understanding should enable the managers to provide a supportive environment for the value producing process.

In view of that evidence, the actual source of the value creation (as in the collaborative project teams) should be the focus of attention. Such a focus should include a strategy to support and speed-up the productive phase within the inter-firm collaborative teams.

The productive phase can be described as the phase where the team is functioning optimally and produces synergistic work. The synergistic work involves the sharing of applied knowledge, the intangibles of knowledge creation, and results ideally in newly generated intellectual capital as an output.

However, the focus of the studies has been primarily the role of CoPs in knowledge creation, intellectual capital, and attempts to create and / or manage CoPs within an organisation. Evidence could not be found of studies on the role of CoPs in inter-firm collaborative teams, specifically on the core team and to what extent the CoP culture, shared practices and meanings create a unique environment and an existing pre-team relationship, that speed-up and enhance the progression of the team to a productive mode.

Much of the knowledge being dealt with in this study is available either in explicit or tacit form. However, evidence could not be found that it has been captured in this particular context and put into the public domain.

The purpose of this paper is to contribute towards new knowledge in understanding the impact of membership to a CoP on the members of an inter-firm collaborative team, and capturing emerging Best Practices for the management of such teams. Understanding the role that CoPs play in terms of team development is a step towards developing and refining a strategy to support and enhance the speedy progression of the team towards a productive phase.

## 1.4 Assumptions

### 1.4.1 Composition of the team

The composition of any team changes over time. This is especially true if it is a big project. The composition of the team will also change over the different phases of the project, for example as it moves from research to testing to production to launching,

etc. In any team there are also a number of different supporting functions such as admin and finance.

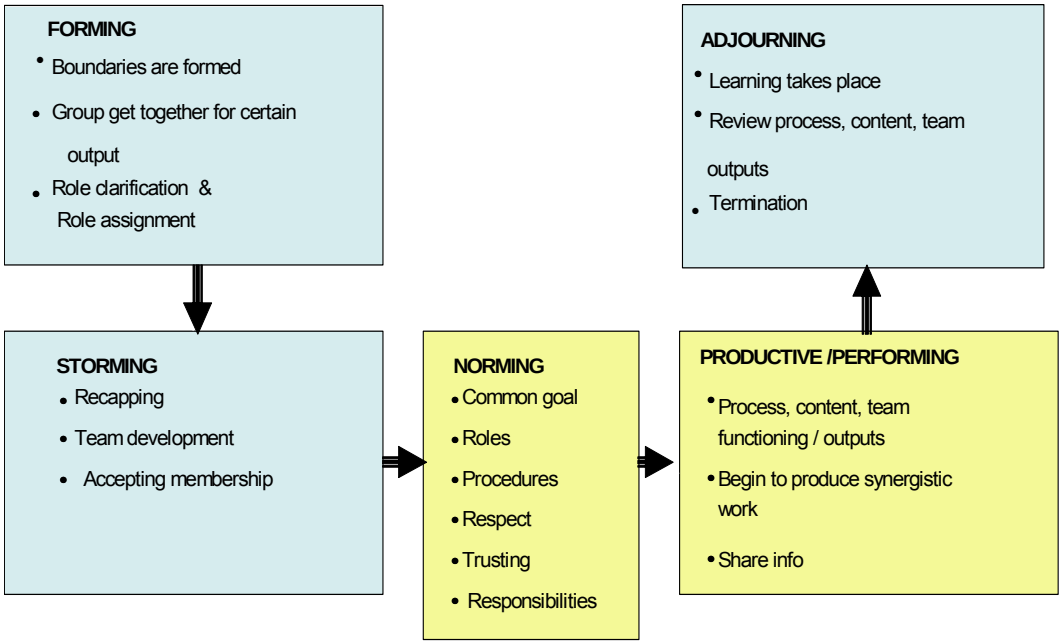
It is assumed, however, that at any *given point in time* there will be:

- A core team that is focussed on the main objective relevant at that specific phase of the project, whether that is research, marketing, or the production phase;
- The core team in the initial phases of a research project will consist of researchers interested in solving the same problem – and therefore are potentially members of the same / similar CoPs (for example liver pathology; fuel technology; etc.).

### 1.4.2 Team dynamics and development stages

It is also assumed that the community of practise *does not replace* the well documented team dynamics and stages of forming and storming, with the associated role clarification and role assignment.

Tuckman's (1965) stage model of team development may be outdated in depicting the development stages as linear, but it is useful in trying to depict the areas of influence of the CoP (norming and productive stages), as illustrated in the following diagram




(*Adapted from Tuckman, 1965)*

**Diagram 4: Potential impact of CoPs on stages of team development**

According to the literature a CoP is an environment where members have already set the norms, ethic standards and acceptable behaviour, thereby creating a trusting, sharing and respectful relationship (Wenger & Snyder, 2000). By implication this means that if members of the same CoP become members of the same team, they have an already established relationship – even if they have never met face-to-face before (Kanter, 2001).

Similarly, the CoP through peer review validates acceptable work processes, procedures and standards, and gives recognition for performance. The CoP members share applied knowledge and experience (Markus, *et al.,* 2000; Styhre & Sundgren, 2003). Should the members of a team belong to the same CoP, they will already use similar work processes and procedures according to the same standards, and share information.

The work processes and procedures referred to here relate to the research processes and procedures. The general administration processes and procedures for the team will most probably be determined by the various organisations involved.

This paper suggests that the CoP shorten and smoothes the norming stage, and hastens the performing / productive stage in team development, because the team members are already in an established a relationship through membership of the same / similar CoPs.

## 1.5 Background

### 1.5.1 General Background

Human interaction has been described in literature as the critical source of intangible value in the current intellectual age (GarcõÂa-Ayuso, 2003). According to O'Donnell, *et al.* (2003), key findings indicate that almost two thirds of organisational value is perceived to be intellectual, and half of the IC is perceived to stem directly from the people dimension.

Intangibles are described as the main drivers of growth and competitiveness in firms currently. Knowledge creation, one of the intangibles, is gaining recognition as the primary factor for the development of economic value (GarcõÂa-Ayuso, 2003). However, the advance of knowledge requires an exchange of ideas, while marketplace profit requires proprietary ownership (Wolcott, 2002). This is creating a dichotomy where on the one hand control, structure and organisation are praised corporate virtues, and on the other hand, intellectual freedom, creativity and novelty are favoured as factors creating competitive advantage (Styhre and Sundgren, 2003).

According to Wolcott (2002) a portion of the solution to this quandary involves collaborative relationships between firms. Such collaborations create the space for sharing knowledge, but enable the various firms involved to contractually control at which point the sharing relationship stops, and the knowledge becomes proprietary.

The conflict between the proprietary ownership of knowledge as a necessary means for profit, and the social nature of knowledge, is currently the fundamental driving force behind the transformation of organisational forms. Building and maintaining corporate alliances has become an increasing important mechanism and capability for the pursuit of both operational efficiencies and competitive advantage (Rosenthal, 1997; Wolcott, 2002; Linnarson and Werr, 2004).

These alliances take on a number of different forms including innovation-oriented collaborative R&D agreements and operations-oriented marketing and distribution agreements.

Firms in regular pursuit of innovation are likely to develop an active network strategy in order to decrease risk and increase the likelihood of success (Wolcott, 2002). Real network power comes from strong ties among every partner in the system – a multiplicity of links reaching in all directions. This is a competitive advantage that is as difficult to create as it is to duplicate (Kanter, 2001).

Powell (1996, in Wolcott, 2002) found that biotech industry analysts explicitly examine the alliances of individual firms and ascribe market value based on the quality and quantity of those relationships.

### 1.5.2 Organisational strategy in relation to the pharmaceutical and biotech industries

Companies caught up in some of the mega-mergers that characterised the pharmaceutical and biotechnology industry recently are vulnerable to the usual integration hazards experienced in such major organisational changes. Integration is especially difficult for R&D operations, which are likely to have different degrees of risk tolerance, different scientific preferences for areas of research, which are reflected in portfolio decisions, and different approaches to governance and decision making (Agarwal, *et al.,* 2001).

Managing an enormous number of discovery and product development programmes is a formidable task, and so is maintaining a heavy weight company's strategic vision, steering a large number of marketing initiatives, and running a huge sales force. This does not even take into consideration the specialised resources such as the

researchers and engineers that have their own unique CoPs, requirements, etc. (Agarwal, *et al*., 2001).

According to Wolcott (2002) the most effective combinations of competencies across companies will ultimately define the boundaries of firms involved in the pharmaceutical and biotech industries. This indicates the potential fluidity of the teams (and team members) involved in alliances and collaborations.

Industry collaborations with universities and other research institutions may involve geographically dispersed researchers and scientists. By implication this means that they may function in a "brick-to-click-to-brick" situation – where the researchers in a brick and mortar lab are involved in collaborative research with researchers in a different bricks and mortar lab, which may be in another part of the city, in another city, or even another country, using technology such as the internet to share information.

An example of such a project was provided by Prendergast (2005, personal interview) and Fletcher (2005, personal interview), both participating in a specific project. The names of the companies have been changed for confidentiality purposes. The project was initiated by the Business Development Unit of ABC, and coordinated by Prendergast.

The project participants consisted of:

- A university
- A scientific and industrial research body; and two companies
- GH Engineering; and
- IJ Group.

The project participants were from two different countries. As coordinator Prendergast was the only person that met the team members face-to-face. The rest of the team held monthly teleconference for a period of about eight months, during which time the project was concluded successfully. Fletcher representing the university's team commented on how well the collaboration worked even though the parties never got to meet or physically worked together.

In such cases the CoP purpose and objectives, rules and regulations, value and quality systems would most probably be the binding factors, rather than organisational culture.

### 1.5.3 Collaborative Agreements

Alliances and collaborative agreements have been discussed from various perspectives, some of which have been reflected in the following table.

**Table 4 Literature regarding collaborative agreements:**

| | |
|---|---|
| Amburgey and Rotman, 2001. | The disparate competencies of<br>• Biotechnology firms (applied research devoted to the exploitation of specific scientific discoveries);<br>• Pharmaceutical companies (large-scale production, marketing, and distribution capabilities); and<br>• University and government laboratories (basic research), have led to a division of labour between these types of organisation. |
| Gambardella, 1995. | Strategic alliances have been able to successfully consolidate the complementary assets of each. |
| These alliances take on a number of different forms including innovation-oriented collaborative R&D agreements - an example of extended innovation - and operations-oriented marketing and distribution agreements. Studies reveal major differences between these types of alliance, for instance: | |
| Amburgey and Rotman, 2001. | Study shows that alliances for extended innovation involve more intense interaction than operations-oriented alliances. |
| Liebeskind, Oliver, Zucker & Brewer, 1996. | Examined how two highly successful new biotechnology firms acquired scientific knowledge. The study found that the scientists in these two firms engaged in a large number of collaborative research efforts, mostly with universities but also with scientists from other companies.<br>These collaborations extended the scope of organisational learning and facilitated the integration of expert knowledge from outside. |

*Adapted from Muller and Välikangas, 2002.*

Muller and Välikangas (2002) raise an important question: Can biotechnology firms circumvent the need to participate in collaborative research alliances by acquiring intellectual property instead - for example, by licensing patents? Problems with this approach include the following:

- The firm may gain access to knowledge that is not linked to its current knowledge base and is therefore not useful;
- Utilisation of the acquired knowledge by the acquiring firm sometimes requires the transfer of routines as well as codified knowledge;
- According to the theory that any asset (including knowledge) that is purchasable in a market cannot provide a sustainable competitive advantage, only collaboration in the research process could provide access to the kind of

knowledge that can confer a sustainable competitive advantage. Competitors do not have access to the new knowledge and IC being created through research collaboration.

## 1.6. Plan of the Study

The focus of this research is twofold.

The *first pa*rt requires the verification of the impact of CoPs on the core members of inter-firm collaborative research teams. The research is not interested on team task activities such as goal setting, task planning, resource acquisition and task control.

The *second part* takes a snap shot of current Best Practices in terms of knowledge sharing and management strategies for inter-firm collaboration teams.

### 1.6.1 Assumptions

For the purposes of this research, the following assumptions will be made:

- CoP members are at a career stage level 2 or higher see description below).
- CoPs transcend company and country borders
- CoPs transcend types of companies, industries and disciplines.

The career level stages according to Dalton and Thompson (1986) can be described as follows:

Level 1: Assistant, performing tasks under supervision;
Level 2: Individual contributor operating independently;
Level 3: Mentor / champion assuming responsibility for others;
Level 4: Director / sponsor / strategist assuming responsibility for the organisation.

A level 2 (or higher) member already has some experience of working in teams, and will be able to actively take part in collaborative inter-firm teams, and contribute to a CoP, which is what this research requires.

### 1.6.3 Limitations

The nature of the study is causal in that it tries to investigate the relationship between variables. However it is not possible to observe all the processes that may account for the relationships between the variables (Cooper and Schindler, 1998).

Another limitation is the fact that the measurement is to a large extent based on perceptions of the people being interviewed as well as the people answering the survey questionnaire.

## 1.7. Conclusion to Introduction

The need for a faster, more flexible and less risky way for organisations to expand their capabilities and competencies increasingly leads to the formation and proliferation of networking strategies and partners.

This paper looks at the knowledge creation approach by means of inter-firm alliances, and in particular the researchers involved in cooperative research projects. Researchers, through their membership of the same / similar CoP, already have a relationship before they are even appointed to the team, even if they have never met face-to-face before.

Understanding the potential contribution CoP membership can provide within these teams is a step towards developing and refining a strategy to support and enhance the speedy progression of the team towards a productive phase.

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# Chapter 2 Theoretical Foundation

## 2.1 Introduction

The scenario presented by this area of research cuts across many of the current issues in business literature. It deals with a plethora of concepts and constructs, ranging from intellectual capital, social capital, knowledge management and innovation, through management practices, team development and social networks, all the way to intellectual property, strategy, and organisational structure.
This chapter looks at the literature of the more relevant areas.

## 2.2 Communities of Practice (CoP)

Similar to guilds of the Middle Ages (Wegner & Snyder, 2000) CoPs can exist within organisations, as is apparent in Orr's (1996) analysis of Xerox repair technicians, or may exist independent of organisational boundaries, as in the case of professional groups (Knight, 2002 in Iverson & McPhee, 2002). These people share a passion about a topic or a concern about a problem which is addressed by sharing applied knowledge and experience in an informal, social manner.

Brown and Duguid (1998) describe photocopier engineers that work together like jazz musicians, able to communicate non-verbally because of shared experience, shared learning, and shared understandings.

Quintas and Ray (2002) paraphrase Wenger (1998) by describing a CoP as an informal social network in which individuals engage with each other to share applied knowledge and experience. This relationship is facilitated by a shared repertoire of concepts, actions, tools, stories, artefacts and discourse.

It is clear from these descriptions that when referring to CoPs the recurring terms and emphasis is on the *informal* nature of the relationship, and on the sharing of *applied* knowledge / experience.

Sharp (1997) describes a CoP as a special type of informal network that emerges from a desire to work more effectively or to understand work more deeply among members of a particular specialty or work group.

Typically such groups do not overlap with company-assigned teams or task forces. Because they grow out of human sociability and efforts to meet job requirements (especially those not anticipated and not supported by the formal organisation and the formal training for work), a CoP is typically not an authorised group nor a role identified on an organisation chart. A person's responsibilities to the communities of which he is a

member may at times conflict with the rules and interests of the companies he works for (Sharp, 1997).

According to Sharp (1997) CoPs are typically small groups of specialists that learn together. They emerge of their own accord - Three, four, twenty, maybe thirty people find themselves drawn to one another by a force that's both social and professional. They collaborate directly, use one another as sounding boards, and teach each other.

The Knowledge Construction Glossary (www) defines a CoP as a group of practitioners involved in a common activity, albeit performing different roles. Other parts of the literature focus on communities that grow up in cross-functional (rather than specialists) groups. Sharp (1997) describes the essential characteristics of cross-functional communities of practice as follows:

1. They are not defined by organisational mandate (e.g., the "organisation chart"), but rather by the ways people actually work together.
2. They involve many different "roles", as opposed to a flat structure.
3. They experience an ongoing flux of community members, who enter the community from the periphery and gain status as knowledgeable members through participation in the community of practice.

Sharp (1997) refer to Steward (*Invisible Keys to Success*) in saying that studies of R&D have found formal reporting structures, mandatory reporting meetings, and formal written procedures effectively destroy the informal communications among team members because they inhibit the informal exchanges that learning depends on. In attempts to manage R&D some companies have slowed it down by an excess of formal procedures, unintentionally impeding communities of practice.

The literature on CoPs highlights the many positive aspects of this form of social networks. However, Wenger warns that CoPs should not be over romanticised:

> *"They are born from learning, but they can also learn not to learn. They are cradles of the human spirit, but they can also be its cages. After all, witch-hunts were also community practices."* (Wenger, 2000: 230, in Quintas and Ray, 2002: 19).

### 2.2.1 Shared knowledge in CoPs

The knowledge created and shared by a CoP differentiates it from other forms of group practice. CoPs enable expertise to be shared and best practices to emerge, freely and informally. The commitment to the CoP overrides any reluctance to share knowledge and, as it is cultivated, the community accepts the boundaries within which its

knowledge-sharing activities fall (ethics / trust). It is this trust among community members that demonstrates the uniqueness of CoPs and their ability to go beyond team and networking practices (Quintas and Ray, 2002: 17).

CoPs enable learning to take place through shared experience, thus creating knowledge that is socially held. McDermott (2001: 1) gives a number of examples of the nature of knowledge sharing that happens in CoPs.

- A group of systems designers for a computer company tried to share their knowledge by storing their documentation for client systems in a common database. They soon discovered that they did not need each other's documentation. They needed to understand the logic other system designers used — why *that* software, with *that* hardware and *that* type of service plan. They needed to understand the *thinking* of the other system designers.
- A petrophysicist trying to interpret unusual data from a deep sea oil well needed help from a colleague who had seen similar anomalies and could help him *think through* the data and how to interpret it. Only in the course of the discussion were they able to understand the anomaly.

All members of a CoP have different knowledge and expertise. Each person is knowledgeable about their own sphere of existing expertise and at the same time *inexperienced* about other's areas. A vital role of the CoP is to provide a support structure between members. That allows reciprocity as new problems or issues emerge. It enables people to sound out new ideas or new concepts before putting them into practice in the workplace or other environments. This sounding out is crucial to drawing on the experience and expertise of the members of the community, and learning from other people's mistakes about what works and what does not. The CoP provides a safe haven for that (Quintas and Ray, 2002: 18; Lesser and Storck, 2001).

### 2.2.2 CoP structure and membership

CoPs are informal, they organise themselves, meaning they set their own agendas and establish their own leadership. Membership in a CoP is self-selected. In other words, people in such communities tend to know when and if they should join. They know if they have something to give and whether they are likely to take something away. When members of an existing community invite someone to join, they also operate on a gut sense of the prospective member's appropriateness for the group (Wenger and Snyder, 2000).

The link between CoPs and 'the organisation' may not be easily defined. A CoP may transcend organisational boundaries, for example where teams from different organisations work on a collaborative project. The community may grow around the

project, with members from various organisations developing shared understandings which may not be available to their respective primary employers outside the collaborative project.

This self-perpetuating group differs from other teams and networks in that - although there is a diversity of experience and background – all members through extensive communication and shared practice over a period of time, have come to share similar goals and interests, beliefs and value systems without any formal organisation. CoPs differ from other groups in that they are informally bound (Quintas and Ray, 2002: 17).

Much of the literature suggests that CoPs are self-managing (e.g. they define the required competence, they are composed of mutually motivated members) and indeed that they should not be over-managed. The clear implication is that CoPs should certainly not be managed by outsiders, since they have little understanding of the nature and value of the knowledge and expertise held within the community:

> *"The group sets its own goals (understanding their speciality and its applications), membership boundaries (the groups itself decides who is in, who is out, who are the respected leaders and who are the more casual followers, personal relationships (from casual acquaintance to friendships to deep emotional bonds), generalised reciprocity ( a sense of mutual commitment to the community – one member may help another just because they belong to the same community, not because of the personal relationship), and production of collective goods (the shared and enhanced understandings and expansions of professional knowledge in the organizational context* " (Sharp, 1997, www).

Sharp also reports studies of R&D communities of practice which have found that formal management approaches from outsiders:

> *"…effectively destroy the informal communications among team members because they inhibit the informal exchanges that learning depends on. In attempts to manage R&D some companies have slowed it down by an excess of formal procedures, unintentionally impeding communities of practice"*
>
> (Sharp, 1997, www).

The strength of CoPs is self perpetuating. As they generate knowledge, they reinforce and renew themselves. The challenge for organisations is to take cognisance of CoPs, identify CoPs or members of CoPs within the organisation, appreciate CoPs and understand how to keep it alive and productive (Wenger and Snyder, 2000).

### 2.2.3 Value of CoPs

Reviewing the literature on CoPs, Sharp (1997) emphasises their value as informal communication networks:

> *"The networks of relationships that employees form across functions and divisions often enable the organisation to accomplish tasks faster or better than would be the case if communication and action took place along formal organisational lines alone. These informal networks can cut through formal organisational reporting procedures to jump-start stalled initiatives and meet extraordinary deadlines. Providing conditions that encourage these social links, revamping formal organizations to let the informal ones thrive, can help organisations harness the real power in their companies* "(Sharp, 1997, www).

It is likely, however, that the value of CoPs may not be fully recognised in many organisations. Management may even be unaware of their existence, and therefore unable to value the knowledge they hold, particularly implicit or tacit knowledge.

In addition, Stewart argues that CoPs undermine formal lines of management:

> *"They are among the most important structures of any organisation where thinking matters, but they almost inevitably undermine its formal structures and strictures* "(Stewart, 1996: 125, in Quintas and Ray, 2002).

#### 2.2.3.1 Reward and Recognition

Leaders intuitively recognise the benefit of developing people's capabilities. That said most leaders have difficulty understanding the value of CoPs. For one thing, the effects of community activities are often delayed. For another, results generally appear in the work of teams and business units, not in the communities themselves. The best way for an executive to assess the value of a CoP is by listening to members' stories, which can clarify the complex relationship among activities, knowledge, and performance (Wenger and Snyder, 2000).

If a leader is aware of CoPs, or members of CoPs in the organisation, and understands the contribution of a CoP to improved performance and innovation, it would be easier to determine suitable reward and recognition strategies to support and reinforce this positive relationship.

### 2.2.4 Characteristics of CoPs

People in CoPs share their experiences and knowledge in free-flowing, creative ways that foster new approaches to problems. Because its primary output – applied knowledge – is intangible, the CoP might sound like another "soft" management fad.

But that is not the case. CoPs have improved organisational performance at companies as diverse as an international bank, a major car manufacturer, and a U.S. government agency (Wenger and Snyder, 2000).

If CoPs are so effective, why are they not more prevalent? Wenger and Snyder (2000) give three reasons.

- Although CoPs have been around for a long time – for centuries in fact – the term has only recently entered the business vernacular.
- Only a limited number of forward thinking companies have taken the leap of installing or nurturing CoPs.
- It is not particularly easy to build and sustain CoPs or to integrate them with the rest of an organisation. The organic, spontaneous, and informal nature of CoPs makes them resistant to supervision and interference.

CoPs, formal work groups, teams, and informal networks are useful in complementary ways. However, CoPs differ from other forms of organisation in several ways, a summary of which is reflected in Addendum A.

#### 2.2.4.1 Belonging

A community makes people feel like members, not just employees – members with privileges but also responsibilities beyond the immediate job, extending to colleagues in other areas. Community means having things in common, a range of shared understandings transcending specific fields.

> *"Shared understandings permit relatively seamless processes, interchange-ability among people, smooth formation of teams that know how to work together even if they have never previously met, and rapid transmission of information"* (Kanter, 2001:169).

Referring to the concept of community in the Web environment Kanter (2001) observes that operating as a community that permits speed, releases human energy and brainpower, engenders loyalty, and reaches across walls and beyond borders to include volunteers, partners, and unseen audiences.

According to Kanter (2001:18) speed comes about because people value their connection to everyone else and know how to work together to permit seamless execution or rapid mobilisation. Human energy and creativity are released because of the motivational potential of feeling like a member, not an employee or a subordinate. In situations where of job-hopping occurs frequently, high performance and even

loyalty are brought about because people are connected to the community in multiple ways beyond economic transactions.

#### 2.2.4.2 Characteristics of Community of Practice (CoP)

Wenger (1998) identified three characteristics of CoPs, which was discussed in more detail by Iverson & McPhee (2002). For more detail, please refer to Addendum C.

1. *Mutual engagement* comes from the interaction of members. By interrelating, members are motivated to negotiate their practices and the meanings of actions. Mutual engagement identifies a condition similar to connection in a network but describes such relation as grounded in common interest and activity, rather than mere interaction.
2. *Negotiation of a joint enterprise* gives a sense of coherence and purpose to the CoP. Members interacts to define significance, shape practices, and react to a larger context. This process creates more than just a stated goal, but creates among participants relations of mutual accountability that become an integral part of the practice.
3. *A shared repertoire* is the CoPs' set of resources for negotiating meaning. Stories, jargon, theories, forms, and other resources form a stock of understood information and techniques that can be utilised by members.

Kanter (2001:18-20) identified seven elements which are contained in the community ideal (even though they are not always present in reality), that show similarities to the characteristics identified by Wenger.

1. *Membership*: When they are members, differences disappear, and connections transcend roles. People feel an obligation to fellow members that they may not feel to fellow workers.
2. *Fluid boundaries*: Communities are loose aggregations. There may be a formal core that is organised and firm, but around that core are people go come and go, move in and out, and become more active on some occasions and less active on others.
3. *Voluntary action*: There is a voluntary quality to the actions taken by community members. They do more than their jobs, because they want to.
4. *Identity*: Community is an idea, not a geographical location. A community exists because many people think it does and define themselves as part of it.
5. *Common culture*: Shared understandings, a common language and disciplines, permit a relatively seamless interchangeability of one for another.

6. *Collective strength*: Communities tap the power of many.
7. *Collective responsibility*: Service to the community as a community can be a unifying force in addition to its pragmatic benefits as a workforce motivator, talent attracter, and brand (reputation) builder. Reputation development was cited by many participants as an important benefit from participating in community activities (Lesser and Storck, 2001; Linnarson and Werr, 2004).

### 2.2.5 Distinction between teams and CoPs

The distinction between teams and CoPs sometimes leads to confusion. The differences between the two constructs be characterised as follows:

**Table 5 Teams and CoPs**

| | Teams | Communities |
|---|---|---|
| 1 | Team relationships are established when the organisation assigns people to be team members. | Community relationships are formed around practice. |
| 2 | Authority relationships within the team are organisationally determined. | Authority relationships in a CoP emerge through interaction around expertise. |
| 3 | Teams have goals, which are often established by people on the team. | Communities are only responsible to their members. |
| 4 | Teams rely on work and reporting processes that are organisationally defined. | Communities develop their own processes. |
| | | *Storck and Hill (2000)* |
| 5. | In a team legitimisation occurs principally through the assignment of formal roles and relationships (i.e. team membership and structure are defined external to the team). | The members of CoPs establish their legitimacy through interaction about their practice (reputation building) |
| | | *Nahapiet and Ghoshal (1998)* |

*Adapted from Lesser and Storck, 2001.*

### 2.2.6 CoPs and Repository Systems

Most of the studies regarding the way people engage with each other have focussed primarily on face-to-face communication. Nevertheless, there is nothing in the classical sociological definition of communities of practice that rule out communication media such as e-mail, discussion groups, or chat rooms as support mechanisms for participating in distributed communities of practice (Hildreth, Kimble & Wright, 2000, in Lesser and Storck, 2001: 832).

The ability to locate, access, and apply existing intellectual capital to new situations was highlighted as an important outcome of community participation in the study done by Lesser and Storck (2001). In this information age communities can stay in contact with other community members, and gain access to information through the use of repository systems on the internet, such as community websites or databases.

The repository systems used by many communities serve a number of important functions:

- They provide a common virtual work space where members can store, organise and download tools and material that community members could find useful.
- The presence of meta-data enabled the individual to identify and locate the author of the document.
- The name of the member attached to information also reinforced the potential value of the content (trust, reputation).
- Virtually all the repositories incorporated some form of human moderation.
- The repositories also served as a mechanism for evaluating the trustworthiness and reciprocity of others within the community. This peer evaluation process within the community of practice assists individuals to build reputations as both subject matter expert and as persons willing to help others.

Iverson & McPhee (2002) approaches this phenomenon from a different direction where they use communities of practise (CoPs) as a theoretical construct which offers an opportunity for understanding the interactive roles of information systems and people.

## 2.3 Community of Practice and Social Capital

A useful framework for understanding social capital in a business context was developed by Nahapiet and Ghoshal (1998). They define social capital as the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit.

Nahapiet and Ghoshal (1998) further express social capital in terms of three primary dimensions.

1. There must be a series of connections that individuals have to others. In other words, individuals must perceive themselves to be part of a network (the structural dimension).
2. A sense of trust must be developed across these connections (one aspect of the relational dimension).
3. The members of the network must have a common interest or share a common understanding of issues facing the organisation (cognitive dimension).

These conditions apply quite aptly to CoPs. By developing connections among practitioners who may or may not be co-located, fostering relationships that build a sense of trust and mutual obligation, and creating a common language and context that can be shared by community members, CoPs serve as generators of social capital. This social capital, in turn, creates an environment in which business performance is positively impacted (Lesser and Storck, 2001).

Nahapiet and Ghoshal (1998) suggest that there are four components to the relational dimension of social capital.

- Obligation refers to a sense of mutual reciprocity.
- Norms include the setting of common standards of behaviour that individuals are willing to abide by.
- Trust involves the predictability of another person's actions in a given situation.
- Identification refers to the process whereby individuals see themselves as united with another person or set of individuals.

All of the above is applicable to the CoP environment. The CoP environment also fosters access to more experienced practitioners (scarce resources), where the CoP membership serves as a selection mechanism for determining whom they are willing to spend time with (Lesser and Storck, 2001).

Lesser and Storck (2001) highlighted four areas of organisational performance that were impacted by the ongoing activities of communities of practice in their study.

- The learning curve of new employees was decreased.
- The company responded more rapidly to customer needs and inquiries.
- Rework was reduced, and duplication was prevented.
- Many new ideas for products and services were spawned.

Virtually all the communities studied by Lesser and Storck (2001) cited the ability to locate, access, and apply existing intellectual capital to new situations as an important result of community participation. They give the example of a specialty chemical company where the support personnel were able to tap into a community of researchers through the use of discussion boards on the internet to identify individuals who may have encountered similar problems in other customer locations.

According to McDermott (2001: 7) most CoPs have a core group of high contributors, a large group of "lurkers," who listen but add little, and a larger group of peripheral members who only participate occasionally. The lurkers often get great value without taking away from the core contributor's interaction. Many lurkers say that they use the community to find out who is working on what or learn about the field and make contact later.

One of the primary reasons that CoPs were seen as an important vehicle for innovation was their ability to create a safe environment where people felt comfortable in sharing challenges. The development of these interpersonal relationships within the community was especially useful in asking sensitive questions or testing ideas that were not fully "baked" (Lesser and Storck, 2001).

## 2.4 Knowledge and Knowledge Management (KM)

Reviewing knowledge literature Sun and Scott (2005) highlighted the following issues:

- Creating an accurate definition of knowledge has challenged many researchers (Bhatt, 2000).
- However, the commonly held view is that knowledge is ''content + structure of the individual's cognitive system'' (Propp, 1999: 227). Content can be viewed as disorganized information, which becomes knowledge when meaning is provided by the cognitive system of the individual. The cognitive system is a combination of beliefs, attitudes, values, opinions, presumptions, and memories that governs the way meaning is provided.
- Maracas (1999) sums it up succinctly by defining knowledge as ''meaning made by the mind'' (Propp, 1999: 264).
- Nonaka (1994) describes knowledge as existing in two dimensions. Explicit knowledge which exists at the epistemological dimension where explication is possible using written or coded formats, while tacit knowledge exists at the ontological dimension. The explication of tacit knowledge requires the use of metaphors and an extensive process of socialisation (Nonaka and Takeuchi, 1996). In whatever dimension knowledge exists, the transfer of knowledge is in large part a transfer of information. The information can be in coded, written, metaphorical communication, or even observed behavioural format. If such information can highlight any discrepancy or failure of the current beliefs and assumptions of the organization, it is said to be unique containing surprise value.
- The beliefs and assumptions of the organization can constrain individual cognition, governing their theory-in-use. However, individuals can have an espoused theory in variance with the theory-in-use (Argyris, 1995). If this espoused theory contains unique information (i.e. surprise value), it can be a catalyst for learning where new knowledge creation takes place.

### 2.4.1 Value of knowledge

In a review of strategic thinking and knowledge management, Carlisle (2002, in Quintas and Ray, 2002) focuses on the resource-based approach to strategy as the underpinning of the knowledge-based view of the firm. All other resources depend on knowledge in order to create value, and knowledge can provide advantages by enabling organisations to use other resources more effectively. Ultimately, Carlisle argues, *firms exist to facilitate* the acquisition, creation, exploitation and transfer of knowledge; with advantages being gained by the 'speed and efficiency of the creation and transfer of knowledge' (Kogut and Zander, 1996: 503 in Quintas and Ray, 2002).

Carlisle builds on the arguments made by Penrose (1959) that knowledge is somewhat different from other resources in that other resources depend on the exploitation of knowledge to add value. Knowledge is the element which transforms inputs to produce outputs, and this requires vision and creativity. Transaction costs theory is seen to be important, but leads to a focus on value *appropriation*, whereas the knowledge-based approach leads to a focus on value *creation*. Transaction costs theory also underplays the importance of sociological processes.

Quintas and Ray (2002: 5-6) reflect on why the relationship between managing knowledge and organisations should be so difficult and contentious. In neo-classical economic theory, knowledge is treated as if it were information. Thus it became the exemplary *public good*: anyone who acquires it may use it or sell it without losing it. Moreover, attempts to market information depend on an element of disclosure to potential buyers that undermines the scarcity of the information and, by implication, its value

According to Quintas, Jones & Demaid (2002: 29) the case for placing managing knowledge on the agenda in organisations of all types is that superior performance and sustainable competitive advantage reside in processes that create and use knowledge efficiently and rapidly rather than in particular products or technologies, which can by instantly imitated. There is greater awareness of the role and importance of intangible assets, brands, intellectual capital, intellectual property rights, expertise, knowledge systems, business intelligence and the ability to innovate.

Patent mining and IP portfolio management has become new buzz words with the increasing awareness of the value of intellectual property in terms of patents and licensing (Aylen, 2001; Rivette and Klin, 2000). However, there is an increasing tendency to refer to intellectual capital (IC) and intellectual property (IP) in the same context, with the relative quick wins that IP rights has brought about recently stealing the limelight. But companies cannot afford to rest on their IP "laurels" so to speak.

Once the patent portfolios have been cleaned up and properly utilised to derive maximum economic benefit, new knowledge still needs to be developed for potential conversion into new IP. Jeffery and Asserson (2005: 18) remark that most of the technology upon which we depend today is the result of R&D (and IP) years ago. There is once again the danger that in the pre-occupation with IP, the actual generators of the new knowledge and innovation (as in the researchers) are neglected, or constrained to such an extent that the quantity and quality of innovation suffer as a result.

### 2.4.2 Tacit knowledge

Quintas, *et al*. (2002: 37) refers to Polanyi (1958) who used the phrase tacit knowledge to describe knowledge that is experiential and cannot be made explicit and communicated through language or any other process of codification. Polanyi emphasised the importance of tacit knowledge: '*we know more than we can tell* '(1966: 4, in Quintas, *et al*., 2002).

Tacit knowledge is not easily visible and expressible. Tacit knowledge is personal, context-specific and hard to formalise and communicate as it includes subjective insights, intuitions and hunches. Tacit knowledge would include what is often referred to as "*know-how*"; knowing the *unwritten* rules and procedures; knowing *why* things happen (causality), knowing *when* (conditional) and under *what circumstances* (contextual) to perform a certain procedure or use a certain tool, etc.

Examples of tacit knowledge include knowing how to ride a bicycle or play a musical instrument. Whereas the basic rules can be written down and communicated, reading and understanding them cannot transfer the knowledge of how to ride or play. This knowledge can only be gained through experience and through trail and error by the individual.

The economic use of tacit knowledge lies in its contribution to productive activity in a given time and context. Tacit knowledge is not directly transferable. It involves matters of individual and group judgement that go beyond the abstracted logic of rational decision making to incorporate more intuitive thoughts and actions:

> *"The key to acquiring tacit knowledge is experience. Without some form of shared experience, it is extremely difficult for people to share each others' thinking processes. The mere transfer of information will often make little sense if it is abstracted from embedded emotions and nuanced contexts that are associated with shared experiences"* (Nonaka, 1994: 19 in Quintas and Ray, 2002).

A growing body of literature has treated collective tacit understanding as a distinct type of knowledge. That is to say, the actions of a group are informed by a body of tacit knowledge that is distinct from the knowledge held by its members. Thus the propensity to act in a given way, which is suggested by a group's culture, has an existence that is in some sense separate from the private predisposition of participating individuals (Quintas and Ray, 2002: 9).

### 2.4.3 Shared paradigms

Kuhn proposed the notion of scientific paradigms, that is, dominant theories that provide a way of looking at phenomena, and an agenda for research:

> '*These I take to be universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners'* (1970: viii, in Quintas, *et al*., 2002: 40).

For Kuhn, scientists are socialised by the shared paradigm with its shared agenda, rules and practices.

Gibbons *et al*. (1994, in Quintas, *et al*. 2002) have contrasted the traditional bodies of scientific knowledge held in libraries and controlled by disciplines or communities of specialist professionals and scholars, with knowledge created in use, by practitioners in their own contexts. Such knowledge may be transient, and a high percentage of it will be implicit (or tacit) rather than explicit.

According to Quintas *et al*. (2002) information only becomes knowledge when it is contextualised, seen as relevant, authentic, capable of being related to experience, in short given a valid meaning. Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the mind of knowers.

Knowledge is not neat or simple. It is a mixture of various elements: Knowledge can flow, and change direction easily and unexpectedly as experience and perspectives change, or be formally structured. Knowledge is intuitive, based on hunches and feelings, without conscious reasoning, and therefore it is hard to capture in words or understand completely in logical terms. Information becomes knowledge through people contextualising the information, and making it relevant based on their personal experiences and values (Quintas, *et al*., 2002). Therefore one can say that knowledge exists within people, forming part and parcel of human complexity and unpredictability. Although we traditionally think of assets as definable and 'concrete', knowledge assets are much harder to pin down because of these elements.

**Table 6 Other views about knowledge and knowledge management (KM)**

| | |
|---|---|
| Demarest (1997). | Distinguishes between two basic approaches to KM, namely:<br>• Information-based (codifying and storing information); and<br>• People-based or inter-actional approaches (connecting knowers). |
| The information-based approach has been criticised for reducing knowledge to information by: | |
| Von Krogh, *et al.,* 2000. | Ignoring tacit knowledge. |
| Seely, Brown & Duguid, 2000. | • Oversimplifying knowledge by removing social context.<br>• Knowledge involves a knower, is difficult to transfer, is digested and not just stored. |
| Conrad & Poole, 2002. | Ignoring the impact of social forms such as networks. |
| Stacey, 2001. | For the people-based approaches, knowledge is inherently tied to social and contextual phenomena. |
| Junnarkar, 2000. | Knowledge requires context. |
| Wenger, 1998. | Knowledge is one aspect of a larger system of knowing. |

*Adapted from Iverson & McPhee, 2002.*

### 2.4.4 CoPs and knowledge

Iverson and McPhee (2002) use CoPs as a theoretical construct which offers an opportunity for understanding the interactive roles of information systems and people. CoPs also act as a model for understanding how KM is negotiated communicatively between people (refer to 2.2.1. Shared knowledge in CoPs).

Three key elements of CoPs – mutual engagement, shared repertoire and joint enterprise – encapsulate the socially constructed nature of knowledge creation, knowledge transfer, and knowledge management systems within and across organisations (Iverson & McPhee, 2002).

Wenger (1998) incorporated both informational and interactive aspects of knowledge into a model of practice within CoP theory through the concepts of reification and participation. Reification is the process of giving form to our experience by producing objects (including symbols and texts) that congeal this experience into ‘thingness’.

## 2.5 Teams

### 2.5.1 Team development

Furst, Reeves, Rosen & Blackburn (2004: 7) compare Tuckman's Stage Model of Development (1965) with Gersick's Punctuated Equilibrium Model (1994) in their discussion of the life cycle of virtual project teams as follows.

Tuckman identified four distinct stages of team development: forming, storming, norming and performing. The forming stage is an orientation period for the members of the group where they become acquainted with each other and the task they face. Efforts to clarify goals, roles and responsibilities often surface as differences of opinions. In the storming stage conflict emerges as members begin questioning and challenging each other. Groups able to resolve conflicts move to the norming stage, where the team recognises and agree on ways to work together, and solidify understanding of member obligations. That increases the levels of trust, mission clarity and coordination in the team. Finally the team reaches the performing stage during which team members' work towards project completion, characterised by a state of interdependence and flexibility, actively helping and encouraging each other. There is a high level of harmony and "comfort" which means that all the energy of the group can be directed towards the task at hand, instead of trying to negotiate difficult relationships and issues. Tuckman refined the theory in 1975 and added a fifth stage – adjourning - which deals with the break-up of the group after the task is completed.

According to Gersick's model a team's evolution is marked by two periods of stability – Phase I and Phase II – punctuated by abrupt changes at the project midpoint that occurs halfway to the deadline. Phase I begin with the first team meeting and continue to the midpoint. During this phase the team try to establish a working agenda and to develop norms that guide early project efforts. These activities parallel Tuckman's forming, storming and norming stages. At the project midpoint, a transition occurs as teams assess the norms and assumptions set during Phase I. Teams dissatisfied with their progress may seek advice from an external facilitator or leader to develop more effective norms. On the other hand, teams satisfied with their performance maintain the status quo. With a successful transition, team members focus on their performance for the duration of the project (Phase II), similar to Tuckman's performing stage. This transition is usually followed by a burst of activity to ensure that the team meets the deadline with an acceptable outcome (Furst, *et a*l., 2004: 7).

### 2.5.2 Team performance

MacBryde and Mendibil (2003: 727) did a detailed study of literature on team performance measure, and they concluded that four dimensions determine team performance:

- Effectiveness – the degree to which task / process results satisfy team stakeholders;
- Efficiency – the degree to which team processes (e.g. communication, leadership, collaboration, decision taking) support the achievement of process results, team growth and member satisfaction;
- Learning and growth – codified in knowledge artefacts, e.g. innovation, transferable skills, documented learning, best practices, methods, process improvements;
- Team member satisfaction – the degree to which team work contributes to the growth and personal well-being of team members.

In their study MacBryde and Mendibil (2003) found a lack of understanding about the meaning of team performance and how to measure it. They also found little evidence of team performance systems.

The dominant view of team effectiveness has utilised an input-process-output (I-P-O) model, where input represents what the team members bring, such as expertise and skills, process represents social exchange and interaction, and outputs represent ideas, decisions or tangible things. However the allocations of variables to the three stages is not always clear, and there is overlap between the concepts of team processes and team effectiveness (Senior and Swailes, 2004).

In a literature study for measures of team performance, Senior and Swailes (2004) found no general purpose team performance measure. They evaluated the following tools:

- Team Development Survey™ (TDS™) (Hallam and Campbell, 1997) – reliability below the normal threshold acceptability;
- Group development questionnaire (Wheelan and Hochberger, 1996) – identifies the different stages of team development, and not performance itself;
- The Team Climate Inventory (Anderson and West, 1998) - concentrates more “teamwork” as opposed to “task work”. The focus is on work team climate and innovation in teams.

Hoegl and Gemuenden (2001) developed the Teamwork Quality (TWQ) approach looking at the quality of interactions within the team in terms of communication,

coordination, balance of member contributions, mutual support, effort, cohesion, effectiveness, efficiency, work satisfaction and learning.

Anderson and West (1998, in Loewen and Loo, 2004) used the concepts of shared perceptions and organisational climate to understand the climate of working groups. According to these authors three conditions are necessary, but not sufficient, to allow both shared perceptions and climate at group level:

- Individuals must interact;
- Individuals must have one or more common goals which predispose them to collective action; and
- Individuals must experience enough task interdependence to develop shared insights.

A positive team climate develops when team members take the time to interact and get to know each other. Effective teams consist of members who are all committed to achieving positive team outcomes. However teams also learn to balance the team's needs with the individual member's responsibilities. To accomplish this, the team members develop both formal and tacit understandings of their goals and the best strategies to reach them (Loewen and Loo 2004: 268-9). In their study Loewen and Loo (2004: 262-4) use the Team Climate Inventory (TCI) developed by Anderson and West (1994) and available commercially, which looks at factors such as participative safety, support for innovation, vision, task orientation and social desirability (tension, disharmony and performance standards).

### 2.5.3 Innovation and creativity

Caldwell and O'Reilly (2003) highlight the difficulty of designing formal control systems to enhance innovation. By its very nature, innovation is largely unpredictable and requires flexibility, opportunism, and adaptability. Secondly, the use of formal extrinsic controls has been shown to diminish creativity and the behaviours necessary for innovation. According to Caldwell and O'Reilly (2003: 500) research suggests that some aspects of group climate, such as participation and group goals, are related to creativity. One way in which group climate or culture may enhance innovation in groups is through norms. They suggest that a strong normative order may act as a social control system to promote creativity and implementation (O'Reilly, 1989; O'Reilly and Chatman, 1996 in Caldwell and O'Reilly, 2003).

From a managerial perspective, it is important to note that social controls such as norms and climate do not have the undermining effects that formal controls often do. When behaviour is controlled by social expectations, instead of feeling controlled by

others, people often feel a sense of autonomy (Deci and Ryan: 185, in Caldwell and O'Reilly, 2003: 501) Ironically normative control may actually exert a stronger influence over attitudes and behaviour – positive or negative - without being viewed as intrusive.

A study done by Caldwell and O'Reilly (2003) investigated the influence of the role of work group norms in promoting innovation in high technology firms. The study showed four work group norms associated with increased group innovation: support for risk taking, tolerance of mistakes, teamwork, and speed of action.

### 2.5.4 Group norms and personal constructs

The group norms and personal constructs as discussed by Hayes (1997) in the following points are relevant to teams as well as CoPs.

- Research into group norms shows that they exert powerful control over group members, which helps to define the group and keep it functioning smoothly and appropriately.
- Group norms are intangible and often hard to express in words. People who belong to groups often try very hard to conform to the group's norms. Acceptance into the group, and membership of the group, serves as powerful motivators and behaviour.
- Group cohesion is an important factor in team-working and it can be seen as deriving from the human tendency for social identification. Both formal and informal communication plays an important part in establishing cohesion. A CoP is in essence a social network, with the same dynamics of cohesion and communication as a group.
- Personal constructs are the individual ways we understand our worlds. It means that we interpret information so that it makes sense to us on our own terms. Differences in personal constructs can sometimes produce misunderstandings or failure of communication.
- Changes to group norms do not happen easily, and deliberate changes are hard to implement. Effective changes of group norms appear to happen only when the pressure comes from group members themselves.

Feldman (1984) identified four entirely different purposes which group norms can serve, all of which is valid in the CoP context as well. Each of them helps to ensure positive, consistent social action among group or CoP members.

1. The way in which the group norms *expresses the central values of the group*. This defines what the group is all about, and directs behaviour within group, as

well as relations with people outside the group. It also serves to indicate, what the group is not, and what is regarded as unacceptable behaviour.

2. The way the group norms help the group to continue functioning smoothly, by *establishing common ground* and making group members' behaviour more predictable.
3. The way the group norms help the group *define what is acceptable social behaviour* among members. This decreases / avoids confrontation or events that might challenge or threaten the coordination of the group as a whole. The group members can function within a relatively "safe" psychological environment.
4. The way the group norms help the group survive by *maintaining its distinctiveness,* and by *rejecting deviant behaviour* shown by its members when the group is under threat. This provides security and confidence to the members.

This does not mean that all the members of the group are obliged to act in exactly the same way. Schein (1988) classifies group norms into two categories, namely pivotal norms and peripheral norms.

- *Pivotal norms* express the most important core assumptions about the nature of the work (for example academics highly rate the value of education, scholarship). Deviation from these norms is considered in a serious light.
- *Peripheral norms* are less crucial dealing with minor issues such as how to seek information. A group tends to be quite tolerant towards deviations from peripheral norms.

### 2.5.5 Group / team cohesion and spirit

Being in a group or team is not the same as feeling that one belongs to group / team. Group cohesion is the invisible bond which links members of a group of a team together. Group norms assist in making a group cohesive (Hayes, 1997).

Keller (1986) studied working groups in American research and development organisations. The highly cohesive groups were much better at meeting the task objectives they had been set than less cohesive groups.

It is easy for a manager to assign individuals to a team. But it is quite another thing getting that group of people actually functioning as a team. Establishing cohesion is an important part of it (Hayes, 1997).

According to Cook and Brown (2002, in Quintas and Ray, 2002) team spirit is something that emerges from the interaction of team members and enables them to play (and work) together – in the same way that Spender's notion of common knowledge enables knowledge about the component parts of a firms activity to be integrated. Casual references to a 'special chemistry' among a group that 'gels' or 'clicks', reflect the realisation that the interaction has generated some form of collective understanding.

However, if team members belong to the same / similar CoP, they already have an existing social networking relationship that provides the cohesion. Additionally the CoP environment supplies the safe environment rich in applied knowledge and experience to facilitate innovation.

### 2.5.6 Boundary spanners

Ancona (1990, in Rosenthal, 1997: 288) studied team relations with parties outside the team – the notion of "boundary management" activities. That refers to activities which cross the team boundary, such as presenting the team to outsiders, getting information and brining it to the team, and buffering the team from outside demands.

According to Rosenthal (1997: 288-9) social networks are important to understand in the team context because when individuals participate in a team, they do not leave their relations with other people at the door. They carry with them the ties (both positive and negative) that they have with other people in their lives, both inside and outside the organisation. Rosenthal (1997) uses the term "network constraints" for a quantative measure describing the pattern of connections between contacts in a personal network. Constraint measures the extent to which relations in a person's network lead directly or indirectly to one contact. Low constraint networks have few redundant contacts and fewer interconnections between contacts - presumably giving broader coverage in terms of access to information and timelines of information. A clique, in which there is a high degree of overlap between contacts, is an illustration of a highly constrained network.

The effectiveness of key individuals (e.g. 'boundary spanners' – those who work across organisational boundaries) is frequently mentioned as being important in learning and innovation. Some cultures provide support for employees who adopt these roles. As Dodgson (1993, in Quintas and Ray, 2002: 25) points out, these roles embody the force of *human agency*, which so often determines the difference between success and failure.

## 2.6 Absorptive capacity of organisations

The ability to recognise, share and assimilate knowledge has been formalised in the term '*absorptive capacity'* by Cohen and Levinthal (1990). Cohen and Levinthal base their concept of absorptive capacity on research into how individuals deal with information and knowledge that is new to them, notably how they learn. As such absorptive capacity is a concept that integrates many information and knowledge issues.

Quintas and Ray (2002: 37) highlight four elements influence an organisation's absorptive capacity in terms of external information:

- *Who brings* the information or knowledge into the organisation? This may be a gatekeeper, someone who monitors the external environment for important information, and if necessary, also translates it into a form that can be understood by the relevant people.

  This can also be the "boundary spanners" as referred to previously, CoP members, or "bridge builders" (Gorjestani and Yannakou, 2004, personal interview*)* used as a term used to describe the people that expand the network.
- *Who receives* the information or knowledge from the gatekeeper? People must be able to understand the ramifications of what is being presented to them. Information acquisition is a key competence within information management, and therefore within knowledge management.
- *The scope* for spotting unexpected significance in *external* signals and for encouraging novel linkages and interpretations to develop. This depends on factors such as the diversity of backgrounds and level of responsibilities within a group.
- The *efficiency* of information and knowledge sharing, requiring a shared language or body of knowledge to increase the ability to communicate *internally* (in the group).

Cohen and Levinthal (1990, in Quintas and Ray, 2002: 37) draw several conclusions about the absorptive capacity of an organisation. They say that the notion of the gatekeeper means absorptive capacity is path-dependent and domain specific.

They also stress the importance of intellectual capital. They believe intellectual capital and past experiences must be codified in a usable, easily accessible way, particularly as the level of uncertainty in an environment increases. That will speed up the learning of subsequent new information and knowledge, thereby reducing the cost of that learning. It will also help organisations to evaluate the appropriateness of new technologies.

## 2.7 Cognitive, social and emotional intelligence

Looking at the characteristics of CoPs one can distinguish cognitive elements (level of training, experience, language, etc) as well as social (for example socialisation in terms of accepted norms, ethics, work values) and emotional elements (such as support, acceptance, and belonging) in the relationship of both CoPs and teams. However, cognitive, social and emotional intelligence are fields of specialisation in their own right, with a fair amount of controversy still surrounding emotional intelligence in particular.
In view of that, only a brief background is given for the purposes of this research. It is by no means representative of all the views, nor exhaustive in detail of the various fields.

### 2.7.1 Intelligence

John B. Carroll (1993; 1997 in Taub, 2002) posited his own theory of intelligence, known as the Three-Stratum theory. The Three-Stratum theory of cognitive ability is a hierarchical model of intelligence and contains three stratum or levels. The first stratum (level) consists of about 70 narrow abilities that are measured by individual tests. Abilities measured at the first stratum include induction, speed of lexical processing, visual discrimination, deduction, and auditory discrimination to name a few. The second stratum contains at least eight broad abilities including Fluid Intelligence, Crystallised Intelligence, General Memory and Learning, Broad Visual Perception, Broad Auditory Perception, Broad Retrieval Ability, Broad Cognitive Speediness, and Processing Speed.
Taub (2002: 138) provides the following descriptions:
*Comprehension-Knowledge* is analogous to crystallised intelligence. It is a measure of the depth and breadth of a person's acquired knowledge. This ability is used to access and apply previously learned strategies and to communicate verbally.
*Long-Term Retrieval* is the process of storing and retrieving information that is not directly dependent on one's store of acquired knowledge.
*Visual-Spatial Thinking* incorporates one's ability to store and recall visual stimuli and to synthesise, analyse, manipulate, and perceive visual patterns.
*Auditory Processing* is the ability to process and discriminate speech through analysis, synthesis, and discrimination of auditory stimuli.
*Fluid Reasoning* is the cognitive process of solving problems of amore novel nature, on a continuum of novelty to automaticity and to solve tasks requiring inductive or deductive reasoning skills.
*Processing Speed* is the efficient performance of tasks requiring minimal cognitive demand which require completion within a specified time constraint.

*Short-Term Memory* is the ability to consciously hold and use information within a few seconds.

*Quantitative knowledge* reflects one's knowledge and ability to manipulate mathematical stimuli.

*Reading-Writing Ability* involves the basic skills and complex abilities involved in reading and writing

The purpose of the discussion of intelligence theories presented in this article is to provide an understanding of the underlying structure of human cognitive abilities – which plays a part in entering the particular field, performing to the extent that a reputation is built and peers accepted and recognise the person.

### 2.7.2 Emotional intelligence

According to Dulewicz and Higgs (2003: 134) great interest has been shown in recent years in the topic of emotional intelligence (EI), stimulated by Goleman's (1996) book, and in particular the assertion that EI explains a higher proportion of variance in individual success than IQ. As long ago as the 1920s, Thorndike (1920) reviewed the predictive power of IQ and subsequently developed the concept of "social intelligences" to explain aspects of success which could not be accounted for by IQ. However, it was not until the early 1980s that Gardner (1993) resurrected interest in factors other than IQ which may influence individual success. In an educational context, he developed and explored the concept of multiple intelligences. In particular, his "personal intelligence" included inter-personal, self-awareness and emotional traits.

However, this field is not without controversy, with some authors claiming EI is a marketing term which is impossible to measure. Dulewicz and Higgs (2003) mention the following examples:

- Steiner (1997: 23 in Dulewicz and Higgs, 2003) comments that the term EQ (a measure of emotional intelligence), although snappy, means less than one might think. An emotional quotient cannot be measured and scored like an intelligence quotient. It should be regarded as a marketing concept, not a scientific term.
- Woodruffe (2001) believes that the construct is not new but simply a new brand name for a set of long-established competencies. Furthermore, some claim there is no evidence for its validity.
- According to Robertson and Smith (2001) a thorough search of the scientific literature failed to provide any studies which demonstrated the criterion-related validity of emotional intelligence for any specific occupational area.
- Luthans (2002) points out the relatively weak theory development, research and measures of EI but also stresses its potential importance for leadership

effectiveness, human resource (HR) performance improvement and other applications.

- Davies *et al*. (1998) suggest that emotional intelligence is not a true intelligence and is best viewed as a cluster of personality traits.

While there are a number of precursors to the concept of emotional intelligence the broad psychological concept was first described by Salovey and Mayer (1990 in Dulewicz and Higgs, 2003). In general they proposed that individuals vary in their capacity to process information of an emotional nature and their ability to relate these to a wider cognition. This ability is seen to manifest itself in certain adaptive behaviours proposed that high levels of EI were associated with success in a business context. It is suggested that "emotionally intelligent" individuals can perceive, understand and regulate the emotions of others, thus making emotional intelligence a significant factor in the success of interpersonal interaction in a work context (Mayer et al., 2000 in Dulewicz and Higgs, 2003).

### 2.7.3 Social intelligence

The psychometric view of social intelligence has it origins in E.L. Thorndike's 1920 division of intelligence into three facets, pertaining to the ability to understand and manage ideas (abstract intelligence), concrete objects (mechanical intelligence), and people (social intelligence). In his classic formulation:

> "*By social intelligence is meant the ability to understand and manage men and women, boys and girls – to act wisely in human relations*" (Thorndike, 1920: 228 in Kihlstrom and Cantor, 2000).

Vernon (1933: 44, in Kihlstrom, and Cantor, 2000) provided the most wide-ranging definition of social intelligence as the person's

> "*ability to get along with people in general, social techniques or ease in society, knowledge of social matters, and susceptibility to stimuli from other members of a group, as well as insight into the temporary moods or underlying personality traits of strangers*"

Kihlstrom and Cantor (2000) remarks that although intelligence has proved difficult for psychometricians to operationalise, it does appear to play a major role in people's naïve, intuitive concepts of intelligence.

According to them the social-intelligent view of personality begins with an assumption that social behaviour is intelligent – that it is mediated by cognitive processes of perception, memory, reasoning, and problem-solving, rather than being mediated by innate reflexes, conditioned responses and the like. Differences in social knowledge cause differences in social behaviour, but it does not make sense to construct

measures of social IQ. The important variable is not *how much* social intelligence the person has, but rather *what* social intelligence he or she possesses.

Most of the sciences and professional disciples have socialisation built into their programmes, for example the internships of medical practitioners and psychologists. The socialisation is even more refined as a person starts specialising and joining specific professional institutions and networks like CoPs. This in effect creates the base for a relationship such as is required for a team to function optimally.

## 2.8 Conclusion - Theoretical Foundation

It is clear from the literature that when referring to CoPs, the recurring terms and emphasis is on the *informal* nature of the relationship, and on the sharing of *applied* knowledge / experience.

Looking at the literature there are two sets of dichotomies that impact on the influence of CoPs on team development.

The first would be the dichotomy of the market that requires proprietary ownership of knowledge as the primary factor for the development of economic value and a necessary means for profit. In contrast to that, the social nature of knowledge means that there must be an exchange of ideas to develop new knowledge, which in turn means there must be freedom to network and interact on a cognitive level.

The second dichotomy deals with the differences between management on the one hand (control, structure and organisation) and CoPs on the other hand (social, informal network, with voluntary participation).

It is these dichotomies that present challenges to management in the current competitive environment.

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# Chapter 3 Research Design and Methodology

## 3.1 Introduction

This research looks at the impact of CoP on the core members of an inter-firm collaborative research team, and capturing emerging Best Practices.

In Chapter 2 the following assumptions were given

- CoP members are at a career stage level 2 or higher.
- CoPs transcend company and country borders.
- CoPs transcend types of companies, industries and disciplines.

## 3.2 Limitations

The first limitation is the fact that the measurement is to a large extent based on perceptions of the people being interviewed as well as the people answering the survey questionnaire.

Another limitation involves the time pressures on research teams. In a number of the interviews the executives stressed the time and work load pressures on the teams, requesting a short, user-friendly survey, preferably electronic. In South Africa though, the internet in many institutions are slow. This predisposes the medium to email rather than a direct online survey.

Although the initial interest in the research was triggered by organisational trends in the pharmaceutical industry, the South African pharmaceutical industry does not undertake significant research and development locally. The research sample included representatives of various industries, but no pharmaceutical companies. However, the latter in it self did not qualify as a limitation as the rest of the sample provided variety within the required scenario.

## 3.3 Research Methodology

The research consisted of primary data (survey) as well as existing data (Best Practices being used in organisations). In both cases the level of control were low as the researcher had no control over the data (Mouton, 2003).

### 3.3.1 Nature of the study

The nature of the study is causal in that it tries to investigate the relationship between variables. However, it is not possible to observe all the processes that may account for the relationships between the variables (Cooper and Schindler, 1998).

Information from some of the interviews conducted indicates that the causal relationship is to a certain extent:

- *Reciprocal* where some of the variables mutually influence or reinforce each other (Cooper and Schindler, 1998). Examples of such a relationship in this research scenario include instances where team members from a previous project form a CoP or nominate members to a CoP, based on their mutual respect and interests. They may nominate those same members for future projects again.
- *Asymmetrical* in a type of *disposition-behaviour relationship*. A disposition is a tendency to respond in a certain way under certain circumstances. Dispositions include attitudes, opinions, habits, values and drives. Behaviour responses include consumption practices, work performance, interpersonal acts and other kinds of performance (Cooper and Schindler, 1998). Interesting examples of this phenomenon are interpersonal differences / preferences; the differences between academic researchers and commercial enterprises; as well business culture differences between some Eastern and Western countries. However, these issues were not part of the research as such, and were not addressed in the survey questionnaire.

### 3.3.2 Control and time dimension

- The design of the study was *ex post facto* as the researcher had no control over the variables.
- Although the interviews and survey took place over a couple of months, the study can be regarded as a cross-sectional study that represents one point in time.

### 3.3.3 Approach and data collection

The approach to this research was based on inductive reasoning moving from specific facts to general, but tentative conclusions (Cooper and Schindler, 1998).

A mix of quantitative and qualitative approaches was followed, to include multiple sources of data – also referred to as triangulation (Cooper and Schindler, 1998; Mouton and Marais, 1994). The data collection consisted of:

- Semi-structured interviews with influential or well informed people in an organisation or community, described as *elite-interviewing* by Cooper and Schindler (1998); and
- A structured survey questionnaire.

This combination provided quantitative data from the questionnaire for breadth, and qualitative data from the interviews for depth.

The research approach followed is portrayed in the following diagram.

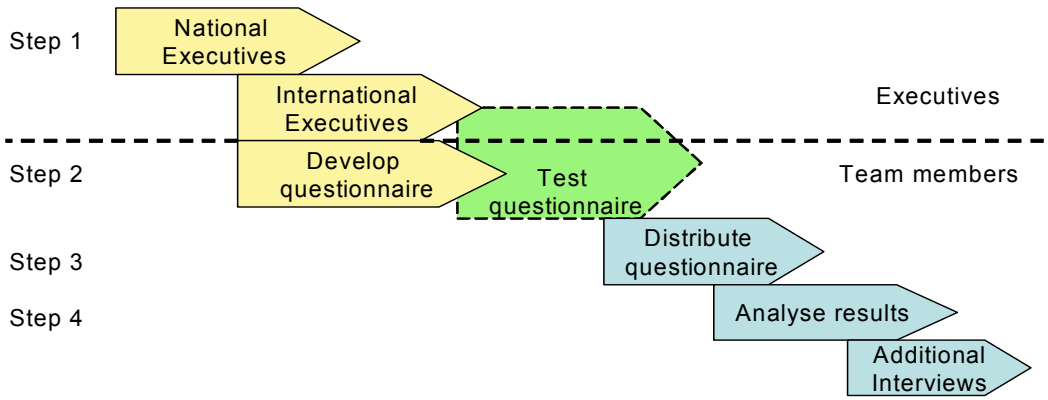



**Diagram 5: Research Approach**

The first step in the research approach was to make contact with executives in biotechnology laboratories, universities, pharmaceutical, chemical and engineering companies. One of the primary outcomes from these contacts with the executives was access to teams that meet the criteria as set out in the research proposal. The interviews also provided qualitative and strategic information about the organisations and their viewpoints regarding collaboration and social networks such CoPs.

This high level contact process was initially done locally in South Africa and then expanded internationally. During these phases, informal or semi-structured interviews were conducted with people top or senior management positions of various organisations (the Interview list under References provide more detail). These interviews provided interesting information and trends about a variety of issues that will be discussed later in this document. Where possible face-to-face interviews were done, otherwise telephonic interviews were conducted.

A survey questionnaire was developed for the *second step* of the research process. The survey was distributed electronically nationally and internationally to the executives with whom interviews were held, as well as additional contacts acquired during the research. The executives and contacts were asked to forward the questionnaire to members of collaboration teams.

During the *third step* of the process the results were analysed. The *last step* in the process was interviews with additional executives. This ran concurrent with the survey.

### 3.3.3.1 Sampling

The sampling approach followed has elements of the following types of sampling

- *Purposive sampling* or judgemental (Cooper and Schindler, 1998; Bailey, 1994). The researcher uses his/ her own judgement about which respondents to choose,

and picks only those who best meet the purposes of the study – as indicated in the assumptions.

- *Snowball sampling* (Cooper and Schindler, 1998; Bailey, 1994). Snowball sampling is conducted in stages. In the first stage a few people with the requisite characteristics were chosen (as represented by the executives indicated in the research approach). Interviews were held with them. These people in turn identify others who qualify for inclusion in the initial interview stage, or for the formal survey stage. The additional contacts were either interviewed, or the formal survey questionnaire was sent to them.

  This approach was followed because suitable respondents were difficult to identify and contact. Senior researchers are best located and motivated to participate through referral networks.

#### 3.3.3.2 Interviews

Bailey (1994) refers to a semi-structured interview based on Merton's focussed interview (1972, in Bailey, 1994). According to that, the focussed interview uses topics and hypotheses selected in advance. The people interviewed are known to have been involved in a particular situation.

In the focussed interview questions are open-ended to provide flexibility and allow for unanticipated responses. It also allows flexibility in terms of the questions asked, which can then be tailored to probe avenues of exploration relevant to the topic being studied (Bailey, 1994: 190).

In this study, contact was made and meetings set up with executives of various national biotechnology laboratories, universities, institutions and companies. At the point of setting up the meeting each person was sent an executive summary of the research proposal. The document also contained a number of exploratory questions for their consideration (see addendum D). These questions served as an introduction to the meeting, but were by no means used as a set framework. The purpose of the interviews was to get rich (contextual) data about the organisational approach to R&D, collaboration, social networks, knowledge sharing and IP issues.

In quite a number of the interviews, time was spent clarifying the terms and concepts surrounding CoPs, and highlighting the difference between teams and CoPs, as the interviewees were not familiar with the terminology. Once that was clarified, the interviewees were able to share relevant experiences and expand on contextual issues applicable in that particular company / industry / institution.

As a consequence of interviewing a range of people over time, new themes and insights developed and the questions were adapted to accommodate those. The interview focus also shifted to accommodate the various types of industries / institutions involved. Interview bias was limited to a certain extent as all the interviews were done by the same person. The interviews were transcribed and sent back to the interviewees for comments.

An interview saturation point was reached in terms of themes and approaches. At this point additional interviews on the executive level were primarily continued as a point of contact with potential survey candidates.

#### 3.3.3.3 Survey questionnaire

Questionnaires are just one of a range of ways to get information from people, or answers to research questions. Incidentally, one of the weaknesses of questionnaires is that they seek answers just by asking questions (Gillham, 2000: 2).

**Table 7 Advantages and disadvantages of questionnaires**

| The advantages of questionnaires include | The disadvantages of questionnaires include |
|---|---|
| • Low cost in time and money.<br>• Easy to get information from a lot of people quickly.<br>• Respondents can complete the questionnaire when it suit them.<br>• Respondents' anonymity.<br>• Lack of interviewer bias.<br>• Analysis of answers to closed questions is straight forward.<br>• Standardisation of questions. | • Problems with data quality.<br>• Typically low response rate and problems with motivating respondents.<br>• The need for brevity and relatively simple questions.<br>• Question wording can have a major impact on answers.<br>• People talk more easily than write.<br>• Respondent uncertainty as to what happens to data.<br>• Misunderstandings cannot be corrected. |

(*Gillham, 2000*)

According to Gillham (2000: 26) Topics usually fall into three main categories:

- Questions of fact;
- Questions about opinions, beliefs and judgement; and
- Questions about behaviour.

**This research questionnaire consisted of three main components**

1. The *first* component contained questions requiring
    - Choosing from a range of options;
    - Yes / no answers.

This part of the questionnaire was used to gain information about the team, monitor conformance to the unit of research requirements, and the assumptions made.

2. The *second* part requested the recipients to rate their perceptions the impact of similar training and /or membership to the same or a similar social network, on the norming phase and productive phase in team development. This was rated using a ten point Likert scale, ranging from 1 – experiencing a lot of problems / delays, to 10 – progressing very smoothly / quickly reaching productive stage.

3. The *third* component of the questionnaire used a five point Likert scale to rate the independent variables as set out in the hypotheses. A five point Likert scale was used ranging from strongly agree to strong disagree.

The Likert scale is a popular variation of the summated rating scale producing interval data. Summated scales consist of statements that express either a favourable or unfavourable attitude towards the object of interest. The respondent is asked to agree or disagree with each statement. Each response is given a numerical score to reflect its degree of attitude favourableness, and the scores may be totalled to measure the respondent's attitude. Since respondents answer each question, it is probably more reliable and it provides a greater volume of data than many other scales. To safeguard against response-set bias, approximately half of the statements were worded favourable, and the other half unfavourable (Cooper and Schindler, 1998: 189, 197).
The questions used in the second part of the questionnaire was inspired from literature on teams and CoPs, knowledge, as well as the concepts of emotional, social and cognitive intelligence.

According the executives interviewed the target group are under time pressure, with full schedules and big work loads, highlighting the fact that people are reluctant to answer long, time consuming questionnaires. To counter that, this questionnaire was kept fairly short and user-friendly (see feedback from respondents). A copy of the questionnaire is attached as Addendum F.

The target group are people that are familiar with, and have easy access to personal computers. The questionnaire was therefore distributed nationally and internationally through the internet as a MS Excel file included in an e-mail message.

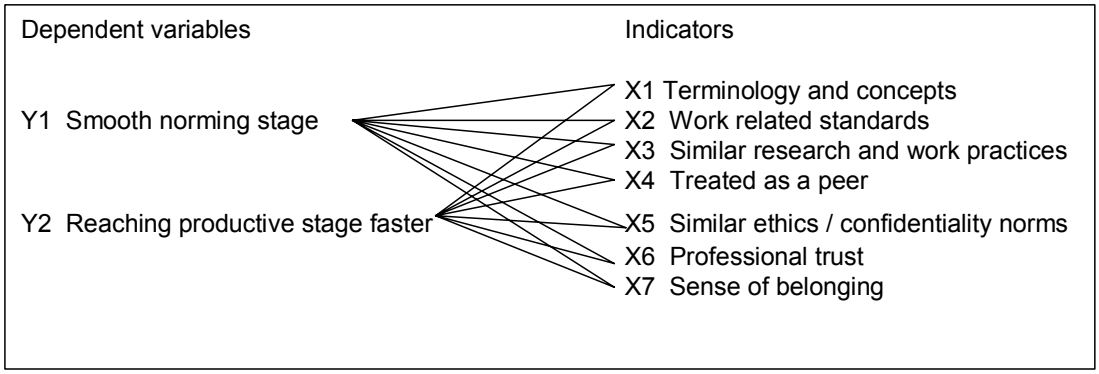
#### 3.3.3.4 Analysis

The initial part of the questionnaire provided information about the team, on which trend analysis was done.

The Likert scale produced interval data for which a *z*-test and a one sample t-test were applied to the hypotheses of the dependent variables. The sample size was too small to do multiple regressions. Correlations between the variables were investigated.

## 3.4 Variables and Hypotheses

Based on the research question, two dependent variables have been identified. The seven independent variables are based on the CoP characteristics identified in the literature.




*Adapted from Mouton and Marais, 1994*.

**Diagram 6: Variables and indicators**

### 3.4.1 Dependent variables

The participants were asked to reflect on previous projects or current projects in which they were involved, where the core team members have the same or similar basic training and/or belong to same or a similar social network (CoP).

Based on their own experience in those projects, they were asked to rate the norming and productive phases of the team development on a scale of 1 to 10 where 1 = a lot of problems/delays; 6 = acceptable and 10 = very smooth / quickly reached productive stage.

$Y_1$ In core teams where the members belong to the same / a similar CoP, the norming stage of team development progresses smooth.

$H_0 : \mu \leq 6$

$H_a : \mu \geq 6$

$Y_2$ In core teams where the members belong to the same / a similar CoP the team become productive quickly.

$H_0 : \mu \leq 6$

$H_a : \mu \geq 6$

### 3.4.2 Independent variables

The seven independent variables can be categorised into three aspects similar to the types of intelligence discussed earlier - cognitive, social and emotional.

The participants were asked to reflect on previous projects or current projects in which they were involved, where the core team members have the same or similar basic training and/or belong to same or a similar social network (CoP).

Based on their own experience in those projects, they were asked to rate the various statements on the independent variables on a scale of 1 to 5 where 1 = “strongly disagree” and 5 = “strongly agree”.

**Intellectual aspect**

$X_1$ The core team members already use the same terminology and frame of reference (conceptual understanding) when dealing with work related issue /problems. (Communication across cultural / language barriers).

- This contributes to a smoother norming stage.

  $H_0$: $\rho_{Y1X1} = 0$

  $H_1$: $\rho_{Y1X1} > 0$

- This contributes to reaching the productive stage faster.

  $H_0$: $\rho_{Y2X1} = 0$

  $H_1$: $\rho_{Y2\,X1} > 0$

$X_2$ The core team members already have similar work related standards.

- This contributes to a smoother norming stage.

  $H_0$: $\rho_{Y1X2} = 0$

  $H_1$: $\rho_{Y1X2} > 0$

- This contributes to reaching the productive stage faster.

  $H_0$: $\rho_{Y2X2} = 0$

  $H_1$: $\rho_{Y2\,X2} > 0$

$X_3$ The core team members already have the same basic research approaches and practices. (Assist when working together across cultural / language / discipline barriers).

- This contributes to a smoother norming stage.

  $H_0$: $\rho_{Y1X3} = 0$

  $H_1$: $\rho_{Y1X3} > 0$

- This contributes to reaching the productive stage faster.

  $H_0$: $\rho_{Y2X3} = 0$

  $H_1$: $\rho_{Y2\,X3} > 0$

**Social aspects**

$X_4$ The members are more prone to treating each other as peers.

- This contributes to a smoother norming stage.
  $H_0$: $\rho_{Y1X4} = 0$
  $H_1$: $\rho_{Y1X4} > 0$
- This contributes to reaching the productive stage faster.
  $H_0$: $\rho_{Y2X4} = 0$
  $H_1$: $\rho_{Y2\ X4} > 0$

$X_5$ The core team members already have similar ethics / confidentiality norms when dealing with work related issue / problems and others.

- This contributes to a smoother norming stage.
  $H_0$: $\rho_{Y1X5} = 0$
  $H_1$: $\rho_{Y1X5} > 0$
- This contributes to reaching the productive stage faster.
  $H_0$: $\rho_{Y2X5} = 0$
  $H_1$: $\rho_{Y2\ X5} > 0$

**Emotional aspects**

$X_6$ In core teams where the members belong to the same / a similar COP, a high level of professional trust is established quickly / is already present.

- This contributes to a smoother norming stage.
  $H_0$: $\rho_{Y1X6} = 0$
  $H_1$: $\rho_{Y1X6} > 0$
- This contributes to reaching the productive stage faster.
  $H_0$: $\rho_{Y2X6} = 0$
  $H_1$: $\rho_{Y2\ X6} > 0$

$X_7$ In core teams where the members belong to the same / a similar COP, there is already a sense of “belonging”.

- This contributes to a smoother norming stage.
  $H_0$: $\rho_{Y1X7} = 0$
  $H_1$: $\rho_{Y1X7} > 0$
- This contributes to reaching the productive stage faster.
  $H_0$: $\rho_{Y2X7} = 0$
  H1: $\rho_{Y2\ X7} > 0$

## 3.5 Criteria by which exploration will be judged successful.

The exploration will be judged successful if it confirms the proposition that membership to the same or similar CoPs contribute to the productivity of the team and enhances the team development process.

# Chapter 4 Survey: Results and interpretation

## 4.1 General Feedback

### 4.1.1 Feedback on the methodology followed for the survey

The actual sample size turned out to be relative small, despite repeated follow-ups and using additional sources provided by various people. Forty four responses were used in the calculation. However, looking at the range of people that responded, it provided a fair cross section of researchers in terms of industries and countries.

The target group consisted of senior researchers who are under a tremendous amount of pressure and time constraints. Even the referral networks did not prove as successful as hoped for. According to informal feedback researchers are also reluctant to answer questionnaires from people they do not know personally or professionally.

### 4.1.2 Feedback on the survey itself.

Feedback from the respondents included the following:

- Some of the researchers found rating the statements fairly difficult as they had worked in various collaborative teams in the past few years, particularly with a range of universities and companies, some teams better than others. Each experience was different, depending on the individuals involved, the real level of expertise (as opposed to the expected level of expertise), and the nature of the work, particularly how close the work was to the core competencies of the researcher. Depending on the project, the competitive nature of the area (and potential returns), and level of contact with team members, the rating of these questions can change.
- Some researchers commented on the problems that arise from different rates of work, e.g. academic requirements for an MSc or PhD tend to be on a longer timescale than applied research for industrial partners. Therefore there is often frustration on the part of the industrial partners at the slow rate of progress from the University partners, while the latter feel pressurised by the industrial partners into taking short cuts.
- A number of researchers said it is very much personality-related, something that was mentioned in interviews as well:
  - Some academics are not happy to do projects dictated by industry, others are.
  - Some are just in it for the research funds, others more for the science.

- Some participate in the team / collaboration just for the other opportunities that it might lead to rather than the immediate task at hand.
- In general, problems which arose were always about differing expectations, or different assumptions. It is critical to set this up clearly in the initial phases.
- It is much easier to relate to team members who are willing to work together, share information, and collaborate on joint tasks and objectives. When there are some members who act independently and refuse to cooperate with the other team members, it creates an air of frustration and burdens the other members with additional work.

  Because of the members who chose not to collaborate, the team spirit is reinforced among the rest of the members, which alienates the factions further.
- Negative patterns of past behaviour have prejudiced the members' attitude to working with certain people on future projects.

- A statement was made that with funded projects self-interest needs to be considered i.e. will the funds be available to support all team members?

Some of these comments confirm potentially asymmetrical relationships in a type of disposition-behaviour relationship where there is a tendency to respond in a certain way under certain circumstances. Dispositions include attitudes, opinions, habits, values and drives. Behaviour responses include consumption practices, work performance, interpersonal acts and other kinds of performance (Cooper and Schindler, 1998).

## 4.2 Background on the sample population

A number of respondents did not answer some of the questions in this section, especially questions 3 to 7. This may be because of a number of reasons, such as not being part of a team currently, a lack of experience or exposure, or even because the respondent felt that the information would indicate the projects on which the person is working.

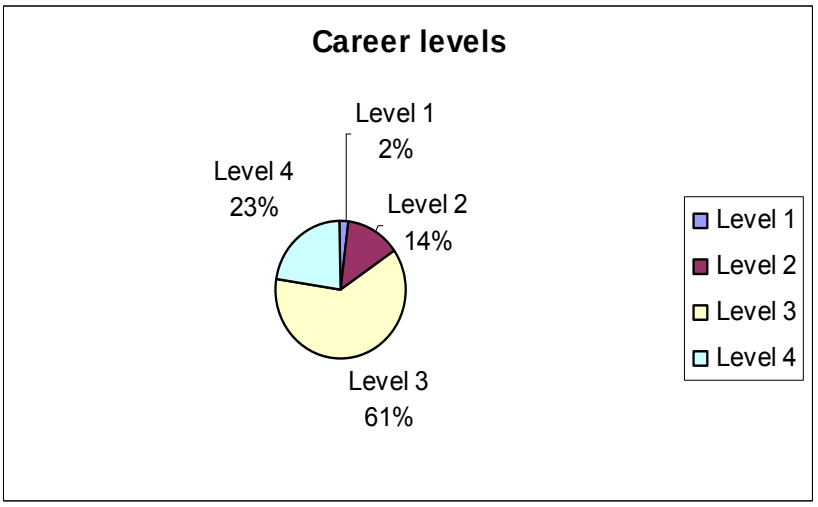
**Question 1 Career development levels**

Dalton and Thompson (1986) defines career levels in the following way:

Level 1: Assistant performing tasks under supervision
Level 2: Individual contributor operating independently
Level 3: Mentor / champion assuming responsibility for others
Level 4: Director / sponsor / strategist assuming responsibility for the organisation

The sample profile included the following levels.

**Graph 1:** **Career levels**



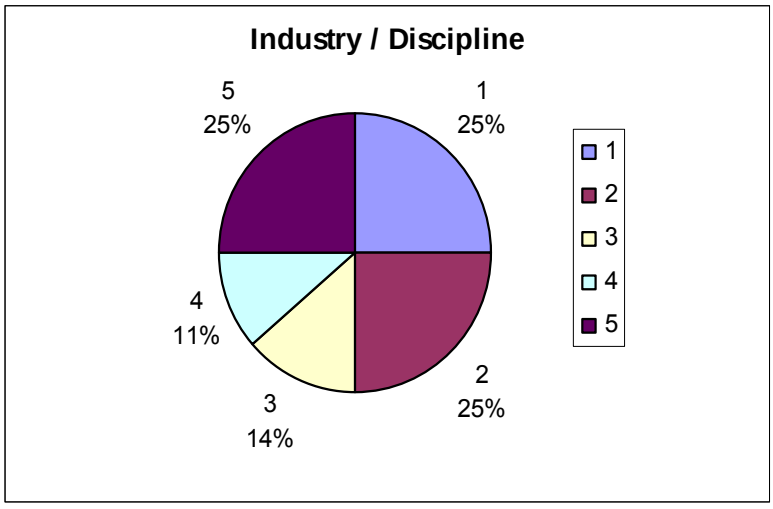

The preponderance of levels 2-4 in the sample population indicates that the survey sample met the requirements set out initially.

**Question 2 Fields or disciplines best describing the respondents' current area of work**

The fields and disciplines were arbitrarily sorted into categories:

**Graph 2:** **Industries / Discipline**

1. Food science / biotechnology
2. Chemistry/ chemical; engineering & metallurgy.
3. Aerospace
4. Consulting & shipping
5. Agriculture, geology, marine & environment.

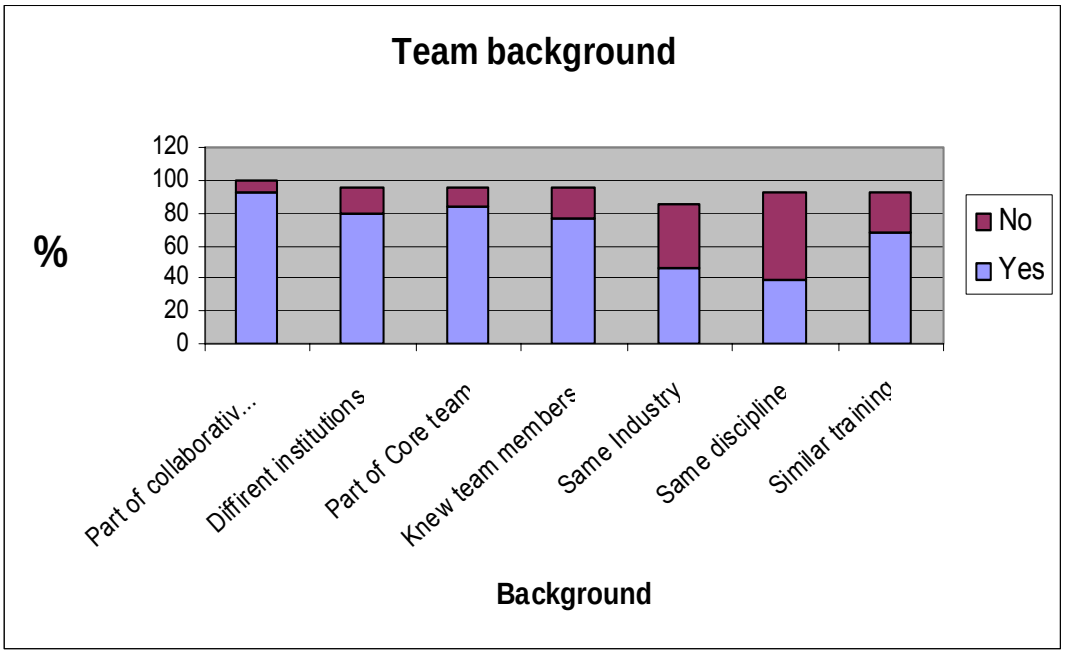


The sample included respondents from a variety of industries and disciplines. Although not asked specifically in the survey for conditions of confidentiality, the respondents are from a variety of countries as well.

**Questions 3-6 Team Information**

The purpose of these questions was to verify the extent to which the sample met the requirements as set out in the defined target population, as well as gathering other team background information.

**Graph 3: Team Background**

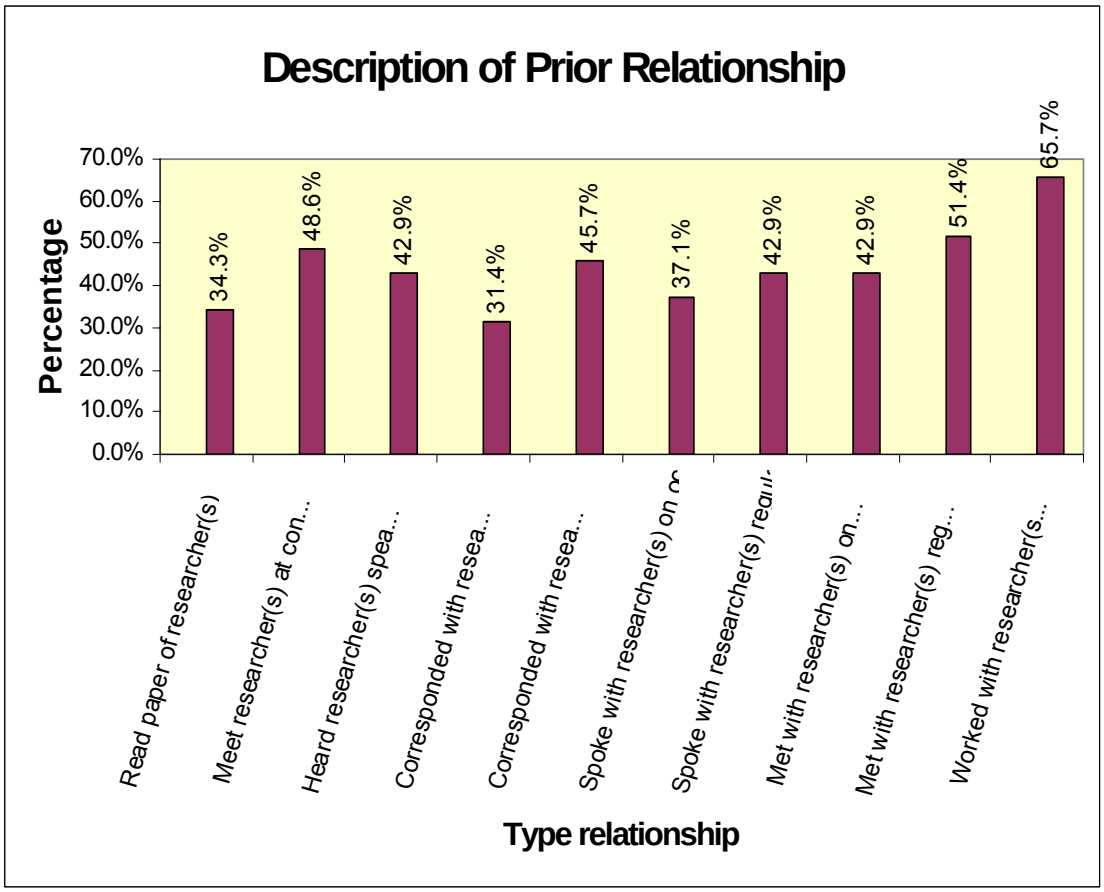



With the exception of a number of consultants and executives, all the respondents were part of collaborative teams; they were part of the core team; mostly from different institutions, not always from the same industry or discipline, but often had similar training (such as the sciences or engineering). In quite a number of instances, they knew the team members in some way before the team was formed. That prior relationship was explored in question 7.

**Question 7 Prior relationships**

In cases where the respondents knew the other team members before the project, the relationship in respect to the team members was described as follows:

**Graph 4: Description of prior relationship**




The majority of respondents who had a prior relationship with team members, had worked with them before (65.7%). The issue of personality and "fit" has been highlighted as an important factor in the interviews as well as in some of the comments received from the survey respondents. According to the feedback, a good fit between specific people on a team, result in them nominating the same people for future projects.

This confirms the potentially reciprocal nature of the relationships as described by Cooper and Schindler (1998), where team members from a previous project form a CoP, nominate members to a CoP or a future team, based on their mutual respect and interests.

## 4.3 Hypotheses testing

In order to test whether membership to the same or a similar CoP have any impact on the team forming processes of inter-firm collaborative teams, some kind of value had to be linked to a smoother norming phase, and to reaching the productive phase quicker. It is clear that assigning a value to a smoother norming phase or to reaching the

productive phase quicker would be very subjective, based on the perceptions of the individual.

A further problem was highlighted by a number of the respondents. They commented on the difficulty rating the smoothness of the norming phase, and reaching the productive phase quicker when they have been part of various teams on various projects – some of which had been more successful than others.

Nonparametric methods provide an air of objectivity when there is no reliable (universally recognised) underlying scale for the original data and there is some concern that the results of standard parametric techniques would be criticized for their dependence on an artificial metric. What scores should be assigned to the “smoother” and “quicker” categories and how do we know whether the outcome would change dramatically with a slight change in scoring? Some of these concerns are blunted when the data is converted to ranks. For these reasons nonparametric tests was favoured.

### 4.3.1 Measurements

#### *4.3.1.1 Correlation and 2-tailed significance*

Spearman's rho (ρ), a nonparametric measure of association for ordinal data, suitable for small samples (Cooper and Schindler, 1998), was used to determine the correlation between the dependent variables ($Y_1$ and $Y_2$) and the independent variables ($X_1$-$X_7$). The same measure was also used to determine correlations between the various independent variables ($X_1$-$X_7$). The full table of correlations is attached as Addendum G.

The correlation coefficient, ρ, quantifies the linear relationship between two variables by indicating the direction and magnitude of correlation. The correlation coefficient ρ, ranges in value between +1, and -1, with +1 indicating a perfect positive relationship, and -1 indicating a perfect negative relationship. Correlation does not indicate causality.

#### *4.3.1.2 Effect size (ES)*

The larger the ES posited, other things (significance criterion, sample size) being equal, the greater the power of the test. Cohen (1988: 79) offers operational definitions for the effect size of "small", "medium" and "large" in terms of (for the purposes of this study) ρ, as a convention for use.

- ρ = 0.1 – small effect
- ρ = 0.3 – moderate effect
- ρ = 0.5 – large effect

Although the values may seem small, these values may represent stronger degrees of association than they seem (Cohen, 1988: 532). Cohen (1988) highlights the principle that the size of an effect can only be appraised in the context of the substantive issues involved. For example if the effect refers to survival as in life and death, even a small effect is critically important; whereas the variance in points for an entrance exam is not such a big issue.

#### *4.3.1.3 Significance level*

The 2-tailed significance level calculated for each correlation indicates the reliability of the correlation. However, the significance of a correlation coefficient of a particular magnitude will change depending on the size of the sample, as evident when looking at the critical values of **r** relative to the degrees of freedom (Howell, 1995). As this is a small sample some of the significance levels which are currently indicated as borderline statistically significant or statistically significant, may increase in statistical significance in the case of a larger sample size.

The decision as to what level of significance will be treated as really "significant" remains to a large extent arbitrary. Typically results that yield probability $p \leq .05$ are considered borderline statistically significant. Results at the $p \leq .01$ levels are then regarded as statistically significant, and $p \leq .005$ or $p \leq .001$ levels are often called "highly" significant (Howell, 1995).

## 4.4 Results from the survey

### 4.4.1 Dependent variables ($Y_1$ and $Y_2$)

Two questions dealt with the dependent variables. The questions asked the respondents to reflect on current or past projects in which they were involved, where the core team members had same / similar training, and / or belong to the same or similar CoPs. Based on that experience, they were asked to rate the norming and productive phases of team development on a scale of 1-10, where 1 indicates a lot of problems and delays; 3 - quite a number of problems / delays; 5 - problems and delays; 6 is acceptable 8 - smooth / fast; and 10 indicate a very smooth phase / quickly reaching productive stage.

**Mean**

The mean for both $Y_1$ and $Y_2$ are slightly higher than 6/10, indicating that the norming phase progressed marginally smoothly and that the team reached the productive phase marginally quicker.

**Mean:**

| Q | Impact on team development on 10 point Likert scale | Mean | Standard deviation |
|---|---|---|---|
| $Y_1$ | The smoothness of the norming phase (phase 3) | 6.11 | 1.603 |
| $Y_2$ | The speed at which the productive phase (phase 4) was reached | 6.43 | 1.690 |

## Correlation

There is a strong positive correlation between the two dependent variables (ρ = 0.763, significance 0.000). See Addendum G.

### One-Sample Kolmogorov-Smirnov Test

| | Kolmogorov Z | Asymp. Significance 1 sided | Most extreme differences | | |
|---|---|---|---|---|---|
| | | | Absolute | Positive | Negative |
| $Y_1$ | 1.019 | 0.125 | 0.154 | 0.142 | 0.154 |
| $Y_2$ | 1.423 | 0.017 | 0.214 | 0.214 | 0.149 |

### One-Sample T-test

| | t | Degrees of freedom | Significance 1 sided | Mean difference | 95% Confidence level of difference | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| $Y_1$ | 0.470 | 43 | 0.320 | 0.114 | -0.37 | 0.60 |
| $Y_2$ | 1.695 | 43 | 0.048 | 0.432 | -0.08 | 0.95 |

Test was done at 95% confidence interval of the difference.

The results from both the one-sample Kolmogorov-Smirnov Test and the one-sample t-test show that the norming phase is basically at an acceptable level (6), and that membership to the same of similar CoPs does not result in any significant difference or improvement in the way the norming phase of team development progresses.

The results from the one-sample t-test indicate that the team progresses to the productive phase at an acceptable rate, and that membership to the same of similar CoPs has a barely significant difference or improvement in speed at which the productive phase of team development is reached. The nonparametric one-sample Kolmogorov-Smirnov test shows a significant value for reaching the productive phase ($Y_2$) quicker.

**$Y_1$** In core teams where the members belong to the same / a similar CoP, the norming stage of team development progresses smooth.

$H_0 : \mu \leq 6$

$H_a : \mu \geq 6$

The population mean is 6.11, and a significance level of respectively 0.320 (t-test), and 0.125 (Z-test). The mean is not significantly higher than 6, and the null hypothesis is not rejected.

**$Y_2$** In core teams where the members belong to the same / a similar CoP the team become productive quickly.

$H_0 : \mu \leq 6$

$H_a : \mu \geq 6$

The population mean is 6.43, with a significance level of respectively 0.048 (t-test), and 0.017 (Z-test). The mean is not significantly higher than 6, therefore the null hypothesis is not rejected.

The values obtained from the dependent variables provide a reference point that was not previously available. The value may, however, change if the sample size increases.

### 4.4.2 Independent variables (X1-X7).

The independent variables were measured using a Likert 1-5 scale, where 1 is "strongly disagree", and 5 is "strongly agree". There are seven independent variables, each represented by between four and nine statements in the questionnaire.

#### *$X_1$ The core team members already use the same terminology and frame of reference*

| Independent variable. | Dependent variable | $Y_1$ | $Y_2$ |
|---|---|---|---|
| X1 Similar terminology | Correlation Coefficient | 0.304 | 0.501 |
| | Sig. (2-tailed) | 0.045 | 0.001 |

**Correlation: $Y_1X_1$**

$H_0$: $\rho_{Y1X1} = 0$

$H_1$: $\rho_{Y1X1} > 0$

The Spearman's rho (ρ) correlation coefficient for $Y_1X_1$ is moderate at 0.304, and the 2-tailed significance value is 0.045, which can be regarded as borderline statistically significant. The null hypothesis is rejected.

**Correlation: $Y_2X_1$**

$H_0$: $\rho_{Y2X1} = 0$

$H_1$: $\rho_{Y2\,X1} > 0$

The correlation coefficient for $Y_2X_1$ is large at 0.501, and statistically highly significant at 0.001. The null hypothesis is rejected.

Similar *terminology and frame of reference* have a stronger and more significant correlation with reaching the productive phase quicker than is the case with smoothing the norming phase.

### $X_2$ *The core team members already have similar work related standards*

| Independent variable. | Dependent variable | $Y_1$ | $Y_2$ |
|---|---|---|---|
| X2 Similar standards | Correlation Coefficient | 0.282 | 0.566 |
| | Sig. (2-tailed) | 0.063 | 0.000 |

**Correlation: $Y_1X_2$**

$H_0$: $\rho_{Y1X2} = 0$

$H_1$: $\rho_{Y1X2} > 0$

The correlation coefficient for $Y_1X_2$ is moderate at 0.282, and not statistically significant at 0.063. Therefore the null hypothesis is not rejected.

**Correlation: $Y_2X_2$**

$H_0$: $\rho_{Y2X2} = 0$

$H_1$: $\rho_{Y2\,X2} > 0$

The correlation coefficient for $Y_2X_2$ is large at 0.566, and statistically highly significant at 0.000. In this case the null hypothesis is rejected.

Similar *work related standards* most definitely plays a role in reaching the productive phase quicker, but has little impact on the norming phase.

### $X_3$ *The core team members already have the same basic research approaches and practices*

| Independent variable. | Dependent variable | $Y_1$ | $Y_2$ |
|---|---|---|---|
| X3 Similar approaches and practices. | Correlation Coefficient | 0.338 | 0.519 |
| | Sig. (2-tailed) | 0.025 | 0.000 |

**Correlation: $Y_1X_3$**

$H_0$: $\rho_{Y1X3} = 0$

$H_1$: $\rho_{Y1X3} > 0$

The correlation coefficient for $Y_1X_3$ is moderate at 0.338, and statistically reasonably significant at 0.025. The null hypothesis is rejected.

**Correlation: $Y_2X_3$**

$H_0$: $\rho_{Y2X3} = 0$

$H_1$: $\rho_{Y2\ X3} > 0$

The correlation coefficient for $Y_2X_3$ is large at 0.519, and statistically highly significant at 0.000. The null hypothesis is rejected.

Similar *practices and approaches to work* have a more significant impact on reaching the productive phase quicker, than on the norming phase.

## *$X_4$ The members are more prone to treating each other as peers.*

| Independent variable. | Dependent variable | $Y_1$ | $Y_2$ |
|---|---|---|---|
| X4 Peer recognition | Correlation Coefficient | 0.012 | 0.272 |
| | Sig. (2-tailed) | 0.939 | 0.074 |

**Correlation: $Y_1X_4$**

$H_0$: $\rho_{Y1X4} = 0$

$H_1$: $\rho_{Y1X4} > 0$

The correlation coefficient for $Y_1X_4$ is weak at 0.012, and statistically not significant at 0.939. The null hypothesis is not rejected.

**Correlation: $Y_2X_4$**

$H_0$: $\rho_{Y2X4} = 0$

$H_1$: $\rho_{Y2\ X4} > 0$

The correlation coefficient for $Y_2X_4$ is small to moderate at 0.272, and statistically not significant at 0.074. The null hypothesis is not rejected.

*Peer recognition* plays a very small a part in reaching the productive phase faster, but does not have a significant impact in smoothing the norming phase.

### $X_5$ - *The core team members already have similar ethics*

| Independent variable. | Dependent variable | $Y_1$ | $Y_2$ |
|---|---|---|---|
| X5 Similar ethics | Correlation Coefficient | 0.160 | 0.385 |
| | Sig. (2-tailed) | 0.301 | 0.010 |

**Correlation: $Y_1X_5$**

$H_0$: $\rho_{Y1X5} = 0$

$H_1$: $\rho_{Y1X5} > 0$

The correlation coefficient for $Y_1X_5$ is small at 0.160, and statistically not significant at 0. 301. The null hypothesis is not rejected.

**Correlation: $Y_2X_5$**

$H_0$: $\rho_{Y2X5} = 0$

$H_1$: $\rho_{Y2\ X5} > 0$

The correlation coefficient for $Y_2X_5$ is moderate at 0.385, and statistically significant at 0.01. The null hypothesis is rejected.

Similar *ethics* has a moderate and statistically significant impact on the productive phase, but not on the norming phase.

### $X_6$ - *High level of professional trust is established quickly / is already present*

| Independent variable. | Dependent variable | $Y_1$ | $Y_2$ |
|---|---|---|---|
| X6 Professional trust | Correlation Coefficient | 0.182 | 0.443 |
| | Sig. (2-tailed) | 0.238 | 0.003 |

**Correlation: $Y_1X_6$**

$H_0$: $\rho_{Y1X6} = 0$

$H_1$: $\rho_{Y1X6} > 0$

The correlation coefficient for $Y_1X_6$ is small at 0.182, and statistically not significant at 0.238. The null hypothesis is not rejected.

**Correlation: $Y_2X_6$**

$H_0$: $\rho_{Y2X6} = 0$

$H_1$: $\rho_{Y2\ X6} > 0$

The correlation coefficient for $Y_2X_6$ is moderate to large at 0.443, and statistically highly significant at 0.003. The null hypothesis is rejected.

*Professional trust* plays a moderate role in reaching productivity quicker, but not in smoothing the norming phase.

### *$X_7$ - A sense of "belonging".*

| Independent variable. | Dependent variable | $Y_1$ | $Y_2$ |
|---|---|---|---|
| X7 Belonging | Correlation Coefficient | 0.415 | 0.667 |
| | Sig. (2-tailed) | 0.005 | 0.000 |

**Correlation: $Y_1X_7$**

$H_0$: $\rho_{Y1X7} = 0$

$H_1$: $\rho_{Y1X7} > 0$

The correlation coefficient for $Y_1X_7$ is moderate at 0.415, and statistically highly significant at 0.005.

The null hypothesis is rejected.

**Correlation: $Y_2X_7$**

$H_0$: $\rho_{Y2X7} = 0$

H1: $\rho_{Y2\ X7} > 0$

The correlation coefficient for $Y_2X_7$ is large at 0.667, and statistically highly significant at 0.000. The null hypothesis is rejected.

A *sense of belonging* clearly plays a role in both phases, but again it manifests stronger in the productive phase than in the norming phase.

This is the independent variable with the strongest correlation to both the norming phase and the productive phase.

### 4.4.3 Relationships between the independent variables

The following table indicates the top 12 relationships between the independent variables used in this study, ranked according to the Pearson correlation coefficient and 2-tailed significance levels.

**Table 8 Relationship between independent variables**

| | Relationship between independent variables | Correlation | Signifi-cance |
|---|---|---|---|
| 1 | Similar approach / practices and a sense of belonging | 0.782 | 0.000 |
| 2 | Terminology and a sense of belonging | 0.777 | 0.000 |
| 3 | Terminology and similar practices | 0.668 | 0.000 |
| 4 | Peer recognition and professional trust | 0.603 | 0.000 |
| 5 | Peer recognition and belonging | 0.590 | 0.000 |
| 6 | Similar approaches / practices and similar standards | 0.586 | 0.000 |
| 7 | Similar standards and trust | 0.568 | 0.000 |
| 8 | Terminology and similar standards | 0.567 | 0.000 |
| 9 | Similar standards and a sense of belonging | 0.565 | 0.000 |
| 10 | Terminology and peer recognition | 0.523 | 0.000 |
| 11 | A sense of belonging and trust | 0.522 | 0.000 |
| 12 | Terminology and trust | 0.507 | 0.000 |

The effect size (ES) as defined by Cohen (1988) is large for all twelve of the relationships in the table, and all of them are statistically highly significant.

It is valuable to note how strong the “hard” factors such as practices and terminology are correlated with the “soft” factors such as sense of belonging. Both peer recognition and trust show strong and highly significant correlations with the other independent variables in this table. However, trust seems to have a low impact on both the norming phase and the productive phase. The impact of peer recognition is statistically not significant for either of the two phases.

That raises a question about the dynamics between the independent variables. It raises a second question whether the issues of trust and peer recognition are consciously perceived by the researchers as important factors or not. Perhaps it only manifests and start to register when linked to the harder issues such as standards, practices and terminology. Suh, Sohn & Kwak (2004) commented on the fact that the scientists working in R&D organisations are typically highly-educated and talented people, mostly of an engineering or science background, and they tend to focus on hard facts rather than softer relational issues.

## 4.5 Summary of survey results

Without exception, all the independent variables have a stronger impact on reaching the productive phase quicker, than on smoothing the norming phase (dependent variables).

**Table 9 Impact on Norming and Productive phases**

| The independent variables that do impact statistically significant on the **Norming phase** ($Y_1$) in order of impact is: | The independent variables that do impact statistically significant on the **Productive phase** ($Y_2$) in order of impact is: |
|---|---|
| 1. Belonging<br>2. Similar approaches and practices<br>3. Similar terminology | 1. Belonging<br>2. Similar standards<br>3. Similar approaches and practices<br>4. Similar terminology<br>5. Trust<br>6. Similar ethics |

In the literature and interviews trust was often highlighted as a crucial factor and a prerequisite to working together successfully. However, it seems that in the case of this survey the trust level experienced by the team members vary a lot, and are much lower than one would expect.

Peer recognition is highlighted in the literature in a similar way, being touted as one of the main ingredients of “social control” mechanisms both in informal social networks, and in formal places of work / teams. Yet these results rate the impact of peer recognition on team development processes low.

However, when one looks at the relationships between these independent variables, there are significant correlations between the hard factors, such as work practices, and the soft factors of trust, peer recognition and belonging.

Most of the sciences and professional disciplines have socialisation built into their programmes. The socialisation is even more refined as a person starts specialising and joining specific professional institutions and networks like CoPs. As discussed earlier, the social-intelligent view of personality begins with an assumption that social behaviour is intelligent – that it is mediated by cognitive processes of perception, memory, reasoning, and problem-solving. It would seem that in this case of fact oriented researchers it is the strength of the cognitive similarities that determines the extent of trust, recognition and sense of belonging experienced.

This is supported to a certain extent by the description of Nahapiet and Ghoshal (1998) of social capital in terms of three primary dimensions:

- Individuals must perceive themselves to be part of a network (the structural dimension).
- A sense of trust must be developed across these connections (one aspect of the relational dimension).
- The members of the network must have a common interest or share a common understanding of issues facing the organisation (cognitive dimension).

Looking at the characteristics of CoPs one can distinguish cognitive elements (level of training, experience, language, etc) as well as social (for example socialisation in terms of accepted norms, ethics, work values) and emotional elements (such as support, acceptance, and belonging) in the relationship of both CoPs and teams. But in this case the cognitive dimension (hard issues) seems to be the foundation on which the social and emotional elements rest.

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# Chapter 5 Interviews: Results and discussion

The interviews gave valuable insights into the current approaches towards managing knowledge, knowledge sharing, IP issues and the management of networking and collaborations.

## 5.1. Introduction

National and international executives from various companies or institutions that are involved in inter-firm collaborations were interviewed. The purpose with these interviews was twofold:

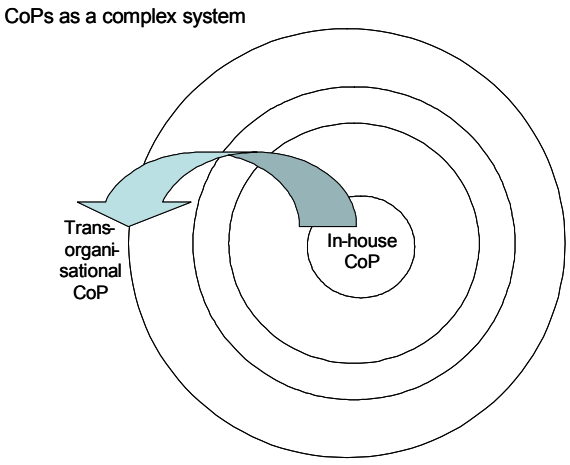
- To get strategic insights and practical inputs on the management of knowledge workers that are members of COPS outside the company, and contextual information about collaboration;
- To gain links and access to inter-firm collaborative team members.

The information gained from these interviews is discussed below.

## 5.2 Conceptual views of CoPs

In an interview with Gorjestani (2004), Chief learning & Knowledge Officer, Africa Region of the World Bank, he shared some conceptual views on CoPs based on material he and Yannakou (2004) co-wrote. According to them a CoP can be viewed as a complex system.

When applying the principles of complex systems to CoPs, it becomes clear that the progression from an in-house CoP to a trans-organisational CoP is not linear. It is rather a (quantum) leap from the one to the other, as illustrated in the following diagram.




*Gorjestani & Yannakou (2004)*

**Diagram 7: CoPs as complex systems**

One of the practical questions raised by Gorjestani and Yannakou was asking why the Global Research Alliance (GRA) as a trans-organisational CoP, is adding more value than for instance an in-house CoP in the South African Council for Scientific and Industrial Research (CSIR), or the CSIR as a whole for that matter? Another question raised deals with the new requirements in terms of (organisational / cooperative) structures; and the roles in CoPs.

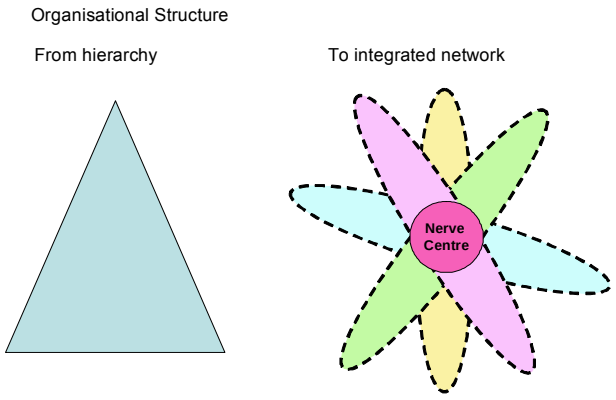
Gorjestani & Yannakou (2004) suggest that:

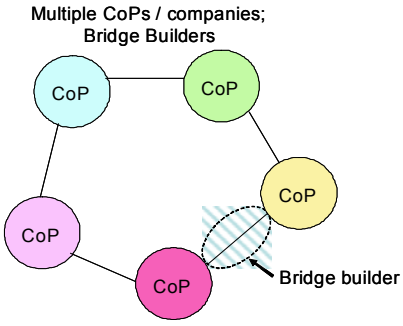
- An individual can belong to more than one CoP, but perhaps play different roles in each.
- More is known about leaders than *bridge builders*, specifically in CoPs. According to Gorjestani and Yannakou (2004) bridge builders are the critical components / link in a CoP as they are the people that expand the network. They promote expansion and thereby add value.

But that raises new questions.

- What are the characteristics and competencies of bridge builders?
- How does one recognise the bridge builders in the company / CoP?
- How does one motivate and support them?

This problem is manifesting to a certain extent in the Global Research Alliance (GRA), where CoPs gets bogged down because of old hierarchical mindsets and jargon – such as "heads" and "anchors" that stop innovation – rather than a network structure where the CEO forms the "nerve centre", with decision-making at a practical level and in an environment with free flowing information.




*N. Gorjestani & A Yannakou (2004)*

**Diagram 8: Structural differences** **Diagram 9: Bridge builders**

## 5.3 The difference between Communities of Practices (CoPs) and Communities of Interest (CoI)

Paterson (2005, personal interview) shared his view on the difference between CoPs and CoIs.

**Table 10 Communities of Practices (CoPs) and Communities of Interest (CoI)**

| CoP | CoI |
|---|---|
| *Community of Practice* (CoP) has a goal or an object, which is not necessarily clearly stated, but informally acknowledged. For example, a CoP of liver pathologists will most likely have an objective of improving the treatment of liver tumours. | Community of Interest (CoI) has a general area of interest, such as poverty alleviation in Africa. |
| CoPs are not about the discipline base, but rather about applied knowledge, implementation, experience and the solving of problems. Such an environment is much more conducive to innovation, and much more powerful in addressing the key questions and key areas emanating from the focus area of the CoP. | CoI is more about the discipline base and conceptual, academic knowledge. |
| CoPs form around closed (defined) questions, but with open scenarios for solutions. | CoIs form around open questions in a closed scenario. |

Paterson also points out that it is difficult to distinguish between *formalised institutions* and *mono-disciplinary* CoPs. Both impose and optimise established disciplines, maintaining the status quo which is not conducive to innovation.

Most interviewees concur with, and reinforce the findings of the literature study on CoPs as presented in the research proposal:

- The foundation of CoPs is a social process, not an economic one (Rosenthal, 1997; Wolcott, 2002; Linnarson and Werr, 2004).
- In contradiction with line management (which is hierarchical), the nature of peer relationships is social, not power or economical (Kanter, 2001).
- The primary foundations on which CoPs are based are trust, relevance and focus (Sharp, 1997; Wenger, and Snyder, 2000; Iverson & McPhee, 2002).
- The primary motivation and social payback obtained from CoP participation is peer recognition (Wenger and Snyder, 2000; Kanter, 2001; Iverson & McPhee, 2002).

- People do not join a CoP to learn. They join to solve a problem. The learning is almost a 'by-product' of the interaction (Sharp, 1997; McDermott, 2001).

## 5.4 Management and Communities of Practice (CoPs)

According to a number of interviewees the willingness or ability of management to consider CoPs and knowledge exchanges favourably, depends on a number of business and culture related factors, such as:

1. *Risk minimisation* in terms of investment. Knowledge is considered important to compete in today's market place. If the organisation operates in a relative *slow changing industry sector*, the risk tolerance of the organisation will be lower. The organisation will probably prefer *institutionalised* forms of CoPs, or even Communities of Interest (CoI). However, if there is a *high rate of change* in the organisation's environment and marketplace, the organisation would tend to have a higher risk tolerance. In order to gain new knowledge and information fast (and cheap), management would be more open to *social networking* opportunities such as CoPs.
2. *Monetary value*. Knowledge has monetary value. Even if the knowledge has no commercial potential for the company at that moment, it may have commercial potential in the future, or potential to other companies to whom it can be sold or licensed, or can potentially help competitors.
3. Improving the *quality of decision-making*. The social nature of CoPs means that members of the CoP are exposed to a lot of information (often informally) from people working in other companies. This information could include new approaches to processes, Best Practices, new product trends, new equipment trends and performance, and reports about people that are performing exceptionally. This type information can inform and improve the quality of decision-making within the company about resources (human and other), infrastructure planning and expenditure, as well as key investment decisions.
4. *Retaining key personnel*. Smaller companies can enhance the personal fulfilment and work satisfaction of the employees by creating opportunity and space for participating in CoPs. The social networking enhances visibility in the peer community; there are opportunities for knowledge sharing and peer recognition. This should contribute to career stability and a higher retention rate of key personnel.
5. *Industry leader* – company strength. Participation in CoPs or creating space and mandating CoPs can signal the leadership of the company in the industry. The measure of participation and the willingness to share information (excluding

proprietary information) can serve as indicators of the company's strength in the industry.

6. *IP Measures and legislation* – increasingly companies and countries are trying to regulate knowledge exchanges and flows for various reasons, such as protecting IP, preventing fraud, and even terrorism. Over-regulation is starting to impact on the informal business and marketplace communication (grape-vine) which plays a critical role in sussing out the viability of business ideas and timing of ventures.

## 5.5 Strategic Decision matrix

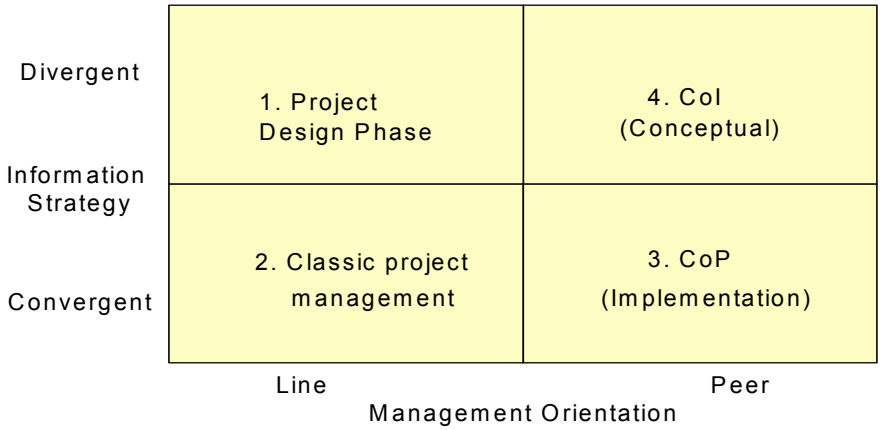
To make a decision on a suitable strategy to follow and resources to use, Paterson (2005, personal interview) recommends that the particular situation / opportunity should be evaluated in terms of the following criteria.

- What is the search strategy to obtain information?
- What am I managing?

The following matrix is based on these two criteria, with each criterion providing two options.

- Convergent information strategy – working towards a common conclusion or result.
- Divergent information strategy – deviate from existing approaches, going in different directions, opportunity for innovation.
- Line management provides control but provides no new knowledge.
- Peer groups provide synergy that can change knowledge and lead to innovation.

The following diagram illustrates the matrix.




*Source: A. Paterson 2005*

**Diagram 10: Decision matrix**

Based on the answers to the questions in terms of the information and management strategies, the following strategic scenarios become apparent.

1. The situation represents a *design phase* where the problem is still being investigated and defined (divergent), line/ project management control is suitable.
2. The situation represents a *classic project team* that has a defined problem and scope (convergent) and the knowledge is stable, line/ project management control is required to meet project schedules, budget and quality requirements.
3. *CoPs* are peer groups, focussed on practical implementation or solution of a problem (convergent).
4. *CoIs* are peer groups that bring divergent information and views to the table and produce conceptual knowledge.

### 5.5.1 Knowledge Strategy

During the interviews it was confirmed that companies have a number of ways to obtain knowledge.

- The company can buy the knowledge (patents, people as specialist resources).
- The company can develop it themselves and sell it. In-house R&D with a purpose to licence or patent the knowledge actually works against CoPs.
- Participate in social relationships like CoPs where knowledge can be acquired. The knowledge shared between peers in CoPs includes intellectual capital, applied and tacit knowledge. However it is shared in an environment of ethics, trust and integrity, with a common understanding of the 'rules' that apply to the use of informally shared information. It is, for example, accepted ethics *not to make notes* during informal gatherings or meetings, as that would be making shared information explicit. It is acceptable to make notes during formal meetings or conferences.
- Large companies can reduce their transaction costs by participating in CoPs. Smaller companies can get the same competitive advantage (knowledge wise) as the large organisations by participating in CoPs and alliances.
- Patent mapping and analysis is a practice that actually works against CoPs and networking. Companies map and analyse the trend and locations of patent developments. They then invest a small mount of money in a relatively isolated laboratory to obtain the research and knowledge – side stepping the main stream.

### 5.5.2 Intellectual Property

A company may be willing to share intellectual property across the value chain of its products to ensure the end product meets minimum quality requirements.

An interesting phenomenon at CoPs is the 'peer bragging', which allows the members to talk about their work prowess. This is social behaviour to gain peer recognition and build a reputation. But, as discussed earlier, this is done in an environment of ethics, trust and integrity, with a common understanding of the 'rules' that apply to the use of informally shared information.

Groups sometimes identify and appoint a person to actively maintain the networking, handle disputes and do gate keeping. The gate keeping to a certain extent prevents duplication or plagiarism, but can also link-up people with similar interests. Publishers of research journals at times play a similar role.

## 5.6 Governance

It is very clear from literature and experience that a CoP cannot be *managed*. CoPs are social peer relationships and networks that exhibit social behaviour characteristics, such as 'belonging' (membership), trust, ethics and peer recognition.

However, a company can mandate and validate participation in CoPs that is aligned with the company or project goals and objectives. Paterson (2005, personal interview) recommends the following approach, which was affirmed and supported by many of the executives interviewed.

1. Managers can be selective about the CoPs that the company formally validate and mandate – many of the interviewees confirmed that this practice was followed in their companies.
2. If the CoP is not in line with the company / project goals, the employees have to attend / participate in their own time – this is also true of most of the companies / institutions interviewed.
3. The company can decide to spend the money, time and space to create a CoP (not necessarily limited to in-house personnel). An example would be where the company start on a new project, and there are no CoPs or networks that have knowledge about the specific issue. The company may decide to organise conferences and workshops to which key knowledgeable people are invited to participate and give input.
    - Although CoPs usually form bottoms-up (workers deciding they want to join a group with similar interests), the company potentially starts a CoP by

creating and *mandating* a space and opportunity. The mandate would set the goal or objective – but what happens in the space cannot be managed.

- The Global Research Alliance (GRA) is attempting to create such a space where diverse countries and scientists can cooperate on joint projects, and potentially form CoPs based on their specific interests.

4. The knowledge that is gained from the CoP can be managed through knowledge management functions.
    - If a person attended a conference, workshop or had other links to the CoP, a 'call' report can be written listing key issues, knowledge, advantages and actionable value gained – common practice in all of the people interviewed.
    - Keeping the manager updated on issues and meetings – also common practice.
    - Manager can accompany employees in high priority cases to conferences to get to know other CoP members, expand own understanding and networking. It is also an opportunity for the manager to evaluate and meet potential new resources.
    - This way the manager should be able to manage the typical money and resources constraints in a logical, productive way.
5. Maturity

    All the interviewees agreed that the maturity of both the CoP members and their managers play an important role.
    - Members cannot contribute or benefit from a peer group such as a CoP if they have not supervised one student at least (Career Stage II or III according to Dalton and Thompson, 1986). They must also be able to communicate and network (which are teachable skills).
    - Managers similarly, need experience to manage knowledge workers, be able to contract and negotiate resources, time and money. This is even more so in a matrix reporting environment of cooperative projects and alliances. The more complex the environment, the more sophisticated the manager required to successful creates a productive and positive work environment. For example, Boeing teaches the managers not to micro-manage, but to let the researchers get on with the job (Whetham, 2005, personal interview).
6. The manager can allow the project team / team leader discretion to nominate additional members based on their CoP experience, as long as there is a

concurrent, clearly defined objective. This is allowed in a number of companies – but again the maturity of the manager is a key factor.

## 5.7 Managing an open alliance

Employees of an organisation will most likely join CoPs to solve a problem. The participation provides motivation and social payback in terms of peer recognition.

Companies can benefit from this social networking relationship in terms of “cheap” knowledge, which can improve decision-making quality within the company, as well as problem solutions.

Without exception the interviewees agreed that a company can only gain these under certain circumstances, for example when

- The relationship (with the CoP) is mandated and supported by the executive management of the company
- The employees involved in the relationship are preferably at a career stage level 3 or higher. A career level of 3 as described by Dalton and Thompson (1986) means this is mentor, champion and integrator that can assume responsibility for others.

However, this does not imply that more junior levels cannot be introduced into CoPs as part of their socialisation processes.

### 5.7.1 Global Research Alliance (GRA)

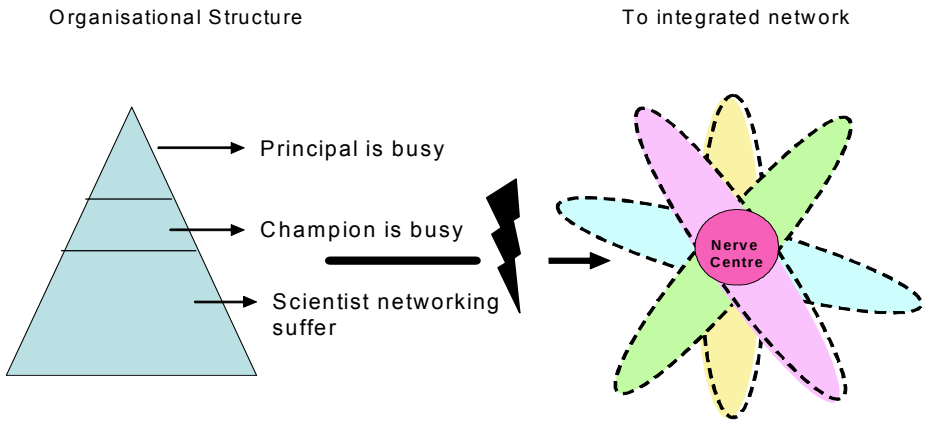
The GRA was formed on a basis of trust between eight Knowledge Intensive Technology Organisations (KITOs) spread across the world. Current membership includes organisations in Australia, Malaysia, India, the Netherlands, Finland, Germany, the United States of America and South Africa. This group represents a large body of scientists and considerable experience and competence able to provide innovative solutions to global problems (http://www.gra.org).

Because the Alliance is mandated and supported by the executive management of the various partners, it is providing a forum and network opportunity where companies and scientists can meet, exchange ideas, and submit proposals for projects from a strong, diverse base of skills and competencies. As such it provides a ’breeding ground’ for CoPs as scientists interact on the various key focus areas and the related projects.

As a relative new venture still going through a growth curve, GRA is experiencing challenges which require unique solutions because of the voluntary participation base. One example is the problem of time constraints and focus of principals and champions – they are all senior people with busy schedules. Alliance issues do not always get the

attention required. This impact on the scientists actually involved in the activities and projects.

The following diagram attempts to illustrate these problems.




*Adapted from A Yannakou & N Gorjestani 2004*

**Diagram 11: Time and structure constraints facing GRA**

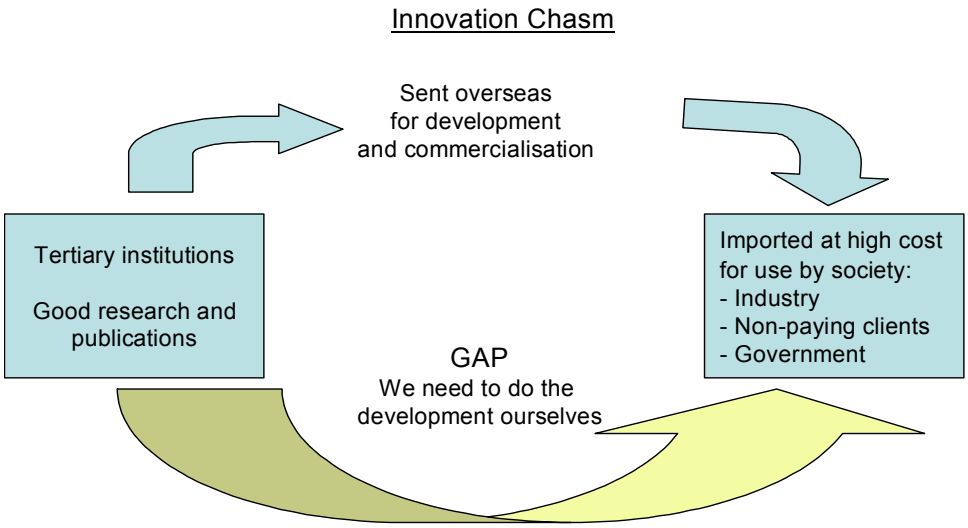
Another problem facing the Alliance involves the structure and management approach for an institution consisting of voluntary, international participants. The Alliance has a flat open structure, with a nerve centre for coordination and administrative purposes (situated at the CSIR, Pretoria). The only other structure feature is the principals and champions representing the partners. However, the participants come from hierarchical structured companies and often fall into the trap of using the hierarchical terms (and implicitly, the concepts) in the open network structure of the Alliance. That mind jump required to optimally establish and utilise essentially a social network environment, remains an insidious problem (Biesenbach, 2005, personal interview).

The third problem facing the GRA is financial – it is quiet a challenge to prove viability and motivate the companies / institutions providing the resources, and to obtain funding for projects (Adams, 2005, personal interview). The formal process of reporting to the various organisational stakeholders, motivating the ongoing input and resources required, and trying to determine who will provide what, is putting a strain on the informal network.

The problems of accommodating a social network from a hierarchical base mirror the problems identified in the literature on companies trying to form CoPs. Companies trying to establish CoPs (social networks) fail if they fall into the trap of trying to manage the CoPs in the same way teams or business units are managed (Brown & Duguid, 1991; Wenger and Snyder, 2000; Swan, *et al.,* 2002; Schwen & Hara, 2003).

## 5.8 Innovation gap in South Africa

In a personal interview Dr Phil Mjuwara (2004) described an innovation gap that South Africa is currently experiencing. On the one hand the tertiary and research institutions produce good research and publications. However, some of the research outputs do not get developed and commercialised in South Africa. Instead it is sent overseas for the development and commercialisation process, after which it is imported back at considerable cost to the consumers.




*Source: P. Mjuwara (2004)*

**Diagram 12: Innovation gap**

Both the cost factor and the need for South Africa to build capacity and create jobs, indicate the need to address this gap by doing some of the development and innovation in South Africa.

Various bodies and institutions in South Africa are attempting to address the innovation chasm. Examples of bodies and institutions are the South African Research and Innovation Association (SARIMA), CSIR, Department of Science and Technology, as well universities, industry and technikons. In order to do this effectively, all these groups need to work together synergistically.

South Africa is not the only country trying to build capacity this way. Australia has similar collaborative projects involving the Australian CSIRO, various universities and commercial companies (Pik, 2005 , personal interview).

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# Chapter 6 Discussion: R&D strategic management

It is clear from the interviews and the literature that R&D management in this new era of knowledge and knowledge workers has become a critical value adding function. The management of R&D differs from the management of other business units within an organisation. The current environment where knowledge has become so important, the need to successfully manage the knowledge workers and R&D function has become even more important.

This chapter reviews the literature regarding R&D strategy and management, and compare it to the information gained from the interviews.

## 6.1 Evolution of R&D

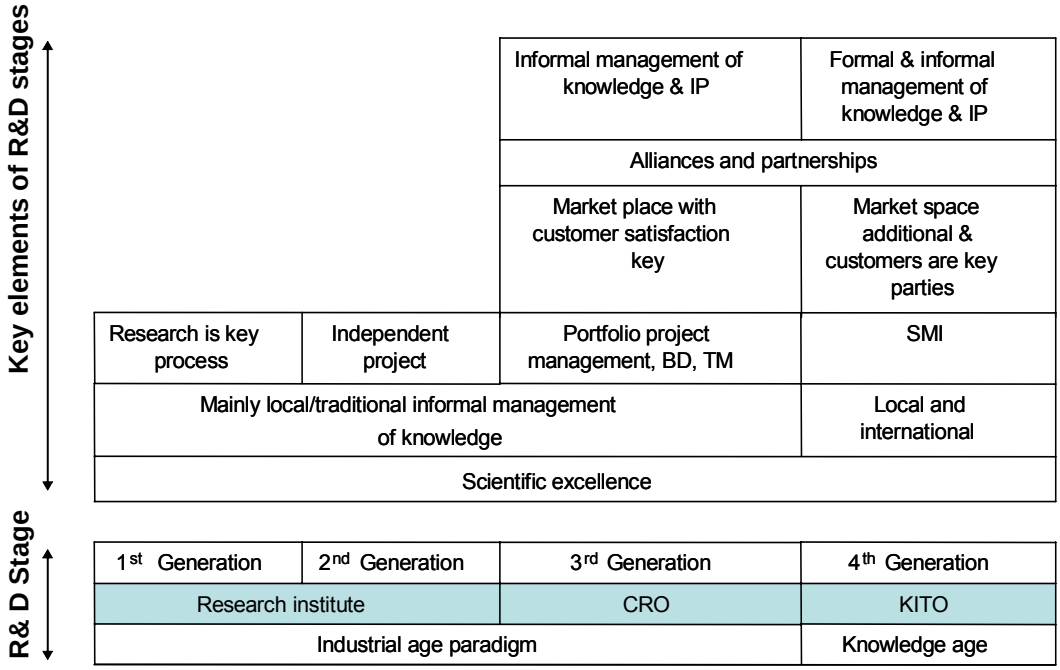
Just as organisations developed over time, so did the R&D approach and management evolve over time. The following table describes key elements of 1st to 3rd generation R&D that is still to a large extent the norm in companies.

**Table 11 R&D development**

| Issue | 1st generation | 2nd generation | 3rd generation |
|---|---|---|---|
| Strategy | None; informal | Partial; project based | Holistic; integrated with the business |
| Structure | Silos; cost centres; disciplines | Project based; supplier-customer relationships with business units | Partnership with the business units; integrated |
| Position of R&D and funding | Line item; fund what can afford | Funds based on need; risk sharing between R&D and funders | Varies with technological maturity, and competitive impact |
| Measuring and evaluating results | Periodic, informal | Project based | Against business objectives, technological expectations |

*Roussel, Said & Ericson (1991)*

It would seem that the majority of companies still have R&D approaches somewhere between the first and third generation R&D. However, some R&D organisations have evolved to the latest 4th generation R&D to cope with the knowledge and information requirements, as indicated in the following diagram.




*Yannakou, K., 2005*

**Diagram 13: Evolution of R&D**

The 4th generation R&D reflects the transition to new ways of doing business in the knowledge based economy, and includes elements such as innovation, knowledge management and IP, strategic partnerships, management of knowledge workers, intellectual capital, and a sharing and collaborative culture.

## 6.2 Innovation networks

According to Fowles and Clark (2005: 46) companies are increasingly establishing innovation networks. These innovation networks can consist of offshore suppliers, distributors, customers, freelance scientists, government and university researchers and even competitors. For many firms, this means that some of the R&D role is performed offshore. For example, more than 100 global companies including GE, IBM and Intel have established R&D centers in India during the past five years, and more are in the works. Boeing is co-developing navigation software with offshore technology providers in India. The Eli Lilly subsidiary InnoCentive is working with a number of major pharmaceutical firms to find scientists in Asia, Russia, and the EU with solutions that can reduce the high cost and time it takes to bring new drugs to market (Fowles and Clark, 2005).

Fowles and Clark (2005) quote P&G executives who rebranded the company's R&D centers as C&D centers, for ''connect and develop,'' to drive its internal mindset and culture toward looking outward for innovative thinking. Their aim is to capitalise on the ''99 percent of research and ideas occurring outside its four walls.''

Fowles and Clark (2005: 46-7) quotes Nokia's Chief Technology Officer Pertti Korhonen in a recent interview with Business Week, that given the complexities of today's technologies and supply chains, ''*nobody can master it all."* Pertti Korhonen explained: ''*You have to figure out what is core and what is context."* When no single company can afford to take on the full technical risk of a massive development project, players within an industry can come together to share the risk.

The current trends in knowledge sharing and collaboration encountered during this research are reflected in the following diagram which presents a continuum of approaches.

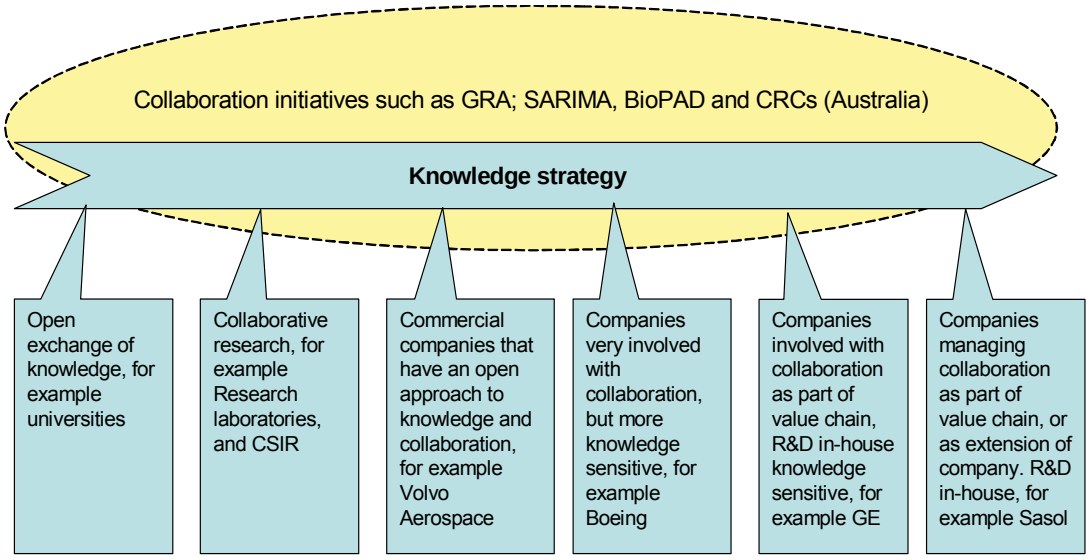



**Diagram 14: Knowledge strategy continuum**

The continuum ranges from free flowing information in forums promoting collaborating and capacity building, such as the GRA and SARIMA; to universities and research institutions such as the CSIR; to companies that engage extensively in collaborative projects, for instance Volvo Aerospace. Large and complex companies such as GE have the capacity to keep their R&D in-house and outsource or collaborate only on value chain level. Even so GE still invests time and effort in scanning critical areas of technology outside the organisation that may impact on the company.

## 6.3 Innovation capacity

Szeto (2000) describes innovation capacity as a continuous improvement of the overall capability of organisations to generate innovation for developing new products to meet market needs. The capacity can be incrementally or radically increased by participation in activities that triggers the supply of innovation resources. An interactive environment in the organisation facilitates the conversion of the resources into the knowledge base of the organisation. Inter-organisational networks create an environment for the interaction and activities such as joint projects, collaborations or alliances for a specific R&D item and may benefit the participants in various degrees.

## 6.4 Knowledge Management (KM) and Human Resources Management (HRM)

A literature study done by Oltra (2005: 71) shows that in today's global, dynamic and complex business environment, both knowledge and human resources (HR) are being increasingly regarded as key levers of competitive advantage. The literature study also shows that in the context of knowledge work, people and knowledge are two concepts inextricably joined. Individual human beings are the ultimate knowledge creators and bearers (organisations do not think by themselves, although they may have ''knowledge enabling'' contexts and ''memory'' systems). Accordingly, organisations should take great care to increase their capability as organisational knowledge enhancers. In this way the strategic management of people can act as a trigger toward effective knowledge-leveraging processes. Oltra's (2005: 71) literature study indicates that both people and knowledge are to be regarded as having special potential as scarce and idiosyncratic resources, consistent with the premises of the resource-based approach to strategic management.

Many KM approaches has been too narrowly focused on information technology (IT). However, the key obstacles being reported as knowledge-leveraging inhibitors – beyond IT tools – are invariably those related to the ''softer'', non-technical side of KM. The key importance of cultural and human aspects as potential levers or inhibitors of the processes of knowledge creation and transfer is widely acknowledged in literature, but often neglected (Oltra, 2005:70).

Oltra (2005: 71) goes on to say that Strategic HRM deserves an explicit consideration in the people-centred KM debate. The integration between KM initiatives and cultural and people-related issues is not always as successful in business practice as anticipated. In other words, although managers are usually keen to recognise the relevance of human and social issues for KM initiatives to succeed, a number of

structural, organisation-embedded elements (e.g. rigid structures, ‘‘old-fashioned’’ cultural traditions, KM-unfriendly policies and routines, communication pitfalls) create obstacles to the KM efforts which are quite difficult to overcome – even despite initial managerial commitment to do so.

During some of the interviews, KM practices were described as time consuming without providing value (*what is in it for me*). Similarly some HR policies and approaches which may be suitable for other organisational units were seen as not accommodating the needs of R&D employees.

## 6.5 Risk management in R&D

Companies operating in research-intensive industries increasingly follow an “outward-looking”, collaborative research and technology development strategy. However, research collaboration always carries risks. The risk of sensitive information leakage is an ever present concern, whether by purposeful betrayal or accidental disclosure. According to Hoecht (2004: 218), traditional legal and bureaucratic control mechanisms are not able to deal with this problem adequately and that the more “outward-looking” the research strategy that a company follows, the more it has to rely on social control mechanisms such as reputational concerns of key researchers and the incremental development of higher levels of trust among individuals.

While innovation networks continue to propagate as a way to help companies reduce technological and commercial risk, a new concern has emerged. With more companies working across corporate boundaries, protecting intellectual property is becoming a much bigger issue. In the US alone, studies suggest that the theft of intellectual property costs companies about $300 billion a year (Fowles and Clark, 2005: 47).

But fears about losing intellectual property are not a good reason to avoid participating in innovation networks. Rather, it is imperative to reduce the risk inherent in such a network by effectively managing the partner relationships.

### 6.5.1 R&D network configuration

A number of companies interviewed follow a “hub-and-spoke” approach to benefit from the knowledge and technology available outside the organisation. This is similar to the “star” networking configuration, as described by Szeto (2000: 154-5).

The network contacts on a one-to-one basis in each period of cooperation so that the innovation data for that particular part of the project need only be secured between the company and one other party.

Most companies establish various collaborations with different institutes at one time, which require careful management to ensure that the innovation value and information

is coordinated and accessible to all the stakeholders.

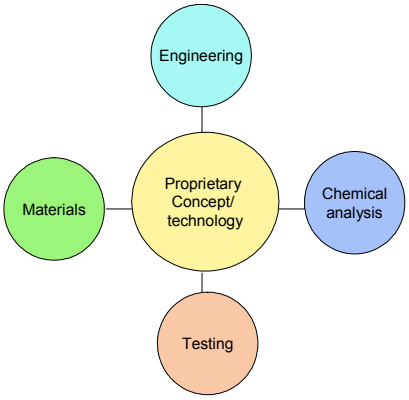



**Diagram 15: The Star or Hub-and Spoke concept - example**

This means that that the company is the only party with the “big picture”. The other parties only get to see a part, which contains the risk incurred.

### 6.5.2 Risk management and knowledge sharing

Most companies interviewed use contracts, confidentiality and non-disclosure agreements as is common in the knowledge and R&D environment. Companies also tend to follow an approach of collaborating and sharing information and knowledge fairly widely while the research is still on a non-sensitive level and increasingly restricting access as development progresses. What the individual companies do with the information gained from the collaborative research will become their intangible competitive advantage.

The following diagram depicts such an approach managing the risk of knowledge sharing and intellectual property (IP).

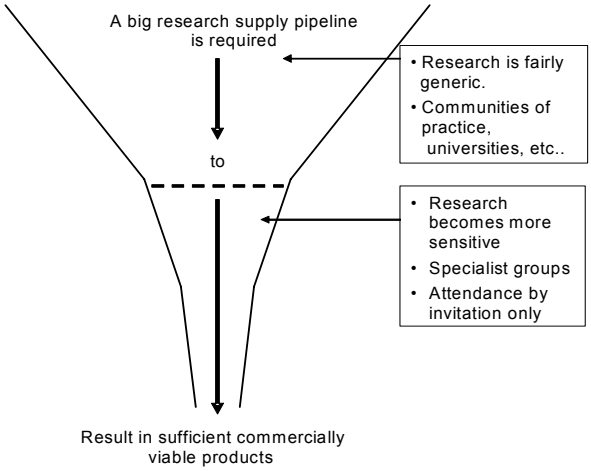



**Diagram 16: Risk management**

### 6.5.3 Value-chain collaborations

Some companies also form integrated production collaborations with other partners as part of the value-chain. The following diagram shows an example of collaboration between the contracting company and other partners both upstream and downstream in the production process.

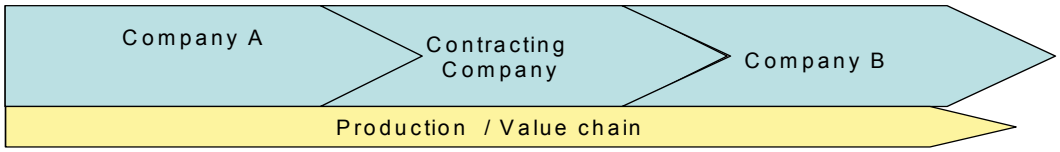



**Diagram 17: Example of an integrated production chain**

In such cases, the partners engage in carefully negotiated contracts, confidentiality and non-disclosure agreements, to ensure a win-win relationship for all concerned.

## 6.6 R&D Strategy

Usually the R&D strategy of a firm will be determined by a number of factors, including its resource and market position as well as its vision regarding innovation. Together with the firm's internal capacities and external collaborations it has a choice between a number of strategies. Hoecht (2004: 223) defines three types of strategies - the firm may

- Be able to rely on internal R&D and technology literature scanning with its own manpower (an introspective strategy).
- Opt for a complementary acquisitive strategy and purchase technology or hire expert staff, or may concentrate on a dyadic cooperative strategy (joint venture, cooperative projects).
- Choose to risk being involved in research networks (extrovert strategy).

This supports the strategies for acquiring knowledge as explained in detail during the interviews.

According to Hoecht the reliance on predominantly inward-looking strategies will only be suitable for firms operating in mature industries with incremental technology development, while "knowledge-intensive" industries will call for a considerable degree of openness with a higher exposure to the risk of information leakage.

## 6.7 Types of management control

The literature on management control in organisations was originally concerned with the optimisation of top-down control. Bureaucratic and output-based management

control systems are not well suited for organisations that depend on a high degree of employee involvement. Where organisations depend heavily on the skills, knowledge and professional commitment of their employees, some degree of delegated management control will be required (Hoecht, 2004: 220).

In the R&D departments at least, some form of delegated rather than bureaucratic control system will be required in order not to stifle the creativity of the researchers and to allow the (in-house) exchange of information and ideas without which science cannot work effectively (Hoecht, 2004: 220).

Research managers need to have trust in the professional competence of their staff and in their willingness to abide by their employment contracts. Monitoring is aided by the practice that researchers normally work in groups of peers (Latour and Woolgar, 1979 in Hoecht, 2004) and physically work within the spatial boundaries of their organisation. Even in this hybrid form of bureaucratic-delegated management control, it is quite obvious that direct supervision and control will not work without some degree of "social control" (Liebeskind and Oliver, 1998 in Hoecht, 2004).

During the interviews a limited number of companies mentioned that they trained their researchers on how to ensure that sensitive information is not leaked, and how to desensitise information before sharing it. A number of interviewees referred to social ethics and understanding in CoPs, where peer control limits information abuse and poaching to a certain extent.

However, other interviewees were adamant that the value of knowledge is such that it needs to be protected by measures that prohibit any sharing until patents were lodged or licenses have been allocated. These IP issues together with practices such as patent mining, strict financial governance regulations, and even anti-trust laws are impacting negatively on CoPs, the sharing of information, and on the business grapevine that provided a source of informal information and feedback used to inform and improve decision-making in the marketplace.

## 6.8 Trust

Trust can be produced in three different ways (Zucker, 1986 in Hoecht, 2004). Trust can be:

- *Process-based*, where trust is tied to past or expected exchange, such as reputation or information exchange;
- *Characteristic-based*, where trust is tied to a person, depending on characteristics such as family background or ethnicity; and

- *Institutional-based*, where trust is tied to formal structures, depending on individual or firm-specific attributes.

The sources of trust production are not mutually exclusive and often work in conjunction. It is practised and exercised between individuals. Trust is a personal judgment and carries an emotional as well as cognitive dimension, even if its object is a system (money, the market) or an institution (the legal profession, the health service).

Hoecht (2004) remarked on the lack of trust internally between researchers. According to him trust within research-oriented organisations is at least as important as trust outside research collaboration. While the risk of information leakage appeared to be satisfactorily contained with the help of a delegated managerial control approach, a noticeable lack of trust among the researchers within the organisation could have long-term negative effects on its research capability. The issue of distrust between researchers within the same organisation, as well as on teams, was encountered both during the interviews and the survey.

In the case study done by Hoecht (2004: 232), legal control instruments such as detailed contracts were considered as normal "rules of the game" by the people involved, and were not relaxed even if the parties had a long cooperation history. In research collaboration with external consultants, lock out clauses and secrecy agreements were not waived even at the most advanced stages of trust-based research collaboration. It appears that all parties accept these rules as being part of their professionalism.

The presence of legal control therefore, does not undermine the mutual trust developed between the parties involved, particularly as there is an awareness of legal control's limited effectiveness.

## 6.9 R&D environment

The scientists working in R&D organisations are typically highly-educated and talented people, mostly of an engineering or science background. They tend to avoid low value creating activities and usually aspire to the pursuit of their own research objectives.

It is therefore essential to consider the task characteristics of R&D organisations. According to Suh *et al*. (2004) strategic activities and tasks of an R&D organisation are typically performed on a project basis. R&D projects are inherently future oriented and commonly require a high level of creativity. Because of the high uncertainty typically associated with R&D projects, changes in anticipated processes and/or methodologies are often needed, and which lead to informal communication. Organisational systems

such as HR and KM systems must remain flexible and autonomous enough to take account of this.

## 6.10 Organisational culture

As companies focus on new ideas adopted from a variety of sources, they value people who are willing to challenge the status quo and have the determination to stick with a good idea in the face of opposition. Participating in an innovation network opens the door to a cultural revolution. Fostering collaboration when valuable intellectual property is at stake should be top management priority, but it requires fine-tuning the corporate approach. Successful innovation networks rely more on trust than process, and this can take years to develop. Freely sharing ideas and information, however, can expedite the process (Fowles and Clark, 2005: 49-50).

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# Chapter 7 Recommendations and Conclusion

This study highlighted the fact that research collaborations cuts across the whole spectrum of business and management areas - from strategy, across legal issues, finance, strategic human resource management, R&D management and innovation, knowledge management, organisational values and culture, and many more. The information from the interviews and the survey provided valuable insights on inter-firm collaborative teams, both on a conceptual level and on a practical level.

At the core of research and collaborations are people working on projects and in teams. These people are increasingly under pressure to produce new ideas, new services and new products, with seemingly little regard as to the well documented requirements for innovation, such as opportunities to exchange information and informal networking. Time pressure often keeps them from interacting in CoPs, while contracts and IP measures prohibit them to freely interact with peers.

In this environment where knowledge is seen as having monetary value, CoPs presents a dilemma, as they are among the most important structures of any organisation where thinking matters, but they almost inevitably undermine its formal structures and strictures (Stewart, 1996, in Quintas and Ray, 2002).

IP issues and transaction cost theory may be regarded as important, but both lead to a focus on value *appropriation*, whereas the knowledge-based approach leads to a focus on value *creation*. IP protection and transaction costs theory also underplays the importance of sociological processes in the creation of new knowledge.

Some of the comments from the surveys may be an indication of self-perpetuating groups where team members from a previous project form a team or nominate members to a team, based on previous experience and / or disposition-behaviour relationship compatibility (Cooper and Schindler, 1998). If this tendency increases, it increases the risk of stagnating and being caught up in mindsets that are too similar and “group-think”. These phenomena are an inherent danger to both groups and CoPs, and do not create an environment conducive to innovative thinking.

Time pressure, IP and transaction cost issues, as well as the tendency to team up with specific people, may result in clique forming where there is a high degree of overlap between contacts. Clique forming is an illustration of a highly constrained network, and not optimal for knowledge creation.

## 7.1 Strategy and Management

Wolcott (2002: 237) cautions that any serious approach to strategy should recognise that no single perspective can provide a comprehensive solution. Network strategy can only be understood by considering strategy at the individual firm level as well. Similarly,

> "*no comprehensive approach to strategy at the firm level can succeed without seriously considering the networks in which a firm operates, as well as the individuals who constitutes individual firms*" (Wolcott, 2002: 237).

The literature study showed clearly that companies in fast moving knowledge industries can benefit from allowing their employees to participate in social networks (CoPs). The economical and strategic benefits for organisations of obtaining knowledge this way, was confirmed by a number of the interviewees.

The interviews highlighted a number of other issues in this regard as well

- The company will only gain and benefit from its employees association with CoPs, if this relationship is mandated and supported by management.
- The company can go further and be strategically proactive to gain and benefit from association with CoPs. This can be done by physically creating space and opportunity for CoPs to form. GRA and SARIMA are example of such funded and mandated opportunities.

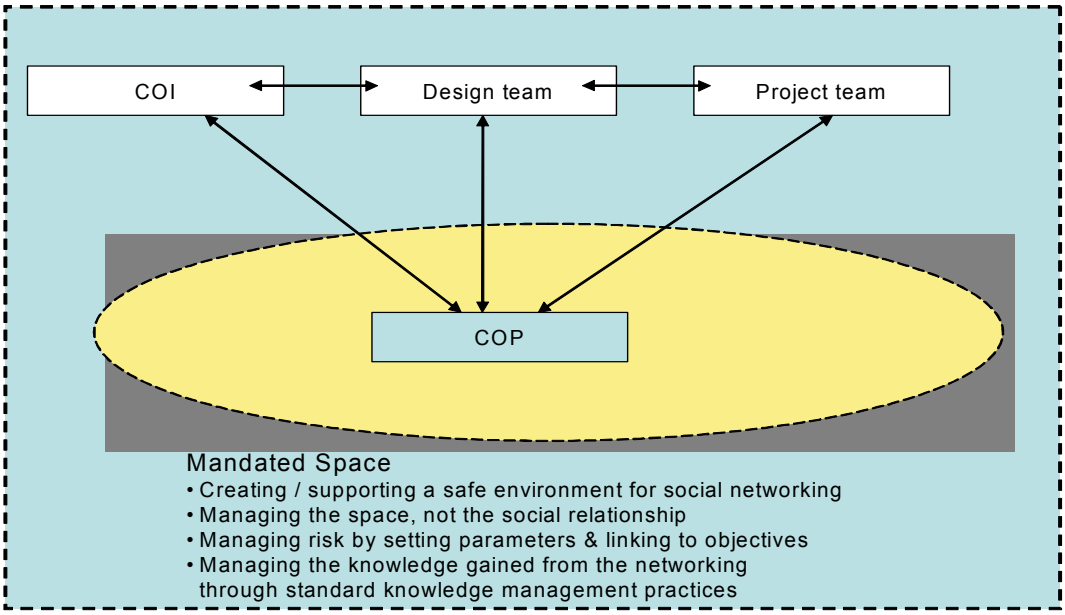


**Diagram 18: Mandated spaces**

COI as well as organisations through project and design teams can all benefit from the extended and applied knowledge and experiences gained in such CoPs.

- The social relationship can be managed by using practical measures such as linking participation to specific project / company related goals and objectives.
- The benefit accrued from the association (knowledge) can be managed using fairly standard knowledge management practices and procedures.

Without the mandated space and support employees may still participate in CoPs privately, but

- The knowledge and benefits will remain tacit knowledge, with no benefit to the firm.
- Management will not have the opportunity to monitor and manage potential risk.

The decision to allow employees to participate in CoPs (or to create space for a CoP to form) is not, and should not be, a lone standing, ad hoc impulse or event. It must be part of a well thought out strategic approach to deal the knowledge and flexibility requirements of a competitive environment. Every firm should have a 'toolbox' of options available to choose from when faced with different situations and their requirements.

The following diagram maps a strategic planning process which can assist management in deciding on specific strategies to be followed for various ventures.

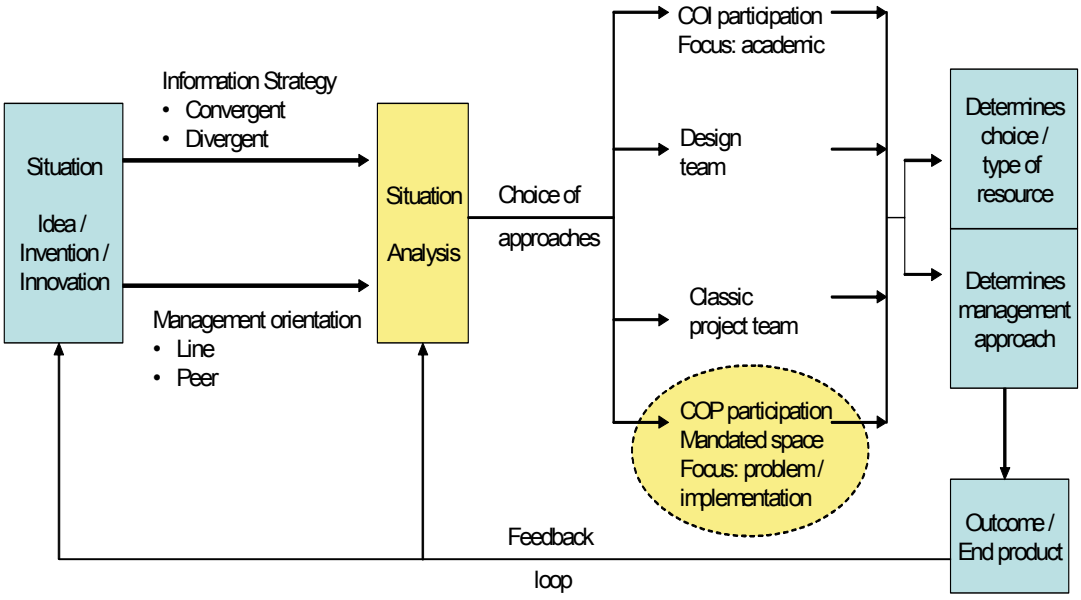


**Diagram 19: Strategic Decision Process**

The strategies chosen should be support by appropriated SHRM processes, policies and systems.

It is important that organisations do not construct narrow visions to focus on hierarchies and contracts, as is the danger currently in terms of IP. Wolcott (2002: 238) points out that a narrowly constructed approach handicaps the organisation's ability to consider alliances and cooperative projects in new ways.

> "*Many issues change as control moves across such a dimension from firm to market governance; in particular, the intermediate space between complete firm control and contractual market relationships presents rich, unique conditions*." (Wolcott, 2002: 238)

Although network strategy deals beyond the boundaries of individual firms, ultimately individual firms still form the basic unit of market competition. Therefore firms should plan strategically and pro-actively on how they wish to deal with the risks involved in information sharing within R&D and the various projects. The particular approach chosen in each case will be indicative of appropriate risk measures to be used to cope with the risks. There are a range of such measures that can assist in this regard, as illustrated by examples earlier in this document.

## 7.2 Inter-firm collaborative teams

The results from the survey prove that membership to the same or similar CoPs have a positive impact on the team development processes in inter-firm collaborative teams. A larger sample should clarify the dynamics between the various variables further, but the impact focus (on the productive stage, more than the norming) will most likely stay the same.

The survey in particular has indicated that similar standards, practices, terminology, ethics, standards, peer recognition, trust and a sense of belonging have more of an impact on the productive phase of team forming, than on the norming phase. The hard factors such as terminology, standards and similar practices have a strong correlation with the softer factors such as a sense of belonging and trust.

As mentioned earlier in this document, most of the sciences and professional disciplines have socialisation built into their programmes. The information from this study should inform both the socialisation processes in the academic institutions as part of the education of professionals, and in the firm in terms of organisational approaches to R&D, information sharing and development of the researchers. The socialisation process should sensitise the researchers regarding the existence and

relevance of social, emotional and cognitive intelligence within social networks. The process should indicate how researchers can benefit professionally on all three levels from these interactions, without compromising the firm or it's IP.

## 7.3 Culture

The ideal organisational culture in the knowledge economy is one of innovation and quality - not just for the R&D function, but for the whole company. Management and employees should see the total organisation as being important. By implication this means that company values should be based on respect and trust. Individual competence, sharing, networking, team work and a customer focus should be valued qualities within the organisation.

Organisations interested in promoting knowledge and innovation should be tolerant of risk and failure, which must be linked with learning and continuous improvement; clear accountability at individual, team, and organisational levels. Although these issues seem obvious, in many cases the stated goals and strategies of companies are in direct contrast with the actual culture, practices and policies on the floor.

Minimum acceptable levels rather than rules should be set. This approach allows space for innovation while still controlling key performance indicators. Communication flows up, down, and lateral should be open in contrast to the silo approaches that are still prevalent in many firms.

The organisation should be open to collaboration, but respecting confidentiality. Training of both managers and scientists can ease working relationships and address the inherent risk in knowledge sharing without using draconian control measures that stifle innovation (Yannakou, 2005, personal interview; *World Association of Industrial and Technological Research Organisations, 1999; 2002*).

## 7.4 Systems and processes

R&D has innovation as a core process, which can be described as the process of developing ideas that can be applied either in the form of products or services for the competitive and financial benefit of the business. The support of R&D processes include the management and alignment of projects, supported by relevant reward and recognition approaches and systems, IP and intellectual capital development, research, knowledge management, people development, strategy development, technology transfer, marketing and customer management. All of these systems and processes should flow from an informed and integrated strategic level organisational approach towards knowledge sharing and acquisition.

The processes must be integrated, supportive towards the innovation process and the researchers using it; aligned with R&D objectives, and non-intrusive, with IT-based support systems. Processes must be benchmarked, evaluated and monitored, and continuously improved to in order to remain relevant, and ensure flexibility.

## 7.5 Additional research questions

The information gained through this study gives very practical insights into the strategy and management approaches of R&D teams and collaborative inter-firm teams.

Both the survey and the interviews raised a number of additional questions that provide scope for follow-on research. On a strategic level for example, there is the question about the impact of the anti-trust laws, financial governance measures and IP control measures on CoPs and innovation. The legislation and IP measures are in some instances actually impacting negatively on social networks and the informal support and information exchanges found in CoPs, which are so important for innovation. In the long run these impediments may prove to be counterproductive to the dynamic processes of business and to the quality and quantity of new knowledge being generated.

On a team level there are questions about the factors that impact on team development. The valuable correlation patterns and dynamics which were indicated should be investigated even further.

The role and profile of “bridge builders” as described earlier offers additional research opportunities.

The South African initiatives to develop and support research and technology are all fairly new, still experiencing growing pains and with many unanswered questions that provide a wealth of research opportunities. Other countries such as Australia have engaged in similar initiatives, which could provide valuable learning and benchmarking opportunities.

## 7.6 Final remarks

The purpose of this paper was to

- Contribute towards new knowledge regarding the impact CoPs on the team development process of an inter-firm collaborative team, and
- Capturing emerging Best Practices for the management of such collaborative teams.

This paper proved that membership of the team to the same or similar CoPs do have some impact on the norming stage, and do assist in reaching the performing / productive stage faster in team development, because the team members already share some common ground through membership of the same / similar CoPs. It has highlighted valuable emerging organisational and strategic Best Practices as is currently prevalent in R&D teams and collaborative projects.

This information is a step towards developing and refining a strategy to support and enhance the R&D function on a strategic and development level. It impacts on the total organisational strategy, culture and norms, which should be support by appropriate strategic human resources management approaches and systems.

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# Addendums

## Addendum A: Snapshot comparison: COP, Formal Work Groups, Project Teams and Informal Network

| | That is the purpose? | Who belongs? | What holds it together? | How long does it last? |
|---|---|---|---|---|
| Community of practice | To develop members' capabilities; to build and exchange applied knowledge, which leads to improved performance. | Members who select themselves. | Passion, commitment, and identification with the group's expertise. | As long as there is interest in maintaining the group. |
| Formal work group | To deliver a product or a service. | Everyone who reports to the group's manager. | Job requirements and common goals. | Until the next reorganisation. |
| Project team | To accomplish a specified task. | Employees assigned by senior management. | The project's milestones and goals. | Until the project has been completed. |
| Informal network | To collect and pass on business information. | Friends and business acquaintances. | Mutual needs. | As long as people have a reason to connect. |
| Community of Interest | To share information and solve common problems. | Friends and business acquaintances. | Mutual interests. | As long as people have a reason to connect. |

*(Source: Adapted from Wenger and Snyder, 2000).*

## Addendum B: Studies on communities of practice (CoP).

| Reference | Focus | Research Methodology |
|---|---|---|
| Schwen & Hara, 2003 | Problems & solutions for development of online communities. | Four case studies on the use of technology in different types of communities. |
| Swan, Scarbrough & Robertson (2002) | Nature and role of communities of practice in the development of technical innovation for the treatment of prostrate cancer – community used as a discursive strategy to promote the innovation. | Case analysis. |
| Styhre & Sudgren (2003) | Clashes between management control and scientific approaches. | • 18 interviews; 2 hours each; semi-structured; interview guide<br>• Researchers decided categories; transcribed and categorised by 2 independent researchers.<br>• Influential discovery and development pharmaceutical researchers with expertise in chemistry, biology, medicine, pharmacology and drug delivery issues that played influential roles in seven new products with huge earnings, developed between 1975 and 1985. |
| Kanter (2001, pp. 311-315) | The concept of community in the Web environment. | Methodology: Survey:<br>Respondents do not constitute a random or representative sample, since survey participation was voluntary and responses were anonymous. They over sampled people who were interested in the Internet. This is simply an opportunistic, suggestive sample that can be used to generate hypotheses and glean insights, and that is how it was used. |
| Markus, Manville & Agres (2000) | Motivation of open source (software development) participants and coordination of their software development.<br>Information regarding the rules, procedures, peer review mechanisms and reputation building opportunities in the open source development CoPs. | • Literature review.<br>• Filled gaps with e-mail communication with small number open source developers.<br>• Triangulated data with academic literature on management, virtual organisations and “public goods” phenomena. |

| Reference | Focus | Research Methodology |
|---|---|---|
| Brown & Duguid (1991) | Organisations as communities-of-communities – to foster working, learning and innovation in companies "(in-house CoPs"). | Literature review. |
| Liedtka (1999) | Focus on the underlying value system that is likely to support communities of practice; concept of metacapabilities. | Literature review. |
| Gongla & Rizzuto (2001) | Evolving communities of practice in IBM Global Services – creation, growth and development of communities of practice in IBM ("In-house" CoPs). | Case study: IBM in house program and the types of communities that emerged from program with the life cycles as observed over 5 year period.<br>Link to literature review to generate general model of how CoPs evolve. |
| Caldwell & O'Reilly (2003) | The role of work group norms in promoting innovation in high-technology organisations. | During a 5 year period participants in executive programmes were asked to suggest norms and beliefs that helped promote innovation (more than 2000 senior-level managers from diverse countries and industries) – 36 items identified that were used as basis of Group Innovation Inventory.<br>2 studies:<br>• 146 participants in university-based management development program or part time M.B.A. program were asked to identify a team or group they were working with, and to assess the group's norms.<br>• A sub-sample of 30 was asked to provide the names of up to 5 members of the group that could be contacted to provide independent evaluations of group norms. |
| Wenger & Snyder (2000) | Describe communities of practice as a new form of organisation, which differ from other forms of organisation in several ways. Communities of practice emerge from companies that thrive on knowledge. | Discuss various case studies – more in-house COP oriented. |

## Addendum C: Characteristics of Communities of Practice

| **Wenger (1998) and Iverson & McPhee, 2002** | **Kanter (2001)** |
|---|---|
| Wenger identified 3 characteristics of CoPs, discussed in more detail by Iverson & McPhee. | Seven elements are contained in the community ideal (even though they are not always present in reality): |
| **1. Mutual engagement** comes from the interaction of members. By interrelating, members are motivated to negotiate their practices and the meanings of actions. Various members of the CoP can offer insights, adopt each others' practices, critique practices, and share frustrations. CoPs manage knowledge through face-to-face interaction, technological connection, professional associations, and other forms of communication<br><br>Mutual engagement identifies a condition similar to connection in a network but describes such relation as grounded in common interest and activity, rather than mere interaction. For example, education within the medical profession via the morning report allows CoPs to demand more of network linkage than information exchange. | **1. Membership**: When they are members, differences disappear, and connections transcend roles. People feel an obligation to fellow members that they do not feel to, say, fellow workers. Membership implies a kind of citizenship, with the right and obligation to speak up.<br><br>**2. Fluid boundaries**: Communities are loose aggregations. There may be a formal core that is organised and firm, but around that core are people go come and go, move in and out, and become more active on some occasions and less active on others |
| **2. Negotiation of a joint enterprise** gives a sense of coherence and purpose to the CoP. Members interacts to define significance, shape practices, and react to a larger context. This process creates more than | **3. Voluntary action:**<br><br>There is a voluntary quality to the actions taken by community members. They do more than their jobs, because they want to. |

<table>
<tr><th>Wenger (1998) and Iverson & McPhee, 2002</th><th>Kanter (2001)</th></tr>
<tr><td rowspan="2">“just a stated goal, but creates among participants relations of mutual accountability that become an integral part of the practice”.<br><br>Negotiation of a joint enterprise recognises that these communities are connected through time and space in a communicative process that constructs knowledge in a purposeful manner. This explains why knowledge travels both within and across organisations. Whether managed or not, and why community members cooperate energetically on problems that do not concern their home organisation</td><td>4. Identity: Community is an idea, not a geographical location. A community exists because many people think it does and define themselves as part of it, whether it is a professional community, a community of interest, or a birthplace.</td></tr>
<tr><td>5. Common culture:<br><br>Shared understandings, a common language and disciplines, permit a relatively seamless interchangeability of one for another, or a relatively seamless passing of the torch.</td></tr>
<tr><td rowspan="2">3. A shared repertoire is the CoPs set of resources for negotiating meaning. Stories, jargon, theories, forms, and other resources form a stock of understood information and techniques that can be utilised by members. Knowing the shared repertoire can be a proof of membership.<br><br>The shared repertoire gives functionality to reifications such as information and places them in a social context of the COP, explaining why this information can only be employed as knowledge under certain circumstance</td><td>6. Collective strength: Communities tap the power of many. People bond to each other and to the community when there is a greater cause that uses their collective strength</td></tr>
<tr><td>7. Collective responsibility: Service to the community as a community can be a unifying force in addition to its pragmatic benefits as a workforce motivator, talent attracter, and brand (reputation) builder.</td></tr>
</table>

## Addendum D Initial Interview Questions

1. Collaborations
    - How much of the organisation's work is based on inter-firm collaboration?
        - Why did the organisation decide on inter-firm collaboration?
        - Why did the organisation decide on chemical / bio- science R&D collaboration?
        - What does the company hope to achieve through these collaborations?
        - What are the criteria on which collaboration partners are chosen?
        - How are the collaborations managed?
        - How do you measure the performance of these collaborations?
        - How do you report on the performance of the collaborative teams?
    - Has the collaborations contributed to the company's overall performance?
        - If yes – in what way?
        - What would you say are the contributing factors to the success?
        - Is the trend of collaboration going to grow?
    - If no – what would you say went wrong, or what happened?
2. CoPs / work-related social networks
    - What is the organisation's view regarding employees participating in work-related social networks / CoPs?
    - If the organisation allows such participation
        - Would you describe the organisation's approach as passive / tolerant or active encouragement? Please give examples if possible.
        - How does the organisation go about minimising the typical risks associated with information sharing?
        - Does the organisation have processes / procedures or informal measures in place to capture / "harvest" useful information emanating from participation in the CoP / social networks? If so, please give examples /detail.
        - Has the organisation benefited from employees' participation in work-related CoPs? If so, please give examples.
        - Does such participation (and the results / benefits from it) form part of the managers' formal performance evaluation? If so, how is it / reported / measured?

# Addendum E: Information about the South African Institutions, GRA and the World Bank.

## African Centre for Gene Technologies (ACGT)

ACGT is an initiative by the Council for Scientific and Industrial Research (CSIR) and the University of Pretoria, established to create a national centre of expertise in third generation biotechnology. The alliance increases the range and availability of resources, facilities, skills and competencies for both partners.

As a world-class platform in gene technologies with increasing involvement by other organisations, the ACGT has a particular focus on gene and genome analysis, and the applications thereof.

ACGT plays an integrating role for activities in the areas of nutritional genetics, genomics and bio-informatics, dealing with gene function & regulation, structural analysis of genes and protein families, transcriptomics, etc. (http://www.acgt.co.za/).

## Biotech partnerships & Development (BioPAD)

BioPAD is part of the drive by the Department of Trade and Industry (DTI) to provide seed money for the establishment of small and medium enterprises (SMEs). In the case of BioPAD it was established to specifically advance biotechnology economic prosperity in South Africa (http://www.biopad.org.za/).

BioPAD receives government research and development (R&D) funding from the DTI. BioPAD in turn provides funding to successful applicants as 'seed money' to start a business.

In the past seed money was provided to SMEs on condition that they formed a partnership / consortium with industry. However, the consortium model is not always successful as the industry partners at times delayed the process because of other business priorities. A new model is being considered to improve the success rate of the ventures.

Biotechnology stakeholders came together and launched a networking initiative called BioForum, which is driven by BioPAD. The focus of this initiative is to promote and enhance the growth of biotechnology in South Africa, and ultimately the whole of Africa.

## CSIR Bio/Chemtek – Food, Biological and Chemical Technologies

CSIR Food, Biological and Chemical Technologies (CSIR Bio/Chemtek) is a business unit of the CSIR, positioned to provide world-class technology solutions in the food, chemical and biological technology domains.

CSIR Bio/Chemtek undertakes work in all phases of the research and delivery value chain: from early discovery, concept to process selection; development and product formulation; to customised synthesis and formulation. is now the largest centre of biotechnology research in South Africa, covering molecular biology, bioinformatics, genetics, genomics and proteomics, microbiology, fermentation technology and biochemical engineering (http://www.csir.co.za).

## Forestry and Agricultural Biotechnology Institute (FABI)

FABI was established in 1997, based on a recognition that the future of Forestry and Agriculture in South Africa will depend strongly on the incorporation of new technologies into these industries. Opportunities for Forestry and Agriculture that have emerged in recent times from the application of various biotechnologies are immense, and almost beyond imagination. Currently, forestry and food crops containing novel genes are already being deployed world-wide. Well recognised examples include the incorporation of genes conferring herbicide and pest resistance to plants. Other products are also appearing increasingly rapidly and this trend will not slow in coming years.

The objectives of FABI are to assist this sector of the local economy, to meet these goals. This is achieved through goal directed research undertaken in partnership with major players in these markets.

Being based at a University affords FABI the capacity to build future human resources in biotechnology, which will be crucial to the future of Forestry and Agriculture in South Africa. A base at the University of Pretoria enables FABI to enjoy collaboration and linkage with the majority of statutory bodies undertaking research in the plant and animal sciences. Added value comes from training grants, participation of students in research programmes and an enormous human and technological resource associated with the University in South Africa.

(http://fabinet.up.ac.za/http://www.dst.gov.za)

### Global Research Alliance (GRA)

The GRA formed on a basis of trust between eight Knowledge Intensive Technology Organisations (KITOs) spread across the world. Current membership includes organisations in Australia, Malaysia, India, the Netherlands, Finland, Germany, the United States of America and South Africa. This group represents a large body of scientists and considerable experience and competence able to provide innovative solutions to global problems (http://www.gra.org).

The GRA wants to provide *thought leadership* and is focussed on the developing world. The five key areas of focus are: water; energy; transportation; the digital divide and health.

Because the Alliance is mandated and supported by the executive management of the various partners, it is providing a forum and network opportunity where companies and scientists can meet, exchange ideas, and submit proposals for projects from a strong, diverse base of skills and competencies. As such it provides a 'breeding ground' for CoPs as scientists interact on the various key focus areas and projects.

### SAAFoST

SAAFoST is a National Association, which is concerned with advancing the knowledge of Food Science and Technology. This it does through encouraging scientific research, organising meetings, seminars, workshops and congresses, publishing papers and assisting in educational activities.

SAAFoST was very instrumental in forming the Food Advisory Consumer Service (FACS) which was launched in January 1995 primarily for the consumer who wants to be informed about food issues such as health, nutrition, safety, preservatives, colours, additives, chemicals, irradiation, processing, labelling etc. The Association responds to and challenges misleading articles, advertisements and claims concerning food processing and the food industry (http://www .saafost.org.za).

### SA Research & Innovation Management Association (SARIMA)

The Association is an outgrowth of the Research Directors Forum (RDF), which met annually for a number of years to review various issues related to research management and administration. It was agreed to form a new association with a wider scope. The Association was formally established in 2002 (http://www.sarima.co.za)..

A number of international institutions support the Association and provide training and development for professional staff. The Association can be viewed as a CoP. Its objectives include:

- professional development and capacity building of those involved in managing research & innovation systems;
- promotion of best practices in the management and administration of research and innovation;

- creating awareness in academic and public forums of the value of a stronger research and innovation system;
- advocating appropriate national and institutional policies in support of research and innovation;
- advancement of science, technology and innovation, and information dissemination.

SARIMA is promoting the formation of technology transfer offices at Tertiary Education Institutions (TEI's) to facilitate interaction between industries (as consumers / users), and the universities and research bodies. This may result in cooperative agreements or consortiums, with which SARIMA will assist as well.

### Sasol Technology

Sasol is an integrated oil and gas company with substantial chemical interests. In South Africa, the company support these operations by mining coal and converting it into synthetic fuels and chemicals through proprietary Fischer-Tropsch technologies. Sasol also has chemical manufacturing and marketing operations in Europe, Asia and the Americas. The larger chemical portfolios include polymers, solvents, olefins and surfactants and their intermediates, waxes, phenolics and nitrogenous products.

The group produces crude oil in offshore Gabon, refines crude oil into liquid fuels in South Africa and retails liquid fuels and lubricants through a growing network of Sasol retail convenience centres and Exel service stations. During the first quarter of 2004, Sasol began to supply Mozambican natural gas both to customers and to Sasol's own petrochemical plants in South Africa. Sasol is also developing in Qatar and Nigeria two gas-to-liquids fuel joint ventures that will incorporate the proprietary Sasol Slurry Phase Distillate™ process.

Sasol conducts research and development (R&D) at Sasolburg and several other sites in the USA, Europe and South Africa. Sasol R&D programmes play an important role in shaping its competitive advantage, especially in the fields of process design, catalyst development and product development and formulation (http://www.sasol.co.za )

### Science & Technology for Competitiveness (Department of Science and Technology)

The Department of Science and Technology strives towards introducing measures that put science and technology to work to make an impact on growth and development in a sustainable manner. This includes focused interventions, networking and acting as a catalyst for change in terms of both productive components of the economy, making it competitive in a globally competitive liberalised environment, and also in respect of the huge development backlog existing among the poorest components of the South African society.

Maintaining an adequate science base and translating it into jobs and growth poses some major challenges. The approach of National System of Innovation (NSI) in recognizing the non-linearity of innovation – where performance is a function not only of the innovation in individual organisations but also of the relationships and networks between institutions – is increasingly driving government towards the role of catalyst, facilitator and strategic investor.

(http://www.dst.gov.za)

### World Bank

On the World Bank's webpage Frannie A. Léautier, Vice President of the World Bank Institute, says their vision is to spur the knowledge revolution in developing countries to be a global catalyst for creating, sharing, and applying the cutting-edge knowledge necessary for poverty reduction and economic development.

The World Bank

- Builds capacity for development by providing learning programs and policy advice in various economic, environmental and socially sustainable development, and knowledge for development.
- Reaches policymakers, academics, and development practitioners in every corner of the world.
- Helps clients apply knowledge to development challenges, country by country. Through courses, seminars, knowledge networks, communities of practice, and expert advice, WBI and its partners reach learners all over the world, promoting the exchange of global and local knowledge.
- Promotes learning via videoconference, the web, in the classroom, on the front lines. WBI and its partners use interactive technologies as well as blended applications of new and traditional educational methods to take knowledge around the world.
- Works in partnership. WBI depends on a global web of strategic alliances to promote multi-directional sharing of local and global knowledge (http://web.worldbank.org ).

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# Addendum F Survey Questionnaire

## Research Summary

This study deals with the impact of Communities of Practice (CoPs) on inter-firm collaborative teams, specifically the extent to which networks / CoPs enhance inter-firm collaboration team forming processes.

A community of practice (CoP) is a type of social network that forms around a specific problem area. The CoP members share applied practical knowledge and experience focused on problem solution or implementation. CoP members usually share a concern, a set of problems, or a passion about a topic, and deepen their knowledge and expertise in this area by interacting on an ongoing basis, for example by attending conferences on the topic, corresponding using various means, and contributing on websites.

The purpose of this research is to contribute new knowledge towards understanding the impact of membership to a CoP on the members of an inter-firm collaborative team. Understanding the role that CoPs play within these teams is a step towards developing and refining a strategy to support and enhance the speedy progression of the team towards a productive phase.

The productive phase can be described as the phase where the team is functioning optimally and produces synergistic work. The synergistic work involves the sharing of applied knowledge, the intangibles of knowledge creation, and results ideally in newly generated intellectual capital as an output.

The questionnaire should take approximately ten (10) minutes to complete. It requires marking the appropriate blocks with Xs, and mailing it back to the contact e-mail address. Your assistance in gather this research data will be greatly appreciated.

**All information will be treated as strictly confidential**

Information will only be used in aggregated form. If you would like me to contact you to clarify any questions, or for further discussions, or would like feedback on the research, please provide your contact details in the space at the end of the questionnaire. You are also most welcome to contact me - see my contact details at the end of the questionnaire.

## Research Questionnaire

This research questionnaire looks at the impact of communities of practice (CoPs) on inter-firm collaborative research teams. I am interested in learning about your experience working on collaborative teams, and belonging or interacting with work related social networks or CoPs.

**Definition of CoPs**
A community of practice (CoP) is in essence a type of informal social network that forms around a specific problem area. The CoP members share applied practical knowledge and experience focused on problem solution / implementation.

## Questionnaire

There are no right or wrong answers to these questions. Please read the questions carefully and be as candid as possible in your responses. Please answer all the questions.

## A Background about the team

**Choose one of the following descriptions and mark with X in the appropriate block**

1 How would you describe your career level at this point?

- a. Assistant performing tasks under supervision
- b. Individual contributor operating independently
- c. Mentor / champion assuming responsibility for others
- d. Director / sponsor / strategist assuming responsibility for the organisation

2 Which of the following fields / disciplines best describes your current area of work?

- a. Biotechnology
- b. Chemical engineering
- c. Pharmaceuticals
- d. Aerospace
- e. Agriculture
- f. Other Please describe in the space below

| | | | |
|---|---|---|---|
| 3 | Are you currently part of an inter-firm collaborative project team OR have you recently been part of an inter-firm collaborative project or research team? | Yes / No | |
| 4 | Do / did the researchers come from different companies or institutions? | Yes / No | |
| 5 | Are you / were you part of the core research team? | Yes / No | |
| 6 | Do you / did you know any of these researchers before the project started? | Yes / No | |

7 If the answer to number 6 is *YES* – choose one or more of the following to describe your relationship in respect to the team members:

- a. Read paper/ article of one or more of the researchers
- b. Met one or more of the researchers during a conference or workshop
- c. Heard one or more of the researchers speak during a conference / workshop
- d. Corresponded with one or more of the researchers on occasion

| | | |
|---|---|---|
| e. | Corresponded with one or more of the researchers regularly | |
| f. | Spoke with one or more of the researchers on occasion | |
| g. | Spoke with one or more of the researchers regularly | |
| h. | Met with one or more of the researchers on occasion | |
| i. | Met with one or more of the researchers regularly | |
| j. | Worked with one or more of the researchers on projects before | |

**A. Background about the team (continued).**

| | | | | | |
|---|---|---|---|---|---|
| 8 | Are the core team researchers from the same industry? | Yes | | No | |
| 9 | Are the core team researchers from the same discipline (for example biochemists)? | Yes | | No | |
| 10 | Do the core team researchers have similar basic training (for example science, engineering)? | Yes | | No | |

## B Impact on team development

Team development is often described as occurring in phases.
***Phase one*** is the forming of the team, where members get acquainted with each other.
***Phase two*** is characterised by interpersonal conflict - it is commonly known as the 'storming' phase.
***Phase three*** is the norming phase where the group becomes cohesive.
***Phase four*** as the performing phase sees the team becoming productive.

## B Impact on team development (cont)

Please reflect on previous projects or current projects in which you are involved, where the core team members have the same or similar basic training AND/OR belong to same or a similar social network (CoP).
Based on your own experience in those projects, rate the following phases of the team development on a scale of 1 to 10 where:

**1** = A lot of problems/delays **3** = Quite a number of problems /delays **5** = Problems / delays **6** = Acceptable
**8** = Smooth / fast **10** = Very smooth / quickly reached productive stage

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | The smoothness of the norming phase (phase 3) | | | | | | | | | | |
| 12 | The speed at which the productive phase (phase 4) was reached | | | | | | | | | | |

## C Information about the team interaction

Please reflect on previous projects or current projects in which you are involved, where the core team members have the same or similar basic training AND/OR belong to same or a similar social network (CoP).
Based on your own experience in those projects, please rate the following statements.

There are no right or wrong answers to these statements. Please read the statements carefully and be as candid as possible in your responses. Please rate all the statements using the following scale.

**1** = Strongly disagree **2** = Disagree **3** = Not sure **4** = Agree **5** = Strongly agree

| | Statements | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| | **A. Similar terminology and conceptual understanding** | | | | | |
| | **In core teams where the members have similar basic training / belong to similar social networks** | | | | | |
| 13 | Differences in the terminology and concepts used on the project are clarified quickly and easily | | | | | |
| 14 | There is seamless sharing of information (sharing of information happens easily / smoothly) | | | | | |
| 15 | It is easy to work together due to the common understanding of the terminology and concepts | | | | | |
| 16 | There are a lot of errors due to differences in terminology and concepts used on the project | | | | | |
| | **B. Similar work related standards** | | | | | |
| | **In core teams where the members have similar basic training / belong to similar social networks** | | | | | |
| 17 | Reaching agreement on the required quality specification for products and services is a major problem | | | | | |
| 18 | More time and effort is required to clarify quality requirements and standards | | | | | |
| 19 | Every person clearly knows what level of performance is expected | | | | | |
| 20 | Both management and the client are satisfied with the team performance | | | | | |
| 21 | Both management and the client are impressed with the team output | | | | | |
| 22 | Team members have different perceptions regarding the quality requirements on the project | | | | | |
| 23 | Conflict is reduced because everyone understands the quality issues and standards | | | | | |
| 24 | Different members have different perceptions of the importance of time | | | | | |
| | **C. Similar basic research approaches and work practices** | | | | | |
| | **In core teams where the members have similar basic training / belong to similar social networks** | | | | | |
| 25 | Team members quickly establish procedures for handling decision-making and methods to move forward | | | | | |
| 26 | Tasks are performed quickly and proficiently | | | | | |
| 27 | The cumulative experience of the team contribute to better performance | | | | | |
| 28 | Productivity is increased because the team has similar approaches and work practices as a base | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 29 | The task performance strategies being used are appropriate to the specific project | | | | | |
| 30 | Processes and controls are not supported by all the team members | | | | | |
| 31 | A lot of time and energy is spent agreeing on the way the work should be done | | | | | |

| | **D. Peer recognition** | | | | | |
|---|---|---|---|---|---|---|
| | **1** = Strongly disagree **2** = Disagree **3** = Not sure **4** = Agree **5** = Strongly agree | | | | | |
| | **Statements** | 1 | 2 | 3 | 4 | 5 |
| | **In core teams where the members have similar basic training / belong to similar social networks** | | | | | |
| 32 | I do not feel confident that the other team members will contribute the necessary skills and knowledge to the project | | | | | |
| 33 | The other team members treat me as their equal | | | | | |
| 34 | Based on their reputations (past performance, publications) I feel I know the other team members | | | | | |
| 35 | Each member is competent to perform their part of the task without supervision | | | | | |
| 36 | Individual accountability is difficult to establish | | | | | |
| 37 | My experience and input is not valued | | | | | |
| 38 | I feel that I can learn from the other team members | | | | | |
| | **E. Similar ethics / confidentiality norms** | | | | | |
| | **In core teams where the members have similar basic training / belong to similar social networks** | | | | | |
| 39 | Everyone understands the sensitivity of the information | | | | | |
| 40 | Team members find it difficult to agree on ethical norms and standards | | | | | |
| 41 | I trust my team members not to take advantage of information produced by the team | | | | | |
| 42 | Some team members may exploit the association / the access to information to their own advantage | | | | | |
| | **F. Professional trust** | | | | | |
| | **In core teams where the members have similar basic training / belong to similar social networks** | | | | | |
| 43 | There is a lot of professional mistrust and competition among team members | | | | | |
| 44 | It easy to voice my opinion and concerns to the team | | | | | |
| 45 | Everyone does not have the opportunity to participate in decision-making | | | | | |
| 46 | Team members are comfortable with high levels of task interdependence | | | | | |
| 47 | My team members do not give me all the information I need | | | | | |
| 48 | There is open recognition of problems in the project and related relationships | | | | | |
| 49 | I trust my team members not to take advantage of me | | | | | |
| 50 | Conflict resolution has not improved over time | | | | | |

| | G. Sense of "belonging" | | | | | | |
|---|---|---|---|---|---|---|---|
| | **In core teams where the members have similar basic training / belong to similar social networks** | | | | | | |
| 51 | Team members are willing to use their cumulative experience to work out problems | | | | | | |
| 52 | The team relationships are competitive and unsupportive | | | | | | |
| 53 | Feedback is constructive | | | | | | |
| 54 | There is a strong sense of "we are in this together" | | | | | | |
| 55 | Team members are proud to be part of the team | | | | | | |

| | G. Sense of "belonging" (continued) | | | | | |
|---|---|---|---|---|---|---|
| | **1** = Strongly disagree **2** = Disagree **3** = Not sure **4** = Agree **5** = Strongly agree | | | | | |
| | **Statements** | 1 | 2 | 3 | 4 | 5 |
| 56 | The team developed a sense of coherence very quickly | | | | | |
| 57 | I feel proud to be associated with this team | | | | | |
| 58 | Interacting with the other team members is stressful | | | | | |
| 59 | Everyone agrees with the team objectives | | | | | |

**Do you have any comments about this section?**

Thank you very much for your time and input.
I would appreciate any comments or additional input regarding the subject and the study.

If you would like me to contact you for further discussions, or would like feedback on the research, please provide your contact details in the space below.

Name and contact details

Thank you very much for your time and input.

René Erasmus

## Addendum G: Correlation Spreadsheet

**Correlations**

| | | | Y1 Norming | Y2 Productive | Terminology | Standards | Practices | Peer | Ethics | Trust | Belong |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Spearman's rho | Y1 Smooth Norming Phase | Correlation Coefficient | 1.000 | | | | | | | | |
| | | Sig. (2-tailed) | . | | | | | | | | |
| | | N | 44 | | | | | | | | |
| | Y2 Reach Productive Phase quicker | Correlation Coefficient | 0.763 | 1.000 | | | | | | | |
| | | Sig. (2-tailed) | 0.000 | . | | | | | | | |
| | | N | 44 | 44 | | | | | | | |
| | X1 Similar terminology | Correlation Coefficient | 0.304 | 0.501 | 1.000 | | | | | | |
| | | Sig. (2-tailed) | 0.045 | 0.001 | . | | | | | | |
| | | N | 44 | 44 | 44 | | | | | | |
| | X2 Similar standards | Correlation Coefficient | 0.282 | 0.566 | 0.567 | 1.000 | | | | | |
| | | Sig. (2-tailed) | 0.063 | 0.000 | 0.000 | . | | | | | |
| | | N | 44 | 44 | 44 | 44 | | | | | |
| | X3 Similar practices | Correlation Coefficient | 0.338 | 0.519 | 0.668 | 0.586 | 1.000 | | | | |
| | | Sig. (2-tailed) | 0.025 | 0.000 | 0.000 | 0.000 | . | | | | |
| | | N | 44 | 44 | 44 | 44 | 44 | | | | |
| | X4 Peer recognition | Correlation Coefficient | 0.012 | 0.272 | 0.523 | 0.371 | 0.490 | 1.000 | | | |
| | | Sig. (2-tailed) | 0.938 | 0.074 | 0.000 | 0.013 | 0.001 | . | | | |
| | | N | 44 | 44 | 44 | 44 | 44 | 44 | | | |
| | X5 Similar work ethics | Correlation Coefficient | 0.160 | 0.385 | 0.299 | 0.196 | 0.139 | 0.332 | 1.000 | | |
| | | Sig. (2-tailed) | 0.301 | 0.010 | 0.048 | 0.202 | 0.367 | 0.028 | . | | |
| | | N | 44 | 44 | 44 | 44 | 44 | 44 | 44 | | |
| | X6 Professional trust relationship | Correlation Coefficient | 0.182 | 0.443 | 0.507 | 0.568 | 0.454 | 0.603 | 0.459 | 1.000 | |
| | | Sig. (2-tailed) | 0.238 | 0.003 | 0.000 | 0.000 | 0.002 | 0.000 | 0.002 | . | |
| | | N | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | |
| | X7 Sense of belonging | Correlation Coefficient | 0.415 | 0.667 | 0.777 | 0.565 | 0.782 | 0.590 | 0.311 | 0.522 | 1.000 |
| | | Sig. (2-tailed) | 0.005 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.040 | 0.000 | . |
| | | N | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 |