UNIVERSITY OF STRATHCLYDE

DEPARTMENT OF MANAGEMENT

INTER-COMMUNITY OF PRACTICE COLLABORATIONS: INTERDISCIPLINARY RESEARCH PRACTICES

by

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A thesis presented in fulfilment of the requirements for the degree of Doctor of Philosophy

2010

This thesis is the result of the author's original research. It has been composed by the author and has not been previously submitted for examination which has led to the award of a degree.

Signed: …….. Date: 29th October 2010

ACKNOWLEDGMENTS

The journey from embarking on and completing this thesis was a long, and certainly interesting, one and the very act of completion would not materialise without help and contribution (in many different forms) from a number of people I am indebted to. First and foremost I must thank Paul Hibbert for his invaluable guidance, inspiration and, most importantly, friendship which made it possible to complete this work. Secondly, I wish to thank Piepraolo Andriani and Joyce Liddle for their inspiration and encouragement, as without it I would perhaps never step on this path. Furthermore, I wish to thank Chris Huxham for her support and understanding for the last three years.

I also feel indebted to the BTG board and all the participants who agreed to take part in the research, devoting their time and sharing their experiences, which formed the backbone of this work. Finally, big thank you to Joanne Roberts and Kevin O'Gorman for an inspiring and pleasant viva experience.

I also wish to thank Kate, Dunc and the boys who took me in as a part of the (*crazy*) family; Vareska and Alex for inspiring intellectual discussions and ideas; Andrew for friendship and endless whisky sessions, and all the other friends I did not mention here by name but who always were around when needed the most.

I also wish to thank my family, who never questioned any of my ideas and provided their support through the years. Finally, and most importantly, I wish to thank Daphey for patience, support, and endless 'helpful' distractions.

ABSTRACT

This thesis builds on the existing theories of Communities, Collectivities and Networks of Practice (Amin and Roberts 2008; Lindkvist 2005; Lave and Wenger 1991) by examining the dynamics of temporary and project-focused inter-CoP (Community of Practice) engagements. As the research setting, this study investigates interdisciplinary research (IDR) engagements across the University of Strathclyde in a period of eighteen months, with organisational ethnography as the chosen research strategy, with a particular concern for practice as the main focal theme of the investigation.

The results extend the understanding of inter-CoP engagements and their impact on involved CoPs and their 'native' practices (Amin and Roberts 2008; Lindkvist 2005; Ferlie et al 2005), providing evidence that individuals, and teams, develop and adopt a range of shared practices characteristic to inter-CoP collaborative engagement. Furthermore, the findings characterize the active co-development of a network of practitioners engaged in inter-CoP through a group of practices specifically aimed at ensuring the development and health of the network. The study, therefore, contributes to the general understanding of the dynamics of temporary inter-CoP engagements as well extending general understandings of practice in the theories of CoPs. In addition, the research contributes to the understanding of the dynamics of interdisciplinary research collaborations.

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CHAPTER I: INTRODUCTION

THE RESEARCH PROBLEM AND APPROACH

The main area of investigation of this research is related to the concept of Communities of Practice (CoPs) and more specifically, into the dynamics of transient, collaborative engagements between individuals from epistemically diverse, professional CoPs. There is no doubt that that due the escalating speed and complexity of knowledge development coupled with increasingly competitive global markets, there is an increasing pressure on organisations to engage into interorganisational, interdisciplinary or inter-divisionary collaborations as a way to progress knowledge development, augment innovativeness, and stay abreast in the progressively networked knowledge economy. As noted by Czerniawska (2004: 786), organising is increasingly taking place in a '*net of fragmented, multiple contexts*', with work and research being '*enacted by groups that fade, intermix and are reconfigured in contexts where uncertainties and contradictions have become ever more visible*' (Blacker and Regan 2009: 162; see also Engeström 2008). Hence, understanding the dynamics of the transient, often project-focused and multidisciplinary teams becomes paramount for many organisations.

Following recent developments in ways of thinking about CoPs as a mean of knowledge development (Gherardi 2009a; 2009b; Bjørkeng, Clegg and Pitsis 2009; Thomson and Walsham 2008; Thompson 2005), the research adopts practice, in its wider meaning, encompassing systems of values, appreciations and shared 'tastes' (Gherardi 2009a), as the focal aspect of the concept. Consequently, building upon the extant literature on inter-CoP engagements (Sutherland Olsen 2009; Ferlie et al 2005; Lindkvist 2005; Fischer 2001; Wenger 1998), this research investigates the effects of such collaborations on the existing practices of CoPs, further suggesting the development of a new set of sustainable practices characteristic of this mode of knowledge development.

Due to the nature of the research problem and the context of the research (as discussed in the following chapters), this study adopts organisational ethnography (Fredericks and Yanow 2009; Alvesson and Deetz 2000; Rosen 1991) as the research strategy, and, consequently, is interpretive at the core. The study investigates a number of interdisciplinary research (IDR) projects and teams at the Strathclyde University over the period of 18 months.

Thus the summary research question for this study was to investigate the dynamics and nature of transient, project-focused inter-CoP collaborations from the perspective of practice on the example of interdisciplinary research teams.

FINDINGS AND CONCLUSIONS

The findings of this research add to existing knowledge in four main areas. First, somewhat contradictory to the majority of extant literature on inter-CoP engagements (Amin and Roberts 2008; Ferlie et al 2005; Lindkvist 2005; Fischer 2001), the results of this research indicate that, although inter-CoP teams of professionals are short-lived and project focused, on many occasions the observed teams developed and shared a wide range of practices specific to this type of engagements. The elaboration and characterization of these practices forms the largest part of the contribution of this research. Secondly, the results suggest that a further distinction should be made in relation to inter-CoP engagements and emergence of shared practices associated with this type of relations, as depending on the levels of integration between members the dynamics of the engagements differ significantly. Consequently, a distinction between the instrumental, integrative and epistemic levels of inter-CoP collaborations, and the resulting development of shared practices, has been characterized. Thirdly, the results of the study further add to the understanding of the dynamics of co-development of shared practices and networks of practitioners; specifically,

processes of co-emergence and co-evolution of particular practices and networks were theorized. This is supported through the identification of examples of the development of practices focused on maintaining and developing an emerging network of practitioners. Finally, the practice-based framework for analysing and supporting interdisciplinary research developed and theorised in this study contributes to the understanding of the dynamics of interdisciplinary research, thus providing some potential tools to be utilised in supporting the future development of this mode of research.

LAYOUT OF THE THESIS

This section outlines the layout of the thesis, providing a brief overview of the contents of the remaining chapters.

- Chapter 2 provides a detailed overview of the literature on interdisciplinary research (IDR) and provides the fundamental link between this mode of research and the theoretical framework of Communities of Practice (CoPs) adopted in this study. Furthermore, as will be demonstrated in the final chapter, the literature review provided in this chapter is further utilised in and informs the process of theorising.
- Chapter 3 provides the second part of the literature review, this time focused on the theme of CoPs and, in particular, the current understanding of inter-CoP engagements. In the final part of the chapter, this leads to the outline of the research problem and direction.
- Chapter 4 explains the context of the study, followed by elaboration of the methodological aspects of the research. These include an explanation of the

philosophical grounding, the chosen research strategy and, consequently, methods applied to the processes of data collection and analysis.

- Chapter 5 presents the results of the study, further providing some theoretical deliberations on the meaning of the findings and exploring the links between the empirical findings and the theoretical frameworks outlined in chapters 2 and 3.
- Chapter 6 provides an integrative discussion and outlines the main areas of contribution of the work, followed by some thoughts on the limitations and potential directions for future research.

CHAPTER II: INTERDISCIPLINARY RESEARCH (IDR): A FORM OF INTER-COMMUNITY OF PRACTICE COLLABORATION

INTRODUCTION

This chapter provides an overview of the extant literature on interdisciplinary research (IDR) with a particular focus on some of the dynamics of this mode of research and the somewhat underdeveloped connection to the literature on Communities of Practice. The chapter will progress as follows. Firstly, an overview of the main approaches and definitions to interdisciplinary research and the intrinsic relationship between interdisciplinarity and disciplines will be provided. Next, the chapter will summarise the discourse on different forms of IDR, highlighting the often blurred differences between multi-, inter- and trans-disciplinarity. Clarifying these differences will play an important role in the subsequent chapters. Next, the chapter will provide an overview of both the main drivers and barriers to this form of research, as present in the existing literature. Understanding these factors will be particularly important during the data analysis and theorising processes, as these often influence the dynamics of interdisciplinary collaborations. Finally, this review seeks to demonstrate how IDR can be understood as a form of collaboration between Communities of Practice (CoP), leading to the next chapter, which will complete the theoretical background of this study.

IDR: WHAT IS IT AND WHY DOES IT MATTER?

Interdisciplinary research (referred hereafter as IDR) has attracted a considerable amount of attention from both academia and policy makers in recent years, leading to a number of studies and reports encapsulating its benefits and challenges (CoFIR 2004; EURAB 2004; Sung et al 2003). As a result new interdisciplinary courses, research centres and programmes were set up (Boni, Weingart and Evenson 2009; Hackett and Rhoten 2009; Sutherland Olsen 2009; Aboelela et al 2007; Rhoten and Pfirman 2007; Eagan et al 2002) with new policies and funding structures aimed at encouraging cross-disciplinary collaboration being consequently implemented (Buanes and Jentoft 2009; Sanz-Menéndez, Bordons and Zulueta 2001). The trend for the development of IDR seems understandable as addressing increasingly complex socio-environmental problems often require expertise from multiple fields of knowledge to be understood and solved (Buanes and Jentoft 2009), further offering the potential for both inter-organizational learning and the generation of new knowledge (Rhoten and Pfirman 2007; Hibbert and Huxham 2005). However, despite the numerous examples of successful initiatives and widely recognised benefits of interdisciplinarity to institutions, researchers and students (Eagan et al 2002, Sanz-Menéndez, Bordons and Zulueta 2001), the complexities, benefits and problems associated with interdisciplinarity are still poorly understood and require further investigations (Huutoniemi et al 2010). Although the concept has gained an increasing amount of support among policy makers, funding agencies and researchers in recent years, meeting the increasing demands for interdisciplinary knowledge seems far from straightforward and often more difficult to realise in practice (Buanes and Jentoft 2009). Indeed, '*with interdisciplinarity hope tends to triumph over experience*' as noted by Petts et al (2008: 595).

Despite many attempts to define interdisciplinary research (Huutoniemi et al 2010; Aboelela et al 2007; Aram 2004; Weingart 2000) there seem to be very little consensus or aggregation around the existing set of definitions (Bruce et al 2004; Morillo, Bordons and Gomez 2003), which are attributed to, among others; the tendency to premature generalisations about the nature of IDR which lead to further fragmentation of the concept (Klein 1990); over-reliance on the author's experience when defining the concept (Aboelela et al 2007); a lack of systematic analysis of the determinants of interdisciplinary research (Carayol and Nguyen Thi 2005); or the obsolete and inappropriate terminology scattered in the extant literature (Klein 2000; Weingart 2000). However, the main reason that can be distilled from the writings on IDR is linked to the inherent complexity of this mode of research. Thus, as aptly noted by Huutoniemi et al (2010: 79), due to its complexity interdisciplinarity defies a single definition, making the process particularly tricky.

By beginning, then, with a common sense description, interdisciplinary research can be defined as a mode of research that transgresses traditional disciplinary boundaries; however, it additionally has also been argued to be a significant factor in new knowledge generation (Hackett and Rhoten 2009), hence adding a further dimension to the definition. Rhoten and Pfirman (2007: 58) note that the term itself is often used to refer to a continuum of possible meaning and activities, with the core of the definition being '*the integration or synthesis of two or more disparate disciplines, bodies of knowledge, or modes of thinking to produce a meaning, explanation, or product that is more extensive and powerful than its constituent parts*'. Similarly, Szostak (2007) places integration of knowledge from two or more (disciplinary) fields as the determinant of interdisciplinary work, whereas Sanz-Menéndez, Bordons and Zulueta (2001) link interdisciplinary knowledge creation to the constant process of 'specialisation-fragmentation-hybridisation', highlighting the central role of the dynamics of interaction of disciplines. Likewise, Klein (1990) links the emergence of IDR – and the

resulting knowledge – to 'fission and fusion', highlighting the interaction between involved disciplines.

Hence, it can be argued that in order to understand the dynamics of IDR it is necessary to understand the relation between disciplines and IDR first. The problem with IDR can be linked to its origins and the nature of knowledge development and disciplinary cultures (Petts et al 2008). Hence the next section will investigate the relation between disciplinary specialisation and IDR. This will help to set the scene for the following detailed discussion on the major drivers and barriers to IDR.

DISCIPLINES AND INTERDISCIPLINARITY: PURITY OR PRODUCTIVITY?

Although the concept of interdisciplinarity goes back to the times of Plato and Aristotle – two interdisciplinary thinkers who attempted to unify different strands of knowledge under the umbrella of philosophy (Klein 1990), the increasing complexity of scientific thought soon lead to escalating specialisation and, consequently, clear divisions between fields of enquiry. The origins of the world discipline go back to this pattern of specialisation, through the Latin *disciplina* – 'a branch of instruction or education; a department of learning or knowledge' (Oxford English Dictionary 1989: 734-5), signifying the taxonomic treatment of knowledge (Aram 2004). Another approach defines disciplines as a collection of tools, methods, procedures, exempla, theories, and concepts which blend into coherent meanings which, in turn, form a certain 'world view' (Klein 1990: 104), hence disciplines shape behaviours and daily practices of individuals. Similarly, Weingart and Stehr (2000: xi) describe scientific disciplines as '*the eyes through which modern society sees and forms its images about the world, frames its experience, and learns, thus shaping it's own future or*

reconstituting the past'. Hence, rather than being responsible purely for knowledge ordering, disciplines '*provide relatively narrow and specialised frameworks to tackle problems*' and control systems of belief and values (Buanes and Jentoft 2009: 449).

Consequently, some scholars defend the clear distinction between disciplines in favour of disciplinary 'purity', arguing that disciplines increase efficiency and communication within their boundaries (Bruce et al 2004), ensure the strength of scientific inquiry and rigour (Boix Mansilla and Gardner 2003), and hence are synonymous with '*methodological rigour, drilling deep or exactness*' (Weingart 2000: 29). Thus Bruce et al (2004) explain that disciplines survived for so long *because* they serve an important role of constraining what a researcher needs to think about by setting clear boundaries on the parameters of interest and methodological approaches to be applied. These boundaries guard the purity of research subjects and limit the complexity within a single discipline by restricting the type of questions that can be asked and methods that can be used, hence necessitating rather narrow criteria for the validity of knowledge. Consequently, interdisciplinarity is often regarded to be a slightly '*suspicious'* endeavour that is too '*soft for real tough minds'* (Weingart 2000: 29), which is '*inherently problematic and difficult to do well*' and '*by nature superficial*' (Kincheloe 2001: 680; see also Massey et al 2006). Moreover, Bruce et al (2004) point out that by removing the disciplinary boundaries, interdisciplinarity can overwhelm an inexperienced researcher by its complexity.

Some authors therefore suggest that disciplinary specialisation can erode the vitality of mechanisms of intellectual interaction and that these mechanisms, operating across disciplines, are necessary in order to enhance the ability of science to address, for example, emergent societal problems (Hackett and Rhoten 2009; Rhoten and Pfirman 2007; Frost and Jean 2003). In addition, it has been suggested that the reconciliation of knowledge across

disciplines can stimulate innovative research both across and within disciplines (Knight and Pettigrew 2007; Rhoten and Parker 2004; Frost and Jean 2003). For example, contrary to the conclusions of Markóczy and Deeds (2009), Zahra and Newey (2009: 1062) indicate that IDR can spark further disciplinary paradigm development, but warn that the process is not without challenges as '*pure theoretical integration in the form of the mixing of central propositions is not always feasible or even desirable because of paradigm incommensurability*'.

The disciplinary – interdisciplinary discourse has been discussed at length in extant literature, often concluding that interdisciplinarity and disciplinary specialisation are mutually dependent. For example, Weingart (2000), following Mittelstraß (1987), concludes that disciplinary competence is often a prerequisite to interdisciplinarity, a notion further echoed by Klein (1990). However, Aram (2004), by recognising the ambiguities of disciplines, concludes that *pure* and *hard* disciplines may enhance interdisciplinary research whereas changeable, internally fragmented and overlapping disciplines affect the ability to *define* interdisciplinarity – in other words claims of disciplinarity can be dependant upon the clarity and distinctiveness of the particular disciplinary boundaries. This somehow paradoxical relationship is probably best captured by Weingart (2000: 40), who stated that:

> *'we can now unravel the apparent paradox of an ongoing and perhaps even intensified discourse on interdisciplinarity in the face of ever more specialisation and fragmentation. In other words, interdisciplinarity and specialisation are parallel. They are mutually reinforcing strategies, and, thus, complementary descriptions of the process of knowledge production'.*

Hence, as already noted, interdisciplinarity and the development of specialised disciplinary knowledge are interdependent processes of 'fission and fusion' or 'specialisation-fragmentation-hybridisation' (Morillo, Bordons and Gomez 2003; Dogan 1996; Dogan and Phare 1990; Klein 1990). Indeed, one of the conceptualisations of interdisciplinarity is based on the dynamics of inter-disciplinary integration, which will be discussed in detail in the following section. Although interdisciplinarity has also been conceptualised as specific forms of curriculum (Lattuca, Voight and Faith 2004; Klein 2003; Klein 1990) or as organisational arrangements (Turpin and Garret-Jones 2000), for the purpose of this thesis the main focus is on the aspects of disciplinary integration and behaviours, which are addressed below.

INTER-DISCIPLINARY INTEGRATION

IDR is often considered to be a form of disciplinary integration (Petts et al 2008; Aram 2004; Morillo, Bordons and Gomez 2003) with a number of different definitions and terms often placing the concept of interdisciplinarity on a continuum depicting different levels of integration between disciplines, fields and knowledge. For example, Paxton (1996 cited in Aram 2004) describes interdisciplinarity as starting at '*being informed of the other discipline or taking notice of it*' (informed interdisciplinarity), through different disciplines influencing each other (synthetic interdisciplinarity) to partial integration of disciplines and building a completely new field with no prevailing disciplinary basis (conceptual interdisciplinarity). Aram's own (2004) treatment is largely in agreement with Paxton, but focuses more clearly on the different levels of integration of knowledge, describing interdisciplinarity on a continuum involving such terms as *disciplinary*, *pluridisciplinary*, *cross-disciplinary*, *multidisciplinary*, *interdisciplinary* and *transdisciplinary*. Others, including Morillo,

Bordons and Gomez (2003) propose the adoption of a relatively coherent set of definitions developed by the OECD (1998: 1237) where '*multidisciplinarity, interdisciplinarity, and transdisciplinarity are used to refer to increasing levels of interaction among disciplines. Thus, in multidisciplinary research, the subject under study is approached from different angles, using different disciplinary perspectives and integration is not accomplished. Interdisciplinary research leads to the creation of a theoretical, conceptual, and methodological identity, so more coherent and integrated results are obtained. Finally, transdisciplinarity goes one step further and it refers to a process in which convergence among disciplines is observed, and it is accompanied by a mutual integration of disciplinary epistemologies*'.

As already discussed above, part of the problem of defining interdisciplinarity arises from the '*somewhat unfocused and interchangeable use of the terms multidisciplinary, interdisciplinary and transdisciplinary*', contributing to '*semantic confusion*' (Petts et al 2008: 596; emphasis in original) among academics and practitioners. Huutoniemi et al (2010) further point out that the existing definitions are rarely concerned with the operationalisation of the concept, hence proving to be rather inadequate. Indeed, as Petts et al (2008: 596) further note that there is a '*general uncertainty - across the research councils, academia and government - about what exactly is being sought, and why*' when it comes to IDR. The following section will attempt to synthesise the existing concepts and provide some distinctions between the different levels of integration.

MULTIDISCIPLINARY AND CROSS-DISCIPLINARY RESEARCH: BORROWING AND COOPERATION

In the simplest terms, multidisciplinary research can be conceptualised as involving two or more divergent disciplines approaching the research problem by using their own framings and methods, hence can be described as 'science of interaction' (Petts et al 2008: 596), which, often being thematically oriented, does not require substantial collaboration and, therefore, integration between disciplines is not achieved (Balsinger 2004; Morillo, Bordons and Gomez 2003; OECD 1998). Similarly, Rhoten (2004) concludes that many so-called interdisciplinary initiatives are merely recombination of the traditional modes of study, with little reconceptualisation, reorganisation, interaction or integration between disciplines; hence these might also, perhaps, be best described as 'multidisciplinary'. In a related vein, considering levels of interaction, Jeffrey (2003) delineates between *cooperation* (as working together for individual end) and *collaboration* (as working together towards common end), which seems to help us to discriminate between multidisciplinary and interdisciplinary research approaches. However, although increased multidisciplinarity does not automatically lead to interdisciplinarity (Schummer 2004), Petts et al (2008) point out that, when it works well, multidisciplinary research still can be beneficial and productive and facilitate learning.

Literature also encompasses a similar concept of *borrowing* relating to the use of methods and theories from one discipline within the research procedures of a different discipline (CoFIR 2004, Klein 1990; 2000). Whilst intensification of borrowing can signal unification of disciplines (or a related move on the continuum discussed earlier), it can also be difficult to map as sometimes borrowed techniques can get deeply assimilated into a discipline without further integration (Klein 2000). This distinction is further highlighted by Huutoniemi et al (2010), who notes that the ingredients of knowledge in multidisciplinarity

can be imported, exported, pooled across boundaries but without being substantially adapted in the course of interaction. Hence, multidisciplinary research remains cumulative and additive, where knowledge is subject to coordination and juxtaposition rather than integration.

INTERDISCIPLINARY RESEARCH: COLLABORATION AND INTEGRATION

As might be expected, there is some overlap in the categorisation of multidisciplinarity, borrowing and interdisciplinarity. According to Bruce et al (2004) the main difference between multidisciplinary and interdisciplinary research is the way in which disciplines collaborate and approach the focal issue. In the multidisciplinary approach each discipline works separately and approaches the problem from their own perspective, whereas in interdisciplinary research the perspectives are combined to provide a systematic approach and collective outcome. Petts et al (2008: 596) further suggest that interdisciplinarity involves '*synthesis of knowledge, in which understandings change in response to the perspective of others*', and hence can be described as 'science of integration' (see also Qin et al 1997). The integration itself can occur between individual scientists, between scientists and their organisations and among different disciplines involved in the research (Gooch 2005). Huutoniemi et al (2010) add a phase / process dimension to this, noting that interdisciplinarity is based on integration across fields occurring at different stages of framing of the research, spanning from defining research questions, to coordinating knowledge flows, to execution of research and finally to formulation of analysis and results.

In beginning to distinguish interdisciplinarity from multidisciplinarity, the various definitions of interdisciplinarity are far from being united or reaching any consensus that makes this distinction particularly clear, with the extant literature being littered with various

labels and sub-definitions of the concept. For example, whereas Salter and Hearn (1996) distinguish between *instrumental* (based on borrowing methods from another disciplines) and *conceptual* (which critically can examine assumptions of disciplinary work) interdisciplinarity, Petts et al (2008) distinguish between cognate (involving synthesis within established domains) and radical interdisciplinarity (involving synthesis within and between established domains) – a difference somehow mirrored in Klein's (2003) distinction between narrow and broad interdisciplinarity on the basis of the relative distance and differences between the collaborating disciplines. Similarly, Huutoniemi et al (2010: 84) distinguish between three levels of disciplinary integration ranging from the integration of different empirical data (*empirical interdisciplinarity*), to the integration of methodological approaches in a novel and integrated manner (*methodological interdisciplinarity*); to synthesis of concepts, models, theories in order to develop new theoretical tools for interdisciplinary analysis (*theoretical interdisciplinarity*).

It has also been argued that there are two distinctive groups of interdisciplinary approaches: those focused on problem solving (that is, instrumental, strategic, pragmatic, or opportunistic interdisciplinarities) and those focused on addressing and challenging the existing structure of knowledge (e.g. *reflexive, critical* or *epistemological* interdisciplinarities) (Huutoniemi et al 2010; Klein 2003). The issue of the structure of knowledge is also addressed in Aram's (2004) study, in which respondents defined 'interdisciplinary' as either 'new knowledge from the confluence, fusion, or synthesis of disciplines' or as knowledge integration, the creation of a new perspective or dialog by demonstrating multifaceted and differentiated understandings of the phenomenon of interest.

TRANSDISCIPLINARITY: FUSION AND SYNTHESIS

Transdisciplinarity, another concept often used interchangeably with interdisciplinarity, can be defined as the development of increasing coherence, unity and simplicity of knowledge (Aram 2004; Klein 1996). Petts et al (2008) further conceptualise transdisciplinarity as a permanent change in disciplinary practices resulting from the increasing complexity of the modern world (research) issues. The new (transdisciplinary) practice '*might literally transcend traditional disciplinary boundaries, challenging and renegotiating them, and in some cases re-drawing the disciplinary map*' (Petts et al 2008: 597), hence suggesting fusion of disciplines (Després et al 2004; Lawrence and Després 2004; Bruce et al 2004; Balsinger 2004). Similarly, Bruce et al (2004: 459) also provide a definition of transdisciplinary research, which '*focuses on the organisation of knowledge around complex heterogeneous domains rather then disciplines and subjects into which knowledge seems inevitably to become organised in academic settings, 'transcending' the academic disciplinary structure*', therefore tackling the issue of science fragmentation (Balsinger 2004; Lawrence 2004; Lawrence and Després 2004). These authors stress the responsiveness, action-oriented and context-specific aspects of transdisciplinarity. Transdisciplinary research is therefore argued to be aimed at tackling real-word problems; that is, it is suggested to be a suitable approach not only for characterizing such problems but also an effective means of delivering solutions (Lawrence 2004; Lawrence and Després 2004). In the kind of process envisaged in these treatments, transdisciplinary research crosses not only disciplinary boundaries of science but also boundaries 'beyond academy' (Szostak 2007; Lawrence 2004).

INTER-DISCIPLINARY INTEGRATION CONTINUUM

As some authors try to distinguish between the three main concepts of multi-, inter- and trans-disciplinarity, they often approach the task of differentiating the concepts by assessing the level of interaction between the various disciplines. For example, Zahra and Newey (2009) approach the concept of interdisciplinarity from the perspective of three distinctive knowledge development modes, which map neatly onto the three categories discussed in this section:

- *borrowing and replicating* signifies borrowing concepts and theories from one field and superficially intersecting them with those from another field with limited, if any, feedback to the original theories. This mode can promote replication of studies and often lacks in theoretical value, hence theories developed in this mode often fail to achieve any credibility, signifying multidisciplinary research.
- *borrowing and extending,* in which theories and concepts from one field are used to spark research at the intersection of fields, and subsequently communicate the findings back to the original disciplines, thus extending the original theories by implementing the new results and learning. However, although theories may be subject to some extension, there is no impact on the core (i.e. values, assumptions etc) of the original fields or disciplines. Finally, this mode of research requires development of certain appreciation for the differences stemming from the development of new theories, hence sharing certain characteristics of IDR.
- *transforming the core* indicates that theories originally imported (or developed) to investigate a phenomena are further synthesised with the focus on the unique domain at the intersection of fields and then are fed back to the original fields and disciplines, often leading to subsequent debates and revisions of the core of scholarship in the existing disciplines.

Similarly, Szostak (2007) places a significant stress on the importance of the ability not only to combine theories, but to be able to integrate them, further concluding that '*the rigour in interdisciplinarity can only come from knowing how, why, and what to integrate*' (p.4), hence indicating that interdisciplinarity can be achieved only through disciplinary integration.

Although there seem to be some general agreement across the literature that one of the conditions for 'real' interdisciplinarity is some level of integration occurring across disciplines, the extant literature is littered with labels and disputes (Klein 1990). For example, Szostak (2007) concludes that the original meaning of the term *transdisciplinarity* signifying integration beyond academy has been somehow lost and became very similar to that of the term *interdisciplinarity*. It also remains rather unclear what and how is being integrated as most of the definitions fail to provide enough detail.

To conclude the above discussion, by summarising the different existing approaches to multi-, inter- and trans-disciplinary research modes, the above definitions can be placed on a continuum, as portrayed in Figure 1. Importantly, the borders between the concepts should be seen as matters for debate, as the various definitions and approaches taken by different authors exhibit significant differences. Although the progressive integration between involved disciplines plays an important role in defining interdisciplinarity and delineating it from multidisciplinary cooperation, the extant literature does not provide clear indication of how to distinguish between the different levels of integration. Furthermore, the literature suggests that, as the integration progresses, the disciplinary practices are being challenged and may require to change and adapt to the new research context (Sutherland Olsen 2009; Petts et al 2008; Ramadier 2004). Thus, examining IDR from the perspective of disciplinary practices could perhaps offer a new framework providing a clearer distinction between the

different modes of integration. I will return to this notion in more detail in the discussion section of the thesis to further investigate the usefulness of adopting the lens of practice to examine the differences between multi- and inter- disciplinary modes of research.

Summarising the discussion so far, it may be concluded that certain levels of disciplinary integration are necessary for collaborative research arrangements to be considered as interdisciplinary, rather than multidisciplinary. The boundaries, however, remain fuzzy and difficult to operationalise as integration can take different shapes and levels (see Figure 1), which can be further influenced by the underlying drivers behind the collaborative arrangement. Similarly, as will be discussed in the following section, barriers can play active role in shaping interdisciplinary research collaborations, hence at least a brief analysis is necessary here.

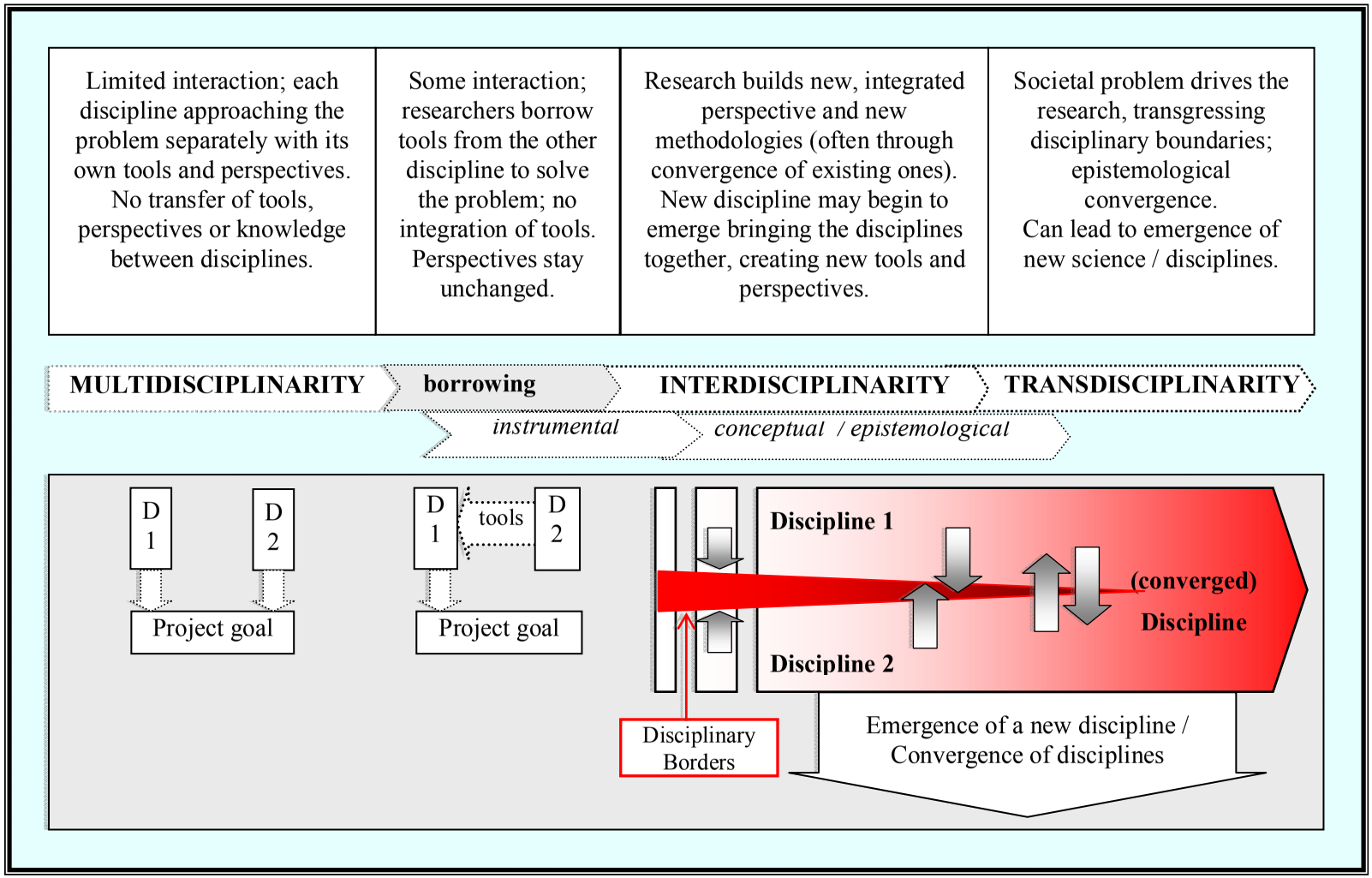

Figure 1: Interdisciplinarity from the perspective of the three levels of integration

WHAT MAKES IT, WHAT BREAKS IT: DRIVERS AND BARRIERS TO IDR

If IDR is to be supported and find a permanent place on the research landscape, some understanding of the underlying reasons, but also the barriers, for which individuals do or do not engage in this rather problematic mode of research is needed. This understanding can aid the development of supportive frameworks or facilitate the removal of potential obstacles as well as, more importantly from the perspective of this thesis, it can also shed light on the underlying research practices of IDR practitioners. It can further be argued that a better understanding of the motives for which individuals engage in IDR can make the distinction between multi- and interdisciplinary research somehow easier to achieve. Indeed, if the primary reasons to engage in IDR are financial rewards or promotion, the levels of disciplinary integration and feedback to the home discipline are likely to be miniscule (hence resembling simpler multidisciplinary cooperation) than if the research was driven by intrinsic interest in solving the research puzzle and pushing the boundaries of knowledge – even if this meant challenging the established rules and beliefs. Similarly, a number of barriers can prevent disciplines from delivering on the full promise of IDR, hence understanding of these is necessary for both theoretical and policy reasons. Consequently, the next section provides a discussion on, firstly, drivers and secondly, barriers to interdisciplinary research collaborations.

DRIVERS TO IDR

Existing literature provides an extensive list of drivers responsible for initiating interdisciplinary research collaborations, ranging from the desire to progress knowledge, through willingness to learn to somewhat less noble funding- or promotion-driven motives (Beaver 2001: 373). Drivers discussed in the literature can further be systemised and categorised into the following four overlapping groups: applicability and complexity; productivity and creativity; knowledge development; and personal and career drivers (Siedlok and Hibbert 2009b). Each of the groups is characterised by different dynamics, and hence potentially having different effect on the dynamics of IDR collaborations and relevant policies. The following sections provide an overview of each of the groups in turn.

COMPLEXITY AND APPLICABILITY

This category of drivers, addressing some of the most fundamental motives for IDR, comprises two interconnected themes of *complexity* and *applicability*. The former one asserts that the increasing complexity of many issues and problems of the modern business and society '*do not come in disciplinary-shaped boxes*' (Jeffrey 2003: 539) and often require integration of cross-disciplinary knowledge to be resolved (Szostak 2007; Klein 1990; 2000). Some of the most notable examples include business and socio-economic issues such as poverty, global trade and innovation (Pettigrew and Knight 2007; Aram 2004; Lawrence and Després 2004; Gibbons and Novotny 2001; Haberli et al 2001) public management fields such as health care (Aboelela et al 2007) and environmental studies (Lawrence and Després 2004); and in areas of science (Welsh, Jirotka and Gavaghan 2006). Following Rittel and Webber (1973), Buanes and Jentoft (2009) point out that disciplines are rather ill equipped to

deal with these, as they call them, '*wicked problems'*, due to the inherent difficulty to define which knowledge is relevant, which solution is the best and when the problem is actually solved. Consequently, the more complex the problems the greater the need for radical, rather than cognate, interdisciplinarity and, hence, the greater the collaborative challenges (Petts et al 2008; Evans and Marvin 2004).

The intrinsic complexity of many problems is further exacerbated by the range of different stakeholders' interests and the breadth of actors involved in any particular issue context (Evans and Marvin 2004; Horlick-Jones and Sime 2004). As Nowotny et al (2001) put it, scientific research and its social settings are interdependent – and the latter undermines perceived disciplinary boundaries and homogeneity. They therefore suggest that this necessitates research focussed on the production of more socially robust, epistemologically eclectic and highly contextualised knowledge. Thus, the increasing complexity of both the modern world and science itself leads to increasing calls for knowledge unification (Balsinger 2004; Kafatos and Eisner 2004).

Applicability, on the other hand, is linked to the increasing criticism and pressure upon academe for greater relevance of academic research. Following the seminal work of Gibbons et al. (1994), a number of authors started to call for more applicable type of academic research, referred to as Mode II research (van Aken 2004; 2001; Pettigrew 2001; Starkey and Madan 2001; Tranfield and Starkey 1998), which often bears characteristics of interdisciplinary (or transdisciplinary) research (Balsinger 2004; Weingart 2000; Gibbons et al 1994). Indeed, Gibbons et al (1994: 26) point out that '*disciplines are losing their functions of orientation and control*' as the Mode 2 knowledge becomes transdisciplinary in character (see Weingart 2000), which can indicate that applicability driven research undermines pure academic research (Bruce et al 2004). This, however, is not necessarily the

case, as Mode I interdisciplinary research is mostly focused on overcoming blockages to further development within disciplines or enable new productive areas of research, and therefore can be considered as '*one of the primary engines of the evolution of disciplines*' (Bruce et al 2004: 460), and hence knowledge development, as discussed in the following section.

KNOWLEDGE DEVELOPMENT

Extant literature suggests that interdisciplinary knowledge is one of the main components of knowledge based society; by some, it has been seen as a rule rather then an exception and a focal point of interest for scholars, policy makers and practitioners (Zahra and Newey 2009; Aboelela et al 2007; Pettigrew and Knight 2007; Carayol and Nguyen Thi 2005; Balsinger 2004; Rhoten and Parker 2004; Jeffrey 2003). IDR is often characterised as leading to scientific advances (Bruce et al 2004), new theories (Zahra and Newey 2009) or the emergence of new disciplines (Hackett and Rhoten 2009). Furthermore, through novel approaches to questions, theories and generalisations it is argued to open up completely new frontiers of research (Marcina 1995; Pickett, Burch and Grove 1999). As noted by Mittelstraß (1987, cited in Weingart 2000), interdisciplinarity often starts by asking previously unasked questions in order to learn something that the discipline itself does not know. Zahra and Newey (2009) suggest that interdisciplinary work can lead to further development of theories, fields or disciplines, as well as changes within the underlying disciplinary paradigms. The process, however, is not without challenges as '*pure theoretical integration in the form of the mixing of central propositions is not always feasible or even desirable because of paradigm incommensurability. For example, the classic conflict between the ontological and epistemological assumptions of qualitative and quantitative research methods has led to warring tribes whose differences appear irreconcilable*' (p:

1062). Furthermore, as already alluded to in previous sections, for a number of proponents of disciplinary 'purity', IDR is likely to act as a hindrance rather than a creative spark for development of disciplinary paradigms (Markóczy and Deeds 2009).

In contrast, boundary crossing questions often have a personal, curiosity driven angle, as one realises the limits of ones own discipline (Aboelela et al 2007), or the potential to establish new perspectives and theoretical frameworks (Knight and Pettigrew 2007). For example, Welsh, Jirotka and Gavaghan (2006) note that IDR forms integral part of the Big Science and by addressing complex research problems, advances knowledge development. Furthermore, not only is IDR often argued to result in the creation of new knowledge, but it also thought to lead to more creative solutions, ideas and major breakthroughs (Zahra and Newey 2009; Hackett and Rhoten 2009; Szostak 2007), as the following section will discuss.

PRODUCTIVITY AND CREATIVITY

IDR is often thought of as one that leads to scientific advances (Bruce et al 2004) and through novel approaches to questions, theories and generalisations (Pickett, Burch and Grove 1999) can open completely new frontiers of research (Marcina 1995), and consequently, novel solutions, often achieved through creative knowledge re-combinations (He et al 2009; Rhoten and Pfirman 2007: 56; Hargadon 2003). Hence, IDR is often being linked to *creativity, progress and innovation* (Buanes and Jentoft 2009) as the '*intersection of disciplines and fields provides an important forum for creative theory building*' (Zahra and Newey 2009: 1059), partly attributed to the increased diversity of IDR teams. Indeed, as a neuroscientist in Gooch's (2005: 118) paper explains, '*it [collaboration among different persons from different disciplines] is advantageous because you have more brains to draw*

upon. The number of neurons firing increases. No two people see the problem alike; it's like having a multi-faceted cube'.

As implied by Gooch (2005), higher creativity and the likelihood of generating breakthrough results in IDR teams (Szostak 2007; Carayol and Nyugen Thi 2005; Morillo, Bordons and Gomez 2003) is often linked to the increased diversity within IDR teams (Boni, Weingart and Evenson 2009). This notion closely resonates with more general case for diversity, extensively discussed in the literature, as a way to increase both innovativeness and effectiveness of organisations. However, it should be noted that mismanaged or unattended-to diversity is more likely to have adverse effects on the creativity of research groups (Kochan et al 2003). For example, Boni, Weingart and Evenson (2009: 410) warn that although diversity of perspectives can lead to novel knowledge re-combinations, the process is often hindered by misunderstandings and misconceptions, frequently leading to conflict and frustration. Exposure to diverse IDR teams has been also recognised as potentially leading to further enhancements within the native disciplines of researchers (Bruce et al 2004; Frost and Jean 2003), resulting in enrichments of tools, methods or theories (which can be considered as more creative) or gains in efficiency and productivity. Where this kind of advance is evidenced it may also lead to shifts in intellectual perspectives and have an impact on attitudes towards IDR (Knight and Pettigrew 2007; Carayol and Nguyen Thi 2005; Gooch 2005; Frost and Jean 2003; Morillo, Bordons and Gomez 2003), further leading to development of new IDR specific practices (Sutherland Olsen 2009) and amplifying the support for this mode of research.

Extant literature provides a wide range of productivity drivers for IDR, ranging from better access to resources, both information and equipment (Luukkonen, Persson and Siverstein 1992) to a variety of ancillary benefits, including, but not limited to, social and human

capital in the form of new skills, relationships and trust; infrastructural capital and access to equipment, databases and methodologies; and perhaps even access to further research funding (Pettigrew and Knight 2007: 6-7). On the other hand, IDR can offer another, particular form of productivity – i.e. academic productivity in the form of increasing publication impact or the number of publications. In particular, it has been suggested that interdisciplinary articles show higher citation rates than articles focused on one discipline and, therefore, scientists may enhance the impact of their research by exploring literature from other fields (Steele and Stier 2000 in Morillo, Bordons and Gomez 2003). In contrast, however, Carayol and Nguyen Thi (2005) found out that publishing in other fields does not significantly increase one's publication impact. Moreover, Luukkonen, Olle and Sivertsen (1992), building on the work of Price (1986), suggest that collaborative authorship is actually a result of economic rather then intellectual factors as co-authors try to compile a full paper out of the fractional work of each co-author. Nevertheless, both the division of labour and the creativity associated with collaborative research have led to a number of initiatives and frameworks to support this approach, with policy makers taking for granted that collaboration will increase quantity and quality of outputs (He at al 2009), and in some extreme cases leading to co-publications being evaluated as somehow superior (Schmoch and Schubert 2008).

The potential for creativity and productivity in IDR teams comes with a problem, however. It derives in part from the positive tension between different standpoints, which means that productivity in such situations should not be seen as a given; potential negative issues associated with process conflict can arise (Kochan et al 2003; Amabile et al 2001). Hence, academic collaborations, which are not guaranteed to yield higher outputs, can impose significant coordination costs related to bridging institutional and geographic distances; hence decreasing the overall gain from collaborative knowledge creations (Cummings and

Kiesler 2007). Perhaps the drive for overcoming these potential downsides can be found in connection with individual motivations, to which the discussion now turns.

PERSONAL AND CAREER DRIVERS

In some reported cases, IDR is linked to personal or career motives ranging from friendship and a willingness to work together (Knight and Pettigrew 2007; Beaver 2001) to realisation of limitations of own discipline (Aboelela et al 2007). Also, the increasing relevance gap, resulting from discussed compartmentalisation of scientific and professional knowledge and the sectoral division of responsibilities in modern society, can often lead individuals to undertake IDR as a reaction to inefficiencies and limitations in their own disciplines (Rhoten and Parker 2004). Other motives listed in the literature include such individual benefits as personal development (Frost and Jean 2003), or the fact that interdisciplinary research is more interesting and stimulating (Bruce et al 2004), and can help to recharge one's energy and excitement (Beaver 2001).

Another group of motives is closely related to a career development and include the opportunities to develop 'new lines of sight' and new theoretical frameworks (Knight and Pettigrew 2007) or development of network, which can help in future career progression (Beaver 2001). In some cases the motivation may be linked to easier access to funds devoted to IDR (Schummer 2004) – a driver that can certainly advance one's career but not necessarily concerned with addressing IDR problems or progressing knowledge. Indeed, increasing pressures from academic institutions or the requirements of some funding bodies may frequently lead to increased interdisciplinary cooperation or, equally, participants may decide to write interdisciplinary proposals as a risk management strategy to access a particular stream of funding (Massey et al 2006). However, in many such cases the work

tends to be associated with a collection of disciplinary researchers assembled merely for the purposes of obtaining such funding, rather than a real IDR team (Rhoten 2004; Schummer 2004; Amabile et al 2001).

Summarising the above discussion, there are many good reasons for interdisciplinary research to become a more permanent feature of the landscape of academic research. Indeed, as noted by Sanz-Menéndez, Bordons and Zulueta (2001: 2) although the policy discourse in the recent decades presented IDR as good, desirable and inevitable, the tools and approaches to measure or promote IDR remain inadequate. However, as some of the above examples indicate this is not always the case as many impending barriers are also identified in the literature. Hence, understanding what may impede IDR efforts, and how, can help in developing better support frameworks. Hence the following section will present the main barriers to IDR found in the existing literature.

BARRIERS TO INTERDISCIPLINARY RESEARCH COLLABORATIONS

Despite the wide recognition of the benefits of interdisciplinary research, there is an abundance of literature providing examples of various barriers to interdisciplinary research. Whereas some authors claim that the success of IDR depends on personal traits and, consequently, the personal barriers are the main ones (Bruce et al 2004; Duncker 2001), others pay particular attention to institutional barriers (Aram 2004; Lesher 2004; Rhoten 2004), the disciplinary and cultural differences between participants (Massey 2006; Carayol and Nguyen Thi 2005; Jeffrey 2003; Sung et al 2003; Duncker 2001) and resulting issues related to communication (Fay et al 2006; Lawrence and Després 2004; Frost and Jean 2003; Lattuca 2002; Duncker 2001). Similarly, Petts et al (2008) delineate five main challenges to

IDR, including the prevailing, and rather undermining, association of IDR with applied or instrumental research and the consequent tendency to value certain (hard) disciplines in the collaborative setting; challenges related to cultural incompatibilities as well as the 'hard wiring' of existing organisation, support and assessment for IDR. The authors further note that the challenges are exacerbated as the diversity of the disciplines involved increases. In contrast, Rhoten (2004) concludes that the main barrier is not related to a lack of extrinsic support or intrinsic motivation but, rather, a lack of systemic implementation, whereas Boix Mansilla and Gardner (2003) attribute the main problem to a lack of clear and explicit assessment criteria for IDR. Hence, similar to the drivers discussed earlier, barriers to IDR can be synthesised into four distinctive, but not exclusive, groups including *disciplinary differences; personal factors; institutional factors,* and *process related factors* (Siedlok and Hibbert 2009b), as elaborated in the following sections.

DISCIPLINARY DIFFERENCES

Increase in the number and differences between the involved disciplines in a (potential) IDR project often translates directly into an increase of complexities and uncertainties of the project. As a result, such challenges can lead to obstructive behaviours, emotional insecurity and, finally, conflicts (Frost and Jean 2003; Finkenthal 2001). These problems are partially rooted in the particular modes of engagement and framing favoured within disciplinary communities (Petts et al 2008). That is, disciplinary communities encourage IDR in different ways and with differing degrees of enthusiasm, leading to the uncomfortable realisation that approaches to IDR may be, to a degree, discipline-specific (Carayol and Nguyen Thi 2005). Duncker (2001) suggests that many of the problems arising in IDR are often deeply embedded in the character of the involved disciplines, each of which has roots in their particular paradigms and associated ontological and epistemological values (see also

Finkenthal 2001; Klein 1990; Kuhn 1974). Similarly, whereas Buanes and Jentoft (2009) define disciplines as social institutions, further noting that interdisciplinary projects inevitably will stumble into obstacles related to disciplinary differences, Sung et al (2003) refer to this kind of collaborative process problem as cultural – or tribal – barriers and point out that they can be as significant as institutional barriers. Such 'tribal' affiliations can be quite strong, thus researchers are often unwilling to abandon their own, particular, disciplinary perspective developed over years of experience (Gooch 2005), partly due to the view that learning another field of knowledge reduces the researcher's time for achieving mastery of their own discipline. There is thus an almost automatic assumption that interdisciplinary scientists are less competent than focussed specialists (Naiman 1999).

Furthermore, norms regarding disciplinary cultural dynamics can also be of importance. For example, the execution of research in teams may be a norm in some disciplines but much more infrequent and unusual in others (Massey et al 2006) – in other words, each discipline, treated as a community, has well developed practices for conducting research which may differ from other disciplines (Amin and Roberts 2008). Undertaking an IDR project may therefore require the development of a new set of practices. Indeed, as noted by Merton (1973; see also Haas and Park 2001), the macro level norms of academic disciplines are often thought to determine the behaviours of the members of the professional community, impacting on behaviours such as sharing or withholding information from other researchers. Haas and Park (2010) further note that the norms and behaviours shared by the 'professional reference group(s)', rather than the whole professional community, are having even larger impact on the individual behaviours and attitudes, resonating with the concept of the role of Community of Practice in shaping behaviours of individuals. Other important aspects of the cultural dynamic include not just disciplinary attitudes towards interdisciplinary research (in the most general terms) but also in the fostering of the relevant skills to undertake it, and

their perceptions of the cost-benefit equation associated with it. On the simplest level, Jeffrey (2003) observes that the skills necessary for interdisciplinary collaboration are different from those needed for disciplinary research. Therefore developing these 'extra' skills requires extra resources in terms of time and effort, whereas, as will be presented in the next subsection, the reward systems may not offer enough incentive for researchers to develop these skills.

INSTITUTIONAL FACTORS

This vast group includes, among others, organisation of academic institutions into departments and faculties, existing reward and tenure systems, funding structures for research at university, government or corporate / private levels, and many other factors that impact on the way universities are organised, operated and evaluated. Since science is organised around disciplinary specialisation, so are universities, funding bodies and academic reward systems, the existing academic reward systems fails to adequately incentivise IDR (Carayol and Nguyen Thi 2005). As a result, the evaluation mechanisms for research are thought to be amongst the most significant and influential barriers to IDR. Not surprisingly, Carayol and Nguyen Thi (2005) found that the discipline-based peer review evaluation system that dominates the sciences leads, naturally enough, to a strong preference for disciplinary research. Similarly, Lesher (2004) points out that most scientific institutions are not positioned to support IDR, instead, the review and reward systems can often penalise interdisciplinary research. The review system in the UK can not only discourage collaborative research, but can often lead to competition between departments from a single unit of assessment (Welsh, Jirotka and Gavaghan 2006). As a result of the different factors and the way universities, departments and individual academics are rewarded and funded,

there may not be enough incentive for institutions to support IDR – a phenomenon characterised as 'disciplinary parochialism' (Pettigrew and Knight 2007).

At a broader institutional level, many authors highlight the influence of funding structures on the prospects for interdisciplinary research (Carayol and Nguyen Thi 2005; Schild et al 2002, Pettigrew and Knight 2007). On the one hand, it is reported that it is difficult to obtain money for an interdisciplinary research (for example, from research councils which are organized along disciplinary lines). On the other hand, some funding agencies seem to require (either or both) international and interdisciplinary collaboration whatever the needs of the research problem at hand, which can result in the brokering of artificial pseudo-relationships between parties that are not familiar with each other (Pettigrew and Knight 2007; Schummer 2004), in order to 'tick the right boxes' that the agency requires.

Interdisciplinary research often comes at a price of slower career progress (Rhoten and Parker 2004) and, consequently, doctoral programmes, often under economic pressures, are inhospitable to interdisciplinary research (Golde and Alix Gallagher 1999; Sung el al 2003), affecting the future willingness, attitudes and ability (skills) of researchers to engage in this mode of research. This leads to the suggestion that the process of interdisciplinary research does not simply require that individuals develop new skills and approaches, but rather also necessitates a degree of 'organisational learning' to change cultures, strategies and structures. For instance, Lattuca (2002) points out, that for interdisciplinary research to take place, institutions need to collectively learn the skills that will allow them to pursue this type of research. She further points out, that this needs to be allied to new institutional strategies that balance other aspects of the institutional academic portfolio (such as teaching) with a commitment to significant research, especially since interdisciplinary research can be more demanding and time consuming.

Other barriers discouraging academic institutions from undertaking IDR can be linked to the technological design (i.e. organisation of research groups; infrastructure or providing relevant training) (Welsh, Jirotka and Gavaghan 2006) or to the administrative complexities (CoFIR 2004) related to interdisciplinary research. Wood (1999), on the other hand, concludes that the biggest barrier to IDR is related to a lack of agreement on what direction it should take, which can be linked to a lack of precise understanding and definition of interdisciplinary research and its role in research agendas (Petts et al 2008).

PROCESS RELATED FACTORS

Extant literature lists a number of factors and barriers impacting on the process of collaborative research. First of all, it can be difficult to determine if IDR is proceeding successfully, since as Boix Mansilla and Gardner (2003:1) point out, the validation of interdisciplinary work can be obscure and challenging for three reasons: the existence of various, often conflicting, standards of validation brought to the table by each discipline; a lack of conceptual clarity about the nature of IDR; and a lack of precedents resulting in the need to developing new validation criteria as a part of the research project itself. To a large extent process issues in IDR context are similar to issues related to team development, however, the multidisciplinary nature of the teams can further exacerbate these issues. For example, Naiman (1999: 293) lists five major pitfalls characterising IDR work, including:

- longer time required to master the other discipline and build shared understanding;
- inequity in the team quality as not all members may be of the same intellectual calibre or have the same levels of commitment to IDR and resulting in need for tough management and leadership;
- longer time required to produce results as well as issues related to co-authorships;

- challenges of organising and performing the work as well as incorporating larger social and political insights often associated with IDR – especially as some team members may be reluctant to do so;
- perception that interdisciplinary work is less exciting and researchers involved in IDR less competent and accomplished.

Similarly, Sutherland Olsen (2009) notes that IDR is rather a slow process riddled with challenges, often resulting from differences in styles of leadership; systems of evaluations; ways of planning and organising work; typical career paths; communication problems and, finally, other problems associated with insurmountable boundaries between faculties. Other process-related barriers include: problems with finding partners, or, in the case of doctoral research, advisors or supervisors; problems with finding relevant literature from multiple research fields; or finding a similarly-minded and supportive research community (Golde and Alix Gallagher 1999).

As can already be seen, some of the barriers listed span more than one of the categories. For example, the extra time required to become a competent partner in an IDR project can be connected to both processual (e.g. in general IDR requires more time and hence discourage researchers keen to get quick results) and personal issues (e.g. the decision to undertake or not IDR may be personal, based on the career choices). Similarly, many of the problems often stem from the disciplinary differences – whether institutional, cultural or both. However, process problems are – like the issue of validation discussed above – often related to problems of understanding, and three underlying causes for such problems can be suggested.

First, it is typical for those taking part in an IDR project to still be firmly rooted in their own disciplinary traditions and culture, which can dominate their values and behaviours (see, for

example, Frost and Jean 2003; Wallerstain 2003; Klein 1990). Hence, for example, agreeing on the choice of methodology for data interpretation can lead to tensions and mistrust among the team members and often requires a significant amount of management (Massey et al 2004; Bournois and Chevalier 1998). These problems are not however limited to the early stages of IDR and tensions are likely to emerge at any stage (Massey at al 2006), which can partly be attributed to the idea that disciplines can be incommensurable and defend what they consider as valid knowledge (Frost and Jean 2003). Furthermore authorship, patenting or data ownership issues are also likely to arise at different, later stages of the process, further hindering collaborative research (Pettigrew and Knight 2007; Gooch 2005).

Second, there is a strong symbolic and linguistic core for any given discipline, which consists of conceptual and discursive particularities, which define the way in which problems, and potential solutions are defined and described (Aram 2004; Wallerstein 2003; Lattuca 2002). This has implications for dialogue in IDR, when the problem of 'talking past' each other can become protracted and troublesome. Essentially, disciplines can vary not just in terms of subjective values (as discussed earlier) but also in terms of what they consider to be 'objective facts'. These fundamental differences can overshadow any similarities between disciplines, hindering any fruitful exchange of ideas and leading to '*dialog between the deaf*' (Boschma and Frenken 2006).

Third, the cultural and intellectual distinctiveness of each discipline enables each to function as a community, resourcing and enabling the collective and individual development of methodological approaches for the development of knowledge within them. However, IDR project groups lack this kind of community-structure support, and individuals within such teams, as they develop new approaches, may find it difficult to locate appropriate and supportive peer networks that can critically evaluate them (Golde and Gallagher 1999). Thus it is possible for IDR processes to be developed (at least to a degree) in a vacuum, with

individuals often finding themselves in '*a state of social and intellectual marginality*' (Klein 1990:12). This potentially increases the risk of the enterprise at the same time as it (potentially) decreases its efficiency.

PERSONAL FACTORS

Personal factors, often overlapping with institutional or disciplinary differences, include: disadvantages in career development associated with IDR; time constraints; defensiveness and intolerance (Aram 2004; Frost and Jean 2003); and (a lack of) the necessary skills and experience for interdisciplinary projects (Welsh, Jirotka, Gavaghan 2006; Carayol and Nguyen Thi 2005; Aram 2004; Bruce et al 2004; Bromme 2000). Closely related to this group of factors are barriers arising from fear of traversing the fields of interdisciplinary research endeavours (Golde and Alix Gallagher 1999). Indeed, as pointed out by Wood (1999), informal discussions with other disciplines are often open and relaxed, however, once they become specific, individuals often decided to retreat back to the safety of own discipline. Thus, overcoming fears and developing pro-IDR attitudes among individuals can be among the most important steps in facilitating this form of research and in overcoming the other barriers. This also can be the first step in acquiring the necessary skills and practices to conduct interdisciplinary research.

BARRIERS TO IDR SUMMARISED

As discussed above, the barriers to IDR are numerous and of different natures. Differences between the groups might be fuzzy and many of the barriers presented in the literature are likely to be part of more than just one of the groups. This further amplifies the notion that

these groups are by no means exclusive or exhaustive. As an illustration, Figure 2 presents that the boundaries between the four groups are permeable and often overlapping. Hence, a clear distinction can be often problematic.

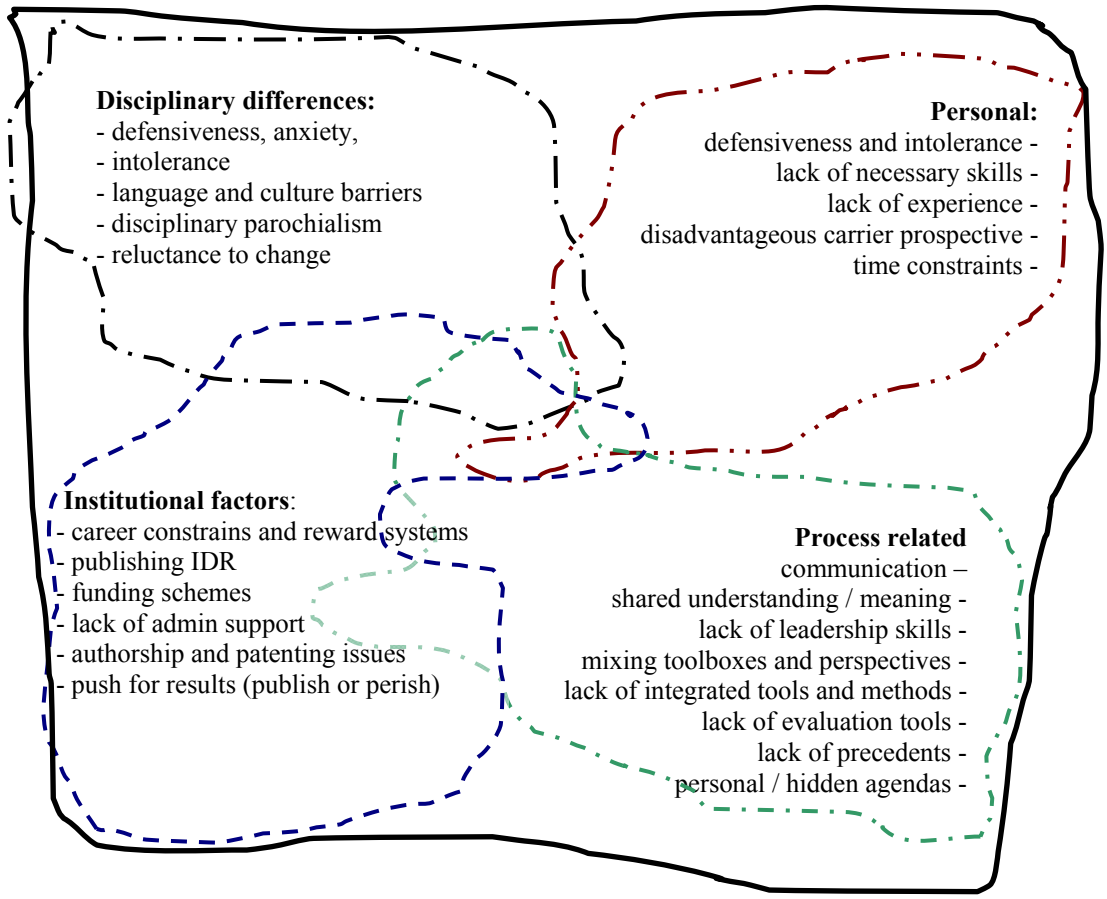

Figure 2: Some of the main groups of barriers to interdisciplinary research.

Each of the groups separately and in combination is likely to hinder development of IDR as widely accepted mode of research. Disciplinary differences, often related to incommensurabilities between disciplines (Frost and Jean 2003), can be used to dismiss IDR as not legitimate or useful, and in some extremes as undermining disciplinary research (Bruce et al 2004). Furthermore, skills developed in disciplinary communities may not be

relevant, or compatible, to engage in interdisciplinary collaborations. For example, Zahra and Newey (2009) note that although highly rewarding, IDR requires specific skills in both theory building and cross-field communication, hence indicating that there is an arising need for institutions and policy makers to further investigate the character of these skills, but also interaction with the existing disciplinary frameworks. At another, more nitty-gritty level, matters such as authorship, patenting or data ownerships can prove to be unconquerable (Pettigrew and Knight 2006; Gooch 2005), further inhibiting any future engagements of individuals in IDR. Clear and shared rules, or drafting a contract regarding these issues may be helpful (Boni, Weingart and Evenson 2009) – but truly interdisciplinary research processes, which may take emergent directions, can make it difficult to specify terms in advance. Although a number of authors attempted to develop step-by-step approaches to performing interdisciplinary research (Szostak 2002; Newell 2001), critics quickly pointed out that these steps were either too general or too exclusive (Szostak 2002; Bailis 2001), indicating that challenges of developing mutual understanding, organizing around a collectively developed conceptual language and building an appropriate *modus operandi* are, to a degree, unique to each IDR project, further exacerbating any attempts to standardise or operationalise this mode of research (Huutoniemi et al 2010). Nevertheless attention to these areas should be a key area in the development of the terms of reference for IDR collaborations, further requiring better understanding of the dynamics of IDR from the perspective of practices and behaviours (Sanz-Menéndez, Bordons and Zulueta 2001).

Another aspect that can have an impact on the process of interdisciplinary collaboration is its nature. In particular, the issue of whether the interdisciplinary research initiative is a part of an administrated project (i.e. with a defined goal and timeframe), sustainable programme, or a more spontaneous collaboration. In the first case, the academic research teams can be defined as ‘task teams’ (Massey et al 2006), and they likely to share many of the

characteristics and dynamics of other problem-oriented team collaborations, discussed in literature elsewhere. However, according to Fay et al (2006) two streams of theories explain the impact of interdisciplinarity on a team's performance (particularly with regard to innovation): *cognitive resources theories*, according to which increasing interdisciplinarity increases the performance of a team and *theories on social identity and categorisation*, which suggest that interdisciplinarity may decrease a team's performance as human actors tend to discriminate against people from 'other' groups. As might therefore be expected, individuals that strongly identify themselves with a functional group (and team association is weak) are less effective and contribute less in interdisciplinary teams, which can be a significant issue. This negative effect can be further strengthened by a lack of 'shared mental models' or common language and assumptions about both group processes and the problem-at-hand. However when team association is 'too' strong, teams may be less likely to listen to outsiders and develop an unhelpful degree of insularity (Fay et al 2006). Thus, on the one hand disciplines as communities can lead to insularity (Ferlie et al 2005) and, on the other hand, can significantly impact upon individuals' attitudes, skills and worldviews towards IDR. Hence, facilitation, management or support of IDR, whether at individual or organisational level, seems to be particularly challenging and requires novel approaches and frameworks to capitalise on the benefits of this form of research. The matters seems further complicated as (collaborative) behaviours of individuals can be mostly influenced by the professional reference groups they are embedded in (Haas and Park 2010), hence suggesting that the understanding of the dynamics of this 'meso' level may be necessary in supporting development of the desired behaviours. Hence, as the discussion above suggests, better understanding of the underlying disciplinary practices, and their dynamics in the IDR context, can offer some an interesting framework to inform the future policies and to aid the attempts to support IDR. I will discuss this in more detail in the next section, however,

before that the communal and cultural aspect of disciplines and interdisciplinarity requires a brief examination.

DISCIPLINARY COMMUNITIES, INTERDISCIPLINARY COLLECTIVITIES

The discussion so far indicated that due to their historical development disciplines became somewhat isolated, often developing particular disciplinary languages, worldviews, research tools, methods and preferences. Existing literature on IDR often defines disciplines as *cultures* dominating behaviours and values of their members (e.g. see Frost and Jean 2003; Wallerstain 2003; Klein 1990), hence, it can be asserted that these cultural traits can have significant influence on the perceptions and processes underlying IDR. Hence, disciplines are not purely a mechanism for ordering and systemising knowledge or cognitive learning, but more importantly, they are the loci of communities with often well developed habits, identities and mechanisms of situated learning, as I shall explain in the argument that follows below.

DISCIPLINARY TRIBES AND COMMUNITIES OF PRACTICE

According to Kuhn (1974; 1970) practitioners of every discipline share three important elements: *symbolic generalisation*, *models* and *exemplars*, which define the way problems and solutions are approached and described by each of the disciplines, ensuring that all the members of the discipline see and respond in the same way to stimuli. In other words, these three elements frame the thinking, intellectual activity, systems of values, behaviours and attitudes of individuals (Aram 2004; Lattuca 2002; Finkenthal 2001), hence disciplines can be treated as a type of community with shared culture, languages and worldviews (Bruce et

al 2004; Lawrence and Després 2004; Pickering 1992; Becher 1989). Indeed, Hayes and Fitzgerald (2009: 425) note that scientists are '*bound together by a common language, displaying occupation specific rituals and comprising the exclusive audience for, and judges of, each other's work'*. The communitarian behaviours of disciplines are further directed by certain institutionalised norms, socialisation and training and often reinforced by systems of rewards and sanctions adopted by particular disciplinary groupings (e.g. departments or research groups). Furthermore, due to their evolutionary trajectories, some disciplines may be tied together by specific patterns of thought (Aram 2004; Finkenthal 2001), whereas disciplines characterised by completely different evolutionary patterns can share a minimum, if any, attributes.

Although often conceptualised as (coherent) communities, the rigidity and coherence of disciplinary structures remains a subject of some debate and disagreement. For example, whilst Bruce et al (2004) define disciplines as stable, systematic communities within which researchers concentrate their experience into a particular worldview, Aram (2004) defines them as quasi-stable, partially integrated, semiautonomous intellectual conveniences consisting of problems, theories and methods of investigation. Similarly, Becher (1989) conceptualises disciplines as self-regulating and self-sustaining communities defined by their own identities and social traditions and practices – a view that seems to be shared to some extent by Haas and Park (2010), noting the importance of the meso-level (i.e. professional reference group rather than disciplines at large) in regulating behaviours and identities. This further implies that disciplines are a form of *community of practice*, in which the community – although rather loosely defined, decides which practices are legitimate and valued. Consequently, some disciplines may not consider IDR, or indeed the research practices and worldviews of other disciplines to be legitimate or valued research 'practice'. This incommensurability of disciplinary paradigms can inhibit any dialog and lead to talking past

each other in IDR context, resulting in professional communities sealing themselves off from other communities (Ferlie et al 2005). Buanes and Jentoft (2009: 449) further note that disciplines provide individuals with '*a personal and professional identity embedded in an 'epistemic community',* hence engaging in IDR can lead to tensions between members of the community but also within individuals' systems of values.

The link to communities of practice, with particular focus on the aspect of *practice*, can be especially helpful in understanding the workings of IDR as this framework deals with the aspects of practices, participation, learning and identity of individuals in different communities (theories related to Communities of Practice will be discussed in detail in the following chapter). For example, Sanz-Menéndez, Bordons and Zulueta (2001) note that one of the dimensions of IDR refers to behaviours and practices of individuals and research groups, consisting of a mix of actions (e.g. use of techniques from other disciplines) and less tangible attitudes and systems of values shared by the individuals engaged in IDR (e.g. criteria of incorporating new members in IDR teams or reasons of engaging in collaboration with external partners). Sutherland Olsen (2009) further notes that an examination of the emergence of practice in multidisciplinary environment can provide a better understanding of the dynamics of IDR, offering answers to the questions of how interdisciplinary groups overcome the challenges and what makes them succeed. Thus, she suggested that the emergence of a certain practice arises as a result of friction between disciplinary practices and is characteristic of interdisciplinary research groups. Similarly, Jamali and Nicholas (2010) found that scientists working in subject areas of an interdisciplinary nature displayed different information-seeking practices compared to those practicing in well established fields with clear boundaries. This further resonates with the wide recognition that IDR often requires different, IDR-specific skills to those necessary to conduct disciplinary research (Welsh, Jirotka and Gavaghan 2006; Jeffrey 2003; Lattuca 2002; Klein 1990). Indeed, the

'*cultivation of skills that are fundamental to interdisciplinary work*' (Klein 1990: 150) is considered to be one of the success factors for IDR projects.

The concept of acquiring these specific skills seems to be further related to development of specific pro-IDR attitudes and appreciation for this mode of research (Amabile et al 2001). In particular, Buanes and Jentoft (2009) note that these like-minded (IDR) researchers are likely to be part of a widespread epistemic network, often referred to in literature as *interdisciplinarians* (Hackett and Rhoten 2009; Aram 2004; Caruso and Rhoten 2001; Daily and Ehrlich 1999). This, as already noted, can create tensions between individuals and native disciplinarian communities, but also challenge individuals' identity (Klein 1990) as they struggle to suspend their own disciplinary identities in the IDR context (Gooch 2005), or seek to '*distinguishing themselves from the ''tribes and territories''*' of disciplines (Hackett and Rhoten 2009: 410). Hence, as noted by Buanes and Jentoft (2009: 450), '*crossing disciplinary boundaries will challenge expectations that others have of me, as well as those of my own. It raises questions concerning my identity, my own values, and I risk breaking norms within my discipline. I also risk my colleagues condemnation*'. Although the norms of professional groups (e.g. disciplines) can influence collaborative attitudes and behaviours, Haas and Park (2010) further note that the smaller 'professional reference group' is likely to exert stronger influence over individuals. Hence, understanding of these tensions, arising from the dynamics of belonging to particular communities can offer some additional insights into the dynamics of IDR.

The discussion so far indicates the prominent role of communities on the behaviours and systems of values of individuals and the pressures these can exert on individuals' systems of values and behaviours. However, focusing the discussion on the institutional aspects of these communities bears the risk of ignoring the role of personal enactment and the role of

individuals on the development of these communities. Hence, these should be briefly considered at this point.

THE EMBODIMENT OF CONNECTIONS: FROM THE PERSONAL TO THE COLLECTIVE

Although IDR is often analysed from the perspective of disciplines or research groups, and often focusing on the structural aspects of research groups or adopting bibliometric techniques to measure the 'knowledge flows' resulting from IDR research (e.g. see Sanz-Menéndez, Bordons and Zulueta 2001), a number of authors propose to include various individual enactments to develop better understanding of IDR dynamics. For example, Bromme (2000: 116) links IDR to personal traits as important factors impeding on interdisciplinary work, further noting that the identity or ego-strength of a researcher may prove invaluable whilst '*moving around in the foreign territory*' of interdisciplinary research. Other personal traits listed in literature encompass reliability, flexibility, patience, resilience, risk-taking, or necessity to abandon 'imposing behaviour' (see Bromme 2000). Hayes and Fitzgerald (2009: 426) note that individuals who are '*equally at home in more than one occupational or organisational culture'* often share certain characteristics, hence referring to them as 'boundary-crossers'. Although the 'boundary-crossers' are part of a larger group, the crossing of boundaries is enacted at the individual level, can be linked to personal preferences and attitudes (not always shared or approved by the group), however, these practices impact on the group and the knowledge exchange at aggregated levels. Hence, personal traits further include attitudes and often specific identity associated with IDR, including, among others, the willingness, ability and practice to look beyond one's own discipline whilst conducting research, openness, trustworthiness, appreciation for cultural

differences, associating oneself with being an interdisciplinarian (Hacket and Rhoten 2009; Aram 2004; Amabile et al 2001; Caruso and Rhoten 2001).

The IDR-specific behaviours, attitudes and practices are not uniform across individual researchers, research teams, disciplines, departments, academic institutions and, finally, nations. As pointed out by Massey et al (2006), a researcher's own perspective, considered both in ontological and epistemological terms, provides the context and determines the choice of suitable frameworks, methodologies and questions – and, consequently, defines an individual's attitude towards collaborative, interdisciplinary research. Nevertheless, a number of researchers emphasise community similarities rather than individual differences. For example, it has been argued that individual attitudes to interdisciplinary research can be partly discipline-specific (Carayol and Nguyen Thi 2005), as IDR is not uniformly supported across different departments or faculties, however, attitudes and behaviours can be similar across whole teams or departments (Haas and Park 2010; CoFIR 2004; Amabile et al 2001; Knight and Pettigrew 2007).

Furthermore, both individualised and community-based attitudes can be problematic. Individual differences in experience and worldviews can create barriers to the effective operation of interdisciplinary teams (Massey et al 2006; Gooch 2005; Knight and Pettigrew 2007; Hibbert and Huxham 2005). In community contexts, Duncker (2001) warns that a sufficiently salient professional identity can lead to out-group discrimination in interdisciplinary setting. Similarly, Ferlie et al (2005) warns that professional groups might seal themselves off from 'alien' practices and other professional groups. Because of the incipient problems of categorisation and the associated lack of trust (Fay et al 2006), a lack of the necessary skills, or practices, can lead to conflict between members of interdisciplinary teams (Amabile et al 2001). Indeed, Rhoten and Pfirman (2007: 58) note

that IDR can be seen as '*a vehicle by which a set of purposeful arrangements and sense of community are established to iterate ideas with others through the course of work, thereby transforming the structure of scientific practice from autonomous, hierarchical, and competitive to interactive, horizontal, and cooperative*'.

Thus although there seems to be agreement that IDR requires new (or adapted) practices, the literature fails to provide detailed insight into how these practices are being acquired or developed, other than loose allusions to learning *in situ* (Bruce et al 2004; Lattuca 2002) and reflexivity (Fay et al 2006; Wood 1999). The above mentioned learning dynamics, marrying the aspects of personal and group (research) practices make the framework of CoP particularly appropriate for addressing the questions raised in this thesis. Hence, the following section will further investigate the links between disciplines, IDR and theories of Communities of Practice.

IDR AND COLLECTIVITIES OF PRACTICE

Summarising the discussions so far, if disciplines (or their subsets in the form of departments, research groups, etc) can be considered as a form of CoPs, IDR constitutes a certain form of inter-CoP engagement, in which interdisciplinary (inter-CoP) teams are often assembled to address a specific problem or research question. Furthermore, there is a probability that some individuals may engage in a number of different IDR teams over a period of time. On the one hand, examining IDR from this perspective raises a number of questions related to the aspect of working across boundaries of Communities of Practice, including: the compatibility and integration of research practices; identity tensions arising from a lack of clear community one belongs to; learning and, as already indicated, becoming

an 'interdisciplinarian'. In relation to that last point, the emergence of a network of practitioners, tied by some shared interdisciplinary practices and identities at the intersection of communities of practice, seems to be implicit. This does, however, seems to contradict some of the existing theories on inter-CoP engagements.

Most of IDR project groups are problem oriented and temporary in the character, which can partly be attributed to the changes in the research landscape and the drivers behind IDR, as discussed earlier. Once the research project is completed the group is likely to dissolve – at least till the next project. This resonates with the recent writings emphasising the changing nature of work practices and work being '*increasingly enacted by groups that fade, intermix and are reconfigured in contexts where uncertainties and contradictions have become ever more visible'* (Blacker and Regan 2009: 162; see also Engeström 2008 and Czerniawska 2004). Furthermore, these new transient groups resemble proposed by Lindkvist (2005) concept of *Collectivities of Practice* – temporary organisations or project groups consisting of individuals from diverse (epistemological) backgrounds engaging in swift socialisation to carry out pre-specified tasks, often within the constraints of pre-defined time and cost. However, due to their temporary character and limited commonalities between the members, these transient groupings are unlikely to develop shared practices or a common identity and the individuals are likely to remain loyal to their existing and enduring CoPs (Ferlie et al 2005; Lindkvist 2005; Fischer 2001). Consequently, adopting the theoretical lens of CoPs to examine IDR practices can, on the one hand, enhance the needed understanding of the dynamics of this form of research. On the other hand, detailed examination of IDR groups can contribute to development of better understanding of the dynamics of the increasingly popular, transient relationships between, often incompatible, Communities of Practice. To enable a theoretically informed investigation of this, the following chapter will provide a

systematic review of literature on Communities of Practice, with a particular focus on inter-CoP engagements.

CHAPTER III: COMMUNITIES OF PRACTICE (COP) AND INTER-COP ENGAGEMENTS

INTRODUCTION

This chapter aims to provide a systematic and critical review of the extant literature on Communities of Practice, specifically focused on the relation to transient team collaborations and the consequent dynamics of inter-CoP engagements. As pointed out by a number of writers (Blacker and Regan 2009; Engeström 2008; Czerniawska 2004), cross-domain and inter-organisational collaborations are becoming pervasive and often unavoidable form of knowledge development; however, as I will elaborate, the understanding of the underlying processes still requires further research for its promise to be delivered.

The chapter will progress as follows. First, the concept of Communities of Practice, alongside its origins and the three most common approaches to defining CoPs will be introduced and discussed, with a particular focus on the aspect of practice as the core of the concept. The second part of the chapter will examine the extant literature on the dynamics of inter-CoP engagements and their impact on the involved communities of practice. Third, as one of the premises of this research is to investigate the potential dynamics of emergence of a network of practitioners, the chapter will further review the three main mechanisms explaining emergence of CoPs as presented in the existing literature.

Finally, following the initial discussion on interdisciplinary research and disciplines, this chapter will clarify the link between the two concepts, further explaining the research problem driving this study. An outline of the research agenda will lead to the next chapter devoted to methodological concerns.

COMMUNITIES OF PRACTICE: DEFINING THE CONCEPT

First introduced by Lave and Wenger (1991), the concept of Communities of Practice (CoPs) constitutes an examination of organisational learning and knowledge creation from the social, as opposed to cognitivist, perspective (Handley et al 2006; Tagliaventi and Mattarelli 2006; Thompson 2005; Gherardi, Nicolini and Odella 1998). Although originally intended to describe '*a delicate, intense form of social interaction visible amongst small groups of artisans, where sustained participation and learning led to increased social and technical proficiency, resulting in progressive identification with, and recognition and centrality within, the group*' (Thompson and Walsham 2009: 1), the concept soon found growing interest in both academic and managerial literature as a mean for: managing and generating knowledge within and across organisations (Nooteboom 2008; Tagliaventi and Mattarelli 2006; Adams and Freeman 2000); examining their role in development of organisational capabilities and gaining competitive advantage (Schenkel and Teigland 2008; Brown and Duguid 2002; Liedka 1999); and, more specifically, in augmenting innovation (Anand et al 2007; Ormrod et al 2007; Pavlin 2006; Swan et al 2002).

Although the recent literature highlights the differences between communities and organisations (Thompson and Walsham 2009; Amin and Roberts 2008; Thompson 2005), nevertheless, the concept often remains linked to organisational learning and knowledge systems, with CoP being conceptualised as the tacit part of organisational knowledge system, alongside more explicit routines (Tsoukas 2002). Indeed, as stressed by Lave and Wenger (1991), CoPs are an *'intrinsic condition for existence of knowledge*' (p. 98). However, as pointed out by Hildreth et al (2000: 29), the '*term CoP has been extended to encompass new meanings that were not part of Lave and Wenger's (1991) original idea. This has led to the term 'CoP' being applied, sometimes erroneously, to a wide range of groups, from project*

teams (Lindstaedt 1996) to functional departments (Sandusky 1997)'. Consequently, as will be discussed in the following sections of this chapter, the recent years witnessed certain return to the original aspects of practice (Gherardi 2009b; Miettinen, Samra-Fredericks and Yanow 2009; Nicolini 2009; Siedlok and Hibbert 2009a), with increasing stress upon the aspects of participation and engagement (Thomson and Walsham 2009: 4-5) as a prerequisite of practicing.

More generally, however, research that adopts practice-based approaches as a methodological lens to examine organisations has been developed (Bjørkeng, Clegg and Pitsis 2009; Gherardi 2009b; Nicolini 2009). Thus, as further pointed out by Thompson and Walsham (2009: 1), the '*current 'CoP theory' as applied by organizations has evolved into something entirely different from the elegant and original dynamic outlined in Lave and Wenger's Situated Learning, and now rests on confused theoretical foundations*'. Indeed, the recent two decades lead to emergence of a number of, often contradictory, definitions and theories of CoPs, frequently removing the idea further away from the original context (Amin and Roberts 2008; Duguid 2008a; Lave 2008), and, as a consequence, weakening the theoretical foundations of the original concept. Nevertheless, the extant discussions can be roughly categorised into three, often overlapping, main groups of approaches focused on the aspects of (situated) learning and knowledge management in organisations (Yakhlef 2010; Hayes and Fitzgerald 2009; Handley et al. 2006; Tagliaventi and Mattarelli 2006; Ferlie et al 2005; Aanestad et al. 2003; Berends et al. 2003; Gherardi, Nicolini and Odella 1998); approaches focused on the structural aspects of community (Lindkvist 2005; Swan, Scarborough and Robertson 2002; Wenger et al 2002; Wenger 1998; also see Thompson and Walsham 2009 or Brown and Duguid 2001); and approaches focussed on the aspect of practice (Bjørkeng, Clegg and Pitsis 2009; Gherardi 2009a; 2009b; Thompson and Walsham

2009; Brown and Duguid 2001). The following part of the chapter will present and discuss the three approaches prevailing in the literature.

LEARNING AND BECOMING: COGNITIVIST AND SOCIAL LEARNING THEORIES

Originally theory about Communities of Practice was deeply rooted in a number of studies into group-based learning in workplaces (Amin and Roberts 2008; Wenger 1998; Orr 1996; Brown and Duguid 1991; Lave and Wenger 1991), offering '*a squarely practice-focused view of organizational learning in which social structure and meaning are continually negotiated through participation'* (Thompson 2005: 152). What started as a description of apprenticeship as learning through participation (Anand, Gardner and Morris 2007) soon became labelled as a '*radical critique of cognitivist theories of learning*" (Handley et al 2006: 641; see also Yakhlef 2010; Gherardi, Nicolini and Odella 1998). This lead to the language of Communities of Practice being used to explain both learning and knowledge generation in a wide, and often incompatible, variety of organisational and spatial, and more recently also virtual, settings (Amin and Roberts 2008; Vaast 2007; Hildreth, Kimble and Wright 2000).

The CoP perspective did, however provide a useful critique to substantive approaches, that viewed learning as being associated with knowledge acquisition, cognition and mental processes, or, as noted by Gherardi, Nicolini and Odella (1998: 273), 'knowledge delivery' from a knowledgeable source to an individual. According to Lave and Wenger (1991) individuals develop their skills and acquire knowledge through *legitimate peripheral participation* (LPP) – a process of continuous socialisation of an apprentice into the world of a practice. Newcomers develop an understanding of the community's practices by

participation (which can take many different trajectories), observation and imitation (Handley at al 2006). However, individuals not only learn through participation but also, through immersion in a number of different CoPs they may (re)develop their viewpoints, including those concerned with their own individual sense of self and integrity (Handley et al 2006), and the meaning and structure of their activities (Wenger 1998). Hence, learning through participating is not reducible to mere acquisition of codified context-independent rules or tacit knowing. Rather, as noted by Gherardi, Nicolini and Odella (1998: 276), it also includes developing the ability to recognise and use context-bounded rules and learning and forgetting rules governing particular activities since they '*have became habits, part of corporeal schemata, of unawareness*'. Learning through participation in CoPs then encompasses becoming a part of the routinised and largely tacit structures – or in other words – participation in a CoP implies '*both issues of knowing and issues of being and becoming'* (Elkjaer 2003: 39; see also Yakhlef 2010). Indeed, Lave (2008: 284) further highlights that the aspect of becoming, or as she puts it, '*the development of identity in relation to the identities of others*', is '*more fundamental than knowledge or mastery'*.

Indeed, as noted by Brown and Duguid (1991), conventional learning theories separate learning from working and knowledge is treated as being codified and stored 'out there' for individuals to refer to it as and when needed (see also Gherardi, Nicolini and Odella 1998: 273). Situated learning, on the other hand, offers new insights into learning through participating. According to Yakhlef (2010: 44; see also Gherardi 1999) learning does not take place in the mind of isolated individuals, but is produced and reproduced in the social relations of individuals through participation in society, consequently placing participation at the core of learning. Hence, situated learning theories acknowledge that learning and knowledge creation is a social process in which the meaning of words, situations and material artefacts is constantly negotiated by individuals (Gherardi 1995) and is *always*

associated with some ongoing practice (Gherardi, Nicolini and Odella 1998). Furthermore, participation is said to be inseparable from the context in which it takes place (Yakhlef 2010), thereby *situating* learning in the specific social or organisational settings (Scarborough and Swan 2008). Therefore, learning is not particularly about gaining individual knowledge (as in the cognitivist approach) but is fostered through membership in different CoPs. The individual learns by *becoming* an insider and a practitioner (Aanestad et al 2003; Brown and Duguid 1991), and incorporating the tacit, rather than just explicit, dimension of learning through participating in communities of practitioners (Duguid 2008b; Handley et al 2006). As exemplified by Gherardi (2009b), many shared tasks carry some tacit knowledge within them, embedded in and understood by a particular community that performs these tasks regularly. As an example, a single look or rather cryptic remark is often enough for two community members, who learnt through participation, to share certain tacit knowing, as described by Cook and Yanow (1993: 380):

> *'a flutemaker would typically make only cryptic remarks, such as 'it does not feel right' or 'This bit doesn't look quite right'. The first flutemaker would then rework the piece until both were in agreement that it had 'the right feel' or 'the right look''.*

Although there is no explicit explanation, both actors can reach an agreement in the form of achieving the quality that is expected and accepted by the community. Thus, according to Brown and Duguid (2001), there is a *tacit dimension* to all *knowing*, and expert knowledge is often a combination of knowing and know-how, of learning and forgetting (Gherardi, Nicolini and Odella 1998). Similarly, Duguid (2005: 113), following Giddens (1984), links tacit knowing within a CoP to 'knowledgeability' as the ability of individuals to 'go on' within the CoP without necessarily being able to give any of the actions they perform 'direct discursive expression'. At yet another level, Duguid (2008b) highlights the difference

between knowing *that* and knowing *how*, with the later often being the product of a specific CoP. Hence, CoPs underpin ways of knowing and the social construction of knowledge.

Aanestad et al (2003: 5), following Brown and Duguid (2000), further highlight that individuals in CoPs '*evolve a way of talking and reading each other*', whereas Roan and Rooney (2006: 433-434) perceive situated and social learning as processes of *becoming* during which *'personal identities are changed*'. In relation to the above example of discussion between flutemakers, it is not only the tacit knowledge that enabled the discourse, but more importantly, certain recognition gained through participation in the community. In other words,

> *'[l]earning is not simply about developing one's knowledge and practice, it also involves a process of understanding who we are and in which communities of practice we belong and are accepted' (Handley et al 2006: 644).*

Hence, the cryptic messages were not only sufficient to point out any faults in the flute – but also accepted and recognised by the community members. Situated learning in CoPs is not merely acquiring knowledge but '*is essentially a matter of becoming an 'insider'' where learners, rather than being given objective knowledge, 'learn how to function in a community' – hence 'they are being 'encultured'' (Brown et al 1989) rather than being educated*' (Lindkvist 2005: 1195). This process of enculturation further involves gaining a certain *legitimacy* in the community (Lave and Wenger 1991).

At another level, participation, or enculturation, involves becoming an insider but also acquiring the '*particular community's subjective viewpoint*' (Doak and Assimakopoulos 2007) and, hence, becoming an integral part of it. Indeed, as noted by Duguid (2008b), the meaning of a text, or an action, depends not only on the text itself but, more importantly, on

the nature of the community interpreting it. Consequently, individuals who join the community are taught not merely how to decode the text, but how to decode it from the perspective of the community they are part of. In other words, situated learning and participation shape the individual's identity (Lave 2008; Brown and Duguid 1998; Lave and Wenger 1991). Thompson (2005: 152) further explains that since learning constitutes an evolving *form* of membership, rather than just being merely a *condition* for membership, identity and meaning are both an essential part of participation – a notion recently reinforced by Lave (2008).

The concept of participation and becoming, however, soon attracted some criticism due to a number of issues, including rather neglected in the literature aspects of power, gender, ethnicity, race or social class (Lave 2008; Anan, Gardner and Morris 2007; Roan and Rooney 2006; Lindkvist 2005; Fox 2000) as the most prominent ones. Although the above issues play significant role in understanding the dynamics of CoPs in general, they are not of particular relevance from the perspective of this thesis[1], except for some aspects of power, which therefore requires some further attention here.

Despite the fact that the original concept of (legitimate peripheral) participation was introduces as shaped by contradictions and tensions among participants, activities and, consequently, identities (Lave 2008; Lave and Wenger 1991), these issues remained largely underdeveloped in the literature. For example, Fox (2000) notes that although the theories of CoP address (to some extent) the relation between identity formation and power, the extant approaches provide little explanation on how individuals can exert enough influence over the

[1] This study did not engage into investigation of the aspects of social class or gender on the dynamics of participation or learning in academia as this could be a topic of another doctoral research. However, it can be assumed that these aspects are not as deterministic in the context of UK universities as in other setting.

existing practices, hence lead to renewal and innovation. Although existing literature provides some examples of established CoPs stifling any attempts to legitimise new (better) practices (e.g. see Scarborough and Swan 2008; Ferlie et al 2005) the dynamics are not well explained. Furthermore, Anan, Gardner and Morris (2007) note that whilst power relations are crucial in sustaining balance within CoPs, the political dimension of their emergence is not well examined.

Another dimension in which issue of power plays significant role relates to the aspects of (increasingly frequent) multi-membership of individuals in a number of CoPs as well as in inter-CoP engagements. Indeed, Aanestad et al (2003) note that working across boundaries of CoPs can be of particular challenge, due to the pressures on individuals' identities. Hence, ones' ability to suspend own identity when moving across CoPs' boundaries may be the key to success. However, some CoPs may not allow sharing of practice or knowledge (Duguid 2008b), leading to potentially hostile behaviours and attitudes towards members of other CoPs (Nooteboom 2008; Scarborough and Swan 2008; Ferlie et al 2005). Indeed, power relations can be associated with the distinction between *ability* and *willingness* to share knowledge or practice with others (Duguid 2008: 78-79). Bringing the aspect of *will* to the equation of power relations in CoPs, and consequently dynamics of inter-CoPs engagements, further suggests that, at least to some extent, by being inherently related to individuals' and CoPs' systems of values, these relations form an intrinsic part of practices of CoPs, as I will argue in the final chapters of this thesis.

The discussion so far indicated that individuals participating in CoPs are likely to become an integral part of the community – a recognised and knowledgeable member progressing into central participation. However, one of the questions arising is *how* do individuals progress towards the core. Whereas Lave and Wenger (1991) provide some indications of a variety of

trajectories by which an individual may be introduced into the CoP, they do not provide much insight into how these trajectories are developed and maintained. This issue has been addressed by Gherardi, Nicolini and Odella (1998) by introducing the notion of *situated curriculum* to highlight the fact that the process of gaining access to CoPs, and hence participating in the process of legitimate peripheral participation, is not random and involves a certain pattern of activities and tasks that '*instruct the process of socialization of novices in a context of ongoing work activities of order*' (p. 273). Hence, legitimate peripheral participation and situated curriculum both denote the progressive character of acquiring mastery in CoPs by newcomers, where *legitimate* refers to existence of a certain, accepted trajectory each new participant needs to take towards full participation (Gherardi and Nicolini 2002; Gherardi, Nicolini and Odella 1998).

Although a number of studies assume that members will progress towards the full participation, becoming full members of the community (Bleakley 2002 in Amin and Roberts 2008), participation may not always take the form of full engagement. Levels of structure and the formalisation of learning and socialisation can vary significantly among CoPs, spanning from informally structured communities (e.g. the Xerox technicians as described by Orr 1996) to communities characterised by rigid structures and formalised socialisation trajectories, often in the form of situated curricula (e.g. academic communities; see Lave and Wenger 1991; Orr 1996). In addition, participation trajectories can vary not only between but also within the same CoP, depending on the members' characteristics, desires and identities. Thus, whereas Lave and Wenger (1991) presumed that legitimate peripheral participation almost always leads to full participation (i.e. mastery), it was later recognised that participation may take different learning trajectories, not necessary leading to full participation, especially since '*not everyone aspires to (or can achieve) full participation*' (Handley et al 2006: 644). Indeed, as noted by Wenger (1998: 154-155), participation may take different forms and follow different types of trajectories, including:

- *peripheral* – which never leads to full participation but is significant enough to contribute to one's learning and identity development;
- *inbound* – where newcomers join with the prospect of becoming full participants, hence there is conscious investment into learning and developing identities;
- *insider* – characterised by continuity of negotiation of identity, even when participant achieved full participation;
- *boundary* - spanning and linking different communities, hence involved in learning from / in different CoPs;
- *outbound* – leading out of a CoP, potentially leading to disassociation with the certain CoP.

Similarly, Handley et al (2006) point out that, often due to the intra-personal tensions arising from the continual negotiation of own identity within and across a number of CoPs, individuals may chose somewhat marginal forms of participation, albeit still fitting with the norms of the CoP, In the more severe case where their own integrity could be at risk, individuals may chose not to participate in the community at all.

So far, a number of kinds of participation were considered. Consequently to avoid an unnecessary 'typological scramble', Thompson and Walsham (2009) suggest describing different levels of participation on a continuum, ranging from *legitimate peripheral participation* (i.e. leading to full participation and identification with the group), through the *marginal* and *contingent* forms of participation in which individuals do not personally identify with the group (although seek to appear as if they did), to *non-participation*, as suggested by Handley et al (2006: 651). Thompson and Walsham (2009) further suggest the inclusion of *legitimate peripheral non-participation* to reflect the increasingly popular feature in electronically networked organisations, where individuals often keep abreast with

learning through 'lurking' around different on-line communities (discussion boards and fora; wiki spaces etc) but not actively contributing in the discussions. Importantly, the 'core' members of these communities accept these 'guests', and freely share knowledge with the whole community.

The examples of marginal or non-participation above highlight an important aspect of *learning* and *becoming* associated with CoPs – namely the potentiality of conflict between identities (integrity), socialisation and learning through participation. One of the reasons for this are the personal histories and values that individuals bring to the communities. These, naturally, may differ significantly from the values, perspectives or ways of doing things within the communities. As encapsulated by Handley et al (2006: 642):

> *'[i]ndividuals bring to a community a personal history of involvement with workplace, social and familial groups whose norms may complement or conflict with one other. These conflicts need to be negotiated and reconciled at least in part if the individual is to achieve a coherent sense of self'.*

In other words, as new members are introduced into a CoP, they not only learn but also make contribution to the CoP, both in terms of bringing external knowledge, but also by introducing different perspectives and ways of analysing problems. As a consequence newcomers can often be caught in a dilemma as, on the one hand, they need to engage in existing and established practices, and on the other hand they may find some aspects of the practice redundant and, as a way of own progressing within the CoP, they can challenge the existing order, identity and practices (Fox 2000; Lave and Wenger 1991). Therefore it becomes imperative to understand what happens within and beyond CoPs in order to analyse situated learning and 'knowledge transfer' within or across them (Handley et al 2006).

Equally important seem to be internal power issues, such as status or pressures from both internal and external sources, as they can significantly impact on participation, learning and the socialisation of individuals (Roberts 2006). Indeed, learning and participation is inherently linked to conflict and contradictions (Lave 2008: 290), and *'the possibilities for learning are therefore formed by the social structure of the practice and the power relations surrounding it*' (Aanestad et al 2003: 4). Hence, power relations can play a significant role in determining the final trajectory of individuals' participation, but also on the future development of the CoP, since, as highlighted by Lave (2008: 290), CoPs '*are engaged in the generative process of producing their own future*'.

Hence, on the one hand, the processes of learning, socialisation and identity formation may be dynamic and cumulative (Brown and Duguid 2001: 202), however, on the other hand the same processes can contribute to insularity, closure and lock-ins of CoPs (Adler et al 2007; Thompson 2005; Brown and Duguid 1998). Furthermore, whilst CoPs distinctiveness and shared viewpoints can inhibit both cross-CoP interactions and the ability and willingness of individuals to engage in these forms of interactions, Tagliaventi and Mattarelli (2006) stress the importance of 'complexification', understood as the distinctiveness and differentiation of knowledge of CoPs, as a prerequisite of renewal and cross-CoP interactions. The authors further note the somewhat paradoxical situation as complexification can, on the one hand, enable inter-CoP interactions but is also, on the other hand, held responsible for incommensurability of views adopted by different CoPs.

This resonates with the earlier discussion of the somewhat symbiotic relationship between disciplinary specialisation and IDR, with a number of authors purporting that well developed, pure and strong disciplines may enhance interdisciplinary interactions (Aram 2004; Weingart 2000). This, however, raises rather problematic question of individuals

belonging to two or more CoPs characterised by (and hence requiring) strong identity: how does one negotiate successfully membership in both communities without becoming torn between the, potentially conflicting, identities. This question becomes especially relevant in the context of relatively large cognitive distance and little affinity between two disciplines, or indeed CoPs (Gertler 2008; Nooteboom 2008).

The theories of CoPs examined from the perspective of learning exhibit further problems that, consequently, have attracted a considerable amount of criticism. For example, Amin and Roberts (2008) point out that what started as a critique of cognitive learning approaches, slowly became orthodoxy for any type of learning in any forms of communities of knowledge. As they highlight, the '*idiosyncratic and always performative nature of learning (...) is being lost to formulaic distillations of the workings of CoPs and instrumentalist applications seeking to maximise learning and knowing though CoPs*' (Amin and Roberts 2008: 353-354). Indeed, the abovementioned generalisations lead to a race to adopt CoPs as a mechanism to harness and manage knowledge within and across organisations, in both real and virtual worlds (Doak and Assimakopoulos 2007; Hernandez-Marti 2005; Lakomski 2004; Ardichvili, Page and Wentling 2003; Swan, Scarborough and Robertson 2002; Wenger 1998). Amin and Roberts (2008: 365) further compare four different settings of collaborative work, highlighting the significant differences in organisational, technical and spatial settings, and criticise the use of the term Community of Practice as a proxy for all situated knowing. Hence, they suggest, there is a need to develop a more robust and heterogeneous lexicon.

In a similar tone, Yakhlef (2010) criticises the recent tendency to over-focus on and often reduce the acquisition (and development) of knowledge to situated learning, discarding some of the useful theories developed within the domain of cognitive approaches. For example, as he further explains, mastering practices in the context of CoPs must include learning *about* the practice, hence involving the, cognitive in its character, process of reflection. Similarly,

situated learning theories do not offer well developed explanation for the '*abstraction or acquisition of theoretical knowledge'* (Yakhlef 2010: 39), assuming that all knowledge is gained in the process of situated learning. Although these are certainly right points, the criticism is potentially overstating the problem, as even in situated learning certain 'cognitive' ways of gaining knowledge are well embedded, though they are embedded and influenced by the particular context (e.g. the aforementioned abstraction would need to be embedded in a particular social setting to mean the same thing to the learners). Similarly, classroom learning will be structured in a particular way so the delivered knowledge is processed in the desired ways. According to Yakhlef (2010: 43), although Community of Practice learning theory '*de-emphasizes the cognitive autonomy of individuals*', a certain degree of autonomy still exists and individuals can both learn and 'entertain their own beliefs', even though these would need to be successfully justified through inter-community interactions to become accepted and embraced part of the community knowledge.

A different learning problem has also been highlighted by Roberts (2006: 631), who points out that as CoPs '*may support the accumulation of incremental knowledge development, they may reduce the scope for radical innovation*'; hence their value as the ultimate tool for knowledge management and development in organisations is overemphasised. Nevertheless, the race to harness knowledge in the modern economy has ultimately resulted in organisations turning to instrumentalist applications and mechanical distillations of the working of CoPs to maximise learning (Amin and Roberts 2008: 353-354), consequently losing the fine detail underlying the workings of the CoPs.

Another problematic feature of CoPs is that related to facilitating knowledge flows across different communities, and not as previously thought simply within homogenous CoPs (Tsoukas 2002). Considering the possible tensions arising as a result of incompatibilities

between CoPs, the utility of CoPs as a mean for knowledge sharing across different communities seems somewhat diminished. Nevertheless for some scholars, CoPs can be both constructed and maintained within and across organisations, which leads the discussion to the next commonly emphasised aspect of CoPs – namely the structural expression of the theory.

To summarise this section, CoPs can be conceptualised as a social activity of acquiring certain skills (learning *that*) but also socialisation process of an individual resulting in development of unique and lasting values, common repertoires and routines, expressions and actions and, subsequently, sense making (Tagliaventi and Mattarelli 2006; Aanestad et al 2003; Brown and Duguid 1998). It is a continuous process of negotiating meanings and identities of CoPs and individuals who share similar manner of interpreting and doing things (Gherardi, Nicolini and Odella 1998). According to Berends et al (2003) adopting CoPs as a medium for organisational learning allows us to overcome the issue of dualism between individual and organisational learning. Hence situated learning contributes to understanding of how individuals in groups learn and contribute to knowledge sharing and development in CoPs.

THE STRUCTURAL ASPECT OF COPS

When referring to 'community' in their original work, Lave and Wenger (1991: 98) defined it as '*a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice*'. It was thus not intended to point to well defined boundaries, groupings or necessarily co-presence, but rather to a conceptual site of participation as '*an activity system about which participants share understanding*

concerning what are they doing and what that means' (*ibid:* 98). Wenger (1998: 5) later defined community in larger, social contexts as '*a way of talking about the social configuration in which our enterprises are defined as worth pursuing and our participation is recognizable as competence*', hence stressing the perspectives of legitimacy and system of values shared by participants. Indeed, as in the flutemaking example, both the knowing and the mandate to advise on the final creation come from recognised competence, whereas the flutemaking itself forms the defined and worth pursuing enterprise. However, the membership may not always be as obvious as in the flutemaking – or other apprenticeship-based CoPs. Brown and Duguid (2001) stress the point that CoPs often result from developing a shared practice and members, although they share common practices, do not necessarily think of themselves as a community in the conventional way. Similarly, a community in the conventional sense does not necessarily constitute a CoP.

As can already be seen, although the use of the term *community* has became rather problematic in the context of CoPs (Roberts 2006: 632; Thompson and Walsham 2009; Handley et al 2006; Lindkvist 2005), the trend towards focusing on the structural aspect of CoPs became dominant for at least two reasons. Firstly, somewhat ironically, the enthusiasm for the *community* results from the appeal of the 'warmly persuasive word' (Williams 1976, p. 66; see also Duguid 2005; Brown and Duguid 2001) often associated with warmth, consensus, comfort and a lack of conflict (Roberts 2006). In the context of organisations this further may suggest the cultural homogeneity (Brown and Duguid 2001), often sought by managers in organisations. However, although Brown and Duguid (2001: 203) point out that '*[c]ommunities of practice are, in fact, as likely to be cold as warm, may sometimes be coercive rather than persuasive, and are occasionally explosive*', in recent years there has been an increasing stress on the aspect of community as the central building block of the CoP concept. As a result, this approach has attracted mounting criticism as becoming

inconsistent with the original meaning of CoPs (Amin and Roberts 2008; Lave 2008; Roberts 2006; Lindkvist 2005; Østerlund and Carlile 2005; Brown and Duguid 2001; Duguid 2005), with particular focus for criticism being the diversion from process to structure For example, Thompson and Walsham (2009: 3) note *'that initial interest in CoPs' practice-based dynamic within management literature (e.g. Brown and Duguid 1991) appears to have degenerated into a scramble for structural typology, where the self-evident, primarily representationalist ontology of the collective noun is softened with the suffix '- of practice'. Instead of a deepening of our understanding of Legitimate Peripheral Participation, we have seen instead a progressive focus on structure'* (stress in original).

Indeed, some authors perceive CoPs as an alternative form of organisational control (Thompson and Walsham 2009; Avellson and Willmott 2002) or an effective means of influencing both thinking and acting of individuals in organisations (Yakhlef 2010). Thus, by increasingly focusing on structures, the concept seemed to be closer within the reach of management tools, particularly as it suddenly offered '*a concrete organizational infrastructure for realizing the dream of a learning organization*' (Wenger et al 2002: x) and new '*practical way to manage knowledge*' in organisations, opening up the 'third wave' in management of organisations (Lakomski 2004: 90). Indeed, as noted by Amin and Roberts (2008b: 22), '*a whole new language and practice of knowledge management, rolled out by business consultants, schools of management, iconic figures publications, manuals, has come to fore with the promise of renewal through situated learning and knowing'*.

Both as a result of the fixation on structure and as an attempt to overcome some of the inherent limitations associated with focusing on the aspect of community, a number of related concepts have evolved in the literature (Thompson and Walsham 2009). For example, Gherardi (2006) proposes to use the term *community of practitioners* to emphasise on the aspect of *practice* (as opposed to community) in CoPs (the next section will review the

concept of CoPs from the perspective of practice). As the concept of CoPs resonates closely with the increasingly common project teams, to accommodate the temporary characteristic of such groups and projects, and the related knowledge transfer and creation, Lindkvist (2005) proposes an alternative view in the form of *collectivity of practice*, as knowledge in these forms of collaborative arrangements is abstract and distributed, hence often leading to a minimalist necessary base of shared knowledge. In a similar manner, Fischer (2001), refers to an assembly of stakeholders brought together to resolve a specific problem as a *community of interest*, highlighting the temporary and project-oriented character of such, often not otherwise having much in common, groups. On the other hand, the above mentioned concept of *communities of practitioners* (Gherardi 2006) indicates that the community is formed around a specific professional or epistemic identity and practice, often with global reach, rather than around a single organisation or project. Indeed, as suggested by Knorr-Cetina (1999), the identity of the professional group can be of great significance and lead to emergence of rather homogenous *epistemic communities* (see also Amin and Roberts 2008), often shaped by common fundamental cognitions, norms and beliefs, although not restricted to any single organisation, geographic location (Ormrod et al 2007) or coherent and well defined group of individuals.

The different, and often more loosely bounded concepts arising from the structural debate resonate with another adaptation of the original concept in the form of Networks of Practice, introduced by Brown and Duguid (2001) to extend the concept to encompass comparatively loosely linked, often dispersed forms of CoPs. Although NoPs do not share the 'localised identity' of CoPs (Ormrod et al 2007: 747); they are frequently shaped by common epistemic roots, norms, beliefs and cognitions, often developed through certain processes of socialisation (situated curriculum) and knowledge sharing mechanisms such as conferences, newsletters, seminars, on-line communities etc. (Ormrod et al 2007; Tagliaventi and

Mattarelli 2006; Brown and Duguid 2001). Identity and practice in these 'dispersed' networks of practice is, therefore, a mix of epistemological roots, professional and personal identities and organisational culture (Knorr-Cetina 1999; Handley 2006). Tagliaventi and Mattarelli (2006: 294) address the complex connection between network and community by explaining that, '*within the boundaries of an organization, a number of different communities co-exist; members of a single community also belong to a broader community that cuts across different organizations. It is appropriate to think of these communities, which are themselves composed of several smaller local communities, as 'networks of practice' or 'networks of knowing' (Brown and Duguid 2001). The substitution of the term 'network' for the term 'community' implies that relationships within a network are weaker than those among the members of a community*'.

Overall, there seems to be a spectrum of structural applications of the CoP concept. At the one end of the spectrum, focussed on geographic co-location, there has been a further extension of the CoP concept into the context of industrial clusters. For example, Brown and Duguid (2002) essentially compare industrial clusters to CoPs with distinct, often tacit, identities and practices characteristic to industrial districts. In a similar manner, Faulconbridge (2007) examines collective learning– an earlier discussed feature of CoPs - within industrial districts as a source of competitive advantage. Hence, rather than shared professional or epistemic roots only, co-location, regional identity, characteristics and history have also been linked to the concept of CoPs, extending the notion of community into new grounds. In contrast, with a focus on dispersed rather than concentrated community, the CoP concept has been applied to on-line communities of practice (Doak and Assimakopoulos 2007; Vaast 2007), in which interaction and collaboration takes place through information and technology systems in virtual environment. Hence, the concept of *community* in CoPs

has been stretched beyond common locale, epistemological or professional roots, through application to the notion of virtual gatherings.

The discussion above already reveals many of the pitfalls of defining the term *community* in the concept of CoPs. Not only is the use of the term often imprecise, but the numerous attempts to address these shortcomings add a further level of complexity and confusion in the terminology. Indeed, as pointed out by Thompson and Walsham (2009: 3), the scramble for structural typology has produced a confusing range of concepts, including *''community of practice' (Lave and Wenger 1991, Brown and Duguid 1991, Wenger 1998, Wenger et al. 2002), 'inter-organizational community of practice' (Moingeon et al. 2006), 'virtual community of practice' (Dube et al. 2006), 'constellation of practice' (Wenger 1998), 'network of practice' (Brown and Duguid 2000), 'electronic network of practice' (Wasko et al. 2004), and 'collectivity of practice' (Lindkvist 2005)*'. Furthermore, the essence of community may be very different in different settings – whether in various types of organisations or across national boundaries, further highlighting problems with the almost universal adoption of the concept in organisations (Roberts 2006).

Focusing on the aspect of community becomes even more challenging when the previously discussed notions of limited levels of participation (e.g. marginal or legitimated non-participation) are taken into account. As a remedy to the 'abusive' use of the term *community*, a number of authors recently pointed out that the core aspect of CoPs is *practice* (Gherardi 2009a; 2009b; Duguid 2005; Brown and Duguid 2001; Brown and Duguid 1998) rather than *community*. Consequently, the next section will examine the concept of CoPs from the perspective of practice.

PRACTICE AS THE ESSENCE OF COPS

For a number of authors practice is thought to be the essence of CoPs (Gherardi 2009a; Thompson and Walsham 2009; Ormrod et al. 2007; Brown and Duguid 2001; Wenger 1998) and the source of epistemic differences between CoPs (Brown and Duguid 2001). Thus it is argued to be responsible for generating a sense of community, associated with a collective knowledge base and common worldviews (Brown and Duguid 1998; Gherardi, Nicolini and Odella 1998), thereby contributing to the stability and continuity of CoPs (Thompson and Walsham 2009; Gherardi, Nicolini and Odella 1998). Gherardi (2009b: 121) further points out that it is practice that generates community, and not the other way round, by forming '*the glue which holds together a configuration of people, artefacts and social relations'*. For these reasons increasing number of authors suggest examining CoPs, situated learning and knowledge creation through the prism of practices (Gherardi 2009a; 2009b; Bjørkeng, Clegg and Pitsis 2009; Nicolini 2009; Siedlok and Hibbert 2009a; Thompson and Walsham 2009; Brown and Duguid 2001), or even reversing the emphasis from 'community of practice' to '*practices of community*' (Gherardi 2009b: 121). Furthermore, recent years saw a number of researchers calling for 're-turn' to practice based studies as an analytical lens for studying organisations (Bjørkeng, Clegg and Pitsis 2009; Blacker and Regan 2009; Geiger 2009; Gherardi 2009a; 2009b; Miettinen, Samra-Fredericks and Yanow 2009). However, although practice-focused approaches to studying CoPs are similar, and in places overlap, with practice-based approaches to studying organisations, this research will attempt to separate, whenever practicable, the two streams, focusing on the approaches stemming from the theories of CoPs.

Before venturing into the details of studying CoPs from the perspective of practice, it should be noted here that, similarly to community, the term 'practice' is rather rich in meanings (Handley et al. 2006; Knorr-Cetina 1999); often ambiguous and applying it in organisational

theories can be problematic. This is further exacerbated by the fact that CoPs can be indistinguishable from other forms of social and organisational arrangements, making the association of practice and community rather difficult (Brown and Duguid 2001). This is important, since as practice is developed through participation in CoPs, notions of practice, learning and community are significantly intertwined. As Brown and Duguid (1998:96) explain, '*the processes of developing the knowledge and the community are significantly interdependent: the practice develops the understanding, which can reciprocally change the practice and extend the community. In this context, knowledge and practice are intricately involved*'. Furthermore, Amin and Roberts (2008: 365) warn about the loose ways the concept of CoPs has been applied and suggest that the practices characteristics of different types of CoPs are not comparable. Instead, '*the use of the term community of practice as a proxy for all forms of situated knowing is unhelpful. The dynamics of the task or craft-based communities studied by the originators of the term seem to be barely replicated in settings of high creativity, epistemic, professional, or virtual learning and knowledge formation*'.

The complexity of practice also includes the problem that certain practices can remain implicit to the practitioners (Brown and Duguid 1998), especially if conceptualised as shared systems of values (Gherardi 2009a). The existence of such implicit practices can help to explain the seemingly intractable epistemic differences between CoPs (as argued by Amin and Roberts 2008, above, and alluded to by Ferlie et al 2005). Going further, it may also be suggested that these differences, or cognitive distance as proposed by Nooteboom (2008), are linked to insularity, closure and lock-in within one's own viewpoint of the CoP (Adler et al 2007; Thompson 2005; Brown and Duguid 1998). Somewhat similarly to Amin and Roberts (2008), Gherardi (2009b: 535) points out that the recent years have witnessed the emergence of an ensemble of practice-focused studies; however, these were rather heterogeneous and without a common definition of the term 'practice'. Indeed, as further

highlighted, on the one hand practice is often thought to be transferable and reproducible, however, on the other hand is described as tacit and often inexpressible in propositional terms, hence difficult to observe, measure or access (Gherardi 2009a: 116; see also Blacker and Regan 2009; Nicolini 2009). To some extent these problems are explained by the tentative and ongoing processual character of practice (Bjørkeng, Clegg and Pitsis 2009: 156). However, regardless of the internal differences between approaches, they are often brought together under the single umbrella of Practice-based-Studies (Gherardi 2009b). Nevertheless, the recent attempts to restore practice-based analytical lens, the re-turn to practice, is believed to help to close '*the chasm between practice-driven theorizing of what people do in their workplace and academic theory-driven theorizing about it'* (Yanow 2006a: 1745; see also Nicolini 2009: 1391), addressing some of the shortcomings of community or learning focused approaches to studying CoPs discussed in the previous sections.

At the simplest level practice has been conceptualised as the collectively elaborated know-how of a CoP (Pavlin 2006; Wenger et al. 2002), or to put it another way, a certain competence of the community (Gherardi and Nicolini 2002) or knowledgeable collective action (Gherardi 2009b). Geiger (2009: 130) further points out that a number of studies approach practice from the perspective of 'what actors do', hence focusing on the processual nature of practice, but neglecting the factors and processes determining continuity, renewal and adaptation of practices. At a more detailed level of analysis, practice in CoPs has been conceptualised as a common repertoire in the form of shared language, routines and artefacts (Tagliaventi and Mattarelli 2006; Wenger 1998). In particular, Wenger (1998) sought to define practice as meaning dynamically associated, through learning, with community structure. Hence, he defined practice in three dimensions: *as meaning*, where practice is a process of negotiating meaning; *as community*, claiming that associating community and

practice yields a more tractable characterisation of the concept of practice (e.g. by distinguishing it from concepts like culture, structure or activity); and *as learning* where practice is treated as an emergent structure, which persists by being both perturbable and resilient, combining continuities and discontinuities, and hence is not static. Indeed, practice always remains dynamic and temporal in its character as CoPs are constantly improvising and supporting the adaptation of new behaviours (Bjørkeng, Clegg and Pitsis 2009; Swan et al 2002; Brown and Duguid 2001; Fox 2000;). The dynamic character of practices is therefore clearly related to the processes of adaptation and change within CoPs. Indeed, as noted by Brown and Duguid (2001: 202):

> *'practice-focused analysis brings investigations of knowledge and identity in organizations closer to the point at which working life is lived, work done, and so working identities created'.*

This dynamic character of practice further resonates with the conceptualisation of practice as *knowing* of the community, in which the know-how (knowledge) of a community is an activity (knowing) rather than an asset (Gherardi 2009b: 121), highlighting the fact that *situated learning*, and hence *participation* represent a particularly unique form of practice (Thompson and Walsham 2009). Berends et al (2003) take a step further and, by applying structuration theory to analyse the notions of practice and organisational learning, conclude that organisational learning is realised in organisational practices as a specific form of structuration. In their view, practices are routinised activities, always embedded in larger social systems, and performed by knowledgeable individuals. Therefore, it can be argued that this approach offers a better framework for analysing the role of individuals in organisational learning. This both dynamic and potentially implicit character of practice can, however, pose further difficulties with defining and conceptualising practices (Fox 2000).

At an even broader level, Gherardi (2009a; 2009b) acknowledges the role of practice in reproduction of society, and consequently communities, where '*practice is viewed as the effect of a weaving-together of interconnections in action, or as a 'doing' of society'* (Gherardi 2009b: 118). In this sense, practice needs to be viewed from the perspective of practitioners and the very activity being performed, taking into account the temporality and processuality of practice, and constitutes '*knowledgeable collective action that forges relations and connections among all the resources available and all the constraints present*' (Gherardi 2009b: 117). In this approach practice comprises not only of set of activities, instrumental or ethical judgments but also collective taste, aesthetic judgment and appraisal systems, which allow individuals not only to perform (shared) practices, but further communicate and share enjoyment, appreciation and, consequently, '*refine the ways in which such practices are enacted*' (Gherardi 2009b: 538). She further illustrates how taste is learnt and taught in the process of becoming a practitioner and, consequently, how taste-making is performed as a collective, situated activity as well as how discursive practices expressing aesthetic judgment are deployed within the community (Gherardi 2009b). This further resonates with the way Giroux and Taylor (2002) link the process of justification and adoption of new knowledge to CoPs to potential refinement of existing practices within the CoP. Hence, justification processes, similarly to developing shared appreciation, should be seen as learning processes in which all CoPs are involved. In larger communities, these processes may lead to the diversification of tastes and identities, and potentially the emergence of smaller CoPs. For example, the development of aesthetic appreciation for certain methodologies, paradigms or ways of doing research (i.e. practices) can lead to the emergence of a unique community of practice characterised by its own, distinctive identity (Gherardi 2009b). A good example is the 'School of Naples' in which '*the fabric of mathematics develops within an epistemic community; it unfolds through the differentiation of schools of mathematics implying differences in terms of practice, and reflects diversities*

in aesthetic judgments on the objects of knowledge' (Landri 2007: 410 in Gherardi 2009b: 544).

The process of refinement of practices, or normative norms (i.e. what is a 'good' practice) can further involve either implicit forms of practicing (i.e. practices are unconsciously modified without questioning underlying norms of good practice) or explicit modes of reflection, in which '*practitioners explicitly question the underlying norms of a particular practice and engage in argumentation process in order to agree on revised norms of good practice"* (Geiger 2009: 140). Indeed, reflection, as an intrinsic part of the learning process, impacts on the processes of forming and refining of practices (Blacker and Regan 2009; Tsoukas 2002; Gherardi, Nicolini and Odella 1998).

Refinements, changes or even adoption of new practices can further be a result of spillovers of practices, as reported by Vaast (2007) and Assimakopoulos and Yan (2006), who report existence of such dynamics between online and offline practices. In both cases, practices characteristic to online communities impact on the practices of the 'local' communities of practice, further suggesting existence of a continuum of practices between the two environments (Assimakopoulos and Yan 2006: 100). Indeed, as Vaast (2007: 284) notes, '*what happens within online communities thus appears intrinsically related to their members' offline situations*'. However, this is not always the case as majority of literature suggests resistance of established communities towards new or modified, often in the collaborative processes, practices (Nooteboom 2008; Scarborough and Swan 2008; Ferlie et al 2005). Hence, this continuity raises some questions related to inter-CoP interactions and emergence, or spillovers, of practices, which will be attended to in more detail later in this discussion.

SUMMARY OF PERSPECTIVES ON COPS

To summarise the above discussion on the three distinct, yet interconnected, aspects of CoP – situated learning (and becoming), community, and practice – it can be concluded that approaching CoPs from the perspective of community comes with a number of shortcomings. First, the boundaries of the community may remain implicit to the members, hence making any analysis rather difficult. Second, what may seem like a community may not actually constitute a CoP as members may not be sharing any practice or identity, although they would hastily be termed as a CoP. On the other hand, approaching CoPs from the perspective of practice can offer more powerful analytical lens, as it is practice that creates community but also systems of values, appreciations and, consequently, identity of the members (Gherardi 2009a). Indeed, as noted by Geiger (2009), whilst focusing on community aspects can only offer a formal, static and reductionist analysis of organisations, practice offers a perspective capable of providing an understanding of the very workings of communities.

The above discussion also highlights another question related to the emergence of CoPs and the aforementioned attempts to create and manage CoPs in organisations, as there seem to be certain tension arising between the approaches. On the one hand, approaches favouring the perspective of community often share the view that not all CoPs are necessarily naturally occurring. Instead '*they may well be 'constructed' communities*' (Tsoukas 2002: 424), hence these approaches often exhibit the tendency towards constructing CoPs to aid organisational learning and knowledge management. This, however, raises the questions about: how the practice, and consequently identity, of such communities emerge; what the underlying dynamics are; and how the shared systems of values (or tastes and appreciations) are created. Practice, on the other hand, is believed to provide more powerful analytical tool to analyse

and explain the dynamics of the very workings and emergence of CoPs (e.g. see Bjørkeng, Clegg and Pitsis 2009; Gherardi 2009a). Furthermore, this approach, rather than promising an easy to implement managerial solution, potentially can provide better understanding of how to support emergence of desired practices, as suggested by Thompson (2005). Consequently, the next section will provide a review of the extant literature dealing with the issue of emergence of CoPs to inform the forthcoming deliberations on the dynamics of inter-CoP relations.

EMERGENCE OF COPS: SPONTANEITY, COLLABORATION OR CONFLICT?

The concept of CoPs as a vehicle for organisational learning and, consequently, a means to gain competitive advantage, lured the attention of both researchers and managers keen to capitalise on the concept. As a result, numerous attempts were made to explain how CoPs emerge – or can be created – and how they can be measured and managed within organisations. Hence, in this section the main two approaches are discussed: one favouring a degree of spontaneity and the other supporting more direct management techniques aimed both at creating new and managing existing CoPs. Subsequently, the notions of conflicting and collaborative emergence will be discussed to shed light on the dynamics of interaction within and between CoPs.

EMERGENCE OF COPS: EVOLUTION OR CREATION?

Although originally CoPs were conceived as informal, organically grown, self-perpetuating and often invisible to larger, formal organisations (Lave and Wenger 1991), recent years have witnessed increasing attempts to deliberately manage, support and create CoPs (Anand et al 2007; Roberts 2006; Duguid 2005; Thompson 2005; Berends et al 2003, Breu and Hemingway 2002; Swan et al 2002). Before considering the possibility of the 'managed creation' of CoPs, this discussion will first consider the 'evolutionary' perspective. As noted by Roberts (2006: 625), CoPs, as *originally defined* by Lave and Wenger (1991) cannot be formed in any controlled manner. Although the majority of the proponents of the group favouring spontaneity generally agree with the notion (Ormrod et al 2007; Thompson 2005; Brown and Duguid 1991) they also note that the role of management needs to shift '*from one focused on command and control to that of `system builder'-facilitating and brokering the development and integration of knowledge within and across communities*' (Swan et al 2002: 482). Roberts (2006: 625) further exemplifies that '*a business can establish a team for a particular project, which may, in time, emerge as a community of practice. But management cannot establish a community of practice. What it can do is facilitate the spontaneous emergence of communities of practice and support those communities of practice that do develop*'. Thus we see that management, from this perspective is concerned with connecting and supporting the CoPs that 'evolve naturally'. Going further, however, a number of authors argue that organisations can construct and support CoPs via creating certain conditions – '*structuring spontaneity'* (Swan et al 2002: 481; Brown and Duguid 2001) or, more specifically, sponsoring certain loose organisational structures around which CoPs may interact (Thompson 2005). Breu and Hemingway (2002: 149) take a step further by suggesting that '*resources for potential identification of members*; *clear purpose that would*

motivate collaboration; *clear organisational benefit* and *recognition by management'* are the *necessary conditions* for CoPs to emerge.

The argument above leads to the suggestion that management can create the context and resources that support the 'natural' emergence of CoPs. As, Thompson (2005: 162) puts it, '*the use of structure in attempts at directly controlling present collaboration (e.g., best practice, targets, introduction of consultants) is likely to fail. Such determinist forms are referred to hereafter as controlling structures. Such a distinction is entirely compatible with the emergent CoP dynamic, in which structure and practice continually interact because it argues that people require preexistent raw materials to communicate (seeding structure), although the way in which such materials are actually used is always subject to negotiation, and thus not amenable to direct control (controlling structure)*'. Thus, Thompson (2005) argues that CoPs have minimum structural requirements and require certain infrastructural investments – the seeding structures – to grow. Similarly, Lakomski (2004: 90) recognises the importance of an enabling rather than controlling, noting that '*the best way to 'cultivate' them* [CoPs] *is by means of a more systematic yet 'hands–off' approach*'.

The seeding structure alluded to above has been argued to inform the development of (new) practices, but in a mutually constructive process; in particular, Berends et al (2003) exemplify how new practices are being enabled or prevented by existing structures via continuous *structuration*. Hence, new practices and CoPs are often a result of renewal and recombination processes, drawing on the practice resources contained within existing structures and processes. Furthermore, by adopting the approach in which practice is the essence of a CoP, it needs to be acknowledged that emergence of practices, and the consequent emergence of CoPs (as the core of CoPs) is inherently linked to learning and developing shared systems of values (i.e. *becoming*). From this perspective, emergence of a

new practice, and potentially but not necessarily new CoP, can be linked to facilitating cross-CoP collaborations (Scarborough and Swan 2008). In a broader context, renewal and emergence of practices can be linked to regional (local) professional associations and certain levels of institutional thickness (i.e. local social, cultural and institutional arrangements) as a factor that can enhance collective learning and development of shared practices and CoPs within regions (Falconbridge 2007). Although it was noted that professional associations can provide forum for generating shared meaning and understandings (Greenwood et al 2002) and shared knowledge production and so they could be conceptualised as CoPs (Brenner 2003), Faulconbridge (2007: 968) proposes to treat them as a catalyst that can '*sow the seeds for 'urban' CoPs that allow CL [collective learning]' rather than being CoPs per se*'.

Overall, then, although there seem to be a general agreement that CoPs are likely to grow organically, they may require certain supporting structures and cultivation within organisations. As noted by Lakomski (2004), if left alone CoPs are unlikely to realise their potential to facilitate learning or aid knowledge management. On the other hand, Faulconbridge (2007: 971) notes that inorganic and institutionalised communities in the form of committees and forums provide relatively little opportunity for collective learning', hence suggesting that any attempts to manage or support CoPs may be counterproductive. One of the possible explanations here is the (managerialist) focus on structures rather than practices, hence leading to emergence of mere groups of individuals without underlying shared practices. Another explanation for poor prospects of CoPs created by administrative action can be rooted in an understanding of the nature of professional groups. These can be linked to epistemic differences, high levels of institutionalisation and a tendency to defend one's own turf, as described by Ferlie et al (2005). Supporting and cultivating CoPs therefore poses a number of challenges and, as pointed out by Lakomski (2004: 90), '*is said to be an art*'.

In contrast, as already indicated, another group of researchers tends to take more pro-active stance, considering CoPs as organisational structures that can be managed. Indeed, Roberts (2006), notes a number of the recent contributions (e.g. Saint-Onge and Wallace 2003; Wenger et al 2002) suggesting that CoPs can not only be cultivated in a wide variety of organisational contexts, but can further be manipulated by organisational designers to leverage strategic advantage. In relation to this, Wenger et al (2002) provide the following specific design principles that can encourage the cultivation of CoPs in organisations:

- *design for evolution* to encourage natural evolution;
- *open a dialog between inside and outside perspectives* to ensure both emergence of shared goals and understanding within the community and relevance in the wider organisational setting;
- *invite different levels of participation;*
- *develop both public and private community spaces* to encourage both all levels of interactions;
- *focus on value* to all the stakeholders;
- *combine familiarity and excitement;*
- *create a rhythm for the community* as it is the stronger indicator of it aliveness.

Although on the one hand these principles indicate that the emergence of CoPs remains an organic process, on the other they assert that organisations can exercise some control over the process by providing favourable structures and shifting the focus to designing for aliveness and organic growth (even if that sounds rather contradictory).

Others in the managing/controlling camp favour more prescriptive and somewhat mechanistic approaches spanning from, for example, specific requirements for CoPs survival (e.g. credibility, success, communications and funding) (Breu and Hemingway 2003: 149-

150) to ready-to-apply models for cultivation of CoPs. For example, Loyarte and Rivera (2007) propose a methodology of cultivation, integration and evaluation of CoPs within organisations, suggesting a number of models to detect, evaluate necessity, and cultivate (that is, if the existence of the CoPs was determined as necessary) of CoPs within any organisation. A similar determinism can be detected in the performance measure model proposed by Schenkel and Taigland (2008), in which the aspects of practice or identity are completely omitted and CoPs are treated almost as organisational database for storing tacit knowledge, where inputs and outputs can be measured and compared. Some of these approaches could be inspired by the earlier work of one of the originators of interest in CoPs. Indeed, as pointed out by Ferlie et al (2005: 129), Wenger (1998) indicates a number of times that CoPs can be readily constructed 'from scratch' in new settings and applied in nearly any organisational context.

In conclusion, the existing approaches to emergence and development of CoPs span on a continuum from generic to highly specific and prescriptive. Considering the issues related to defining CoPs discussed earlier, it seems logical to discount the prescriptive extreme of the continuum. Indeed, as observed by Thompson (2005), the mechanism and requirements for the process of 'seeding' remain largely unexplained by the literature and conclusively, despite many attempts to conceptualise CoPs' manageability, ability of organisations to actively encourage the growth of CoPs (in controlled way) remains uncertain, as in the example discussed by Ferlie et al (2005).

CONFLICTING EMERGENCE

A completely different explanation of emergence of CoPs can be linked to the notions of conflict within, or between CoPs. Tensions arising within existing CoPs can be linked to some of the practices becoming outdated and 'stale', and hence becoming challenged by newcomers (Fox 2000). This, in turn, can lead to negotiations of the existing practices, or at the extreme, emergence of new CoPs (Geiger 2009; Down and Reveley 2004; Fox 2000). In a similar tone, Anand et al (2007: 425) conclude that it is individual agency that can catalyse the emergence of new practices under certain conditions (e.g. organisational support, alignment of individual and organisational goals). However, the same forces are equally likely to '*disrupt the existing patterns of territoriality in an organization*' (Anand et al 2007: 425), hence possibly exerting negative power upon the established and accepted practices. Another factor that can lead to breaking out from the established community and trying to develop new ways, or practices, is linked to generational differences, and consequent conflicts. Indeed, 'young guns' can challenge the (outdated) 'dull routine of old farts' (Down and Reveley 2004), further identifying themselves as more entrepreneurial, progressive and less risk-aversive (sub)group of employees. However, there is also continuity alongside the frustration and change. Conflicts can emerge not only between newcomers and 'old timers' but can result from a struggle for power by full participants (masters) who may want to uphold their central position against other full-participants, resulting in alliances with more 'junior' participants (Lave 2008; Fox 2000). Alternatively, changes can arise from a struggle for the ethical, or as pointed out by Geiger (2009), modifications to practices can result from conscious reflection and systematic questioning of the legitimacy of existing practices by the members. He further explains that this is likely to happen as a result of incidents of breakdown or situations when the ethical rightness of the practice is being questioned.

On a broader scale, a similar trigger for the emergence of new practices and CoPs can be linked to cross-CoPs dynamics, often characterised by conflicts. The intertwined nature of CoPs (for example in the form of NoPs) means that the practices and identities are in constant interaction and can lead to some adjustments, permanent changes or emergence of new practices or CoPs. As Tywoniak (2007) and Brown and Duguid (2002) point out, CoPs are embedded in wider contexts and, hence, should be coordinated and studied it those contexts rather than in isolation; this implies a need to include the analysis of inter-CoP power relations as they can have an impact on existing practices of the CoPs of interest.

COLLABORATIVE EMERGENCE

Inter-CoP collaboration is a phenomenon that both has positive potential and gives rise to a number of difficulties. For example, Duguid (2005) highlights that in the case of different CoPs with different practices epistemic barriers often arise, preventing knowledge sharing even if the CoPs belong to the same organisation. This can be attributed to existence of cognitive distance between partner CoPs (Nooteboom (2008) or a lack of necessary affinity (Gertler 2008). Nevertheless from the positive perspective, although difficult to bridge, exposure to Inter-CoP differences can create opportunities for further learning (Aanestad et al 2003); innovation (Swan et al 2002); reflection (Berends et al 2003); the reconsideration of assumptions underlying the workings of any CoP (Brown and Duguid 2001); and, finally, amendments to the native practices.

However, as different practices across boundaries may be largely incompatible (Amin and Roberts 2008; Handley et al 2006; Wenger 1998), working across boundaries may prove to be particularly challenging to individuals. As mentioned earlier, individuals may feel

pressurised when moving between CoPs as each time there would need to re-adjust their practices but also identities. As exemplified by one of the respondents in a study by Aanestad et al (2003: 8), '*it is painful to let go of your professional identity. You invest quite a lot when you spend many years on your education. For some individuals it is impossible to let go of their identity, and they will work in their traditional way until they retire. […] When it comes to the professional roles, it is built into the whole structure of the health sector*'.

Hence, working across CoPs boundaries requires one's ability to suspend own identity, since established work practices, which are linked to the fundamental identities, priorities and agendas of different professional group, may act as an important factor in facilitating or inhibiting change. Strong CoPs (or professional group) identity has been linked to intimidating effective cross-CoP exchanges, but in contrast Tagliaventi and Mattarelli (2006: 294-295) point out that any CoP must first strengthen its own uniqueness and differentiation before the processes of 'perspective taking' (i.e. reciprocal cross-community exchanges) can occur. This may seem counter-intuitive, as strong identities might be thought more likely to be associated with clashes, obstructive behaviours, and conflict (Ferlie et al 2005; Frost and Jean 2003; Finkenthal 2001), than successful interactions. This, however, resonates with the similar dynamics described in relation to IDR, where strong, developed disciplines were more likely to succeed in IDR collaborations (Aram 2004). In relation to inter-CoP interactions, this complexifications (Tagliaventi and Mattarelli 2006), or purity and strength, would require to be supplemented by some levels of flexibility, as strong but inflexible materials are likely to crack and crumble rather than support each other. This flexibility can be further linked to certain practices, systems of values and attitudes towards (or appreciation for) collaborative work and learning, with some CoPs displaying more aptness to learn (Ormrod et al 2007). However, the boundary between 'not enough' and 'too much' complexification remains unexamined.

Inter-CoP discourses can not only lead to new practices or enhance learning (Scarborough and Swan 2008; Gherardi and Nicolini 2002), but can help to overcome the reported problems of isolation (Brown and Duguid 1998). Indeed, Thompson (2005: 163) notes that '*sustained epistemic interaction with the wider world*' can prevent CoPs from '*suffering from the 'epistemic inhibitions of its own paradigm"*'. In a similar vein, Adler et al (2007) highlight that one of the major weaknesses of CoPs is the risk of closure and insularity. Furthermore, Thomson (2005: 163) suggests that for CoPs to overcome these risks, they '*should ensure that they generate appropriate vehicles and practices to encourage and support epistemic interaction not only within the community, but between the community and the context of the organization and wider market*'. Although this sounds plausible, it remains unexplained what the 'appropriate practices' are and how they can be developed, with the exception of the use of mechanisms of *brokering* and *boundary objects* (Wenger 1998). Although powerful as concepts, these mechanisms are characterised by their own shortcomings and hazards. For example, Wenger (2000: 265) warns that brokering, due to the nature of CoPs, can sometimes lead to certain occupational hazards of *uprootedeness*, *homelessness*, *marginalisation* and *organisational invisibility*, hence both alienating and challenging the sense of belonging of individuals engaged in traversing inter-CoP boundaries. Similarly, the use of boundary objects can have adverse results as the same objects may bear different meaning and importance to different communities, hence resulting in individuals or communities avoiding certain objects all together (Thompson 2005; Sapsed and Salter 2004; Wenger 1998). Furthermore, Sapsed and Salter (2004) argue that boundary objects are ineffectual in the context of dispersed projects (and hence groups) with little opportunity for face to face interaction due to their marginality. Some organisations may try to solve the problem of inter-CoP communication and knowledge exchange by explication and codification; these, however, are also likely to fail (Duguid 2005). Therefore, Thompson (2005: 163) suggests that organisations nurturing CoP approaches should not attempt to

transfer out and standardise 'best practice' from various participative communities, but rather focus attention on the most appropriate means of prompting people to communicate. In this vein, Wenger (1998: 114) explains that when a boundary encounter becomes established and provides forum for mutual engagement, a practice is likely to start emerging, over time becoming a form of collective brokering. However, the process itself remains rather underexposed, and so does any detail on what these practices might look like and how, except for bridging to other CoPs, do they interact with the native practices of CoPs. There is also no indication of how similar or different the involved CoPs and their practices may be.

It can be concluded that, to a certain extent, CoPs are 'manageable structures', as denoted in Figure 3; however in accord with the extant literature, it needs to be noted that too much control or formalisation is likely to have a negative effect on CoP development by both impeding learning or, through too detailed prescriptions of practice, leading to meaningless behaviours (Janowicz-Panjaitan and Noordhaven 2008; Wenger 1998). At the same time both public and private organisations are subject of increasing pressures and expectations to engage in more productive knowledge exchange practices (Blacker and Regan 2009), especially across organisational, divisional or disciplinary boundaries.

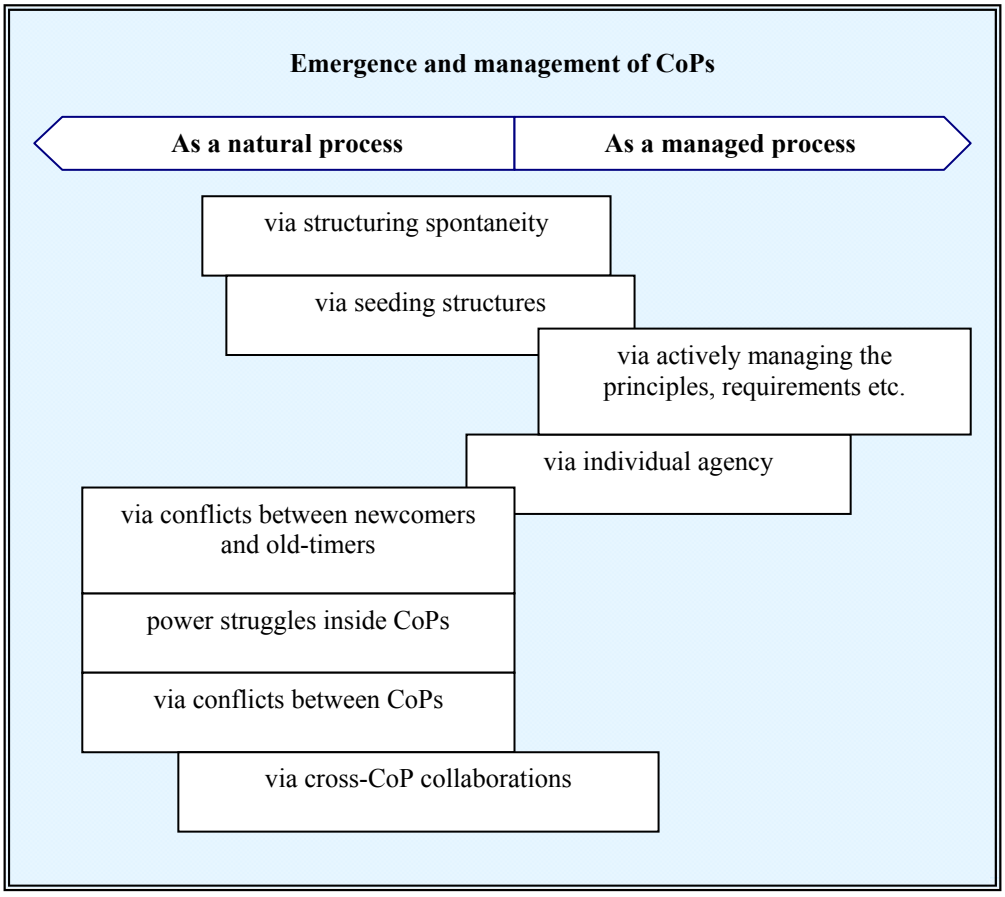

Figure 3: Emergence and manageability of CoPs.

Some more detail on how practices come to be at the intersection of CoP boundaries is offered by the example discussed by Bjørkeng, Clegg and Pitsis (2009), in their account of formation of new practices as a result of interorganisational collaboration. The authors conceptualise the process of emergence, or becoming, of shared practice as involving three main mechanisms:

- *authoring boundaries* as process of establishing what activities are part of legitimate practice, and which are not.
- *negotiating competencies*, which involves co-constructing norms outlining competence. Here the authors further stress the 'becomingness of the rules' as a process in which

practice and competence are in the constant process of constructing and refining each other.

- *adapting materiality* indicating a process by which material artefacts and practices are dynamically negotiated and co-constructed (Bjørkeng, Clegg and Pitsis 2009: 149).

Although the framework proposed by Bjørkeng, Clegg and Pitsis (2009) provides some valuable insights into the emergence of practice, it involves organisations with rather similar epistemological backgrounds (hence their worldviews and practices are likely to be similar) and over a rather prolonged period of collaboration, where a certain sense of permanency and stability prevails. One of the unanswered questions, hence, is whether temporary groups characterised by larger epistemological differences would also tend to develop shared practices, as in the above example. I will attend to this question in the next section, which will provide a summary of the discussion so far and outline the research problem and direction.

INTER-COP ENGAGEMENTS AND EMERGENCE OF NEW PRACTICES

The discussion so far raises a number of questions as many of the mechanisms and processes responsible for emergence, renewal and interchanges between CoPs remain unanswered. For example, the question regarding (potential) emergence of new 'boundary' practices in the context of increasingly networked organisational arrangements remains largely unanswered. On the one hand, as described by Bjørkeng, Clegg and Pitsis (2009), collaboration is likely to lead to the emergence of new practices characteristic to the engagement (e.g. emergence of new norms of 'doing things' and practicing, emergence of 'we' identity, etc). On the other hand, as described by Ferlie et al (2005), collaborations between professionals are

challenging as social and cognitive boundaries between professions can retard the successful exchange of practices.

One possible explanation, as discussed in relation to IDR collaborations, could be the relative epistemic distance between involved communities, with incommensurability increasing as the distance increases. This, to some extent, has been addressed by Amin and Roberts (2008a) by pointing that practices characteristic to different types of CoPs are incomparable, further proposing to distinguish between the following four types of collaborative arrangements, as defined by different types of practices:

- *craft or task-based work*: often hierarchical and apprenticeship based, long lived, often leading to development of socio-cultural institutional structures;
- *professional practice*: often based on formal, regulatory hierarchically managed institutions; well established and long-lived communities;
- *epistemic or high-creativity collaboration*: short lived; often project based, bringing a number of high-profile individuals from a number of epistemic fields;
- *virtual collaboration* – often self-regulating communities in which practices and social interactions are mediated through IT technologies, virtual communities emulate the other groups.

Indeed, crossing boundaries between the different types of groups, often considered as CoPs (Amin and Roberts 2008a: 356) is going to be challenging, partly due to the differences in practices but also potentially lack of necessary affinity between members to engage into a 'productive dialogue' (Gertler 2008: 209), however, may till be necessary. Furthermore, even if CoPs (roughly) belong to the same group (e.g. professionals), the epistemic differences may prove to large to bridge (Nooteboom 2008; Ferlie et al 2005), preventing from productive collaboration and sharing or creation of knowledge. In the context of

interdisciplinary engagements, similar explanation found in the literature is that of disciplinary incommensurability (Zahra and Newey 2009) and varying systems of values related to the different epistemic communities (Buanes and Jentoft 2009).

However, at the same time extant literature suggests that cross-boundary engagements, often based on knowledge sharing, are becoming a rule rather than an exception, forming a backbone of the increasingly networked, global world (Siedlok and Hibbert 2010). Hence, cross-boundary exchanges are becoming increasingly important for both private and public organisations, with organising progressively taking place in a '*net of fragmented, multiple contexts*' (Czerniawska 2004: 786) and work being '*enacted by groups that fade, intermix and are reconfigured in contexts where uncertainties and contradictions have become ever more visible*' (Blacker and Regan 2009: 162). Indeed, as discussed in the previous chapter, complexity of knowledge and calls for greater applicability or research often demand working across (epistemic) boundaries between disciplinary tribes. Furthermore, in the IDR setting '*collaboration between the partners is of vital importance, yet takes shape without strong predetermined rules or central authority'* (Engeström 2008: 1786) highlighting the elusive, improvised and decentralised nature of these engagements in situations when there is no clear central authority or force responsible for assembling and managing these types of teams, increasingly made up of non-craft communities (Heckscher and Adler 2006).

The extant literature does not agree on the nature of these project-oriented teams, and their relation to CoPs, shared practices, systems of values or sense of belonging of individuals. For example, Lindkvist (2005) argues that due to their temporary character, project-based teams are less likely to evolve into fully developed CoPs and should, therefore, be referred to as *collectivities of practice* as success of such collaborations depends on shared goals and individual knowledge of its members and agency. He further explains that '*typically these*

kinds of groups consist of diversely skilled individuals, most of whom have not met before, who have to solve a problem or carry out a pre-specified task within tightly set limits as to time and costs. As a result they tend to become less well-developed groups, operating on a minimal basis of shared knowledge and understandings. Such a group, I suggest, constitutes a 'collectivity-of-practice' (ClP)' (p. 1189)

Similarly, Fischer (2001) refers to these epistemologically diverse groups as '*Communities of Interest'*, further noting that these can be thought of as 'communities of representatives of communities'. Consequently, the learning dynamics are different, more complex and multifaceted, from those based on legitimate peripheral participation in more traditional CoPs, as there is no single core that participants can move towards. Members of such groupings are exposed to different set of challenges, including communication and learning that requires understanding of different perspectives and vocabulary. Indeed, inter-CoP collaborations often involve '*a profound mutual suspicion and incomprehension'* and as a result '*there seems to be no place where the cultures can meet*' (Snow 1993 in Fisher 2001: 2). This view is largely mirrored in the work of Ferlie et al (2005: 129-131), who argue that CoPs of professionals tend to be cellular, self-sealing and institutionalised, hence they are less open to multiple memberships, fluid participation and, as a result, external knowledge and learning. Indeed, new practices developed through collaboration between CoPs are often frowned upon and discarded, '*highlighting the difficulties of translating new practices across an organisation*' (Scarborough and Swan 2008: 170), hence inhibiting learning and knowledge sharing.

On the other hand literature also suggests development of shared inter-CoP practices and potential emergence of new multi-CoP community. For example, Ferlie et al (2005: 129) note that emergence of '*a genuine multidisciplinary community of practice was rare, but*

possible' – a notion to some extent supported by the example of development of shared practices by a smaller project team within organisation (Scarborough and Swan 2008). Similarly, Hayes and Fitzgerald (2009) report emergence of certain knowledge-stewarding communities that make inter-CoP interactions possible. Furthermore, they suggest that these interactions are made possible by 'boundary-crossers' – individuals able to translate the behaviours, knowledge-systems and social values between the distinct groups. Although closely resembling brokering, the indication of knowledge-stewarding CoPs also signifies possible emergence of both a network of individuals and practices characteristic to increasingly common, temporary collaborative groupings. This is further supported by the observed process of emergence of 'intertwining of work practices' (Sutherland Olsen 2009) – a particular way of working through extending individuals' repertoire of work practices and overlapping with the partner's field. Furthermore, as noted by Sutherland Olsen (2009: 406), the intertwined way of working '*has an additional function – it allows them [partners] to develop respect of their colleagues' expertise in spite of their different backgrounds*', hence potentially impacting on the 'native' system of values of each of the involved disciplines. Hence, the partners in the above example needed to engage into '*the development of shared understanding and common interpretative schemes*' (Lam 2005: 125), a process that requires 'to occur over time, through repeated, practice based interaction (shared work experience)' (Gertler 2008: 209) to develop, what Powell and Grodal (2005: 60) termed as '*broader bandwidth for communication*'. Although this 'bandwidth' could be thought of as some enabling or supporting structures, the existing literature remains silent about, to use the same metaphor from the world of information and communication technologies, the information protocols that are closer to the idea of practices in these often transient interdisciplinary teams.

To summarise the discussion, Table 1 provides a synthesis of the main theoretical concepts related to transient, project-induced and involving professionals interactions as present in the existing literature. The next section outlines the research agenda resulting from the discussion presented so far.

Author /// Theoretical distinction or concept /// Main characteristics or features:				
Fischer 2001	**Ferlie et al 2005**	**Lindkvist 2005**	**Amin and Roberts 2008**	**Sutherland Olsen 2009**
Communities of Interest	***Professional groups & CoPs***	***Collectivities of Practice***	***Epistemic Communities***	***Intertwined practices***
• multi-epistemic, heterogeneous communities: *communities of representatives of communities* • temporary and assembled to solve a specific problem • potentially more creative than homogenous CoPs • different, more complex learning dynamics: multi-faceted, no single core as in LPP • knowledge is tacit and fragmented; partners possess important yet incomplete understanding of the problem (*symmetry of ignorance*) • challenging communication and need to develop understanding of others' perspectives and vocabulary; • requires externalisations in the form of boundary objects which have meaning across the boundaries of knowledge systems --- *mutual suspicion and incomprehension hindering collaboration*	• organisations contain many professional groups, each operating in a distinct CoP • often unidisciplinary; cellular, self-sealing and institutionalised • defend their jurisdictions and identity by sealing themselves off from other professional CoPs • mechanisms to validate knowledge and training, control entry and exit of individuals and enforce professional standards • not open to multiple memberships, fluid participation, external knowledge and learning and spread of new work practices • strong social and cognitive boundaries between and within professional groups are impermeable and retard exchange of knowledge --- *development of multidisciplinary community of practice is rare and unlikely*	• temporary project groups • pre-specified tasks within limited time and budget • highly autonomous projects • members haven't met before: swift socialisation • highly specialised and competent individuals • members represent different 'thought worlds' and perspectives • difficult to establish shared understanding or common knowledge base resulting in radically dispersed, distributed or individualised knowledge base; incomprehensible to any single member • operate in transactive memory fashion: knowing who knows hence indicating high degree of self-organisation --- *notion of CoPs does not fit with temporary and project organisations*	• purposefully organised, temporary, ambiguous and uncertain exploratory projects • highly independent individuals with substantial egos, high expectations, rudimentary rules and procedures • driven by peer recognition; inquisitiveness, professional commitment, corporate or ethical responsibility, career, loyal towards the problem, not group • absence of social dynamics of cohesion and mutuality • identities not shaped through joint work • requires 'organised slack' for free thinking, problem visualisation, serendipity • requires active managing of dissonances through *codification*,' • *visionaries* to spread of the knowledge --- *given the immense scope for fragmentation, misunderstanding and disunity, success is far from guaranteed*	• iterative and highly interactive interdisciplinary collaborations among scientists • fuzzy or flexible division of labour • proximity and shared interest in success of the task • individuals deeply embedded in disciplinary practices and worldviews • to overcome barriers develop intertwined practices to complete lab experiments through expanding own repertoire into domain of partners • development of respect for colleagues' expertise in spite of different backgrounds which allows use of knowledge (particularly know-how) from other domains without full understanding --- *they seem to have found a way to turn the] friction into something positive*

Table 1: Summary of theories related to inter-CoP engagements

RESEARCH AGENDA

The presented discussion raises a number of questions related to the dynamics of temporary, epistemologically diverse and often project-oriented collaborations. On the one hand, the literature suggests that strong professional groups that individuals are embedded in are likely to hinder exchange of knowledge and shared practices among the members of these teams (Ferlie et al 2005) and in the rare event of emergence of some shared practices, these are likely to be only fleeting (Ferlie et al 2005; Fischer 2001). Lindkvist (2005) argues that due to their temporal character, project teams are less likely to evolve into fully developed CoPs and should, therefore, be referred to as collaborative *collectivities of practice*, whose members are usually more centrally involved in, and concerned with, existing and enduring CoPs and Networks of Practice (NoPs). Individuals engaged in such collaborations usually work on the minimal basis of shared knowledge and 'swift trust' and rather than going through the process of 'enculturation', individuals remain to operate more like 'free agents'. However, as Lindkvist (2005: 1200) further notes, the group may '*develop a pattern of interaction and a collective competence needed*', hence suggesting emergence of some shared practice among members. This resonates closely with the example presented by Bjørkeng, Clegg and Pitsis (2009), which suggests emergence of shared practices and identity among professionals coming from different organisations (although the nature of the projects is different in their example).

Hence, it remains unclear whether these short-lived, project-oriented collaborations can be looked at from the perspective of shared *practices* and be thought of as a type of Community (or Network) of Practice. If so, the next question is what skills and practices are developed by individuals in such collaborations; where these shared practices reside and how these

practices relate to the native CoPs (NoPs) that such individuals are rooted in. Could these, perhaps, form an integral part of 'collaborative intentionality capital' of an organisation, as purported by Engeström 2005? Finally, considering the increasingly repeatable nature of cross-CoP collaborations, can these individuals be considered as an emerging network of practitioners, linked by shared practice, and if so, how these practices are propagated among the members.

By answering some of the above questions, the thesis can further contribute to a better understanding of the dynamics of IDR, providing some new angles for both policy and practice of this mode of collaborative research.

The remaining part of this thesis will attempt to address these questions. However, before presenting the findings, the following section will present the details of the methodology adopted in this work.

CHAPTER IV: METHODOLOGY

INTRODUCTION

Some of the most widely assigned essays on methodology (e.g. Guba and Lincoln 1994) seem to imply that interpretative project is one that is carried out by a particular type of person (an interpretivist) whose worldview is defined by a particular epistemological and ontological paradigm (interpretivism). This literature is bracing stuff. Packs of scholars take sides in longstanding philosophical disputes and clash over a bedrock beliefs that drive their research. Reflecting on my own work, however, I find it hard to square such accounts with experience.

Most of my work is question driven. (Soss 2006: 131)

Most certainly I feel sympathetic with the quote above, hence, writing a chapter in which I should state what is my own philosophical or epistemological position was harder then I expected. The main purpose of this chapter is to provide an overview of the methodological choices alongside their justifications adopted for this study, however, first I will briefly outline my ontological and epistemological position as this is particularly important due to the qualitative nature of the study.

Before I proceed to the discussion on research context, strategy and design, I should provide a brief description of my metatheoretical position here, and outline the implications my position had on the research design, which will be discussed in detail in the subsequent sections of the chapter. As noted by Saunders, Lewis and Thornhill (2003), ontological and epistemological assumptions of a researcher inform the theoretical perspective of the research, further defining validity of knowledge. At the simplest level Morgan and Smircich (1980) suggest that ontological grounding can be roughly divided into objectivist and

subjectivist approaches, with the former assuming that reality is a concrete structure (or process) that is given, somehow external to individuals, hence it can determine the behaviours of individuals (Cunliffe 2010; Morgan and Smircich 1980). As a result, knowledge is also treated as explicit and real, often reducible to measurable facts and the casual relations between facts (Cunliffe 2010). On the other end of the spectrum, subjectivist approaches perceive reality as a product of human mind; socially constructed by autonomous individuals who give meaning to the surrounding world, hence the focus of the research is on understanding what is happening rather than just delineate patterns, systems or facts (Cunliffe 2010; Morgan and Smircich 1980). In a similar vein to the latter approach, the main premise of this research is to develop better understanding of the social interactions and how autonomous individuals understand and engage with interdisciplinary practices.

Although I attempt to develop rather coherent set of practices as the final output, these are not to be understood as universal actions that are undertaken by all the individuals engaged in IDR. Instead I attempt to provide an outline of some emerging, shared understanding of IDR that further translates into certain, emergent practices in the broad meaning of the concept (e.g. as proposed by Gherardi 2009a). Shared in this meaning does not indicate that any of the described practices are understood and mean exactly the same to all the participants. On the contrary, these practices are constantly being negotiated in relation to the specific time and place (hence they are situated and contextualised), however, at the same time these practices are relatively stable and, to some extent, experienced as 'objective' (Cunliffe 2010). Furthermore, I should acknowledge that my role as a researcher was intrinsically connected to the research setting and the final results of the study. Indeed, whether intentionally to or not, I played an active role in developing the shared meaning of the practices and mediating the meaning of the research participants, with the final outcome being my interpretation of the observed phenomena. As I will later elaborate, my role was

both that of an outsider and an insider and my embeddedness meant that I both shaped and was shaped by the experiences related to the research. Indeed, my position is well within subjectivist approach, and hence the research focus, strategy and design are shaped by my philosophical grounding.

The remaining part of the chapter will progress as follow. First, I will discuss the context in which the study has been conceived and conducted, as this in turn had further implications on the questions driving this study as well as the adopted research strategy and design, all of which will be also discussed in detail. Consequently, in the second part I will provide a detailed analysis of the research strategy, followed by a discussion on research design.

RESEARCH CONTEXT AND STRATEGY

Due to the fact that this study has been externally funded and linked to another externally funded project, it is necessary to outline the wider context and its implications on the design of this study. This is particularly important, as these factors have had an impact on the research questions, research approach and direction adopted in this research. Consequently, the following sections will outline the context of the study, paying particular attention to how the context influenced methodological choices and outcomes. Indeed, I believe that withholding any of these details could result in questioning the reliability of the research (Ghauri and Gronhaug 2005).

THE BACKGROUND TO THE RESEARCH PROJECT

This research project has been developed in relation to Bridging The Gap (BTG) programme at the University of Strathclyde - an initiative funded by Engineering and Physical Sciences Research Council (EPSRC) to encourage research collaboration between mathematics, engineering and computer sciences by brokering research projects and interactions between researchers from the above disciplines. The University of Strathclyde developed a series of initiatives and events over the period of three years, to bring these disciplines together under the theme of Managing System Risks. In other words, the main goal of the BTG project was to stimulate research collaboration across a range of departments and disciplines at the University of Strathclyde.

Upon successful award of the BTG funding, the project team realised that the project would benefit from involvement of additional support to provide a reflective view on their activities and an expert opinions on collaborative processes, together with development of new theories. This came partly as the realisation that interdisciplinary research may seem easy on the surface but the underlying processes and motivations can be complex and often misunderstood, and the project team was keen to develop better understanding of the dynamics and effectiveness of the initiatives undertaken, hence progressing the theoretical understanding of interdisciplinary collaborations. Furthermore, the goal was not just to generate a series of interdisciplinary collaborations, but rather to initiate long term change within the university by making interdisciplinary research part of the 'research ethos'.

As a result this research project was initiated and funded from the University's resources with two distinct goals. First, to further theoretical understanding of interdisciplinary research collaborations (the theoretical angle of the research) and, second, to provide support

to the BTG project (the practice angle of the research). This practice angle of the research was envisaged in at least three different forms:

- to provide feedback on different initiatives and events organised under the umbrella of BTG;
- to provide advice on the best strategies for supporting interdisciplinary collaborations at different stages of development;
- to develop and implement a survey study that would enable to measure the levels of interdisciplinary 'collaborativeness' across the university over the period of the project.

Although the research proposal ensured flexibility in designing the research strategy, it has envisaged some preferred approaches to be employed, namely participant observation, interviews with participants and a design and execution of an annual survey to learn about the levels of interdisciplinary research across the university. The role of the researcher further included providing a continuous feedback and advice on the past and future approaches to stimulate interdisciplinary collaborations, hence the research approach included both elements of organisational ethnography and action research, as will be elaborated in the following sections.

DEVELOPING THE RESEARCH QUESTION

The premeditated elements of the research and the research setting influenced the choices and range of methodological tools to be adopted in the later stages of the research, further having an impact on the process of elaborating the research problem. As the research progressed, a number of issues relating to interdisciplinary research (IDR) were identified, both from reviewing the existing literature on the subject and from the early findings. One of

the early identified issues related to different dimensions and aspects of learning in IDR, resulting in searching for appropriate theories and frameworks that could be applied in this particular context. As a result, my attention was drawn towards the concept of Communities of Practice (CoP) (Brown and Duguid 2001; Lave and Wenger 1991) as this framework offered an interesting angle of situated learning to develop and inform a collaborative model of interdisciplinary research. The initial literature review attracted my intrinsic interest towards some of the aspects of Communities and Networks of Practice (CoPs and NoPs), further shedding some light on potential overlaps between existing theories and IDR collaborations. The subsequent in-depth review of literature on CoPs lead to the identification of a number of gaps in the existing theories, as discussed in the previous chapter, in particular where these related to connections between the identified gaps and ongoing research on IDR.

Figure 4 outlines: the context of this research and its connections to the BTG project, which acted as both research site and a client; the goals and outcomes of the project; and the relationship between the frameworks of IDR and CoPs.

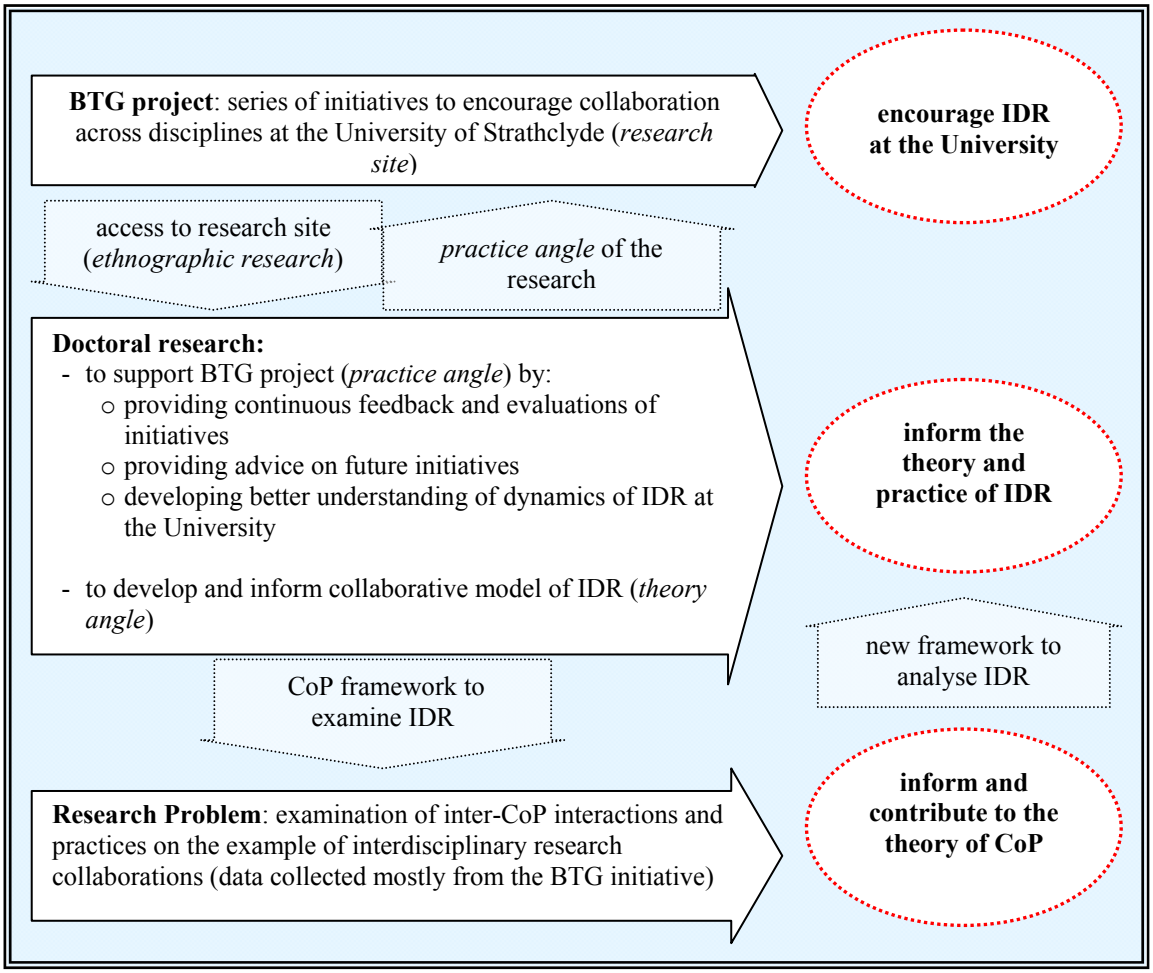

Figure 4: Research context and interrelations between the three projects.

As depicted in Figure 4, this research drew data from the BTG projects gathered through observations, interviews, documents analysis (e.g. email communications) and, to a limited extent, surveys. Hence, as a result, the choice of research approach in this study has been, to some extent, dictated by the original proposal and arrangements with the BTG project board. These factors further influenced the research design and the research problem underlying this study.

Since the research is drawing from facts acquired through observation and subsequent interviews, it can be placed within the inductive, as opposed to deductive, theory

development approach, within the qualitative research domain. This approach was appropriate due to the exploratory nature of the research, with the following quote very well describing the process and remit of this research:

> *'The researcher may observe something s/he does not understand, typically resulting in questions such as 'Why?', or 'Why does this happen?' For example, the researcher may observe a specific practice, a way of doing things that is counterintuitive or in conflict with that which s/he has been exposed to previously. This is often the case in 'qualitative' research with a prime emphasis on gaining understanding. A key purpose in the later case is to 'construct theory', i.e. to come up with an adequate explanation.' (Ghauri and Gronhaug 2005: 15).*

Indeed, questions related to the observed practices underlying interdisciplinary collaborations triggered a search for existing theories to explain the observed processes, and subsequently leading to further questions related to the nature of inter-CoP engagements. The relationship between themes of IDR and CoPs is not a straightforward sequence but is characterised by continuous interactions and iterations of questions being further developed as both the data and reflections on the literature review unveiled new details (Soss 2006; Ghauri and Gronhaug 2005). Hence, although the main goal of the research was to further develop an understanding of inter-CoP interactions, especially transient and project oriented groups, the research also strove to provide a new theoretical lens to understand the dynamics of IDR.

FROM RESEARCH CONTEXT TO RESEARCH STRATEGY: INTERPRETIVE ORGANISATIONAL ETHNOGRAPHY

The context of the research is one of the factors that need to be further examined in terms of the impact it had on the choice of research strategy and design. Another aspect that requires at least a brief outline is that of the philosophical grounding, as this justifies and provides support for the analytical approach adopted in data analysis. Indeed, as Cunliffe (2010: 1) argues, '*considering our metatheoretical positioning provides a basis for building crafted, persuasive, consistent and credible research accounts'*, hence these can have a powerful impact on the design, progress and the final results of the study. Finally, some consideration needs to be given to the portfolio of adopted methods and tools.

INTERPRETIVIST AT THE CORE

The exploratory nature and the focus of the research questions naturally indicated that, rather than an experimental science concerned with laws, an interpretative search for meaning of the phenomena would be the most suitable approach to adapt (Geertz 1973: 5; Yanow 2006b: 6). Indeed, exploration and the extending of theoretical concepts were from the very beginning at the very heart of the research

Although well suited, this choice came with some consequences. Fists, any observed phenomena are likely not only to be to be interpreted by the researcher, but these interpretations to be deeply rooted in hers/his *a priori* knowledge and understanding of the surrounding world (Yanow 2006b: 9). Hence, this *a priori* knowledge and understanding can act as a set of lenses through which the researcher perceives the phenomena, with the risk of filtering out those aspects that seem meaningless and are not understood. However, due to

the dynamic character of these pools of knowledge, as the research progresses new meanings can be acquired and developed, hence extending the spectrum of understanding (Pader 2006; Soss 2006). Indeed, as explained by Pader (2006: 166), although finding relations and patterns is central to research, it is not always a straightforward undertaking as '*the commonplaces of our ways of thinking, seeing and acting seem, to us, normal and natural; and 'normal' things typically do not attract analytic attention. Things we do not 'see' and do not think to question because of their normalcy are, in effect, invisible'*. Consequently, it is pivotal that the aperture of the research lens should stay wide open at all times, allowing as much detail as possible, whether it seems meaningful or more like a random noise at the time.

Although to some extent predetermined, the adopted qualitative approach offers a number of advantages. First, qualitative approaches are often associated with seeking to explain the dynamics, origins and assigned meaning of social phenomena (Denzin and Lincoln 2000, Yanow 2006b), which was required in the case of inter-CoP collaborations. Furthermore, in contrast to quantitative approaches which usually are limited to providing answers only to the specified questions, qualitative approaches are often employed in emergent theory development, achieved through the concurrency of data collection and analysis, which is distinctive to such approaches (Yanow 2006b; Rosen 1991; Gummesson 1991). As discussed in the previous chapter, the nature of this research was highly exploratory and not driven by pre-developed propositions. Instead the research problem oscillated around unexplained phenomena within the social sphere of how things are achieved and why. Furthermore, as the focus of the inquiry was on *practice*, which is considered as both an organisational and a social phenomena (Nicolini 2009; Thompson and Walsham 2009), an ethnographic approach seems particularly suitable for this kind of research (Blacker and Regan 2009; Gherardi 2009a; Llewellyn and Spence 2009; Nicolini 2009; Thompson and Walsham 2009).

ETHNOGRAPHIC EXPLORATION

The roots of ethnographic studies are deeply embedded in anthropology and by employing mostly naturalist modes of inquiry (Rosen 1991; Gill and Johnson 1991) are recognised as well suited for research into social interactions or, as in this particular case, Communities of Practice (Ormrod et al 2007; Assimakopoulos and Yan 2006; Tagliaventi and Mattarelli 2006; Aanestad et al 2003; Berends, Boersma and Waggeman 2003; Gherardi and Nicolini 2000). The main goal of an ethnographer is to grasp the 'native's point of view' (Tedlock 2000: 457), and hence, to interpret the *behaviours* and relevant *meaning systems* of the actors of the studied social system (Rosen 1991: 10; see also Miettinen, Samra-Fredericks and Yanow 2009; Geertz 1973), whilst at the same time being embedded in the system.

Although in the 'classical' ethnography of anthropology the role of the researcher often has been completely omitted (Shehata 2006), it has been recognised and placed at the centre in later reincarnations of the method. For example, Ortner (1996: 281 in Yanow 2006: 120) defines ethnography as '*the attempt to understand another life world using the self – as much as it is possible – as the instrument of knowing*' or, as noted by Shehata (2006: 246), it is the ethnographer's self that becomes both the '*conduit of research*' and '*primary vehicle of knowledge production*'. This, however, bears further consequences. First, the results are correlated to the epistemological beliefs of the researcher (Spooner 1983: 3), as these would determine what data are being selected, how the relationship between the data and the purpose they were gathered is seen and what they actually mean (Rosen 1991). Hence, it is the researcher's task to develop certain '*ethnographic sensibility*' (Pader 2006) to look beneath the surface and see not only the obvious patterns, but also be able to attend to what is not being seen or spoken and can impact on the studied phenomena (Yanow and Schwartz-Shea 2006: 120). Secondly, as ethnography investigates dynamic social systems, the

presence, identity, background and personality of the researcher can also have an impact on the study, through ethnographers impact on the system and the lives of those studied (Rosen 1991: 2) but also what data would be revealed to the researcher (Yanow 2006b; Shehata 2006).

Although rooted in anthropological tradition, ethnographic research soon found space in organisational studies (Miettinen, Samra-Fredericks and Yanow 2009; Yanow 2006b; Rosen 1991), as it offers an effective tool to investigate behaviours, beliefs, motivations, power relations, decision making or daily practices of people in organisations (Geiger 2009; Orr 1996; Hammersley 1992; Rosen 1991). However, some further modifications were made to better suit the contexts of organisational research. For example, Rosen (1991: 3) delineate between 'general' and 'organisational' ethnography, noting that whereas the general type is focused on the daily and un-organised lives of people, organisational ethnography '*is predominantly concerned with those social relations coalesced around a subset of goal-oriented activities'* (Rosen 1991: 3) as these issues under research are usually both *partial* and *specialised* (Spooner 1983: 4). Similarly, Alvesson and Deetz (2000) note that data collection and analysis in research driven by organisational ethnography can prove to be rather problematic and time consuming if to be followed by the rules originally developed in anthropological studies, and hence suggest adoption of *partial ethnography* in the organisational context. This approach is further recognised to provide researchers with the opportunity to achieve distance and critical perspective on things that may otherwise easily turn to be normal, natural or rational as a result of overexposure to the research setting (Alvesson and Deetz 2000) and to alleviate some of the dangers of 'going native' (Aanestad et al 2003; Tedlock 2000). Hence, partial ethnography is believed to offer the distance and reflective space, as well as necessary focus on the core of the phenomena.

In a similar manner, Miettinen, Samra-Fredericks and Yanow (2009: 1315) note that organisational ethnography is more likely to have a focused theoretical concern, as opposed to often a-theoretical anthropological ethnography, and the researcher is more likely to '*slide along the continuum from full participation to 'pure' observation, and back, as she moves from the situationally-appropriate role adopted for purposes of 'being there' to the more scientific-observer role adopted for interviewing managers, executives, and other 'experts''*. Moreover, as noted by Rosen (1991), in organisational ethnography the researcher often studies 'individuals like themselves', rather than 'invading' a foreign culture as often witnessed in more traditional anthropological approaches. This, consequently, has an impact on the process of access, data collection and the resulting sense made of the observed phenomena. Hence, organisational ethnography first of all is likely to be focused on a particular problem or empirical ground, but also allows the researchers to move between roles, hence alleviating the risk of becoming too embedded in the studied environment.

Ethnography, whether organisational or in the wider sense, is often considered more than just a research technique. For Rosen (1991: 13) (organisational) ethnography is wider than just collection of tools, defining it '*as a method of 'seeing' the components of social structure and the processes through which they interact'*. Similarly, Bate (1997: 1153) notes that ethnography can constitute a research paradigm in its own right, which in certain situations can reveal '*many things that present approaches, especially the 'managementcentric' ones, are missing'*, a view that seems to be resonating throughout the collection of essays edited by Yanow and Schwartz-Shea (2006).

In the approach adopted in this particular research, ethnography constitutes a certain strategy rather than a paradigm or structured way of describing the findings. This choice is further supported by a number of previous studies into CoPs that adopted similar approaches (e.g.

Ormrod et al 2007; Berends, Boersma and Waggeman 2003; Gherardi and Nicolini 2000; 2002; Orr 1996) as this approach is considered to provide insights into the everyday behaviour of an organisation or community in its natural setting (Assimakopoulos and Yan 2006; Bryman 2004). Indeed, as pointed out by Berends, Boersma and Waggeman (2003: 1044), this strategy '*reveals the fine texture of practices'* and is well suited to grasp the social dimension of the phenomena of knowledge or practice at the time and place they occur (Tagliaventi and Mattarelli 2006), but also as they are 'becoming' a particular practice (Bjørkeng, Clegg and Pitsis 2009). Furthermore, the dynamic character of ethnography allows for concurrency of data collection and analysis, as well as emergent theorising and development of research questions (Rosen 1991), hence addressing the artificial separation of analysis from other research activities, which could be '*a narrow and limiting construal of what transpires in crafting research*' (Yanow and Schwartz-Shea 2006: 125).

In this research the focus is on particular practices related to inter-CoP interactions observed in the example of interdisciplinary research processes; hence somehow narrowing the scope of the observation. Furthermore, this approach also allowed me to 'slide' between the roles of observer and participant, which would be difficult to achieve by adopting a different research strategy. Finally, my role at the University granted privileged access to the research settings and actors as I could be considered 'one of them'. Hence, this research strategy seemed particularly relevant for the questions and setting of the research.

ENGAGED ETHNOGRAPHY: ACTION RESEARCH ELEMENTS

The fact that this research was closely related to the BTG programme obviously had some impact on the process and results of the study and hence requires to be reflected upon. The BTG research bore a number of features characteristic to action research (AR), and through

continuous feedbacks it had a significant influence over the research setting (i.e. BTG initiatives). On the one hand, this arrangement had an impact on the researched practices and relations, however, on the other hand it allowed me to capture much wider spectrum of data, including 'data in action', rather than only post-hoc recollection and rationalisation that surveys or interviews would provide (Huxham 2003). However limited, my dual role as researcher and an agent of change still requires to be acknowledged. Through working with and reporting to the BTG board, which was responsible for overlooking the initiatives, I had an indirect influence over the research. AR is often described as highly reflexive, systematic, experiential and participatory mode of investigation (Berg 2004) in which the researcher investigates reality in order to transform it but at the same time transforms reality in order to investigate it (Kemmis and McTaggart 2000). The researcher usually stands alongside and with the community rather then outside as an observer or a consultant (Berg 2004; Eden and Huxham 1996). However, there is no agreement on such issues related to the balance between research processes and intervention, and the different researcher identity dynamics associated with these poles of action and research (McInnes, Hibbert and Beech 2007).

Another challenge posed by adopting an AR approach is related to the background, beliefs and values of the researchers themselves, as encapsulated by Hillon and Boye (2007: 360), who raised the question of whether '*the validity of action research depends more upon the observer's worldview, ideology, or past experience than upon some other sort of measure to indicate the quality of change in the lives of those involved in the intervention?'*. This indicates that the researcher should be aware of both the fact that he or she is also a subject of the research (Eden and Huxham 1996) and the weight of hers/his interpretation on the results and any changes inflicted through 'action' in the research setting.

Indeed, in this study, my role varied from observer to participant, from solely collecting data to actively influencing the decisions taken by the BTG steering group, which consequently would impact on the BTG initiatives under investigation. Moreover, each follow-on interview had a potential to ignite reflection and further changes in the way interviewed participants understood and engaged with other disciplines –which I consciously did on a number of occasions. Hence, the research approach adopted in this study could be termed as *engaged organisational ethnography*. The main difference between AR and this approach is that although I acted (to limited extent) as a change agent, unlike in most AR approaches I still conducted the research through adopting an ethnographic approaches.

Ethnographic research approaches are usually a combination of different research methods, most often including observation, interviews and documents analysis. These techniques can either be used as 'stand alone' or in combination, in which each method can be used to corroborate or refute provisional interpretations derived through the other methods (Yanow and Schwartz-Shea 2006: 120), which was the approach adopted in this study, as will be described in the following sections.

RESEARCH DESIGN

Adopting a certain research approach, in this case interpretive organisational ethnography, has cascading repercussions for the research design and methodology. The original design for the research suggested a qualitative approach largely based on ethnographic observation with elements of action research, as the researcher whilst investigating the phenomena, was to engage in a cycle of collaborative exchanges to change and improve the organisational processes under study (Huxham 2003; Greenwood and Levin 2000). As a consequence of this choice the somewhat more practical issues related to the design of the research need to be considered next.

According to Hoggart, Lees and Davies (2002: 50) the following three questions are important in the context of research design: is it '*credible* (capable of providing convincing conclusions), *directed* (targeted at the question in hand) and *feasible* (given cost and time constraints)' (italics in the original). The pre-determined research setting to some extent ensured *feasibility* as it provided an instant and almost unlimited access to a research site at minimal cost. Similarly, the pre-determined research interest, although not too specifically, ensured the research was *directed* and focused on the issues relevant to both theory and practice. Furthermore, ensuring rigorous data collection and analysis, as will be discussed in the following sections, can ensure the credibility issues are also satisfied.

Janesick (2000) compares research design in qualitative research to choreography. Rather than a fixed and rigid structure it needs to be approached as a dynamic process where the role of the researcher is similar to that of a choreographer, who needs to act as necessary as

the research dance unfurls. Although dynamic by nature, there are a number of elements that research design comprises of:

- development of the research question (or problem) that would guide the work;
- selection of site and participants;
- access arrangements;
- study timeline;
- selection of appropriate research strategy
- the place of theory;
- identification of researchers philosophical and epistemological position;
- ethical issues (Janesick 2000: 384-385)

Since the aspect of research problem and questions development have already been discussed alongside a (brief) summary of the research approach and epistemology; these elements will not be attended in the following sections. Similarly, the extensive literature review chapters already set the theoretical grounding for this work; hence the place of theory is not to be discussed in this chapter. The remainder of Janesick's (2000) design elements are discussed below.

SITE SELECTION, ACCESS ARRANGEMENTS AND TIMELINE

Whyte (2004) notes that access can prove to be a real problem in ethnographic studies; however, this was not the case in this research. As already discussed in the previous sections, the site selection, timeline and, to a large extent, access were pre-arranged during the development of the proposal for this research. The BTG initiatives provided sites for

observations and provided access to individuals for follow on interviews. Similarly, newly formed IDR groups provided further situations in which to conduct observations.

Access to the initiatives was endorsed by the BTG management team, whilst my participation and early relationship building in turn provided easy access to individuals to conduct follow-up interviews. The same dynamics applied to gaining access to observe newly formed groups at work. My role and the action-oriented aspect of the research further provided access to the monthly Board Meetings, where an interdisciplinary management group was shaping the development of the BTG project, discussing past and future initiatives, sharing IDR experiences but also engaging in new IDR projects. My role in these settings was twofold: to observe how the group worked together and to provide feedback and advice based on the conducted observations and interviews. Additionally, I interviewed the board members at different stages of the project to gain a better understanding of the observed events. However, although some initial arrangements were made, as the study unfolded some improvisation, typical of the work of a choreographer, was necessary to collect additional data, access additional individuals, or answer new, emerging questions (Janesick 2000: 382). Whilst arranging interviews I usually proposed to come to the interviewees' location to ensure that they felt relaxed and in familiar environment but also to gain insights into their work environment. During the project I did not encounter any refusal or difficulty in access to any of the initiatives, meetings or participants, thus providing access to a wide range of exceptionally rich data.

The timeline of the research was largely determined by 18 months funding arrangements, between May 2007 and December 2008. However, as my access to the BTG initiatives remained open, some additional observations and interviews were conducted after the

initially designed period of study, and overall observations and interviews continued until June 2009.

ETHICAL CONSIDERATIONS AND ARRANGEMENTS

As with most research concerned with participation of human beings, in this research some ethical issues need to be attended to. While the construction of this research did not place participants at any particular personal or professional risk, all due care was exercised in the conduct of this study. In the case of all the observed initiatives, participants were made aware of both my role and the goals and scope of the research as it related to the BTG programme and my own doctoral programme. Participants in the follow-up interviews explicitly agreed to take part in the research, and were asked for permission to use the anonymised interview transcripts for the purpose of the research, with the option to withdraw their participation at any point.

All results of this study are presented in a way that ensures anonymity to all participants, and 'raw' data are held in securely encrypted files. Overall, professional ethical care has been applied to all aspects of the data collection and analysis.

Having established the general framework for the study, the next sections will discuss the data collection and analysis methods.

DATA COLLECTION TECHNIQUES

As mentioned earlier, a combination of participant observation and interviews were adopted in this research as the main modes of data collection, additionally supported by document analysis. Consequently, these methods are the subjects of a detailed discussion in this section.

PARTICIPANT OBSERVATION

Soss (2006: 131), following Waltz (1979: 13) notes that '*once methodology is adopted, the choice of methods becomes barely tactical*', a claim that seems particularly relevant in the case of any ethnographic study. Indeed, observation is often thought to be the core of ethnography, making these two elements nearly inseparable. As Angrosino and Mays de Perez (2000: 673) note, observation '*has been characterised as 'the fundamental base of all research methods' in the social and behavioural sciences (Adler & Adler 1994, p. 389) and as 'the mainstay of the ethnographic enterprise' (Werner & Schoepfle 1987, p. 257)*'. Although a daily activity, observation for research purposes requires some skills and structure to deliver reliable results.

Observation: a daily practice or a learnt skill?

Pader (2006: 174) notes that '*participant-observation is not at heart alien practice, as it is so much a part of what we do in our daily lives'*, however, what differentiates 'daily observations' and ethnographic research is that the goal of the latter is to explicate patterns and phenomena otherwise being taken for granted. Not only is participation a part of daily life, but often '*the starting point of all research*' (Baker 2003: 149), harkening back to the

roots of scientific inquiry where curiosity about observed phenomena often lead to '*hours and days of intense, direct observation, partnered with theoretical thinking, in a way that allowed theories to emerge out of observational data'* (Yanow and Schwartz-Shea 2006: 121). Furthermore, the recent re-turn to practice based studies somehow confirms the anticipation that observational data will become '*the most powerful source of validation*' (Adler and Adler 1994: 389) or, as put by Barrett (1996: 237), '*qualitative investigation with a difference*'. This resurgence can be partly attributed to the demystification of the method as well as recent shift towards the study of 'particular' rather than the 'general' (Angrosino and Mays de Perez 2000; Abu-Lughod 1991; Geertz 1973) – as can be seen in the examples of partial or organisational ethnography. Consequently, rather than trying to describe the composite of whole organisations or cultures, which would bear significant validation challenges, it became much more acceptable to focus on ever-changing relationships, behaviours and lives of individuals or smaller groups to inform more general theories.

Due to the number of challenges related to data collection, analysis and translation into '*scientifically useful information*' (Ghauri and Gronhaug 2005: 90), observation for research purposes, just like any other research method, requires to be systematically learnt and developed (Adler and Adler 1994). Indeed, as Yanow and Schwartz-Shea (2006: 121) point out, learning *how* to look and how to see for scientific purposes can take considerable practice and may require some process of denaturalisation of researchers in order to enable seeing beyond the obvious. Indeed, ''*normal' things typically do not attract analytic attention*' (Pader 2006: 166), and hence researchers need to develop 'ethnographic sensibility'.

Another challenge relates to the often dynamic characteristics of data collected through observation, bearing many characteristics of process data (Langley 1999). Indeed, as

highlighted by Nicolini (2009), in order to theorise practice, it is necessary to connect the here-and-now of the situated practicing and the elsewhere-and-then of other practices, indicating that practice is not just an event recorded at a particular time and place. Langley (1999: 692-693) further points out, that process data collected in organisational context are difficult to analyse and manipulate for a number of reasons:

- data are a collection of 'events' which researchers may not be familiar with. Hence they often require some means of conceptualisation and detecting patterns;
- data can involve multiple levels and units of analysis, not necessarily clearly defined; fluidity of phenomena can hinder sense-making processes;
- data can have different temporal characteristics, stretching from time-wise minuscule events to long term trends;
- data are eclectic as they are composed not only of discrete events but also involve variety of other, both qualitative and quantitative, information.

Hence, researchers undertaking organisational observation need to be able to see the patterns, connections and dynamic character of practice in focus. Consequently, a lack of 'ethnographic sensibility' can lead researchers to misread others' actions (Yanow 2006) or simply not realise what is happening in the studied environment.

For the needs of this research I strived to adopt the attributes suggested by Marshal and Reason (2007) to increase my effectiveness, including curiosity, willingness to articulate and explore purposes, humility, participation and radical empiricism. My previous research experience and background helped me to develop my ethnographic sensibility, whilst extensive travel, inherent inquisitiveness, combination of determination and patience, and, finally, interest in photography have all contributed to shaping my peripheral vision and developing the skill to see the emerging patterns, existing differences or foreground the

regularities from the picture developing around, but without losing the sight of the background. To calibrate my senses and highlighted additional aspects of the observed phenomena I conducted an extensive literature reviews on both IDR and CoP. Furthermore, after each initiative I discussed some of the observations with the BTG facilitator (also trained researcher) to firstly, see if my observations are similar to those of the facilitators (hence corroborate my findings); secondly to compare perspectives (did the same event look the same from different from different perspectives) and, finally, to see if there are any additional details that I did not see at that time and should pay more attention to next time – or explore during the interviews. Since data gathering and analysis in ethnographic studies are often happening concurrently (Yanow 2009), these discussions were also utilised to see if any interesting patterns were emerging from the observations and what could be their meaning.

Tensions of observing and participating

Participant observation can pose significant challenges to untrained researchers, especially in the spheres of validation, contextualising meanings or ethical issues (Angrosino and Mays de Perez 2000). On the one hand, it is argued that both parts of the term are important, as *observation* aids understanding of the explicit meanings projected by the individuals, whereas *participation* can help to unearth the implicit meanings taken for granted by the individuals, but explicit to the researcher only through participating (Lichterman 1998). On the other hand, active participation of the researcher impacts, and potentially interferes with, the research setting (Heracleous 2001), which can further lead to the researcher becoming over-subjective (Kock 2004). Similarly, the attitude with which researcher enters the setting can have a significant effect, especially when the researcher instead of appreciating tries to correct the observed situation(s) (Berg 2004). The level of involvement (participation) in the

research setting is hence one of the most important decisions a researcher needs to face. For example, Hoggart, Lees and Davies (2002), following Junker (1960) distinguish between four different combinations of observation and participation: the *complete participation*, often associated with covert observation in which the researcher bears the risk of 'going native' (Denzin and Lincoln 2000); the *complete observer* in which social interaction is avoided; the *participant as observer* and *observer as participant* with the former placing more focus on participation whereas in the later observation takes priority before participation.

In the case of my research, my role as a researcher was to some extent dictated by the research context and accessibility issues, as discussed earlier. As I was acting on the behalf of BTG, access was almost automatically granted to meetings and initiatives. The introduction would usually be made by one of the facilitators, making participants aware that I was there to observe and collect data as I was providing support to BTG. As for the engagement, most of the time my role was closer to that of an 'observer as participant', however; on a number of occasions the role would shift closer towards participation. On a few occasions I fully participated in some of the shorter exercises and initiatives (e.g. speed-dating[2]), which offered me the opportunity of first-hand experience. The range of levels of my participation is depicted in Figure 5 where the area shaded in red indicates my role as participant-observer.

[2] Some of the BTG initiatives were started with a speed-date session in which participants were given 5 minutes to get to know each other in terms of research interests. The limited time and quick turnaround was also used to facilitate development of skills of presenting yourself or your research interests to other disciplines.

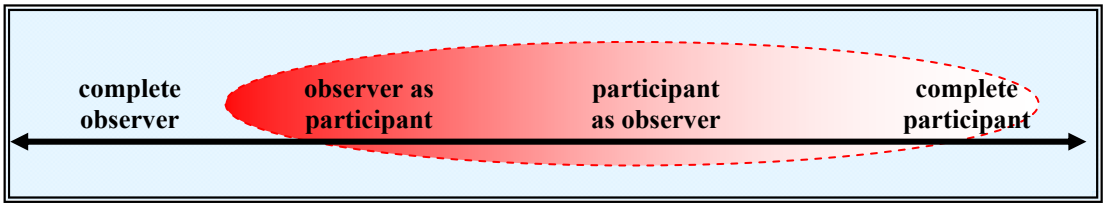

Figure 5: Research placement: between observation to participation.

Hear nothing, see nothing, say nothing – or see and hear everything

As it probably is clear by now, observation can be extremely challenging due to its often unsystematic character (Angrosino and Mays de Perez 2000). The amount of data that may (or should) be recorded, especially when an unstructured approach is adopted, can be both daunting and overwhelming, especially during prolonged periods of time. Hence, Werner and Scholepfle (1987) propose to distinguish between the following three types of observational studies:

- *descriptive observation* where the researcher observes everything in a child-like manner where nothing is to be taken for granted and so nothing is to be discarded as irrelevant;
- *focused observation* where certain aspects can be ignored as irrelevant;
- *selective observation* where the researcher focuses on a specific attributes of the observed activities (Angrosino and Mays de Perez 2000: 677-678).

Unstructured, or descriptive, observation often is used in conjunction with grounded theory approaches (Seale 2004; Baker 2003) as it can reveal patterns of behaviours that can lead to development of new theories and insights, previously unimagined. Focused and selective observations mirror the earlier discussed division between general (anthropological) ethnography and organisational ethnography (Miettinen, Samra-Fredericks and Yanow 2009), often focusing on a specific aspects of the research setting. It could also be asserted that research can start with the descriptive approach, however, as concurrent data collection

and theorising occur (Rosen 1991), more focus can be introduced, leading to a shift towards focused and selective observation.

This certainly was the situation in my research as at the beginning attention needed to be paid to nearly anything that was happening around (within the limits of feasibility of course). As the focus slowly crystallised around learning and than practices related to IDR I could focus more attention on the relevant aspects of the observed scenes, picking up much more detail rather than trying to capture everything at the same time. The following elements were at the core of the observations:

- *conversations between participants*: attempts to capture whole dialogues (verbatim or as close as possible to it), quotes and keywords that highlighted attitudes, indications of past experiences with IDR; type of language used (and any changes) according to the situation; changes over the time in both individuals and groups; etc;
- *communication*: how individuals communicated with researchers from other disciplines; how communication changed and adapted over the time or according to situation; what techniques or props were used, how and by whom; how did individuals approach other members; how questions were asked or clarifications provided; who, when and why was asking questions; how research problems and expertise was communicated in different situations or over the time (changes in); etc;
- *group dynamics*: details of how groups formed, who were the active members and how they influenced the final outcome; how conflicts were resolved; how participants engaged or disengaged from the group; how consensus was reached; how shared understanding and bounding were achieved; any techniques used by individuals to manage the group; etc;

- *patterns of behaviour*: differences in behaviour of individuals from different disciplines or groups; changes in behaviour of individuals according to situation or over the time; how IDR is understood and perceived by different groups; how different groups approached IDR projects (from conception to delivery) and how the approaches changed over the time; key elements of behaviour observed; emerging patterns; behaviour during the events, during breaks, after events; etc;
- *learning, skills and practices related to IDR*: this became more prominent focus of the observation after formulation of the research question; any behaviours that could indicate learning, developing specific skills or practices (understood in the wide context) that were specific to IDR setting; delineate between disciplinary and interdisciplinary research practices; changes in attitudes towards other disciplines, individuals or IDR; etc.

The list above is to some extent indicative as at the early stages of the research the approach was much more open, with wider range of details being noted during the observations. Figure 6 provides an example of excerpts from notes taken during the observations.

XY used quite technical language in his presentation and often related to '*ZS's and KJ's problems*'. He related the techniques to the problems presented to him. '*As I understand the problem, ZS's and KJ's problem….'*
(…)
Whilst summarising the problems and presentations, QW pointed out that '*a lot of the topics covered in the presentations can be used to help and resolve some of the issues. The question is: how do we push it forward. How we progress from here – I have no idea. I have a problem and the solution is here – but do we do that?*
He also recognised the need to '*frame the problem'* in such a way that it could be addressed by the other disciplines.
Finally, he summarised that '*there is a great scope for collaboration'*.
In the further discussions he pointed out another potential problem: are the problems he is facing a text book problems or '*is there a research embedded in the problem?*' He admitted '*having difficulties in defining what the issues are'*.
(…)
KJ admitted that he '*struggled during the meetings to formulate what I actually want. So I used ET as a sparring partner to identify what I want'*.
(…)
At this point STAMS was clarifying what was said: *so your aim is… what you want to do is…*
(…)
Interestingly, 3 people from MS went to talk to XY and 2 STAMS went to talk to ZS and KJ.

Whilst having a chat with AB (s)he pointed out that the MS people already decided that they wanted to work with XY after the Speed Dating. We also were wondering on the importance of the language and type of problem that attracted the different disciplines: more mathematical intensive problem had attracted STAMS and the applicable, down to earth problem of medical devices attracted MS.

Some interesting comments:
'we just need to get a general topic to be interdisciplinary'
Both teams also focused on real-life application of the research: (…)

It appeared that the teams worked from THEMES towards APPLICATIONS and then tried to LINK the disciplines to it.

When asked if they actually ready to take it forward, CD seemed to pull out a bit commenting that 'we need an application, people with a problem to do it'. The idea was then taken up by DD. there was certain lack of commitment to the idea. Also the process was rather artificial: look for a common theme that would satisfy everybody.

Figure 6: An example of data from observations of some of the events.

Process for recording observations

Berg (2004: 173) suggests that field notes should be completed immediately after the observed event as well as any other chance meeting or encounter outside of the boundaries of the study setting. Due to the nature of the research and the relationship with 'informants' most of the time I was able to take notes during the events as they were unfolding, rather than waiting till the end of the event, as often suggested in anthropological ethnography (Berg 2004; Burgess 1991). Notes were recorded in a notebook and I tried to capture the exact words of the participants, often transcribing whole conversations, whenever relevant and possible. In the cases where recording the exact wording was impossible, I made every attempt to remain as close as possible to the original dialogues and situations, with at least key phrases and keywords being noted.

During the times of higher activity, I have often reverted to taking summary jotted notes, which were later developed into more detailed descriptions. Re-developing these notes further served a second role as it provided time and space to reflect on the observed phenomena after gaining some distance from the research setting. In addition to the observations of the BTG initiatives and meetings, I gathered data through unstructured and unplanned observations of events that presented themselves as an opportunity. Notes were usually completed as soon as it was possible, however, a few times I made a short summary notes in such occasions by using a mobile phone to avoid potential memory erosion. Furthermore, analytic notes and subjective reflections (Berg 2004) formed part of the preliminary data analysis and sense-making. Due to existence of certain overlaps with interview data more details about the type of data collected during observations is provided in the section succeeding the discussion of the interview data collection, which follows below.

CONVERSATIONAL INTERVIEWING

As aforementioned, observation is often used in conjunction with other methods, predominantly interviews and document analysis (Becker and Geer 2004). Interviews formed a substantial part of the data collection for this study, and hence an elaboration of the theoretical considerations related to interviews in ethnographic studies is presented below.

Time, place and a notepad: or is there anything more?

Despite some of the problems inherent to interviewing, it remains one of the most commonly used techniques for developing understanding about other human beings, their actions, motivations or feelings (Fontana and Frey 2000). Interviews form a backbone of the research on communities and networks of practice, often acting as a primary research method. However, interviews are not free from criticism. Cochrane (1998) highlights an erosion of the method in terms of applying it as an easy-to-do and training-free way of gathering data, ironically asking whether it really is '*enough simply to buy a tape recorder, invest in a suit and tie or a smart dress, write some letters, prepare a semi-structured questionnaire and seek out some research subjects*' (Cochrane 1998: 2123). Indeed, complexity of interviewing is often underestimated (Ghauri and Gronhaug 2005) as is the required time and effort. Markusen (1994) suggests that each 2-hour interview requires around 10 hours of preparation, transcription and organising the data. I completely agree with the above statements, as the act of an interview is usually the easiest and shortest part of the work involved. With good quality interviews the process usually involves the following aspects that require some consideration, as suggested by Fontana and Frey (2000: 654-656):

- access;
- understanding the language and culture of the respondents;

- self-presentation;
- identifying informants;
- gaining trust;
- establishing rapport;
- collecting empirical materials.

From my experience two other aspects missing from this list are post-interview relationship management and, probably most importantly, deciding upon the interviewing technique.

Although much has been written about interviewing, there is no consensus or single formula on how to do it (Berg 2004). As with many qualitative methods, the research context and purpose, the researcher's abilities and access issues are likely to determine the final shape of the approach. One of the first decisions that is usually taken in the early stages of the research project is how structured and directed the interviews are to be. In general, interviews can be placed on a continuum starting with 'structured', (where respondents are merely answering a pre-prepared questionnaire), through semi-structured (where the interviewer comes with a number of topics or questions in mind to discuss), to unstructured, free-flowing conversations where almost any topic relevant to the research problem can be discussed in a flexible manner. Each of the approaches poses a different set of challenges and will produce different type of results.

Conversations or interviews?

In the realm of ethnography the suggested mode of interviewing tends to be at the semi- or un-structured end of the spectrum, sometimes referred to as 'open-ended' or 'in-depth' interviewing. However, as suggested by Yanow and Schwartz-Shea (2006: 117), they should

be referred to as 'conversations' as '*one is more likely to talk about having a conversation than about talking in depth or open endedly*'. This further resonates with the dynamic and interactive nature of this kind of interviewing, where the final meaning is often negotiated between the interviewer and interviewees (Fontana and Frey 2000), in which researchers develop a '*more accurate and clear picture of a respondent's position or behaviour'* (Ghauri and Gronhaug 2005: 101). Yanow and Schwartz-Shea (2006: 118) further notes that conversional interviews enable '*the exploration of how people make sense of their emotional experiences and how this sense making connects to action*', hence allowing exploration of the unobservable aspects of practices. The conversations are not necessarily always pre-arranged and can include informal interviews during the fieldwork (Fontana and Frey 2000; Malinowski 1967; Lofland 1971) or outside of the research setting whether by the office water cooler or the watering hole (a café, pub etc) attended by the participants of the study. These exchanges can often help the researcher to gather information that could not be directly observed (Snow and Thomas 1994) or gather additional insights from actors relevant to the research (Fontana and Frey 2000; Hertz and Ferguson 1989). Often serendipitous, these conversations are likely to resemble 'chatty exchanges' or 'small talk' (Yanow and Schwartz-Shea 2006: 118), which can turn into a 'big' talk or formal follow-up interview, hence further highlighting the dynamic nature of research design (Janesick 2000). Indeed, in this research part of the data originates from unstructured and often serendipitously initiated conversations that in some cases lead to more formal interviews.

Another challenge for the researcher is to keep the balance between allowing participants to focus on areas that they consider important and relevant (Thompson and Walsham 2009) and nudging, or directing, the conversation towards some purpose or focus relevant to the research question (Yanow and Schwartz-Shea 2006: 118). This resonates somewhat with the distinction between interviewer as a miner or a traveller, where the miner '*digs nuggets of*

data or meanings out of a subject' whereas the traveller '*wanders along with local inhabitants, asks questions that lead the subjects to tell their own stories of their lived world, and converses with them*' (Kvale 1996: 3). According to Yanow and Schwartz-Shea (2006: 118), interviewing in the interpretative mode can be referred to as a 'purposive conversation', hence, as indicated by the 'purposive' part, some minimal structure is usually necessary, even if only in the form of loose topics (Thompson and Walsham 2009). Overall, the required amount of structure is dependent on the subject and the setting of the research (Yanow and Schwartz-Shea 2006: 119).

Thoughts on the adopted process

In arranging the interviews for this research I would usually suggest to visit the location of the respondent, as the location can be a key issue in data collection, further offering the opportunity for observation of artefacts and interactions between the respondents and their colleagues (Elwood and Martin 2000). In the majority of times I would prepare a few bullet points of topics to be explored in the interview. Due to the fact that in most cases these were follow-up interviews related to earlier events, the first topic would usually relate to the particular event. Subsequently, the interview would explore other, more general, experiences of interviewees with IDR, leading the conversations beyond the setting of BTG initiatives only and towards the more general dynamics of IDR. Importantly, the list was used as a signpost of topics that may be worth exploring rather than a strict list of questions to be asked or discussed. I was constantly switching between the miner and traveller, depending on how the conversation was developing over the time.

Whilst conducting interviews I was aware of the role and influence I played in the dialogue and actively tried to minimise the assertion of my own opinions or ideas. The basic strategy

was to let the interviewees talk without interruption. However, at times when some aspects were not clear I would seek to use the dialogue to uncover the meanings to achieve fuller understanding of the perspectives presented by respondents. Additionally I would adopt a similar approach to interviewing to that discussed by Oinäs (1999), in which I would first create an atmosphere of trust, before engaging the respondent in the interviewing process. This would usually be achieved by a small, informal conversation, often personal and leading to creation of some mutual bond. Indeed, this often was possible because of arranging the interview in interviewees' locations, where small artefacts often helped me to find some common subject to start friendly conversations.

The majority of the interviews, with the agreement of the interviewee, were recorded and subsequently transcribed. When taping the interviews I still took as complete notes as possible as recording can often lead to decreased concentration by the researcher (Ghauri and Gronhaug 2005). Additional note taking further acted as both an 'insurance policy' in case of any technical problems with the recording and as a tool to manage the flow of the conversation. Indeed, on a number of times I would go back a page to recall an incident mentioned earlier in order to clarify any misreading on my side, or to establish the relationship between items. During transcription and data analysis these notes further helped me to see how I perceived the data at the time of the interview. On occasions when recording was impossible for various reasons, I would take more detailed notes during the interview and strive to transcribe the interview straight afterwards.

Finally, silence often can be as powerful as words and hence should be paid a close attention to (see also Knoben and Oerlemans 2006; Jacobs and Coghlan 2005; Morrison and Milliken 2000; Poland and Pederson 1998). Silence, or unwillingness to discuss certain aspects of the question, often indicate conflict, personal disagreement or power tensions, which need to be

handled with utmost care in order not to destroy the rapport with the interviewee. Indeed, as Poland and Pederson (1998: 293) note, although '*speech is often the focus of qualitative research, what is not said may be as revealing as what is said, particularly since what is left out ordinarily far exceeds what is put in'*. Oinäs (1999) further suggests that a degree of sensitiveness is needed to interpret the importance of silence or multivoicedness in interviews. I always strove to pay particular attention to any contentious topics, and if there was such an opportunity, to gain some more details about them during the rest of the interview. However, silence played another important role in the interview process adopted for this study. Taking notes, rather than relying only on recording, often leads to short periods of silence when the interviewee had already finished talking and I still would be taking notes. These short periods of silence often gave the respondent time to reflect and triggered another string of thought, leading to more detailed responses, without my direction.

Finally, after seven years of involvement with projects that almost always required interviewing people I sympathise with Cochrane's statement that interviewing, in any form, requires much more than a smart outfit and a recorder or a notepad. Indeed, the process requires skills and sensitivity if it is to be productive.

BRINGING THE OBSERVATIONS AND INTERVIEWS TOGETHER

Due to the overlap between observations and interviews, a further note is necessary to outline how the two primary sources of data related in this particular project.

The majority of the interviews were arranged with participants of BTG initiatives as follow-on conversations, often related to their experiences with the BTG programme. However, the interviewees were also usually asked about non-BTG related experiences with, or opinions

about, interdisciplinary research. Furthermore, as already mentioned, a number of informal interviews were also taken during or after the initiatives – usually over a lunch or other serendipitous meeting. In some cases I used emails and follow-on phone calls to obtain additional details or clarifications. Indeed, as pointed out by Fontana and Frey (2000), technological progress has changed many of the research processes, adding the option of 'virtual interviewing'. These form of interviewing offers the benefit of additional time to phrase follow up questions (Markham 1998). Figure 7 depicts the main sources of data informing this research.

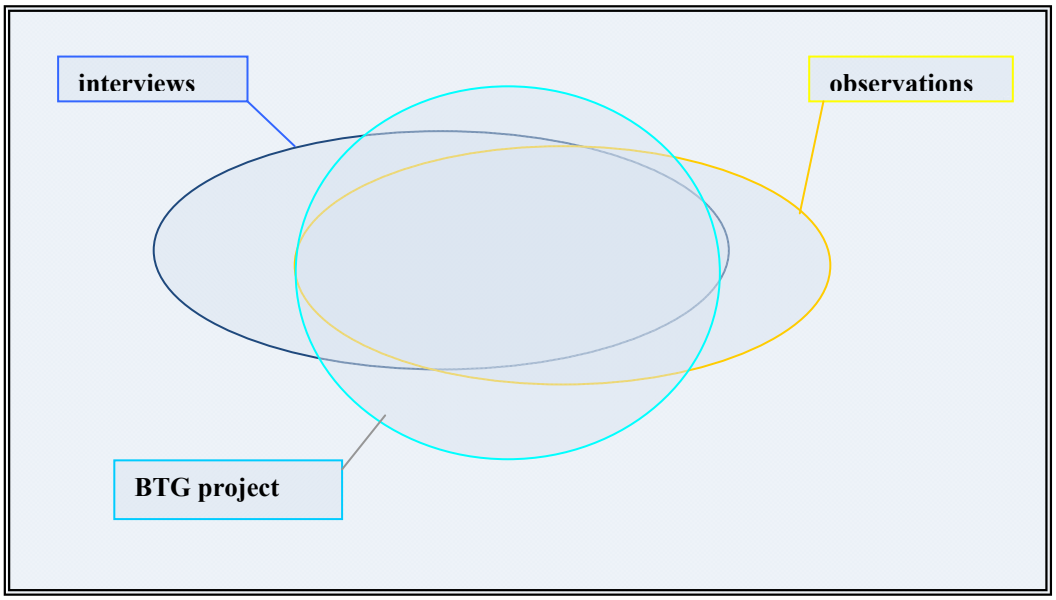

Figure 7. Main data sources and the overlaps between BTG project and data sources.

Table 2 presents details of the sources of *observational* data informing this study whereas Table 3 presents details of the data utilised in this study from *all* sources.

Type of event	*Description (relevance)*	*Research data and additional details*
BTG Board meetings	Participation in BTG steering committee meetings over the duration of the RAIS project: • interdisciplinary project steering group • working together for long period of time (3 years) • responsible for facilitating IDR across the university • evaluating and assessing IDR proposals and projects • exposed to learning about IDR • members involved in various BTG events • members involved in IDR projects (within and outside of BTG)	• observations with extensive notes • minutes and other supporting documents • interviews (formal and informal) with the board members 14 board meetings attended and observed**;** further supported by a number of informal follow-up meetings with the board members and the project administrator. Frequent and detailed discussions about observed dynamics of the group with the project facilitator to compare and validate observations and early findings. Other additional material used in the research include auxiliary documents (minutes, agendas, email communications from the members etc)
BTG management-related meetings	Participation in meetings with different groups of stakeholders that could influence and facilitate IDR uptake across the University. This involved the following groups and their remit: ***departmental champions:*** • tasked to represent BTG and champion IDR in their departments • feedback and advice about initiatives and how to increase uptake of IDR in their departments • majority of Champions involved in the BTG initiatives and projects • recurring meetings held to both gather feedback and to facilitate IDR among champions ***Meetings with departmental officers, including:*** - **research directors** - **seminar organisers** - **doctoral office** • discussions about barriers and ways to increase uptake of IDR in departments • particular focus on facilitating	• observations with extensive notes • formal (follow-up) and informal interviews with the participants of the events / meetings • other related material (emails, follow-on discussions, supportive and meeting output documents) Champions meetings was a recurring event, hence offering the opportunity to observe any changes in the group dynamics or behaviours and attitudes of individuals towards IDR as well as development of any research linkages between champions. Further supported with follow-up interviews with the champions and discussions about observed dynamics of the group with the project facilitator to compare, update and validate observations and early findings. Meetings with different groups of stakeholders from across the university (research directors, seminar organisers) were focused on supporting IDR at different levels of departmental structures (e.g. interdisciplinary / cross-departmental seminars; interdisciplinary staff secondments; early involvement of doctoral students in IDR events). The discussions

	inter-departmental placements of staff (mini-sabbatical); interdepartmental seminars and events, involvement of doctoral students in IDR at early career stages; transfer of some of the BTG activities into Doctoral Office • majority of participants research active with experience in IDR • facilitating development of potential research links among the participants ***BTG programme management meetings, including:*** - **inter-BTG annual groups meeting** - **meetings with EPSRC representatives** • meetings with other BTG programme groups to compare experiences and differences • discuss different approaches to facilitating and development of IDR across universities • meetings with EPSRC (funding council) representative in charge of BTG and IDR to discuss how EPSRC understands and supports IDR • recurring meetings	were focused on what were the barriers and opportunities for staff in various departments and at various stages of career to get engaged in IDR. Majority of the participants (with exception for administrative staff) were active research staff, often with experience in IDR. Another goal of these meetings was to facilitate new potential linkages between the participants, with the opportunity to gain funding for any new research ideas developed. Meetings with other BTG provided an opportunity to see how IDR is facilitated, but also understood at other universities involved in the BTG initiative. The meetings included discussion sessions focused on various aspects of IDR, one of them being learning and practicing IDR as a part of the job. Observations were supported by a number of informal interviews with the participants. Meetings with EPSRC representatives provided opportunity to understand how the funding council affects the development of IDR practices; supports IDR-relevant skills and attitudes; develops supportive funding structures; how IDR becomes institutionalised; etc.
BTG short / non-recurring events	These events formed the core of BTG programme with the goal of bringing inter-disciplinary teams around common interest together and encourage them to discuss how each can contribute. Discussions often were centred on a tangible idea / problem. In this group are included: - **lunchtime speed networking events** - **lunchtime seminars** - **new joiners (i.e. academic staff) meetings** - **themed seminars and workshops** - **focus groups on particular problem, initiative or research theme**	• field observations with extensive notes • formal follow-up interviews • informal interviews • output documents (proposals in writing; presentations; etc) • email communications among participants and with the facilitator The form and timing of the initiatives varied from 1 hour lunchtime meetings to 2/4 of a day events. These are non-recurring events as events that led to a number of meetings are included in the next group. These events could be divided into three groups: - exploratory networking meetings where participants were encouraged to look for potential research interests and overlaps

	• exploratory networking meetings and seminars • development of new IDR groups and project ideas and proposals • discussions of interdisciplinary groups on new problems (interdisciplinary at core) • bringing existing research problems to new, interdisciplinary perspectives in search for solutions	and development of potential research proposals - exploratory theme-focused meetings where participants were looking for projects around the theme - problem-focused events aimed at exploration of other perspectives and overlaps between disciplines Observations of the groups were further supported by formal and informal interviews and discussions about observed dynamics of the group with the project facilitator to compare, update and validate observations and early findings.
BTG recurring events	Another important part of BTG programme consisting of events aimed at bringing interdisciplinary groups to work on a common problem. The final goal was to develop a solution or larger proposal(s) for external funding. These events were longer in duration, often including reoccurring meetings. Examples included: - **Sandpits** - **problem-focused series of seminars** - **follow-on proposal / project development groups** • initiated as problem-focused exploratory events • follow-on work focused on either solving particular problem or developing research proposal • bringing existing research problems to new, interdisciplinary perspectives in search for solutions	• observations with extensive notes from the main / initial event • observations with extensive notes of the follow-up working group meetings • formal follow-up and informal interviews with the participants • output documents (proposals in writing; presentations; etc) • email communications among participants and with the facilitator • other related material The form and timing or number of recurring events varied. These events were either long (more than 1 day) or/and recurring events. In some cases the group would originate from the exploratory events (previous group) and result in more focused work on particular problem. These events could be divided into two groups: - focused on solving existing research problems originating in one discipline by exposure to new interdisciplinary perspectives - re-combining approaches and tools to develop new research approaches (e.g. workability of elderly people; planning aspect of next Mars mission). Observations were further supported by formal and informal interviews and at some occasions with discussions about observed dynamics of the group with the project facilitator to compare, update and validate observations and early findings.

Non-BTG related events	This group includes observations conducted outside of the BTG research site, but of events relevant to IDR. - **participation in training course including participants from variety of disciplines** - **events and meetings with other departments focused on potential collaboration** - **other meetings / events with interdisciplinary dynamics**	• observations - sometimes incidental and informal • informal interviews These are mostly incidental, non-BTG related observations of events that were relevant to understanding of IDR dynamics.

Table 2: Sources and details of observational data informing the study

Type of data	Details
Total number of interviews:	**51 interviews (largely formal, separate from conversations on-site)** **46 formal interviews (ranging between 30-120 minutes with the majority lasting about 80 minutes)** **1 informal / unplanned (90 minutes)** **7 short interviews during one of the University-wide events (between 10-15 minutes each; recorded and transcribed)**
Total number of observations (events)	**52 different events in total** **8 non-recurring / short events** (between 1.5h and 4h) **15 recurring / long events** 4 long events (1x 2 days event; 3x 1 day events) 3 project groups: 5 meetings (1.5-3h each) 3 meetings (1.5-3h each) 3 meetings (1-2.5h each) **26 BTG management related meetings** 12 BTG board: regular meetings (1-2.5h) 2 BTG Board special meetings (1-2h) 5 Champions meeting (2-3h) 3 BTG management related meetings (including officers from other departments) (1.5-3h) 2 BTG groups meetings (1.5-3h) 2 EPSRC representative meetings (2-3h) **3 non-BTG related events** (non-BTG related meetings between potential partners and collaborative meetings) (1.5-3h)
Other sources of data	**Electronic communication; meetings minutes and other relevant documents** *Emails:* in total some **987**; out of which **144** email threads had direct relevance for this research, and **67** email threads were used directly in the coding process (*included as data in NVivo*). *Minutes and other relevant documents:* **105** documents were used directly in the coding and theorising process (*included as data in NVivo*) Other documents employed in the study included: - agendas and minutes from meetings; - meeting notes from participants; - project proposals at different stages and iterations of development; - presentations from various meetings; - research summaries produced by participants; - proposals and applications for funding submitted to BTG steering committee. The above data were gathered over the 18 months period. **Survey data:** the annual survey included a number of open-ended questions where participants were asked about IDR experiences, attitudes, practices, skills etc. The responses from three surveys (2007, 2008, 2009) were collated and included in the data analysis (both directly in the coding process and indirectly in the process of theorising).

Table 3: Details of the data used in the study.

Although the final results are informed by a large number of participants (e.g. participants to different events), the final number of recorded respondents is limited to the directly identifiable individuals (e.g. both formal and informal interviewees; participants to the Focus Group etc) 57, with further details provided in the Appendix III. Once the principal data were collected, either in the form of field notes from observations or as interview recordings, they were transcribed verbatim for the purpose of further analysis. The next section provides a detailed discussion of the processes of data treatment and analysis adopted in this study.

ENGAGEMENT WITH THE EMPIRICAL DATA

One of the biggest challenges, but also most important issues, to any researcher working with qualitative data is that of sense-making and the inference of relationships from what may appear to be disconnected and diverse set of raw data. As indicated by Berg (2004) notes in their raw form need to be condensed and made systematically comparable, which can be achieved by *objective coding*. This approach seems to be particularly suitable for this research, as it has previously been adopted by a number studies into CoPs (e.g. Anand, Gardner and Morris 2007; Sapsed and Salter 2004; Aanestad et al 2003).

From data collection to theorising: the process

It is a common practice in qualitative research focused on development of new theory, rather than testing pre-existing hypothesis, to adopt grounded theory principles (Falconbridge 2007; Berg 2004; Berends, Boersma and Waggeman 2003; Eden and Huxham 1996; Strauss 1987; Glaser and Strauss 1967). This research follows the general principles of grounded theory (Strauss and Corbin 1998) as a vehicle for data collection and analysis and theory

development (Faulconbridge 2007; Berends, Boersma and Waggeman 2003) with more deliberate interpretive approach adopted in the stage of data analysis (Prasad 2002). Strauss and Corbin (1998: 12) further note that the processes of data collection, analysis and theory development are often intertwined and taking place concurrently, which also was the case in this research. Additionally, the final construction of theory in this research has been completed in the process of writing, as described by Feldman (2004: 298):

> *'A final step is ongoing as I write articles in which I try to explain what I have come to understand and why I believe it is important. The effort involves shaping the data in a way that will help people to understand the point I wish to make without violating the sense of the observations. The reason for this effort is that ethnographic research yields observations that are relevant to many points of theoretical interest and that these observations are tangled and interwoven in the fabric of everyday life. As I attempt to pull out and follow one strand, I must make decisions about what constitutes a strand, and about what surrounding fabric needs to be explained in order to make sense of the strand. During this process I find that questions arise that did not arise from any of the previous analytical efforts. I interpret this as a function of the richness of the data rather than a failing of any of the earlier analytical efforts'.*

As outlined in the previous chapters, the research question driving this research was not precisely pre-determined but rather the focus developed concurrently with the data collection and analysis. Although one of the main assumptions (or misconceptions) of grounded theory is to approach coding and theorising with suppressed existing pre-conception (Suddaby 2006), in many cases, and especially in organisational contexts, the pre-existing theory often plays a more important role in the process (Suddaby 2006; Berends, Boersma and Waggeman 2003) than often advocated by the literature. Similarly, this research was

informed by an extensive literature review, which was appropriate since the approach aimed to elaborate and extend the existing theories, as advocated by Strauss and Corbin (1998: 12).

My research into IDR started with limited pre-existing knowledge about IDR itself, however, the observed phenomena soon triggered the initial search for an appropriate theoretical grounding to provide direction for the further data collection. Further reading on theories of situated learning and CoPs provided a new theoretical lens that on the one hand squarely fitted with the observed phenomena and provided additional perspectives for theorising; however, on the other hand it soon revealed gaps in the extant theories, which became the driving forces for this research. Consequently, the analytical approach adopted in this study utilised a combination of both inductive and deductive theorising, in which '*the development of inductive categories allows researchers to link or ground these categories to the data which they derive. Certainly, it is reasonable to suggest that insights and general questions about research derive from previous experience with the study phenomena. (...) Researchers, similarly, draw on these experiences in order to propose tentative comparisons that assist in creating various deductions. Experience, thus, underpins both inductive and deductive reasoning*' (Abrahamson 1983: 286 in Berg 2003: 272-273).

Although some initial data analysis and theorising occurred reflectively in the process of data collection, the formal coding was conducted and completed after completing the data collection and transcription.

From data collection to theorising

In this research the operationalisation of the research at different stages involved a number of steps and experienced and detached researchers (Alvesson and Deetz 2000) as I explain below.

During process of data collection, although performed by me, two additional actors were involved for the validation purposes, as described in Figure 8. First, the Second Researcher, although not involved in the data collection itself, provided support in terms of quality checks for both technical side of data collection (i.e. are the observations and interviews conducted correctly) and the more general direction of research (i.e. questioning early conclusions and theories; ensuring that the data collection stays 'open' as long as possible). Furthermore, as mentioned earlier, frequent informal discussions with a BTG program administrator (also a trained researcher) often acted as a quality check for the data collection process. I was thus able to check if I missed something important, whether my understanding of what was said or done was consistent with the administrator's observations, etc. This process also was utilised as a mean to gather additional details about the observed events, especially when multi-group work took place.

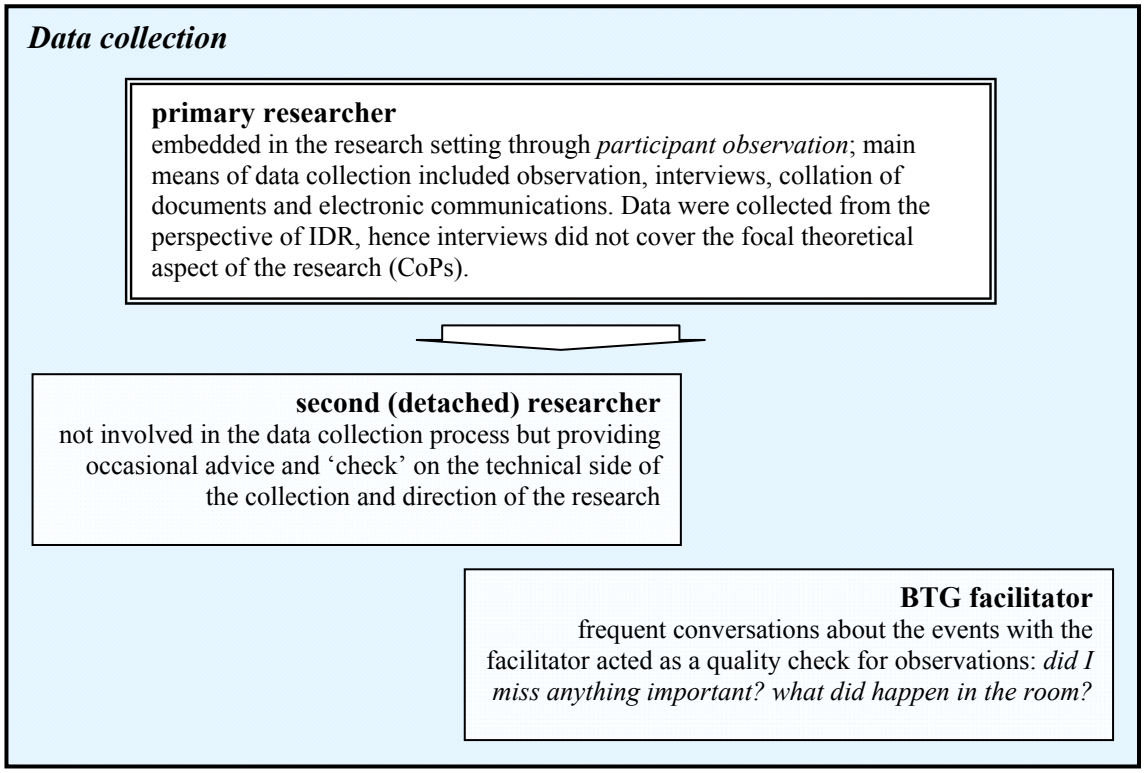

Figure 8: Strategy for demonstrating rigour of data collection.

Collected data were subsequently transcribed, imported and organised with the use of NVivo 8 software to aid the process of data coding and analysis, which otherwise would be significantly more laborious and time consuming but would also potentially lead to simplistic coding procedures (Peschl 2004). The software enabled multiple re-iterations of the coding and emerging frameworks without loss of complexity, whilst also offering modelling and visualisation tools to aid theorising. However, the software was mostly utilised in aiding the process of data organising and coding, as no software package can substitute the creative component necessary in the process of interpretation (Suddaby 2006: 638).

According to Berg (2004) the selection of criteria for coding data should be both exhaustive and rigidly and consistently applied, ensuring maximum objectivity so that the analysis of the same data by an independent researcher would yield the same or comparable results. This

approach ensures reliability of the categorisation (Anand, Gardner and Morris 2007) and consequently validity of the research (Tagliaventi and Mattarelli 2006). This can be achieved by independent coding by two or more researchers followed by comparison and discussion of the developed codes and categories (Anand, Gardner, Morris 2007; Tagliaventi and Mattarelli 2006; Berg 2004) or by feeding back to research stakeholders and participants (Ormrod et al 2007). Furthermore, this stage can be performed on a sample of data rather that the whole set (Anand, Gardner and Morris 2007). Another strategy to ensure rigour and validity are peer review and debriefing, which form an integral part of graduate study process. These processes can expose both data and interpretations to a respected colleague to '*point up possible sources of misinterpretation and the 'suppression' of themes voices that do not 'fit' the 'storyline'*" (Baxter and Eyles 1997: 514).

The coding process adopted in this study included two stages: first a sample of data was coded rather than the whole set, to test the coding procedure as well as coherence of emergent theories (Anand, Gardner and Morris 2007). This was performed by, first, reviewing the data archive and selecting extracts that were relevant for the theme of Communities of Practice and inter-CoP practices. Around 20% of all data was reviewed at that stage. In the second step the selected extracts were assigned descriptive code(s), which were derived during the process of coding and, to some extent, were grounded in the literature on CoPs. Figure 9 provides an example of an extract and codes assigned. There was no rule determining how many codes could be assigned to each data extract at this stage and the approach adopted was to remain open and creative rather than limiting the analysis by a fixed maximum number of categories to be developed or maximum number of codes to be assigned to each extract. Another aspect of coding relates to how the coding categories relate to the original statements by the respondents. Berg (2004: 269) distinguishes between *manifest* and *latent content* analysis, with the latter extending the analysis beyond the

physical elements present in the data by uncovering the deep structural meaning underlying the data. He further concludes that the best results can be obtained by combining the two modes. Consequently, the codes might encompass both *sociological constructs* formulated by the researcher and *in vivo codes* representing the exact terms used by respondents (Strauss 1990; Berg 2004). In my case both approaches were adopted, as some coding categories being derived from the verbatim sentences in the data, whereas some were based on the deeper, structural meaning engulfed in the data.

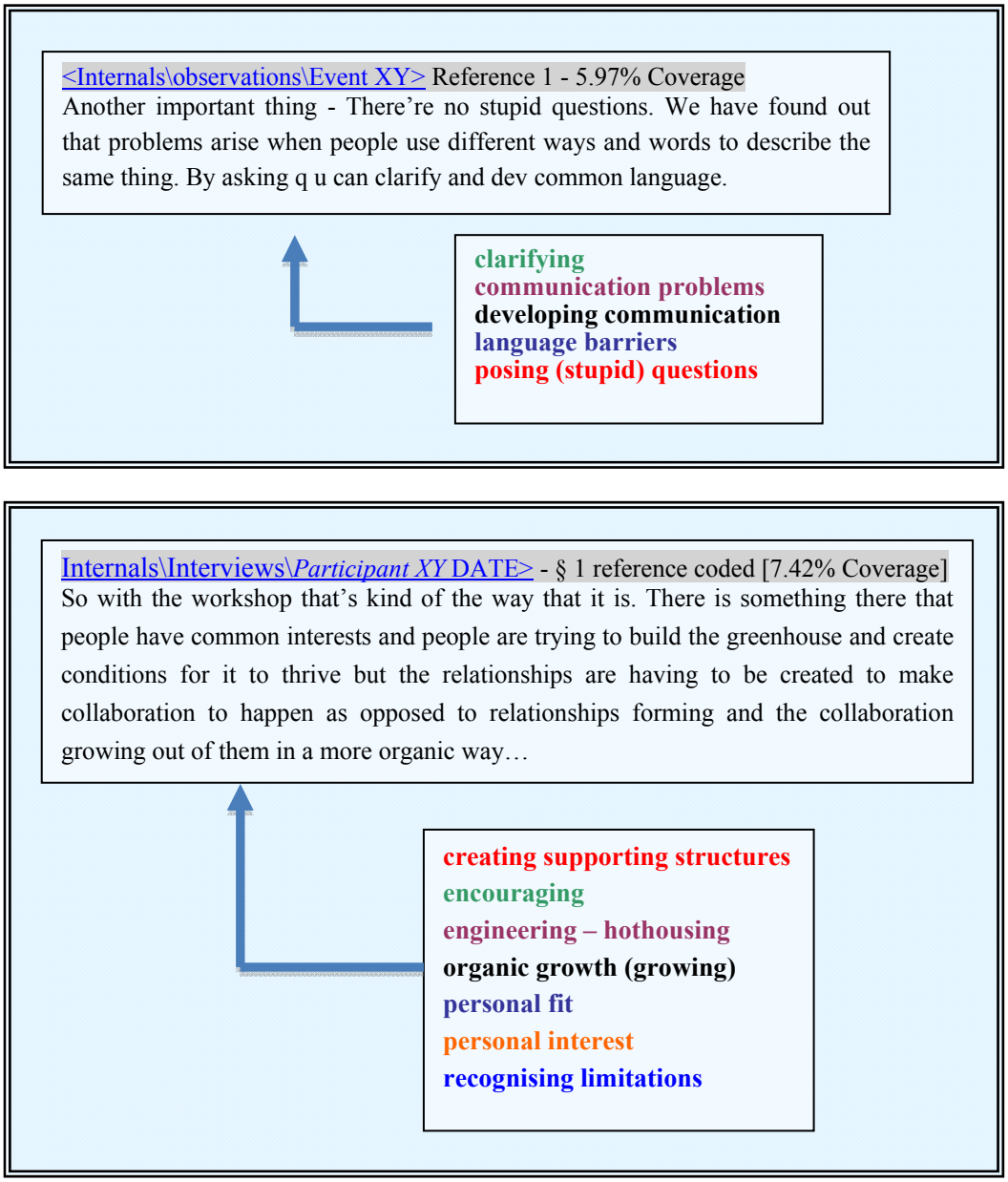

Figure 9: Examples of a data extracts and assigned coding categories.

As already discussed, coding procedure to be considered objective and valid should yield similar results if conducted by another, independent researcher. This approach has been adopted for this research and upon completing the sample coding, the developed coding categories were reviewed by a second researcher (supervisor). At this stage, the second researcher challenged the relevance of extracted data and assigned codes, suggesting the need for further contextual elaboration where the meaning was not clear or not sufficiently

developed. Additionally, the coding procedure and samples were presented during the regular meeting of a research group in the department for further comments about the coding process and clarity. As a result, the coding procedure was reviewed and revised for the second phase of coding. Figure 10 depicts the validation process at this stage of data analysis.

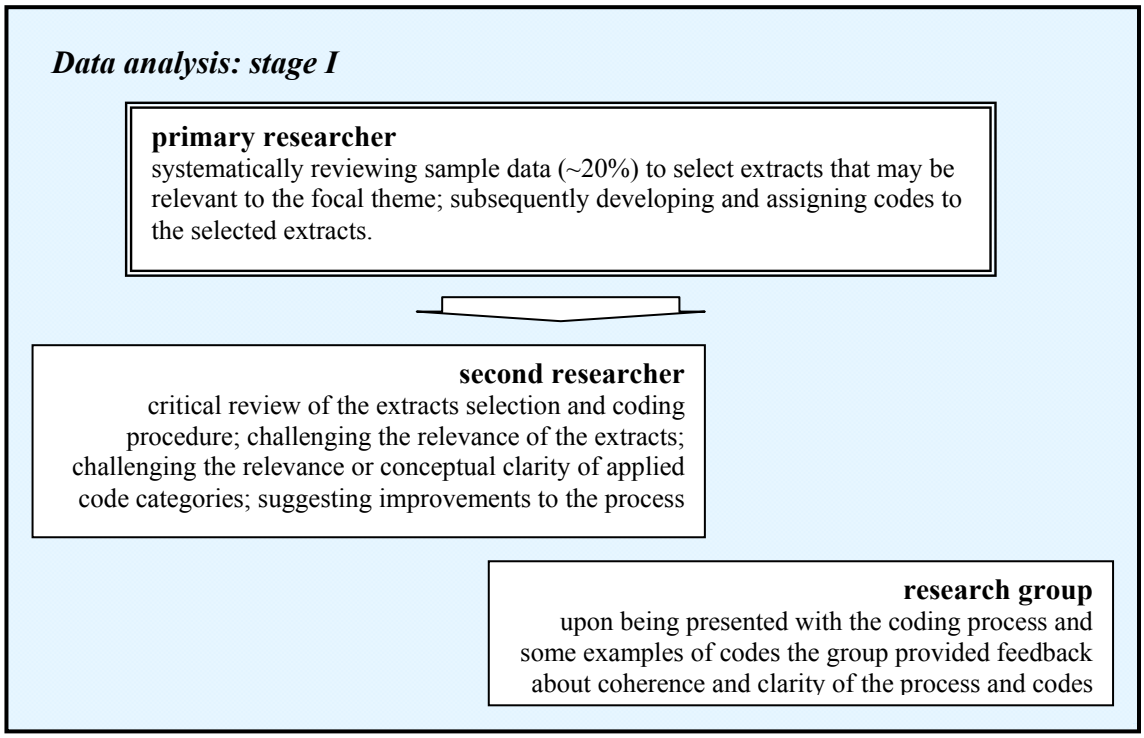

Figure 10: Validating data coding procedure.

Consequently, the emerging structure of coding categories was re-assessed and adjusted and the original sample of data re-coded. At this stage there were no attempts to link or cluster the emerging codes and, for that reason, the codes were kept as 'free nodes' in NVivo package, hence, not being categorised in any way. In total 108 coding categories were developed, with the number of coded items (data extracts) reaching over 2470. Appendix I presents the 'list of open codes developed at this stage of the research together with the number of sources in which the code can be found in and the total number of extracts coded

with any given code. Appendix I further presents the breakdown of coding categories and number of codes for the main sources informing the research.

In the following stage I attempted to first cluster the codes and develop appropriate labels for each emerging cluster and than assign relationships between the categories. These categories were formed emergently and did not closely adhere to any theoretical structures present in the extant literature. This is probably the most demanding and difficult stage as one of the goals of grounded research is to '*achieve a practical middle ground between a theory-laden view of the world and an unfettered empiricism'*, which can be achieved by reflecting upon the progress and process of theorising (Suddaby 2006: 635). Furthermore, this is the stage of data analysis at which, as noted by Suddaby (2006: 638), researchers frequently place too much emphasis on the coding procedure, often neglecting the interpretive side of the analysis, resulting in sets of conceptual categories '*divorced from both the data and the original research question*'. Berg (2004) notes that there is no one best, or easy to describe, approach to developing categories and any adopted tactics should foremost be consistent with methodological requirements of the research, the questions being asked as well as with the properties of the investigated phenomena so the categories are grounded in the data they are derived from (Berg 2003; Glaser and Strauss 1968). Glaser (1978) further introduced the term 'theoretical sensitivity' to highlight the importance of interpretive insights in the process of data analysis and the risk of overfocusing on the mechanical techniques for data coding. In the approach adopted in this research I attempted to take these points into account, ensuring that there was a balance between further categorisation of data remaining relatively open but at the same time reflecting the data and being relevant to the research problem. Constantly zooming in and zooming out on the data and observed phenomena further helped to generate less overly focused and mechanistic approach to interpretation of data, hence ensuring creativity in the process (Nicolini 2009).

The clustered and categorised coded sample data was than developed into an initial theoretical concept. As a means to test and validate the emerging model it has, first, been presented during the monthly departmental seminar and, secondly, presented during a recognised international conference (EGOS) in 2009. Furthermore, during the subsequent discussions the second researcher (supervisor) questioned the clustering procedure and logic and suggesting further developments when there was a lack of clarity or consistency. Figure 11 demonstrates validating strategies adopted at this stage of engaging with the empirical data.

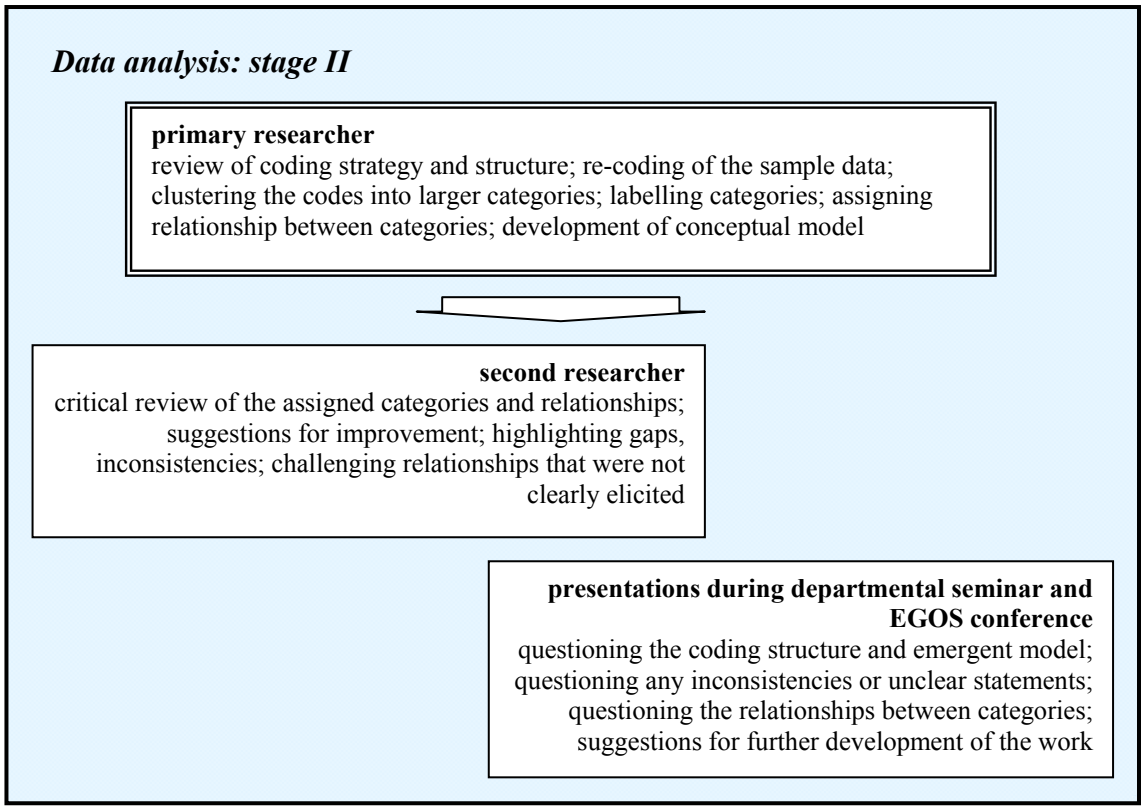

Figure 11: Strategy for validating data analysis.

To further ensure rigour of the coding process, at this stage I started developing a memo note for each of the coding categories (one of the functions in NVivo allows attaching memos to

different items, including coding categories – or nodes as the software refers to codes), with a short description of what is the essence of the particular coding category. This procedure allowed me to keep track of my understanding of the codes but also ensure consistency in the use of the code. Each memo would contain a short description of what the code means, which other codes and categories does it relate to and, in most cases, would contain examples of extracts from the data. Figure 12 presents an example of a memo related to one of the coding categories.

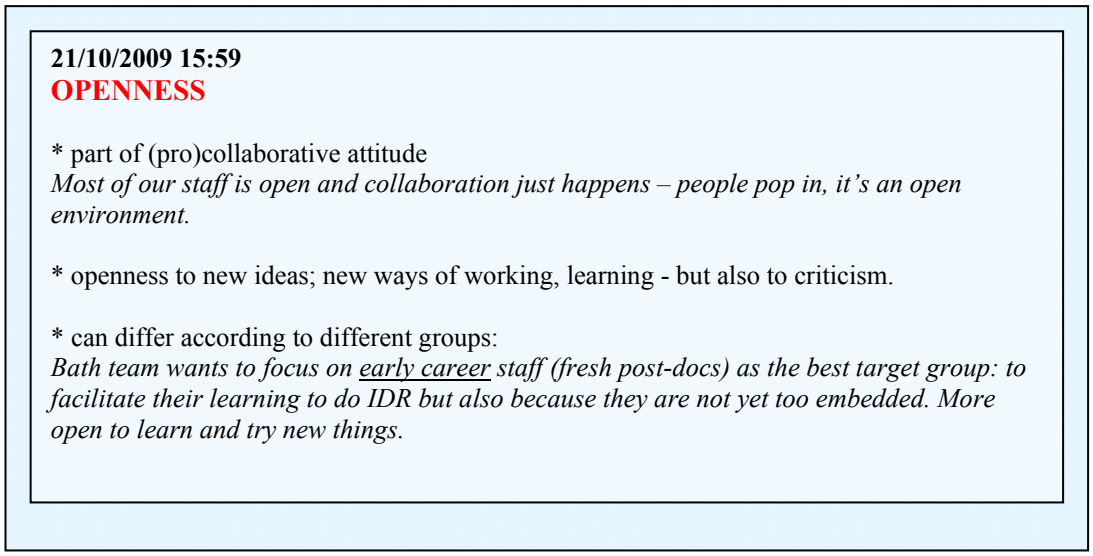

Figure 12: An example of a memo attached to a coding category.

The next stage involved further refining of the coding structure and, subsequently, process of coding of the remaining data. The initially developed coding categories and linkages between them were re-assessed according to the received feedback as well as the result of further coding process. In the next stage the coding categories were brought together under the following five broad headings derived through initial clustering and theorising:

- Determinants of practice and network development
- IDR attitudes
- IDR Network

- IDR Practices
- Learning

The coding categories were further refined, re-grouped, split or merged accordingly and the data was moved from the state of, as referred to in NVivo, 'free nodes' to a tree-like structure of coding categories. To ensure consistency in this process I created another diary-like memo, which contained information about the data structuring process. In the memo entry for each coding category was created, containing information about any changes to the coding category, meaning of the coding category, what other themes or categories it linked to, which theme it belonged to and why. An example of three different entries from the memo is presented in Appendix II. Additionally to the electronic diary, I kept a notebook to note any new thoughts and ideas as they stroke, organise and confront the coding categories and relationship among them during the process. Extensive use of graphs, notes and tables formed an integral part of the data analysis process.

The final list of the coding categories is presented in Appendix III. As the coding process progressed, related categories were arranged into conceptual clusters and assigned a label or summation of the cluster. Furthermore, during the process some of the initial coding categories were re-assessed and broken down into smaller, more detailed groups (e.g. within the initial category of '*recognising limitations*' three kinds of limitations were further delineated). This stage of data analysis was further aided by the use of the model visualisation and building function offered by NVivo. The final model is presented in the in the findings chapter (see Figure 14).

The content of the categories, the logic of the linkages and the resulting theoretical concepts were subjected to continuous questioning by the second researcher (supervisor) until a coherent picture emerged, that is interpretable in a consistent way from both insider and

outsider perspectives. Although comments, suggestions and, sometimes challenging, critique from independent researchers formed an important and necessary part of the research process and in most cases the input was much welcomed and appreciated, the final decision about which suggestions to address always depended on my own judgement based on thorough knowledge of the context and goals of the research. Moreover, whether the suggestions were implemented or not, on each occasion I would try to develop a thorough justification for the decision. Figure 13 summarises the process of engaging with data and development of the conceptual model discussed in the next chapter.

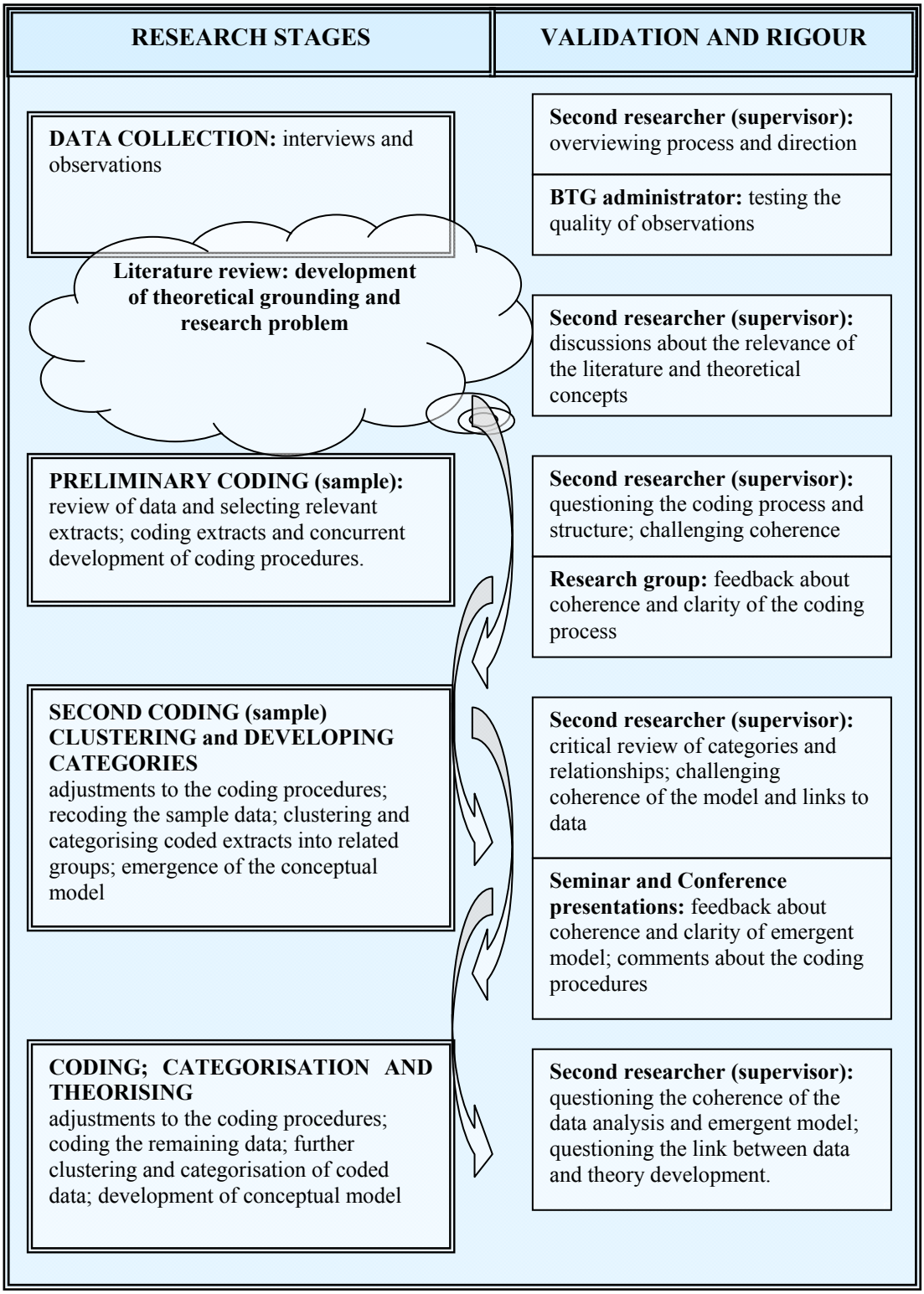

Figure 13: The process of engaging with empirical data: ensuring validity and rigour.

The following chapter presents results of the data analysis together with detailed discussion of the findings and their relevance and significance to the research problem outlined in earlier chapters.

CHAPTER V: FINDINGS AND RESULTS

INTRODUCTION

This chapter provides a discussion of the findings from the research. The collected data were analysed in the manner described in the preceding chapter and, to further ensure richness and closeness to the data, the findings presented here utilise illustrative, exact quotations as captured during the data collection process. However, to meet ethical requirements, any information that could identify particular participants has been anonymised. Appendix III presents additional details of the respondents that took part in the research, including details of disciplinary affiliation and position of the respondents. In the following discussion each quote is labelled with the corresponding number assigned to each participant and the source of the data (i.e. corresponding interview or event number). If the data relates to more general observation in which participants were not identified, the label contains the corresponding number of the event only.

As discussed in the earlier chapters, the focus of the research was on the dynamics of the temporary and problem oriented inter-CoP interactions and the development of shared practices, potentially leading to emergence of a community of practitioners. Extant literature, on the one hand, suggests that, although increasingly prominent in modern organisations (Blacker and Regan 2009; Heckscher and Adler 2006), these transient teams are unlikely to develop shared practices, or become a fully developed CoPs (Lindkvist 2005). As Ferlie at al (2005) point out, strong professional CoPs that individuals are embedded in are likely to hinder exchange of knowledge and the development of shared practices among the members in such teams. Furthermore, in the rare event of the emergence of some shared practices these are likely to be only fleeting (Ferlie et al 2005; Fischer 2001). On the other hand, some examples in literature demonstrate emergence of shared practices and identities among

professionals from different organisations working together on a project (e.g. Bjørkeng, Clegg and Pitsis 2009). It remains unclear whether these short-lived, project-oriented collaborations among professionals can be looked at from the perspective of shared *practices* and be thought of as a type of a Community of Practice, or should be differently typologised (refer to Table 1 for a summary of extant theoretical debates). Hence, the main premise of the research is to build upon the existing understanding of these dynamics and to advance the current understanding of the dynamics of the emergence of practices and community.

Although this became the focal point of the study, following the emergent, interpretive stance adopted for this research, both the data collection and analysis remained largely open and non-discriminative to allow other emergent themes and patterns to be captured. As a result, through a number of iterations of open coding, clustering and ordering data, the following five emergent themes were identified:

- IDR Practices
- IDR Network
- Learning
- Determinants of practice and network development
- IDR Attitudes

The results provide a number of interesting observations that contribute to theories concerned with inter-CoP engagements and, as will be further demonstrated in detail, the emergence of practices specific to these types of temporary 'teams'. Hence, the first two themes form the backbone of the following discussion, and the contribution of this research to theory development. Due to the high volume of findings yielded in the research, it is well beyond the capacity of this thesis to present comprehensive findings related to each of the

themes, therefore, only discussion of the first two themes (IDR Practices and IDR Network) will be presented in detail in this work, followed by more general discussion of the most relevant findings related to the remaining themes. This is not to diminish the central role of the findings related to the remaining three themes, as all the findings were used in the process of theorising. Accordingly, insights from these themes are drawn upon where it is central to the argument and there are clear thematic overlaps. Nevertheless, these minor findings will be further developed at a later data and disseminated in other outputs in the future.

Consequently, the first part of the chapter will present detailed findings related to the two focal themes followed by the summary of the findings of the three remaining themes. I have also decided to include parts of the discussion in some of the sections in order to reinforce and connect the relevant findings to the relevant theoretical frameworks. The final part of the chapter will provide a more general discussion of the findings in the context of extant theories.

DETAILED FINDINGS

The goal of this part of the chapter is to present and discuss the findings derived from the research, with particular focus on the themes of IDR Practices and IDR Network, with the remaining themes used in more limited manner to support the processes of theorising and conceptual model development. Table 4 presents the breakdown of the results of coding for each of the themes, highlighting the number of coded items under each category.

Theme	Number of references
IDR Practices	**1051**
IDR Network	**50**
Determinants of Practice and Network Development	1049
Learning	248
IDR Attitudes	69

Table 4: Breakdown of coding results.

IDR PRACTICES: EMERGENCE OF INTER-COP PRACTICES

IDR practices constitute the largest theme in terms of number of coded items with 40 coding categories (see Table 5), containing 1051 data extracts. Indeed, whilst analysing the data, a number of practices characteristic to effectively (or otherwise) engaging in and conducting IDR were identified, coded and, subsequently clustered into smaller groups. Furthermore, as will be discussed in this chapter, not only active practices related to 'doing IDR' were identified, but also a number of practices which were aimed at extending the network and propagation of these IDR practices among individuals, suggesting that a self-aware network of IDR practitioners exists.

As earlier discussed, conceptualising practice can be a daunting task, due to its multileveled and dynamic nature. In this research I have adopted the wider understanding of practice, as proposed by Gherardi (2009a), hence rather than attempting to capture only practices as actions or activities (i.e. what people do), the data further captures related appreciations, systems of values or attitudes, or hybrids of these elements. Furthermore, as the research was conducted at the same time as IDR groups were developing, it offered an opportunity to capture practices in the process of 'becoming' (Bjørkeng, Clegg and Pitsis 2009).

Through the numerous iterations and refinements, 40 IDR practices were included in the final picture, as presented in Table 5. The table also presents the number of sources and specific extracts related to each coding category. The last column presents ratio between number of extracts coded with each category and number of sources of each coding category as an additional measure of coding reliability. The ratio averages around 1.7 across all the coding categories, indicating that none of the themes is over-reliant on a small selection of sources.

Coding category	Sources	References	Refs / Sources
Brokering connections	21	37	1.76
Clarifying	11	12	1.09
Compromising	9	9	1.00
Cultivating	8	11	1.38
Disciplinary competence	14	18	1.29
Disengaging	6	6	1.00
Ensuring procedural justice	12	16	1.33
IDR competence	20	34	1.70
Involving others	21	24	1.14
Negotiating	17	21	1.24
Networking for IDR	11	14	1.27
Posing (stupid) Qs	5	8	1.60
Project tasking	7	9	1.29
Providing focus	11	15	1.36
Recognising limitations of home cop	16	18	1.13
Recognising own limitations in research	11	13	1.18
Research competence	12	13	1.08
Unpacking the problem	13	18	1.38
Up-Framing	11	18	1.64
Visiting partners location	6	9	1.50
Risk taking	7	9	1.29
Reflecting	8	11	1.38
Communicating capabilities -- visibility	8	12	1.50
Pushing boundaries	10	11	1.10
Sharing students	11	17	1.55
Adapting presentation relationally	16	21	1.31
Accommodating	16	22	1.38
Finding ResQ	18	22	1.22
Developing communication & listening	22	50	2.27
Recognising competence	25	52	2.08
Describing the problem	27	41	1.52
Investigating fit	26	39	1.50
Searching for connections	27	48	1.78
Building fit	27	47	1.74
Seeking opportunities	27	44	1.63
Exploring	30	41	1.37

Exploiting existing network	32	49	1.53
Recognising opportunities	33	60	1.82
Recognising limitations	35	68	1.94
Engaging	37	64	1.73

Table 5: Details of coding categories under the theme of IDR practices.

The subsequent clustering led to identification of five main categories within the theme of IDR practices, as presented in Table 6 below. Furthermore, Figure 14 presents the final structure of practices and clusters under the theme of IDR practices. The subsequent sections of the chapter will provide detailed discussion of each of the categories and practices identified in the study.

Coding clusters	Number of references
Collaborative practices	299
Exploratory practices	263
Practices aimed at Developing the network of practitioners	153
Reflective practices	238
Re-presentational practices	98

Table 6: Five main groups making IDR practices.

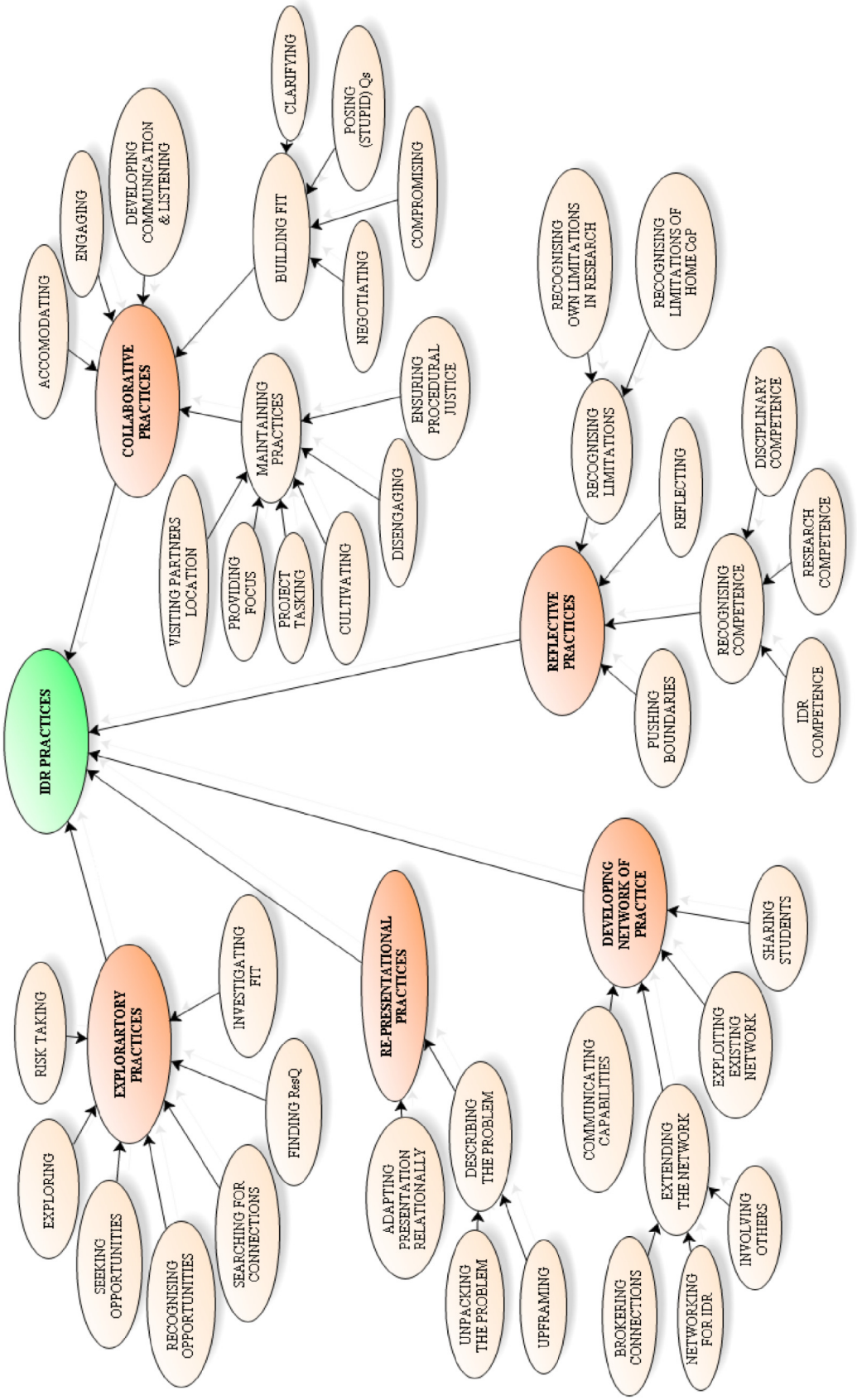

Figure 14: Final structure IDR practices

EXPLORATORY PRACTICES

The first group of practices identified in this study relates to initiating and engaging with interdisciplinary research. These practices proved to be crucial for the emergence and propagation of the network of practice (and practitioners) but also for (re)production of IDR practices in the long term. *Exploring*, *recognising opportunities* or *risk taking* are often the first, somewhat experimental, steps in the area of IDR – and hence learning the practice, acquiring an appreciation for it and engaging in further development of the network. In the words of Gherardi (2009a: 536), '*practice is an analytic concept that enables interpretation of how people achieve active being-in-the-world*' and some of the exploratory practices discussed below act as enablers for being in – or at least entering – the sphere of interdisciplinary research and becoming active in the world of IDR. This group contains seven coding categories, as presented in Table 7.

Exploratory practices	Number of references	Number of sources
Exploring	41	30
Finding the Research Question	22	18
Investigating fit	39	26
Risk taking	9	7
Recognising opportunities	60	33
Searching for connections	48	27
Seeking opportunities	44	27

Table 7: Break down of identified exploratory practices.

None of these practices should be treated as completely distinct from the others – rather they work in harmony with each other, weaving together into a larger tapestry of, often concurrent, exploratory practices. Furthermore, the above practices are inherently linked to a number of practices in other themes. Table 8 provides a brief characterisation of each of the practices in this group as well as lists the other, closely related, practices as identified in the study.

Practice	Characterisation		Closely related to
	Activity	**Appreciation**	
Exploring	Investigating the potential for new solutions to existing problems and often translates into attending events that provide cross-boundary learning exposure	Iteratively developed taste for cross-boundary collaborations through learning about benefits and processes of this mode of work	• risk taking • recognising limitations • recognising opportunities • recognising competence • visiting partners location
Seeking opportunities	Active pursuit of new collaborative opportunities without pre-defined collaborative problems or established relationships	Developed appreciation for cross-boundary collaborations as a way of working	• recognising opportunities • recognising competence • recognising limitations • communicating capabilities • exploiting existing network • networking for IDR • engaging
Searching for Connections	Actively searching for defined expertise in the context of an established problem.	Developed appreciation for cross-boundary collaborations as a way of working	• recognising limitations • recognising competence • communicating capabilities • engaging • investigating fit • recognising opportunities • re-presentational practices
Recognising opportunities	Setting aside disciplinary preconceptions to entertain different perspectives, in order to identify opportunities	Developed appreciation for utility and potential of different cognitive frames, especially in combination	• seeking opportunities • searching for connections • recognising capabilities • brokering connections • engaging
Investigating fit	Explicating epistemological and personal compatibility as a basis of potential collaboration	Recognising the value of competencies residing in other CoPs	• recognising opportunities • seeking opportunities • recognising competence • accommodating • exploring • finding a research question • building fit
Finding a research question	Negotiating the focus, scope and goal of the inter-CoP collaboration to the benefit of all involved parties	Appreciating the different needs and expectations of other members	• seeking opportunities • exploring • investigating fit • building fit • engaging • disengaging
Risk taking	Taking a chance on collaboration whilst demonstrating awareness of the associated risks	Developing a tolerance for the discomforts and setbacks associated with collaboration	• recognising opportunities • exploring • pushing boundaries

Table 8: characterisation of exploratory practices.

The following sections provide detailed discussion of each of the categories, together with data examples from the fieldwork, before returning to a more general discussion of exploratory practices in relation to extant literature.

Exploring

Two overlapping dimensions of *exploring* as a practice were identified. In the first dimension exploring seems to be driven by existing research problems and familiar tools, and/or the curiosity of individuals interested in some other ways of solving existing problems. Some participants recalled venturing into the field of IDR as a result of finding themselves near the disciplinary boundaries, where the unknown 'other discipline' was offering new perspectives at the problem they were interested in solving within their own disciplinary fields. As one of the respondents explains:

> *'I started looking at direction that wasn't standard group theoretic view of symmetry – but instead it's more concerned with properties of graphs.' (Participant 8; Interview 9)*

There were two reasons for looking for new directions for researching the problem: first, the 'standard' ways did not offer a solution to some of the problems at hand and, secondly, as the participant explained later, it was due to the willingness to push the research problem further, beyond the way it was framed within the discipline. This confirms the drivers fuelling the emergence of IDR in the extant literature discussed earlier – in this particular case being a mix of complexity and personal drivers (Newey 2009; Szostak 2007; Rhoten and Parker 2004; Jeffrey 2003), but also realisation of the limitations of one's own discipline (Aboelela et al 2007). Indeed, these were probably the most common motives for engaging in IDR highlighted by many of the respondents.

From the perspective of theories on CoPs, this particular attitude suggests that inter-CoP engagements are likely to be an effect of a particular need requiring collaboration (as the majority of literature on inter-CoP engagements tends to portray, e.g. Lindkvist 2005; Ferlie et al 2005; Wenger 2000; Wenger 1998) or the rather underdeveloped in the extant literature aspect of attitudes of individuals, which translates into an appreciation and, consequently, explorative practices (exploring) for sources of knowledge outside of the native CoP (Gherardi 2009a). In more concrete terms this practice can lead into a number of techniques and actions being interwoven into the fabric of daily practices of individuals. For example, one of the respondents described that:

> *'even before we had the real collaborations we used to look into other domains to motivate our work. And then later we started meeting people who actually are working in different areas and we started making contacts with them.' (Participant 22; Interview 24)*

The above statement suggests that for this particular group working across boundaries became part of their daily research practices. Another respondent provided more detailed account of exploring practice in action. In this case, during one of the BTG initiatives, the individual explained how he recently attended some events, seminars, exhibitions or conferences in other disciplines, which were vaguely, if at all, related to his own field of research:

> *XY talks about the recent seminar on control systems he went to – although not his subject, he points out that he came back with 8 pages of notes on who is leading the research, what are the problems they are facing etc. (Event 40; Participant 33)*

This individual was explaining to the other group members how he finds new partners, projects and ideas to apply his research tools and expertise. In the follow-up interview he explained the value, but also challenges, of cross-attending conferences, concluding that they can be a great vehicle for finding partners and fostering IDR; however, the lack of support (e.g. financial support) and the limited number of researchers engaging in this kind of practice can be inhibiting. This somehow resonates with the notion of interdisciplinary processes being developed, at least to a degree, in a vacuum, or certain state of '*social and intellectual marginality*' (Klein 1990:12) as, at least in some groups, the number of like-minded researchers may be limited to just a few individuals. In the context of theories on CoPs this example further resonates with professional communities tending to seal themselves off from others and not accepting new inter-CoP practices (Scarborough and Swan 2008; Ferlie et al 2005), hence likely to expose individuals engaged in this type of engagements to alienation and criticism from the members of the native CoP (Haas and Park 2010). However, in another example exploration of opportunities to engage with other disciplinary fields became an integral part of their regular research practices of the whole research group. As one of the respondents explained:

> *'In the search of new applications both XY and I have travelled abroad and met other teams and people who work on similar applications but from different perspectives. So it is fundamental to the way we work' (Participant 22; Interview 24).*

Even more importantly, both of the individuals in the example above held senior roles within the research group, which resulted in the managerial support for the dissemination of the practice among other members. As further explained by the respondent:

> *'We have no formal process for it but because I'm the [senior position in the department] and people know I'm keen on cross-disciplinary work, if they have any thoughts that their work may have cross-disciplinary applications then they would come and talk to me. (...)*

My experience is that [senior position in the department] has a unique position in a way that they can promote and encourage ideas across the whole department – if they wish. And importantly department would listen to what they saying, even if they not actually going to follow your advice' (Participant 22; Interview 24).

The above statement suggests that support form the 'core' of CoP (those in central positions of mastery) is important for the propagation of practices aimed at inter-CoP engagements, to potentiate these new practices becoming part of the fabric of the 'regular' practices of the CoP. Furthermore, such support can mitigate the risk of marginality, as discussed by Klein (1990), and different defensive behaviours of CoPs (Duguid 2008; Scarborough and Swan 2008; Ferlie et al 2005). This notion has been further confirmed by the remaining results with 15 data extracts originating from 12 different sources coded as 'managerial support' within the category of Drivers of Emergence of IDR Practices and Network (see Appendix I). This point is further summarised by the following statement from another participant:

'Partly it was [name], the previous head, who did that. He came in and made things happen. I came from a traditional academic setting and since I came here I learnt a lot. [name] was always looking outside and made people do the same' (Participant 32; Interview 35).

The second dimension of exploring is related to an intrinsic willingness to learn *about* IDR as a mode of research, its potential benefits, dynamics and workings. The following explanation from one of the participants illustrates the second dimension of the practice:

'The other project is the [name] I mentioned last time. This is where we can learn from about multidisciplinary projects. Because it is funded it makes it much slower than working with a client. So I decided to use the extra time to learn and see how it could be

done. I could do it the easy / fast way – just "architecture". But because it is such a complex problem – it's not just a building but the whole social issue with it. I thought lets see who can have some input. So I involved ESRU (The Energy Systems Research Unit); humanities to deal with the social regeneration of the area; a specialist in asthma in buildings from here; civil engineering and other partners' (Participant 1; Interview 1).

As will be discussed later, this aspect of the practice relates to realising both the benefits of inter-CoP approaches and limitations of the approaches hosted by a single CoP – both important factors in developing shared, boundary spanning practices. Indeed, this often can be the first step towards developing taste and appreciation (Gherardi 2009a) for working at the inter-CoP boundaries.

Although exploration arguably forms an integral part of academic research, in the context of IDR it takes a slightly different form, which can potentially lead to feeling of being forced outside of comfort zones. A number of respondents described working across disciplinary boundaries as both challenging and demanding, which resonates with the potential of IDR to overwhelm an inexperienced researcher with its complexity (Bruce et al 2004). Furthermore, it seems that the early, exploratory stages of engagement in IDR can prove to be especially demanding, pushing participants too close to the limits of their comfort zones. As one of the participants vividly described the tensions stemming from the idea of attending one of the BTG events:

'It may force you to get out of your comfort zone. I didn't want to do that but then I thought it may be beneficial. So I weighted and decided that the benefit may be higher than the speed-dating sacrifice' (Participant 2; Interview 3).

Hence, engaging in collaboration with other CoPs can be perceived as difficult, at least for some individuals. In other examples, where IDR engagement was somewhat imposed on the individuals, this exposure to new, interdisciplinary context, required some additional effort and, as described below, 'mental gymnastics' from the participants. As one of the participants, asked to take part in evaluating research presentations and proposals from other disciplines, recalls that the exercise:

> *'forced me into kind of mental gymnastics – trying to make sense of research in very different fields and fields very different from my own' (Participant 10; Interview 11).*

In other cases, the sheer unexpected complexity of the new fields may push individuals outside of the comfort zones, as admitted by one of the participants during the meeting:

> *'I came along with a very fuzzy idea of what is nostalgia. It is much more complicated than I thought.' (Event 31; Participant 10).*

Indeed, removing the somewhat protective disciplinary fences can be an overwhelming experience to researchers (Bruce et al 2004), hence, in the decision to engage with the new practice individuals may be negotiating their own disciplinary integrity (Gooch 2005). Furthermore, the examples above suggest that, to become a permanent practice, exploration is not limited to practices as certain 'actions', but often involves development of an appreciation and new systems of values for this form of engagement, as elaborated by Gherardi (2009a). Exploration and developing taste, and other practices, appear to be intertwined and concurrent as individuals progress in their inter-CoP interactions.

Furthermore, exploring forms an important stepping stone for the inter-CoP engagements to be initiated; a 'pre-practice' developed by individuals or CoPs, which potentially impacts on other CoPs and their practices. Indeed, the explanation provided to the group by one of the participants about attending seminars and conferences in other fields both made them aware

of the technique and exposed them to learning, whilst also made them aware of anyone from another field attending their conferences for the purposes of exploring. This understanding can make the initiation of inter-CoP collaboration easier. Additionally, the practice can potentially become a part of practices within a CoP, providing it is both supported and adopted by a significant number of participants.

Focusing on exploring can further enhance the existing understanding of the processes leading to emergence of practice. The majority of the existing literature focuses on existing, and often well-established, practices. Although Bjørkeng, Clegg and Pitsis (2009) provide a fine examination of the process of emergence of practices in a collaborative setting, even in that case, as in most of examples, the parties are already pre-determined, hence not providing any insights of how individuals and CoPs go around searching for and engaging with potential partners. Hence delineating the practices of exploring extends the understanding of emergence of new (collaborative) practices by demonstrating the initial steps that need to be developed and undertaken.

Exploring, to some extent, constitutes a rather 'fuzzy' stage at which individuals do not have any particular project or problem in mind and are often unsure whether inter-CoP collaboration is something they are interested in pursuing. In some ways, exploring can therefore be compared to the first few attempts at wine tasting; the stage at which individuals have not tried it yet and have no idea if wine, and the associated community, is something they can actually enjoy and want to pursue. Exploring provides individuals with the opportunity to get exposed and potentially develop appreciation for new practices and communities. Exploring as a practice can be initiated by an external event (e.g. research problem that cannot be tackled by the native CoP); by curiosity or personal drive; by being

exposed to other practitioners (e.g. within native CoP); or, finally, can be imposed upon individuals or CoPs (e.g. through involvement in certain events and initiatives).

Although, in some cases, exploring has become an integral part of CoPs practices, in many cases it was associated with crossing the boundaries of comfort zones, hence potentially preventing from further engagement in IDR collaborations. Furthermore, a lack of support for, or understanding of, the practices of exploring can create tensions between established, native practices, alienating participants engaging in this practice. However, considering the increasing complexity of research problems (Szostak 2007; Jeffrey 2003) and pressures upon organisations to engage into collaborative works (Blacker and Regan 2009; Czerniawska 2004), it can be hypothesised that exploring needs to become fundamental part of the practices of many communities and organisations.

Seeking opportunities

In many aspects interrelated with the previous practice, the practice of *seeking opportunities* describes how individuals look for IDR opportunities to engage in. In comparison to exploring, which is often the first step towards the unexplored land of interdisciplinary research, seeking opportunities tends to be somehow more defined. Individuals already know they want to engage in IDR and now are on the lookout for potential IDR research prospects. Hence, the seed of appreciation for inter-CoP engagements has already been sown, and at this stage individuals need to develop and deploy new practices to find potential collaborative opportunities. As explained by one of the respondents:

> *'I'm usually looking for projects out there – something that could involve other departments' (Participant 1; Interview 1).*

Although the boundary between exploring and seeking opportunities can be rather fuzzy, as some of the examples in the previous section suggest, seeking opportunities often involves more focus and a more systematic approach than it might appear at first. For example, this is how one of the respondents explains the process underlying seeking opportunities:

> *'You have to think 'I wonder if there is anybody who would be interested in this' and then do a search and try to track people down, then go down and visit them and say 'this is what I was thinking about doing – does it interest you'? You've got to be pretty proactive about that. These things don't just happen by chance. End even if you go to things like the University Research Day you are unlikely to end up having the right type of conversation. So you've got to decide if you want to work with people and then find them' (Participant 22; Interview 24).*

Indeed, individuals willing to engage with other CoPs need to be proactive, but also know how to find and engage with potential partners. Whereas some respondents mentioned '*cold calling*', when they would send abstracts of their work and research interests to other researchers (e.g. people they quoted most), hoping to find potential collaborators, others preferred more targeted approaches including, for example, utilising existing contacts in both academia and industry to publicise their expertise and interest in research collaboration. Similarly, attending any of the BTG initiatives often formed part of seeking opportunities to engage with other disciplines, and often was perceived as a good strategy to find like-minded individuals from across the university. There are, however, certain costs associated with seeking opportunities, as the practice often required some investment of both time and money:

'Active search for potential opportunities is difficult – the effort / return benefit. People have no time. It's the scanning for ideas versus passing ideas up - informal chats can bring ideas up, passing it onto a network and finally lead to collaboration. Collaboration often starts over a drink - people relax and start talking about ideas. A new idea can pop up' (Participant 7; Interview 8).

Although, as in the example above, seeking opportunities can be regarded as 'enhancing serendipity', in other examples the practice can be instigated by some changes in circumstances of individuals, for example changing the direction of research, arriving at research dead-end or moving jobs, as described by the following example:

'when I joined Strathclyde I knew that the engineering department was very strong. The first thing I did was I made contact with the Engineering Department asking if they would be interested in collaboration. And [name] was the first person that I met – and he is very enthusiastic. So, things grew out of that…' (Participant 22; Interview 24).

As in the previous example, the individual already knew and wanted to pursue collaborative work and, similarly, already had some idea of where to go and how to engage with potential partners (which is not always the case, as will be discussed in the forthcoming parts of the chapter). Furthermore, one of the observations made during the research suggests that newly appointed staff to the university were often easier to attract and engage in the BTG events and the participants were more open to creating contacts with other departments. One of the reasons for this could be the lack of well-developed internal networks and CoPs, which can make individuals more prone to seek inter-CoP opportunities.

Similarly to *exploring*, *seeking opportunities* can become an integral practice adopted by CoPs, which can further take a slightly unusual form of delegation. For example, in one of the BTG events one of the participants whilst introducing himself stated that:

> *'my research is nowhere near the agent theory but I am the research director at [particular discipline] department and I'm here on behalf of some colleagues and to see how [particular discipline] could be used in this field' (Event 4; Participant 38).*

The following example demonstrates how inter-CoP engagements can become a high priority item on agendas of CoPs, consequently requiring development and adoption of some practices characteristic to this type of engagement. As a result, some initial research opportunities were identified and pursued by the department alluded to above.

Furthermore, the practice has been recognised as important not only for individuals or CoPs, but also for organisations. As one of the participant explained during one of the informal interviews:

> *'There are 3 things to that. The first one is personal contact – that's the most important thing. And what you'd have to do if the university per se wants to, endeavour to, make itself known as a potential contributor to, lets say the space programme – or any other – the gas industry or the oil industry. You would have to start showing up on symposiums, conferences. For example in the ESREL conference in Norway which I just came from the Loughborough university had 7 or 8 people there. And there was nobody there from Strathclyde.' (Participant 18; Interview 19).*

Indeed, this practice translates into a number of tangible actions as well as more intangible aspects related to appreciation at both individual and organisational levels. The explanation

above further highlights the need for organisations to develop or support the development of a range of collaborative practices.

Searching for connections

The main difference between this group of practices and the previous one lies in focus on particular problem or research idea. Whereas in the previous group individuals could see benefits of engaging with other disciplines and would make the effort to find potential partners, they usually would have some generic idea of what projects and research they were interested in – without being too specific. In this group, the individuals' quest for partners is fuelled by an existing (research) problem they are wishing to solve. Hence, the dynamics of the practice differs from the previous two practices, with main focus on extending the perception of the problem by adding new perspectives, as described by one of the participants in the following example:

> *'we were trying to find people who were interested in areas of risk – different areas of risk and [name1] mentioned [name2] (...). So [name2] came on board and they was interested in the idea of the environment and social risk. And a lot of research on risk perception from psychology – which is my background – has a lot to do with the social risk. So we just started talking on what we can actually do together' (Participant 5; Interview 6).*

Indeed, on a number of occasions participants of BTG events admitted that they already had a problem or idea in mind and were looking for connections to other disciplines to further investigate the problem from new perspectives. Searching for connections has been the main driver for a series of events including research seminars, talks or some of the BTG workshops, which were organised around a specific research problem or idea, often proposed

by one or more individuals willing to explore what other disciplines could bring to the table. At the same time, many of the participants confirmed that they attended some of the interdisciplinary events because they were on a lookout for connections to other disciplines to progress work on some specific issues. For example, one of the participants to an event who decided to attend and present a problem to the group commented that these type of events:

> *'were good way to find out what happens and what people are doing – quickly. For me it was clear the first morning who can help and who can't. I knew quickly that [name1] and [name2] can offer something to us.' (Participant 2; Interview 3).*

After the fist event, they engaged in collaborative research with both [name1] and [name2], over time further attracting individuals from other disciplines.

In comparison to seeking opportunities, searching for connections often meant that the participants would approach potential partners in a slightly different way with focus on the particular problem they are interested in – rather than in generic search for any overlaps. This further translated into more specific choices of individuals or CoPs to be approached and had an impact on the way individuals presented themselves or the problem at hand (these aspects will be discussed in the later sections).

Furthermore, similarly to the earlier examples, the practice can also become part of the larger set of CoPs' practices, as described in the following example in which a department developed, and sustained, a set of practices that could help to identify new connections:

> *'In this department we are very – we talk a lot. People talk a lot about what they doing. So there is a plenty of opportunities of somebody saying "ohh, I'm thinking about this idea"*

and then somebody saying "that sounds relevant to something I have been reading. Have you thought about talking to…"' (Participant 22; Interview 24).

On another level, recent technological progress has been linked to practice as an enabler to finding the right type of expertise and making the connections in a more efficient way, as explained by one of the respondents:

'Internet helps to find and get the best person – within minutes you can be on the phone and talk to the expert. This is global market in intellect' (Participant 3, Interview 4).

However, many of the respondents found searching for connections more difficult and challenging, often asking how to find and approach the right people with the right skills in order to find new perspectives to apply to an existing problem. For one reason, knowing which discipline to look into for relevant type of expertise was one of the problems. Whilst searching for connections within the home CoPs seemed easy (e.g. through attending seminars or conferences related to the discipline) this practice could become overwhelmingly complex in interdisciplinary contexts. As one of the respondents explained:

'It's difficult to find information on available expertise. I know and collaborate a lot with electrical engineering department. I need some maths expertise but don't know who is there and who can help me...' (Participant 13; Interview 14).

Having a focused problem in mind can make the search much easier for individuals (at least in comparison with the purely exploratory approaches, including cold calling), however, as CoPs often seal themselves off from others (Ferlie et al 2005), hence preventing efficient knowledge exchanges, finding individuals with the relevant expertise may require some additional effort and techniques – even though the right person may be sitting in the room

across the street. The following example shows how the practice may sometimes look in reality:

> *'I went to pharmaceutical department at some point to talk to them and developed a link – now we have a student using their equipment there. But to find it took some effort. I was looking for somebody in Scotland with that instrument – $100k – so I googled and found an abstract from some event at Glasgow University. It mentioned the use of the machine – but no details. So I phoned the distributor to ask who bought the machine. And it was somebody in the pharmaceutical department. But I could not find it here…'* *(Participant 13; Interview 14).*

The process and effectiveness of searching for connections can further be affected by the nature, history and previous experiences of the 'native' CoP. As one participant warned, the spectrum of the vision applied by an individual, or the CoP, looking for connections to a problem is affected by the previous experiences but also by the cumulative experiences of one's native CoP – a '*tunnel vision'* that filters out which other CoPs are worth considering as potential partners. In other words, each CoP is likely to be having exchanges with certain CoPs, applying certain tools and perspectives. Hence, individuals from these CoPs are likely to be looking only at certain number of CoPs whilst searching for connections. As one of the respondents pointed out that during one of the BTG events, due to the tunnel vision and focus on computer-oriented solutions, the workshop did not attract anyone from the psychology field, who could bring another, useful perspective to the problem at hand:

> *'I'd love to see a couple of mainstream post-cognitive psychologists there, a human performance expert – these kind of things. That's part of the tunnel vision that it all needs to be computer oriented…'* *(Participant 17; Interview 18).*

Indeed, as another participant explained, it may not be easy for a space engineer to see, and be able to connect to, solutions offered by a music department. Widening this search spectrum can pose a challenge and require some experience from the individuals.

Before moving to the next practice in this group, I will summarise the discussion so far and clarify how the main differences between the above discussed three practices. First, *exploring* is focused on finding out about collaborative work with other CoPs and finding out whether an individual – or CoP – can develop an appreciation for this type of practice. The second group – *seeking opportunities* – indicates that an individual (CoP) already developed some appreciation and have acquired taste (Gherardi 2009a) for inter-CoP engagements and encapsulates a range of practices aimed at finding potential partners. Finally, *searching for connections*, is related to defined research problem or idea that an individual – or CoP – are willing to tackle through engagement with other CoPs. Techniques and approaches used in each of the cases are likely to differ as is the range of potential partners to be involved. For example, whereas seeking opportunities may involve attending somehow arbitrary conferences and events as a way to find potential partners, searching for connections is more likely to involve internet searches, utilising a network of peers or attending and presenting at events with potential partners.

The next practice identified in the exploratory group relates to developing a certain ability to *recognise* opportunities for inter-CoP engagements – a practice closely interlinked with the three practices discussed above.

Recognising opportunities

As already indicated in the previous examples, being embedded in norms and tastes of the native CoP may affect the ability of individuals to identify potential links to other disciplines that could potentially translate into collaborative projects. Hence, another identified practice relates to the ability to see through preconceptions and differences between CoPs, which may obscure seeing real opportunities offered by collaborative inter-CoP engagements. To recognise opportunities, individuals often required detailed and prolonged discussions combined with an extra effort to discover what other CoPs might offer and how their expertise can translate into collaborative opportunities. Indeed, there is an obvious overlap with the previous practices aimed at searching for opportunities as, for the search to be successful, at least one of the parties needs to be able to recognise the opportunities. This is not always a straightforward task and requires some learning, as explained by one of the respondents:

> *'I had no idea about management science and what they do. It would have probably never crossed my mind to go and talk to them – whereas after I spoke to [name1] and [name2] I see how we could work on the problem together and where they fit'. (Participant 2; Interview 3).*

Being able to recognise unobvious connections and opportunities often can force an individual into:

> *'kind of mental gymnastics' (Participant 10; Interview 11)*

or, as framed by another respondent:

> *'you need much more mental bridging in here' (Participant 14; Interview 15),*

hence stretching cognitive frames imposed by native CoPs. It also requires some persistence and ability to see beyond some of the obstacles. For example, on a number of occasions a

newly formed interdisciplinary group, which came up with a collaborative research idea, would often retreat and discard the idea upon an initial research and discovering that somebody else had already been looking at the same, or a similar, problem. This often was the point at which the group could not see any value in continuing the discussions and, in some cases, decided to dissolve. The problem in many of these situations was that the members did not actually look in detail into the existing approaches or problems – instead at the first sign of the idea being addressed (successfully or not; in the same or completely different way) they decide to abandon the ship. However, as observed in some of the cases involving individuals with more experience in working in interdisciplinary contexts, some participants would often step back, re-assess the initial idea and the identified 'competing' approaches and see how the interdisciplinary approach could add a new perspective to the problem. Furthermore, in some of the observed cases individuals suggested contacting the other groups and researchers already working on the problem to see if, first, they would be interested to be involved and, second, to find out what they thought about the interdisciplinary approach being proposed by the group.

Another, more structured, approach proposed in one of the groups included a suggestion to organise:

> *'weekly based research seminars for those who are interested in the topic to learn what is known and to identify more precisely the gaps. Maybe it will take more time, but almost for sure we can finally work out a good proposal, but with more effort and better organization' (Participant 33; El. Comm.1).*

Hence, although the opportunity was not obvious, the participant could see value in devoting more time and effort to identify the real opportunities. This was further linked to the belief that, on the one hand, new and original interdisciplinary opportunities are more difficult to

recognise whilst, on the other hand, IDR offers many novel and more exciting problems and solutions to work on. Consequently, recognising IDR opportunities, or indeed opportunities lying at the intersection of CoPs, can both require extra effort, tools and techniques but, even more importantly, developing an appreciation for these opportunities. This appreciation and sensibility to IDR opportunities has been further demonstrated by another participant, who, despite the fact that he could not see any opportunities for himself, he could recognise collaborative opportunities for colleagues in his department. As he explained:

> *'I can't really see myself engaging with architecture at the moment but I guess some other people in the department may be – e.g. in the smart buildings projects' (Participant 31; Interview 34).*

Indeed, some of the practitioners after recognising a potential opportunity for their colleagues or CoP put an extra effort in ensuring the connection was made and the opportunity could be realised as a successful collaboration.

However, not all individuals are able to see queries or potential new ideas as opportunities for themselves or their home CoP. This, on the one hand, can be rather frustrating for individuals pursuing opportunities, and detrimental to the CoP on the other, as illustrated by the following example:

> *'So essentially the person who I've mailed had not really seen a potential research connection but just seen a query and passed it to a person who was just doing some teaching. And that just fizzled down and there hasn't been any development to that connection. So one thing that I think is a real lack at the moment is that if you have a problem that you think may be related to an area outside your own expertise it's not clear who is the right person to go to try to pursue that. And also if you connect to somebody it's not clear whether the response that you getting is active responses or rather just "go away*

and shut up" kind of responses. And I've got a distinct feeling that it was just this "thanks for your enquiry but we are all right here – thanks" response. And it's a shame because I think there's some scope for work in that area but without having a connection to somebody who can actually talk sensibly about it it's very hard to see how to pursue.' (Participant 8; Interview 9).

As can be seen from the above example, the appreciation and recognition of an idea is not always shared by individuals – or indeed CoPs. To some extent this could be contributed to academic profession instilling competitive behaviours and preventing individuals from pursuing a larger, common interests, as further explained by the respondent:

'all academics are quite competitive and the academic profession encourages the competitive instinct in all of us – and for that reason trying to collaborate involves finding a way of shaping that competitive instinct so it does not prevent you from finding common interests and skills that can match together' (Participant 8; Interview 9).

Hence, engaging in inter-CoP collaborations may require some further practices being developed by CoPs willing, or being forced to, venture into this cross-boundary form of knowledge development. The discussed example further indicates the co-evolutionary dynamics between the development of IDR practices and networks of potential practitioners. As individuals develop the ability to recognise, and appreciate, inter-CoP opportunities, they are likely to engage and possibly involve others, further fuelling the development of the network. Additionally, as noted by another respondent,

'the more interdisciplinary you are, the more gaps to bridge you see'(Event 5; Participant 40),

indicating that experience can sharpen the ability to recognise opportunities. Hence, the continuous attainment and refinement of the practice, in a way similar to development of

appreciation for more complex wines (Gherardi 2009a), can lead to certain proficiency, which can be interpreted as the progress towards mastery in more traditional CoPs (Lave and Wenger 1991; Amin and Roberts 2008).

However, inter-CoP interactions may not always be recognised as something beneficial or as an opportunity. Instead, collaborations may be perceived as a necessity. Indeed, if all inter-CoP collaborations, similarly to IDR, are thought of as inherently problematic, less rigorous, yet more risky and suspicious endeavour for 'soft' minds (Massey et al 2006; Bruce et al 2004; Kincheloe 2001; Weingart 2000), then not surprisingly some CoPs may not be willing or able to see and recognise collaborative opportunities. Hence, recognising opportunities offered by inter-CoP collaborations can prove to be a difficult and may need to be developed and engrained within the fabric of practices of CoPs and individuals, just as other practices that sustain the daily operations of CoPs. As a practice, recognising opportunities relates to shared appraisal systems of a community; a particular taste which can further be defined as '*a sense of what is aesthetically fitting within a community of practitioners'* (Gherardi 2009a: 535). Hence, being able to recognise and appreciate the opportunities offered by IDR, or other inter-CoP interactions, may be a precondition for the development of other IDR practices, or, indeed, becoming involved with a new community.

Investigating Fit and Finding a Research Question

In this section two of the groups of practices - *investigating fit* and *finding a research question*- are discussed together, as they share a number of similarities and, as observed in the research, usually overlapped with each other. Furthermore, they often related sequentially to the previous group of practices. Indeed, it seems almost logical that upon identifying some potential opportunities partners are likely to embark on the process of

concretising the research ideas. Hence, at the stage of seeking opportunities, potential partners may start investigating the fit between their differently involved expertises and the tools and practices of each of the CoPs. They may then start developing research questions or, in more general terms, a potential focal issue around which collaborative engagements are driven. A number of forms of practice related to both investigating fit and developing research question were observed during the research.

The importance of these practices became apparent in contrast to the tendency of some of the groups to attempt to accommodate everyone in the room, whatever their potential interest in the general subject, in emerging IDR projects. Especially when the research topic was rather loosely defined, groups often attempted to find a research question that would involve the interests and expertise of all the members, or their respective disciplines. On a number of occasions, this led to projects which lacked clear direction or ownership, as highlighted by the following reflection from one of the participants:

> *'we were hunting around for projects that would suit many individuals in the group who had very diverse interests. Which was a good thing in some respects – but what kind of came out of that as a project that no-one had really any specialist knowledge in. So we all kind of emerged with this kind of idea, which people were interested in, but maybe in some of periphery kind of fashion. It wasn't really with anyone's main line of research…'* *(Participant 20; Interview 21).*

The tendency to over-accommodate and resulting bad 'fit' between involved expertises and interests could not only hamper the project, but also further affect the future attitudes of individuals towards IDR and collaborative engagements. Indeed, a number of respondents complained about meetings that, although they tried to involve all the members, often did so at superficial levels, with some individuals becoming rather frustrated with the lack of focus

and the feeling of arbitrariness during the initial meetings (c.f. Amabile et al 2001). Hence, *investigating fit* and *finding a research question* soon proved to be valuable practices in the IDR context, especially at the exploratory stages of development.

Two dimensions of investigating fit were observed in the research setting. The first related to investigating certain disciplinary compatibility; i.e. fit between epistemological and philosophical standings preferred by both involved CoPs and individuals, leading to prolonged discussions about how, and if, the involved disciplines, worldviews and tools can be integrated, as depicted by the following quote:

> *'our philosophy is probably totally opposite – so we need a longer dialog to see if there are any complementarities. And it also would be useful'. (Event 28; Participant 41)*

This often preceded the stage of developing a shared research idea or problem, and to some extent, was on the border of exploring. On many occasions, especially when mostly science-based disciplines were involved, the groups did not engage in philosophical debates as disciplinary compatibility did not seem to be such a problem. Instead, these groups often cut straight to the chase by directing the discussion to an apparent research problem or idea on the table.

In this second dimension, individuals often approached the problem from their respective disciplinary perspectives, however, over the time there was a tendency to widen the focus and look beyond the 'usual' approaches, as pictured by the following discussion:

> *The discussion focused for a while on how all the parties could be involved. [name] suggests that 'we could look at the economics for NHS – which would make it more powerful. [name] can see the benefits of making the research wider, almost macro level... (Event 32; Participant 47)*

This was the stage at which the group started to see the forest through the trees, and as soon acknowledged by another member,

'this could be the key strength to give such broad overview of the problem itself. The novelty may lie in bringing more aspects to the study' *(Event 32; Participant 42).*

Hence, it the example above, investigating fit was the first step towards forming a research problem for the interdisciplinary group to address. However, as already evident above, there also was some tendency towards over-accommodating in the process of investigating fit. As one of the participants noted,

'I still can't see how this integrates – but can see and be persuaded' *(Event 32; Participant 43).*

Finally, after a number of iterations, the above respondent and some other participants did not feel their expertise would fit with the general theme and decided to disengage at that stage.

On the contrary, hastily developed research problems without engaging into investigating the fit between participants often led to either individuals dropping out after a few initial meetings or focusing the efforts of the group on projects that were undeliverable due to unexplored intrinsic differences between the involved parties.

Some individuals adopted a number of techniques to help them to investigate fit and ensure engagement of individuals in the potential project. One of the participants spent considerable amount of time considering whether his expertise can fit within the problem before venturing into the developing the idea further, as explained below:

'I wrote down on a piece of paper 3 things which I knew something about which could vaguely be fit with that topics and thought about it for a couple of days and then picked

one. And started thinking now – how we going to take it forward?' (Participant 25; Interview 28)

This, however, was a prelude to a series of interdisciplinary seminars and workshops, led by the individual, with focus on developing new approaches to modelling by bringing different disciplinary expertises and methodologies in the field.

In another example, one of the more active and experienced participants, after becoming frustrated with the initial meetings and ill-defined fit, emphasised that inter-CoP groups need to spend more time and effort on investigating fit and developing research question to ensure more successful outcomes and better dynamics in the future. As he explained:

'Because I'm pretty sure that if you go through several discussions, earlier or later you will find some nice problems. But we were working almost half year on writing a proposal and still there is a doubt whether we can submit this proposal or not…' (Participant 33; Interview 37)

Indeed, ill-defined fit often led to ill-defined research questions and failure for the collaborative initiative in the longer term.

However, due to the complex nature of IDR, recognising the fit may be as challenging as recognising opportunities. As one of the experienced participants in IDR reflected on their experiences of working with mathematicians:

'mathematicians are good at that – if you talk to them, once they actually understand the underlying problem, they go 'Aaaaa, oh that's easy – it's exactly like in the prediction of stock market!' – because it actually is the same equation they already have used. So it takes understanding the problem first.' (Event 33; Participant 25 – informal interview)

He further pointed out that,

> *'from experience, especially with mathematicians, they know that sometimes it takes time and more understanding of the problem' (Event 33; Participant 25 – informal interview)*

Hence, it sometimes takes time before the fit becomes obvious to the participants, further linking to the discussed issue of *recognising opportunities*.

Another dimension of investigating and recognising fit relates to the human side, as although there may be an obvious disciplinary fit, a lack of personal fit is likely to prevent any future collaboration from materialising, as described in the following example:

> *'After identifying the people with the skills you need is the question how do you get people to like each other…There were some attempts to get collaboration going with bioengineering recently. It is related to another phase of the project related to putting the equipment into a patient – we have no expertise in validation of the interaction. We need a specialist to do that – a physiologist or somebody from bioengineering. So there were a number of attempts. We came together, identified the areas where we need help, identified people with the right skills in biotechnology department. We contacted them, went over.*
>
> *FIVE people went over, ZERO success rate. Sorry – there is a potential, a chance for ONE success…' (Participant 2; Interview 3).*

Considering there was an apparent (at least to one of the sides) fit between the disciplines, one of the reasons for failure could be attributed to a lack of personal fit between the involved parties. This is to some extent reinforced by the following example:

> *'We had some seminars; we talked it through, blah blah blah…And that hasn't worked. Nothing afterwards. We also talked to physiology: 'yes, I can do it. I'd like to do it' - but*

then it went nowhere. And you just don't understand why things didn't progress…' (Participant 2; Interview 3).

Another possible reason explaining the failure is the possibility that what one of discipline, or individual, recognised as an opportunity might have not has been perceived in the same way by the other side.

An equally important issue at the early stages of IDR collaborations relates to finding a suitable research question for the potential project and the involved parties, especially as there was often mentioned during the events recognised risk of IDR projects turning into consultancy, hence lacking the merits of original research. This danger was especially evident in relation to individuals searching for applications for their existing tools and techniques in other disciplines, which was often not seen as a valuable or valid research project. Indeed, as one participant commented,

'just bringing two disciplines can fail – there is no novelty in either, Hence referees won't see any point [in funding the idea]' (Event 45; Participant 35).

Hence finding a 'real' research question constitutes an important part of inter-CoP engagements. However, the difficulty may be arising from the fact that, as observed in some of the events, '*integration in the form of the mixing of central propositions is not always feasible or even desirable because of paradigm incommensurability*' (Zahra and Newey 2009: 1062). Investigating fit, hence, can help to identify these incompatibilities before further work begins.

However, as could be expected, another aspect that can affect the process of investigating fit and developing a research question relates to the cognitive and epistemic distance between the involved disciplines. As often pointed out, the greater the distance the greater the

challenge to recognise potential fit and develop valid research question. As one participant described,

> *'if I was sitting down and working with someone much closer related to my field I probably wouldn't need as much [work and effort to find research overlaps] - because I suppose if you close enough you can probably sit down and write a paper together. But something like my area; and [name1]'s is more of a psychologist and [name2]'s is more sociologist – I think we will need a bit more focus than just sit down and knock out a paper' (Participant 16; Interview 17).*

Hence, as the example suggests, the bigger the differences between the involved CoPs the more difficult, and hence requiring more time, effort and skills, *investigating fit* and developing shared project is going to be. Indeed, as another participant pointed out,

> *'you need to work harder on those' (Participant 31; Interview 34),*

whilst referring to developing collaborative interdisciplinary proposals and ideas.

The examples discussed so far suggest that CoPs, and individuals, who repeatedly engage in inter-CoP interactions, are likely to develop a set of practices related to investigating fit with other CoPs and negotiating a suitable focus of the potential collaborations, in a way somehow similar to the process of authoring boundaries (Bjørkeng, Clegg and Pitsis 2009). However, at this stage rather than constructing legitimate activities to form part of practicing, participants are still authoring the foci and scope of the potential practicing. Hence, both *investigating fit* and *finding a research question* form a central part in the process of emergence and legitimisation of practice.

Furthermore, results of this research seem to confirm the existence of the two approaches adopted by different groups developing IDR proposals, as described by Hackett and Rhoten

(2009). Indeed, some groups did commence the collaborative engagement by investigating the fit and focusing on expertise and research interest of the participants before trying to arrive at the 'legitimate' research question. As a result, some members decided not to pursue the discussions as they felt there was not enough fit for them in the setting. The remaining participants soon formed dynamic groupings that went on pursuing the newly identified opportunities. Other groups from the very beginning were concerned more about legitimacy of the research question and the need to accommodate disciplinary expertise of each participant within the research problem. As the project progressed, these groups seemed less and less committed and integrated and in most cases dissolved straight after, or sometimes even before, the results could be delivered. This resonates to some extent with the observations made by Hackett and Rhoten (2009: 423) suggesting that the groups that were previously '*schooled in the rules of interdisciplinary collaboration*' had failed to '*learn the rules of interdisciplinary collaboration*'. In the case of this research, although groups were not formally schooled in IDR, they seemed to fall into the same trap of over-accommodating and focusing on over-encompassing research themes, often failing to investigate the fit and then progress to developing of the research question. Indeed, being 'nice' and 'integrative' could prevent some of the groups form proper investigation of the fit and, consequently, developing research questions that are neither well thought through nor ensure enough engagement and commitment from the participants. This, in turn, is likely to lead to collaborations that are not based on shared practice but rather an assembly of incompatible, disciplinary practices and interests. Indeed, individuals are likely to stay loyal to their native CoPs and practices, as depicted by Lindkvist (2005).

Finally, efforts invested into investigating fit and the subsequent development of the research problem could lead to some unexpected and challenging results. In particular, the initial framing of the problem might be challenged in the context of inter-CoP collaborations. As in

the following example, investigating fit may lead to further re-conceptualisations of the problem due to new perspectives being applied, as demonstrated in the following example:

> *'For example, if you come and present a problem with the design of your tablet to deliver a drug, some biologists may actually question the idea of using a tablet as a way of delivery. You may end up discovering a real problem in the end' (Participant 30; Interview 33)*

Situations like this can be both revealing and challenging. On the one hand, it can '*liberate a person's thinking from the limiting assumptions of his own professional group, and stimulate fresh vision*' (Milgram 1969: 103), and, consequently, through diffusing the findings to the home CoP, refine existing theories and redefine boundaries of the CoP (Zahra and Newey 2009). On the other hand, risk-aversion and a tendency to seal off from neighbouring CoPs (Ferlie et al 2005) can lead to the rejection of such approaches as too radical. Hence, a certain comfort with risk taking is required for these CoP-boundary challenging practices.

Risk taking

Although only a few explicit instances of risk taking were identified in the data, the observations and informal interviews often indicated that this is an important factor in inter-CoP engagements. One of the aspects of engaging in inter-CoP initiatives an individual is likely to face being pushed outside of the comfort zone that home CoPs and their familiar practices offer (Bruce et al 2004). Indeed, as pointed out by one of the respondents:

> *'IDR may also be pushing people out to discomfort zones. The kind of 'this is not what I know – what do I say next?' dilemma makes people retreat back to the comfort zone of own expertise' (Participant 2; Interview 3)*

Indeed, extant literature identifies IDR as rather risky career strategy (Rhoten and Parker 2004), further indicating that working across the boundaries involves some levels of risk

taking. As already mentioned, on a number of occasions, novice participants in some of the groups were easily discouraged and would not take the risk of pursuing IDR ideas

'simply because somebody else did something similar' *(Participant 33; El. Comm.1).*

Instead of devoting some more energy and time to developing the research question, they would prefer to retreat to the familiar disciplinary frames. This has been later criticised by more experienced participant who explained that the group

'almost gave up – instead of organising a weekly based research seminar for those who are interested in the topic to learn what is known and to identify more precisely the gaps' *(Participant 33; El. Comm.1).*

There seemed to be certain risk aversion linked to the unknown territory of interdisciplinary research and, indeed, first forming valid research questions.

Furthermore, largely in accord with the extant literature (Carayol and Nguyen Thi 2005; Schild et al 2002, Pettigrew and Knight 2007), participants in this research often perceived interdisciplinary proposals as more risky and difficult to obtain funding for, often bearing higher probability of rejection. As described by one of the participants:

'If you go to the grant [body] and it's too unusual to them they say: Oooh! Risky project – I take something which I know…Because it can fail.' *(Participant 21; Interview 22).*

This can be partly attributed to both the fact that IDR proposals are often judged by experts embedded in '*relatively narrow and specialised frameworks to tackle problems*' (Buanes and Jentoft 2009: 449) and to the lack of articulated evaluation frameworks for inter-CoP projects (Pickett, Burch and Grove 1999). Furthermore, developing interdisciplinary proposals and obtaining funding is often considered as more demanding in terms of time and

effort (Lattuca 2002). Indeed, as recognised by the respondent, individuals and teams need to be ready to put the extra effort and take the risk if they want to pursue interdisciplinary ideas:

> *'some of the ideas that I may have a little bit crazy in regards to – they are not within the discipline. So if you go out now into a normal grant body, some of them may be excited, some of them may say 'hey, she needs to prove it works'. So it's very risky environment to get money. Sometimes you need to fight very hard to say hey, we need to do that' (Participant 21; Interview 22).*

As already discussed, one of the identified barriers to the development of IDR networks and practice lies in disciplines and individuals willing to defend the existing conceptual boundaries, exposing the practitioners of this mode of research to the risk of finding themselves in '*a state of social and intellectual marginality*' (Klein 1990:12). Similarly, individuals may find the incompatibilities between practices, and the consequent collaborative challenges, including additional time and cost investments, to some extent repellent. However, in this study the practice of effective risk taking was associated with a tolerant appreciation of the unavoidability of these challenges.

At another level, extant literature often recognises working across boundaries as, on the one hand, rewarding, developmental and stimulating (Bruce et al 2004; Frost and Jean 2003) and on the other hand disadvantageous for professional career development (Rhoten and Parker 2004). The findings of this research are largely in agreement with the literature, further highlighting the importance of risk taking in practicing IDR, as illustrated in the words of anther respondent:

> *'My interest is very broad. It can be good and bad. In the US it's suicidal – To get anywhere you need to become a recognised, international expert in something to get promoted. I just switched field again – and if I was shooting for professorship it would take me forever. But I don't care. I get bored doing the same for too long. 5 years is OK*

but 10 years would be too long. I don't care if I don't get the professorship' (Participant 14; Interview 15).

This attitude applied to a number of participants of the study, who with varying degrees took the risk to pursue IDR. To a large extent risk taking can be conceptualised as a certain attitude or preference, in a way similar to practices defined as tastes and systems of values (Gherardi 2009a), hence it often translates into actions that enable or prevent IDR from materialising. As observed in the study, the levels of risk taking related to engaging in IDR differed across different CoPs and individuals. Whereas individuals from certain CoPs were more prone to take the risk and extra time and effort to engage into open IDR discussions, others displayed their preferences to engage in well defined projects with clear roles and disciplinary inputs. This suggests that risk taking as a practice might not be acceptable in some CoPs, but nevertheless it can be a ''correct', acceptable or even honourable practice to engage in for the members of some other CoPs (Buanes and Jentoft 2009).

Summary

The overlapping and interconnected group of exploratory practices discussed above can be thought of as, to some extent, determinants of the success of proliferation of inter-CoP engagements. Indeed, in the first instance individuals often need to engage in exploration to find out whether working across boundaries is something for which they can develop a certain taste and appreciation. Indeed, the development of an 'aesthetic' appreciation for certain 'ways of doing research' can change the CoP and the underlying practices it engages in (Gherardi 2009b), in a way similar to development of different schools of thought within disciplines (Gherardi 2009b; Landri 2007).

The following steps often include a number of techniques focused on finding the right inter-CoP projects and connections worth pursuing. Hence, *investigating fit* and *finding a research question* play an important role in ensuring collaborative ideas meet high standards of validity and novelty, rather than turning into a multidisciplinary consulting project. Indeed, practices related to developing a research question can ensure well developed and supported research questions that can withstand the critique and scrutiny of evaluation panels, often made up of disciplinary experts. This can be particularly important, as it is '*especially easy to critique research conducted at the intersections of academic disciplines*' (Zahra and Newey 2009).

Considering that there is little empirical research to address the process by which members engage (or not) in integration across disciplines (Hackett and Rhoten 2009), and indeed CoPs, the results above shed some light at the processes of investigating fit and developing research questions in the interdisciplinary context. This seems particularly important since majority of extant research focuses on already established practices or teams (Bjørkeng, Clegg and Pitsis 2009), failing to provide insights into the stages of negotiation of, for example, the final mix of participants. Although the extant literature mentions, for example, some of the problems related to finding partners from other CoPs (Golde and Alix Gallagher 1999), the discussion does not go into the details of how individuals overcome these problems – especially in the stages of the development of the idea. The above discussion sheds some more light on these aspects of (potential) practice development.

RE-PRESENTATIONAL PRACTICES

The second group of identified practices was probably one of the first and easiest to observe in the inter-CoP setting. This category refers to the specific ways that research projects, ideas or expertise were (re-)described and communicated in the IDR context. In many observed instances the problems, ideas or tools needed to be de-contextualised to attract attention and understanding from different disciplines. Four distinct practices were identified in the research, three of which were further clustered together, as presented in Table 9.

Re-Presentational practices	Number of references	Number of sources
Adapting presentations relationally	21	16
Describing the problem	41	27
Unpacking the problem	18	13
Up-framing	18	11

Table 9: Break down of identified re-presentational practices.

Finally, *re-presentational practices* were grouped into *adapting presentations relationally* and *describing the problem*, which further includes *unpacking the problem* and *up-framing*. Table 10 provides characterisation of each of the practices together with the list of coding categories each of the practices is closely related to.

Practice	Characterisation		Closely related to
	Activity	**Appreciation**	
Describing the problem	Reconceptualising problems and ideas through a number of techniques to make them accessible to all partners	Understanding and respect for the different ways partners perceive the problems and ideas from other CoPs	• reflecting • searching for connections • building fit • exploring • seeking opportunities
Unpacking the problem	Decontextualising research problems by breaking them down into smaller components that can be more easily approachable to other CoPs	Understanding and respect for the different ways partners perceive the problems and ideas from other CoPs	• reflecting • seeking opportunities • searching for connections • engaging • investigating fit • building fit • up-framing
Up-framing	Decontextualising research problems by generalising and discarding CoP-specific perspectives	Understanding and respect for the different ways partners perceive the problems and ideas from other CoPs	• reflecting • searching for connections • engaging
Adapting presentation relationally	Constantly monitoring and adapting the way problems, expertise or ideas are presented according to the mix of the inter-CoP audience.	Appreciation of how partners in different CoPs use and relate to particular language	• up-framing • reflecting • engaging • investigating fit

Table 10: Characterisation of Representational practices.

Describing the problem: Unpacking the problem and Up-framing

It seemed that the way of presenting (research) expertise or research problems in the inter-disciplinary context could often determine the success of the exploratory phase of the inter-CoP interactions, whether in the process of seeking opportunities or connections. It was not unusual in this research to see less experienced participants coming to the events and presenting themselves, the research problem or the expertise of their native CoP in a way that often would prove incomprehensible to the other members of the event. Using disciplinary jargon, presenting and approaching problems from narrowly specified

disciplinary perspectives and overlooking the fact that the audience may not have the necessary background knowledge to comprehend the details were among the problems most often observed in the research. As one of the respondents reflected after a networking event:

> *'I spoke to a mechanical [engineering] person during the [speed] dating – and the person was using too technical language. I felt it was very difficult to understand him - too difficult terms'. (Participant 37; Interview 42)*

However, over time some participants displayed an awareness of the problem and, consequently, started developing certain practices and techniques to address the situation. As one of the participants vividly described:

> *'You have to realise, when you are presenting your work to someone from other discipline, that you may have been seeing the problem in a way that is not very useful. And by understanding what their problem is better, you can take a different perspective on the problem they trying to solve. And that usually comes from arguing and sort of 'oh, that's not good. Why bother to do that when the real problem is this?'' (Participant 22; Interview 24).*

Hence, as the above example implies, unpacking the problem to the level of more basic elements through discussions was one of the techniques adopted by some participants. These questioning, or as one of the participants put it, 'teasing out', was applied to see the problem from different angles and dissect it to simpler and more generic elements that could be easily understood through other disciplinary frames.

At the simplest level, participants would try to express the problem by using different vocabulary, however, when that technique proved not to be sufficient for the situation, the group often would adopt a number of boundary objects to aid the process. In such situations individuals often used diagrams, flipcharts and symbolic representations to articulate the

problem, which resonates closely with the adoption of new technologies or boundary objects in inter-CoP engagements (Carlile 2002; Wenger 1998).

Furthermore, it soon became apparent that different disciplines had different ways of describing research problems, but also expectations of how problems should be approached. This, consequently, often lead to misunderstandings, frustration and potentially conflict. Hence, the ability to break the problem down in a way that would suit different disciplines was soon recognised as a competence, as one of the participants described below:

> *'another aspect [of successful IDR meetings] is how good people are at breaking down the problems – science is quite specific, deterministic. I found mathematicians much more focused on details then we are – it gets to the level that they are more focused on maths then on the problem. And we are not interested in such a detailed focus'* *(Participant 2; Interview 3).*

Consequently, incompatibilities between the practices of unpacking the problem, and a lack of consensus, could prevent collaborative research between the two communities. Furthermore, presenting a problem in overly disciplinary manner can repel potential partners from engaging in the problem, as explained by another participant:

> *'If it was [name]'s problem – if it was framed in terms of big chemical equations – I would not have applied'* *(Participant 16; Interview 17).*

The respondent additionally admitted that the reason they attended the workshop was the generic and inclusive way the research problem was presented. It seemed an important factor for some participants that the description was written:

> *'in normal language – in more general terms and it said that we will concentrate on a particular problem from the chemistry but one need not know chemistry to come along'* *(Participant 22; Interview 24)*

when deciding whether to attend or not. Hence, as the respondent further pointed out, unpacking and re-framing the problem made the initial connection possible.

On a number of occasions individuals who attempted to attract and involve other disciplines to the problem often decided to adopt the route of generalising and de-contextualising of the research problem; or, in other words, developed the practice of *up-framing*, as explained in the following example:

> *'They [MoD] no longer say we look for bids for an aircraft. They say we have to transport 50 people from point A to point B – because they want the most creative solutions. And if you can actually do that without actually creating an aircraft – that's fantastic. Cos then someone can just transport people like in StarTrek. They would never have had this bid before' (Participant 22; Interview 24).*

Hence*, up-framing* and *unpacking the problem* can significantly increase the range of potential partners and solutions attracted to the research problem, as well as circumvent attracting only closely related CoPs, as explained in the following extract:

> *'Because then you'd end up getting the same people applying for that but you may not realise that there may be someone over in music department by solving NASA problems… there may be someone that their methodology would show a lot of insight but if you frame the problem in a certain way they may not think they are welcomed' (Participant 22; Interview 24).*

These practices, however, may require slightly different approaches in relation to different disciplines. For example, to attract some CoPs may necessitate a more focused approach, often involving translating the problem into more relevant (disciplinary) frames to sound

attractive but also more accessible to the more distant disciplines. As explained by another respondent:

> *'Maths – they are really eccentric. You need to translate the problem so maths are attracted to the theme. We still struggling with that…' (Event 3; Participant 30).*

However, as described in another, previously discussed, example, once the problem is de-contextualised and unpacked, and once

> *'mathematicians actually understand the underlying problem, they go 'Aaaaa, oh that's easy – it's exactly like in the prediction of stock market!'' (Event 33; Participant 25),*

the likelihood of successful collaborative engagement becomes much higher.

However, unpacking and up-framing the problem may prove more difficult in the inter-CoP context than it might sound, as there is some risk of over-simplifying the problem, which in turn can have an opposite effect. For example, this is how one of the respondents describes the somehow puzzling experience of trying to up-frame the problem:

> *'Before the presentation I sat down and thought about the way to present the problem in an abstract way for the mathematicians. That lead to questions during the session and what maybe should be done differently. Maths wanted more science in the presentation. I missed out equations because a lot of them were obvious to experimentalists. But then they wanted to know them to understand how the model works' (Participant 25; Interview 28).*

Hence, it requires some learning and experience to be able to judge which details should be left in and which should be left out. In another example, the respondent explains that:

> *'You need to be honest with what you are doing and link to different audiences. You can simplify and generalize but not take the technical terms. People don't like to be looked down on, especially students' (Participant 36; Interview 41).*

Indeed, it is important to keep the balance and not to fall into the trap of oversimplifying but also be able to generalise in a manner that is attractive to a wide range of potential partners. Furthermore, when presenting to inter-disciplinary audience, individuals may need to develop yet another ability of adapting their presentations according to the make-up of the audience, as already alluded to in the earlier examples, and further explained in more detail in the next section.

Adapting presentations relationally

Adapting presentations relationally as a practice was often observed in conjunction with other practices, for example *searching for connections* or, as will be discussed later, *engaging* and *building fit*. In the simplest terms, this practice translates into the ability to adapt the content and language of presentations, whether presenting a research problem or expertise, according to the audience. Although it may sound simple, many of the less experienced participants often failed to convey the message in an appealing way that would lead to inter-CoP collaborative engagements. This can be linked partly to the use of jargon discussed above and disciplinary perspectives but also to the lack of the awareness that the presentation may not be fully understood or seem in any way appealing to the audience. As one of the respondents explained:

> *'when giving a presentation – you need to talk to the audience. If the audience is interdisciplinary not everyone would know what you are talking about. Some of them may not get 90% of it. But then you give them a primer, something that shows the bigger picture – and that's what it all is about: a greater good'* *(Participant 36; Interview 41).*

To an extent this overlaps with the discussed *up-framing*, however, this practice indicates the need for a more dynamic approach whilst seeking inter-CoP opportunities.

Adapting presentations relationally has further been recognised as a desirable skill in the context of IDR, which can be developed and mastered by individuals. As one of the respondents reflected:

> *'I think through the workshops I also picked up something about presentations. Some peoples' presentations gave very simple language and understanding. This is very useful. For example [name] – his presentation was simple. It's a nice skill. Most of us (...) tend to give a talk in own company. In particularly me – I talk to mathematics...*
>
> *So I think this is a skill during the workshop' (Participant 37; Interview 42).*

And, as he further explained:

> *'You need to learn to explain yourself in a simple language so other people will be able to understand you. This is important. Otherwise you won't be able to find a partner to work together' (Participant 37; Interview 42).*

The learning process was particularly obvious during the speed-networking events, in which individuals were required to repeatedly explain their expertise within a very tight timeframe to colleagues from various disciplines. Whereas some less experienced individuals tended to use too much jargon and, generally, were not understood (as in the earlier example of mechanical engineering), others quickly reflected upon the experience and have changed the way they were presenting themselves according to who they talked to. As one of the participants described:

> *'after 3 or 5 people you find yourself knowing what to say and you do it quickly' (Participant 28; Interview 31)*

whereas another participant noted that:

'if during 2 minutes you are using difficult language – nobody will understand you' (Participant 37; Interview 42).

What at the beginning seemed almost like a recording from an answering machine, became a much more dynamic and adaptable message after some time. By taking part in a number of speed-networking events, I further observed similar changes in my own efforts to present my research interests. Indeed, just after finding out the background of the networking partner, I would already make first adjustments to both language and content of my 'pitch'. After some time, my presentation hardly resembled my 'normal' introduction when interacting with colleagues from the field of management.

At another, slightly deeper, level the changes may not only apply to the content of presentations but may further have an impact on the conceptual and relational orientation towards partners from epistemologically different CoPs, as described by another participant, who realised that:

'each time I have to change the frame of mind when I write [with a colleague from another discipline]' (Event 29: informal conversation with a participant).

Other participants, after realising the importance of this practice, often inquired with the BTG facilitators about the mix of participants going to attend the next meeting, as they desired to prepare the presentations:

'in a way that touches upon the interests people have [in the meeting]' (Event 38; Participant 33).

Indeed, for some individuals this became a regular, and extremely useful, practice in the context of engaging in and developing IDR.

However, not all of the participants were able to develop the skill and adopt the practice, which was particularly visible during the University Research Day. After talking to a number of poster presenters from across a range of disciplines, one of the participants commented that a large number of presenters were unable to convey their message and did not seem to understand the problem. As they further pointed out,

> *'the real key to get across to people – especially on the science side – is that they not communicating with scientists and it's their job both in the poster and in the oral presentation of it to find a way to communicate it to intelligent, lay audience in a way to communicate significance' (Participant 10; Interview 11).*

As a result, in the following year the BTG steering committee provided training for poster presenters to develop the skill and adaptability necessary to operate in the increasingly interdisciplinary context.

Summary

The significance of *re-presentational practices* is difficult to overstate as they can often support successful engagement between individuals from different CoPs. In a way similar to the biologists who '*were able to adjust their way of communicating in reaction to the comments from the chemists and they made some of their practical knowledge more explicit in order to communicate it to the chemists'* (Sutherland Olsen 2009), participants in this study often gained the skills to *adapt presentation relationally* and learnt how to express their ideas to different audiences. Furthermore, both the discussed *up-framing* and *unpacking the problem* resemble the techniques of meta-coding and use of some boundary objects in order to aid to de- or re-conceptualise the problem (Amin and Roberts 2008). However, the examples discussed in this research shed some more light on the process by which these

practices are being developed and adopted by the individuals and, finally, recognised and supported by the whole organisation. Furthermore, the potential risk of over-simplifying signifies another dimension of meta-coding and working across CoP boundaries. It can not only be detrimental, but also highlights the dynamic character of these practices and the need for constant re-negotiating of the final shape of the practice among members (Bjørkeng, Clegg and Pitsis 2009). Furthermore, although the results indicate that re-presentational practices can be acquired through experience, the dynamic and changeable nature of inter-CoP collaborations suggests that this is an ongoing learning and adaptation, rather than one-off event. However, the process can be supported and facilitated.

COLLABORATIVE PRACTICES

The next group of identified practices relates to the process of collaborative work across CoP boundaries. These practices are responsible for developing and maintaining collaborative engagements, often based on negotiating and building consensus, but also constructing shared understanding of what good collaborative practices are (c.f. Bjørkeng, Clegg and Pitsis 2009). Table 9 presents the collaborative practices identified, together with the number of corresponding occurrences in the data as well as number of sources the occurrences are linked to. Furthermore, as the table indicates, a number of the coding categories were grouped into two clusters within the group of collaborative practices, as shown in the Figure 15.

Collaborative practices	Number of references	Number of sources
Accommodating	22	16
Developing Communication & Listening	50	22
Engaging	64	37
Maintaining practices	--	--
Project tasking	9	7
Ensuring procedural justice	16	12
Cultivating	11	8
Providing focus	15	11
Disengaging	6	6
Visiting partners' location	9	6
Building fit	47	27
Posing (stupid) questions	8	5
Clarifying	12	11
Negotiating	21	17
Compromising	9	9

Table 11: Break down of identified collaborative practices.

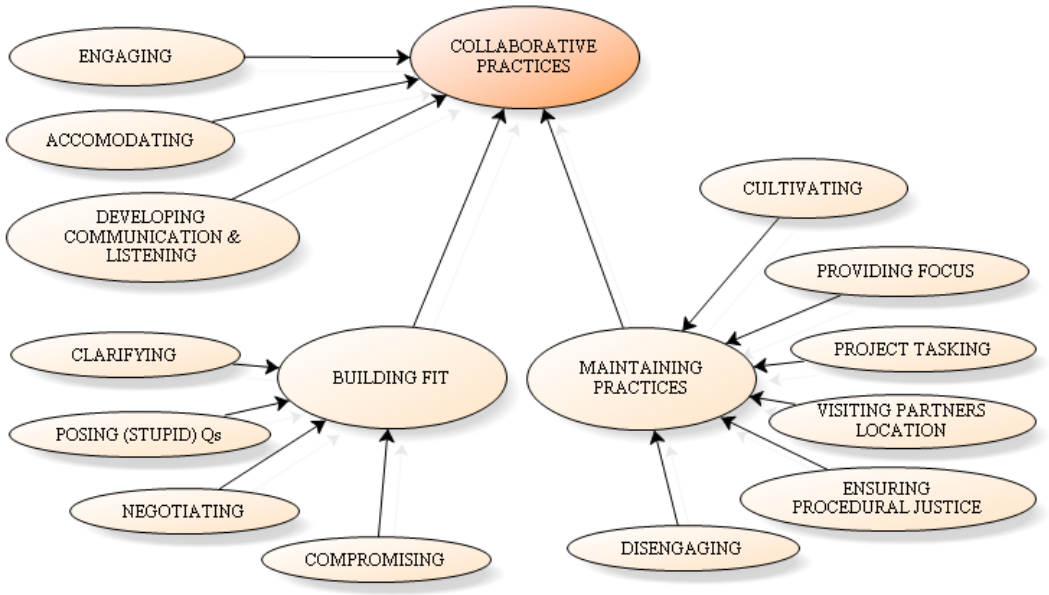

Figure 15: Identified collaborative practices.

Table 12 provides a summarised characterisation of each of the practices in this group, whereas the subsequent sections will provide detailed discussion of the identified collaborative practices.

Practice	Characterisation		Closely related to
	Activity	**Appreciation**	
Engaging	Involving partners intimately in the project as a whole to support ownership	Appreciating the value of intrinsic motivation for collaboration	• building fit • accommodating • organic growth • ensuring procedural justice • searching for connections • seeking opportunities • recognising opportunities
Accommodating	Adapting the project approach to align, as much as possible, with that the anticipated needs and expectations of participants	Appreciating that partners will have different needs and interests	• investigating fit • developing a research question • engaging • up-framing • developing communication and listening
Developing communication and listening	Enabling dialog around key terms to support shared understanding between partners.	Iteratively developing sensitivity to nuances in discourse that signify potential misunderstandings.	• reflecting • accommodating • adapting presentations relationally
Building fit	Actively shaping and reshaping ideas in discussion to maximise the compatibility between partners' approaches, expectations and expertise	Appreciating that partners will have different needs and interests	• finding a research question • accommodating • engaging • developing communication and listening • cultivating
Clarifying	Undertaking detailed questioning to support good understanding among members	Appreciating the potential problem of different assumptions and preconceptions	• posing (stupid) questions • developing communication and listening • investigating fit • recognising opportunities
Posing (stupid) questions	Challenging pre-conceptions, assumptions and misunderstandings through asking simple, non-trivial, questions	Appreciating the potential problem of different assumptions and preconceptions	• clarifying • developing communication and listening • building fit • engaging
Negotiating and Compromising	Actively re-negotiating the scope and processes of the collaborative engagement	Appreciating that partners will have different needs and interests and that these will change dynamically	• accommodating • developing communication and listening • describing the problem

Cultivating	Protecting space for gradual, personal interaction to build mutual trust, understanding and friendly relations among partners.	Appreciation of the long term nature of collaborations and the essential role of trust	• developing communication • building fit • visiting partners' location • exploring • investigating fit • recognising competencies
Providing focus	Specifying clear directional aims	Appreciation for the value of clear leadership	• engaging • clarifying • accommodating • recognising IDR competence • project tasking
Project tasking	Delegating and assigning tasks among team members	Appreciation and respect for competencies and abilities of partners	• engaging • recognising IDR competence • recognising limitations
Ensuring procedural justice	Building fairness into the delegation of project tasks	Appreciation of the role of justice in the longevity of collaborations	• recognising competence • challenging boundaries • engaging • negotiating and compromising
Visiting partner's location	Learning about other CoPs through visiting and immersing in partner's environment	Appreciation of the value of experiential learning	• engaging • ensuring procedural justice • building fit
Disengaging	Leaving oneself, or excluding others, from 'unhealthy' collaborative arrangements	Appreciation of appropriate and inappropriate collaborative behaviours	• building fit • ensuring procedural justice • accommodating

Table 12: Characterisation of Collaborative Practices.

Engaging

The discussion in the previous section already indicated that it is not always an easy task to *engage* members of other CoPs in collaboration. On a number of occasions respondents pointed out the problems they encountered whilst attempting to engage other individuals or disciplines in IDR projects, especially when individuals were able to perceive the difference between real and superficial engagements. As one of the respondents explained:

'I can find the people with knowledge – like [name] – and then need to convince them. But it's not just to ask them to help me out in this case – I need to immerse them in the idea, in the problem. They need to feel and take the responsibility – it's not just that they help me

out there. And that leads to knowing each other and trusting each other. We take it further than just professional arrangements' (Participant 2; Interview 3).

Indeed, the results confirmed that for IDR to be realised, and not to slip into simple multidisciplinary consultancy, there was need for more than just a simple exchange of tools or techniques, confirming the large body of literature that often makes a distinction between the different levels of cross-disciplinary integrations (Aram 2004; Klein 1990). This was also confirmed by another respondent, who highlighted that:

'in collaboration both parties need to be excited about the project to get success at the end. Otherwise it turns into consulting and dies away' (Participant 7; Interview 8).

Hence, the practice of engaging a potential partner at more than just a superficial level can play a significant role in success of inter-CoP collaborations.

The task, however, often proved to be rather difficult and challenging as illustrated in the failed attempts to engage the disciplines of bioengineering and physiology in an interdisciplinary project, discussed earlier. Despite numerous attempts at engaging and the initial, rather positive *'yes, I can do it. I'd like to do it'* response, it finally '*went nowhere*', leaving the project leader rather puzzled. Hence, an overlap and initial fit are not yet a guarantee of a successful outcome. On other occasions participants were able to provide some examples of techniques and tools they utilised to engage potential partners, as in the following example:

'How do you find these people and how do you approach them? It's the same with local companies – how do you get them interested? You can always use some of the 'techniques' – invite them to give a presentation or to some departmental day, get them interested when you meet them through some event – e.g. institutes'(Participant 2; Interview 3).

The respondent, however, further pointed out that this process requires time and effort, and relating to the rather fast-paced BTG initiatives, concluded that

'this is more of slow-date them then speed date them' (Participant 2; Interview 3).

Indeed, on many occasions respondents pointed out that engaging partners, building fit and developing trust required time rather than being hot-housed or engineered, as will be further discussed in the following sections.

Personal engagement was often linked to, on the one hand, personal development and satisfaction individuals could derive from the inter-CoP collaboration and, on the other hand, the willingness to channel more effort into these types of engagements. As one of the participants explained,

'true cross-disciplinary work is where there is synergy between the two areas and the fact that you are collaborating with somebody from other disciplines is inspiring you to see things in different perspectives and come up with new ideas in your own domain. And this is essential. Otherwise you just become a service subject that does development of systems for other disciplines and that's not the point…' (Participant 22; Interview 24).

Furthermore, as another participant pointed out during an event:

'this [IDR] can be often achieved 'on Saturdays' if there is willingness to work together' (Event 15; unidentified participant).

Hence, the above results affirm the role of personal engagements, satisfaction, stimulation and excitement related to this type of collaborative work (c.f. Knight and Pettigrew 2007; Bruce et al 2004; Beaver 2001) as one of the drivers of interdisciplinary research. Furthermore, the results indicate that the level of personal engagement of individuals could

potentially indicate the difference between multi- and inter-disciplinary research projects – one of the aspects remaining largely unanswered in the extant literature (Aboelela et al 2007; Aram 2004; Klein 1990).

At a higher level of aggregation, the willingness and ability of individuals from a CoP to engage in IDR was compared by one of the respondents to the technology adoption model with leaders, early adopters and followers, thus indicating that the willingness and ability to engage in inter-CoP interactions by individuals can be dependent on the CoP they belong to, and the levels of support and recognition offered by the CoP. Hence, the existing worldviews and attitudes shared by the CoP members can be related to their success in engaging in inter-CoP collaborations.

Accommodating

Accommodating, as already indicated in the earlier discussion, is closely linked to the practices of *investigating fit* and *developing a research question*. For example, on some occasions individuals made an extra effort to ensure that their presentations are comprehensible to all the participants. However, in some of the events the rather negative process of over-accommodating has been observed, often leading to research proposals characterised by lack of a clear focus or ownership and bad fit between disciplines or individuals. When asked about one of the failed attempts to develop an IDR proposal, one of the respondents explained:

> *'I think it was to try and accommodate everyone's agenda in the group. There was no real, clear direction on where the project should be and I have to say, with the collaborations I had in the past, which had been successful, were really driven by one person: 'this is my*

idea, this is what I want to do – what I need are people from A, B and C' (Participant 20; Interview 21).

At another level, accommodating often required some additional flexibility from individuals, as interdisciplinary research often significantly differed in the way it was conducted from the way individuals normally worked. For example, developing a methodology or collecting data often required considering multiple perspectives. One of the observed groups spent a significant amount of time and energy on negotiating what the relevant data would be, and how it should be collected, to accommodate the perspectives of all the participants. At some point of the negotiations, the group agreed to include additional items in the research design, justifying the decision as '*we can always delete them later*'. However, at that stage it seemed important for the integrity of the group to include the additional items, although it was not certain if these would add value to the results. On another occasion, a participant from a successful time-honoured inter-CoP group pointed out that, although the group tried to accommodate all the perspectives at the design stage, they still run into some problems later, when individuals embarked on the analysis of data and results development. As they explained:

'Because you bring to the table a case study – the data was collected for me and I find it interesting but then, of course, they have other questions that they would like to know and the data is not there' (Participant 16; Interview 17).

Logically, certain levels of accommodating can help to engage individuals in the project, however, the skill of ensuring that all the necessary aspects are included, and at the same time being able to avoid the issue of over-accommodating, can be rather difficult and may require some experience in order to develop a level of mastery in the practice.

Developing communication and listening (ability to listen)

Communication problems are probably the most often mentioned obstacle to IDR projects in the extant literature (Sutherland Olsen 2009; Fay et al 2006; Lawrence and Després 2004; Lattuca 2002; Frost and Jean 2003; Duncker 2001), with Zahra and Newey (2009) further noting that IDR often requires certain set of skills in cross-field communication. Unsurprisingly then, communication problems were observed in the majority of the events in this research, with varying levels of intensity. Different teams adopted different ways to develop communication, displaying different ways of understanding the problem. However, the majority of the participants were aware that developing communication, or a shared symbolic repertoire, is time consuming and could easily become a project in its own right (Duncker 2001). For example, one of the observed groups spent a significant part of the meeting explaining what the word 'planning' meant in each of the disciplines involved, and consequently discovering that even 'common language' and simple words often conceal divergent assumptions and meanings (Burch and Grove 1999). Indeed, reflecting upon some of the events, one of the participants noted that:

'in order to establish good working collaborations the first stage is to try to understand the language that each of them use for the same things – or perhaps for different things. And I think it can take quite a long time before you understand where the gaps in use of language can lie. And sometimes the very short, intense periods – like the RP event – can fail to give sufficient scale for actually overcoming these weaknesses. Because the events are very fast and you trying to achieve some kind of objectives very quickly there is a tendency for both parties to use the language that they are familiar with and if there is intersection in that language, that intersection can actually be assumed by both sides to be a common understanding. Whereas actually it's only in trying to develop details later is

when you actually can understand that the use of the language is not common – it looked as it was common but in fact it's quite distinct' (Participant 8; Interview 9).

However, the practice of communicating and listening was often simpler to advocate than accomplish, as trying to discard the embedded meanings of words can be rather challenging and require some levels of reflection, as explained by one of the participants engaged in the aforementioned process of negotiating the meaning of the word 'planning':

'The problem is that when I use planning I'm going to carry on using what I mean by it – even if you tell me what you mean by it all it means is that I understand that you have a different interpretation of the word but it's not going to change the way I use it because it's too embedded in my everyday work. So the best that we can hope for is that I realise that when I use the word planning it's not going to mean the same thing that it means to you. But it's not going to be easy for me to overcome that gap of the use of the word – just by explaining what it means by the word. Somehow you've got to connect what you mean by planning to something that the other person understands and has some different terms for – or can construct new set of terms for it. So it's not enough to tell you what I mean by planning – you've got to understand it in concrete terms by seeing how it applies to a problem' (Participant 8; Interview 9).

Hence, developing communication and shared meaning goes deeper than just acknowledging the differences and often requires prolonged awareness, reflection and ability to discard one's own meanings of different terms. Furthermore, developing communication is often closely linked to listening, as pointed out by another respondent by noting that:

'being able to listen fully and not automatically assert your ontology'(El. Comm.related to collated responses to Online Survey; participant unidentified)

could determine the success of an IDR project. Somehow similarly another participant linked successful collaborative research to:

> *'An ability to listen to and invest in understanding alternative perspectives (without becoming an expert in the other areas); a willingness to question one's own assumptions in relation to those of others - including assumptions related to theory, objectives of research itself, methods, etc'* *(El. Comm.related to collated responses to Online Survey; participant unidentified).*

Consequently, developing communication can challenge beliefs and worldviews of individuals working in an inter-CoP context, as it often requires development of awareness of the habits and corporate schemata of home CoPs (Gherardi, Nicolini and Odella 1998: 276) and developing new ways of '*talking and reading each other*' (Aanestad et al 2003: 5) in the context of inter-CoP collaborations. As a result of this situated learning related to inter-CoP collaborations (disciplinary) identities of individuals can be challenged, as indicated by Roan and Rooney (2006: 433-434).

In many of the observed events the use of diagrams, simplifications, metaphors and synonyms formed an integral part of the process of developing communication, resonating with the use of boundary objects discussed in the extant literature (Amin and Roberts 2008; Carlile 2002; Fischer 2001). Another technique suggested by one of the participants was to use previous, already solved problems to explain what the core of the problem was, how the problem was understood by the discipline and how it was solved. This exercise was believed

> *'to make much more concrete the way in which the two sides are using language'* *(Participant 8; Interview 9).*

The respondent further explained the concept:

'if I come to you and say – here's a real problem, here's a problem that you can understand the structure to, and when I say I've got a solution to it I mean that I will apply these techniques that I call planning and that is how I will solve the problem. Then you can say right, whatever you call it – planning or whatever else – I understand what that process is, what these techniques are. What the thing is that you use planning to' (Participant 8; Interview 9).

Hence, rather than dwelling on the issues of language, the responded suggested some techniques to focus on developing understanding of the practices of the partner CoPs. In tackling the existing problems, whilst also learning which solutions from other CoPs worked.

Finally, one of the departments, which contained individuals from a number of different disciplines, formalised the practice of developing communication by establishing a regular events to facilitate development of communication, as described in the following example:

'Sharing common language is an issue – sometimes we work in 10 different areas. We have a workshop to help to understand each other". In an organised Away Day they can develop shared understanding and ways to work together across disciplinary boundaries' (Event 22; Participant 17),

hence, resembling to some extent a form of situated curriculum (c.f. Gherardi 1998).

Building fit

Linking closely to, and often overlapping with, the previously discussed practices of *accommodating*, *engaging*, *developing communication* and *investigating fit*, *building fit* reflects a range of techniques in which the focus is on developing understanding between partners, their tools and worldviews. In other words making sure not only there is good fit,

but also it continues along the way of the progressing collaborative engagement. To a large extent building fit resonates with the notions of practice understood as meaning being constantly negotiated by the (dynamic) community (Wenger 1998) who achieve active being in that community through continuous learning and adapting (Bjørkeng, Clegg and Pitsis 2009). Furthermore, the observed practices of building fit displayed some commonalities with the processes of authoring boundaries (Bjørkeng, Clegg and Pitsis 2009). However, due to the emergent nature of the community in this research, the process often differed. Furthermore, four more specific practices have been identified within the *building fit* practice, as depicted earlier in Figure 15, and further elaborated in Table 12.

The task of achieving fit between members and CoPs was hardly ever easy and straightforward. Instead, on a number of occasions interdisciplinary teams found themselves at a dead end, with little fit between the expertise brought by different CoPs. This was associated with a need for some more pro-active engagement directed at improving the fit and leading to the development of more integrative research problems. One of the respondents, being frustrated with the continuous poor fit between disciplines, proposed a series of initiatives, including seminars and cross-reading and cross-researching the field (i.e. engaging with literature from fields other then the native field of the member). As he elaborated the idea:

> *'I would volunteer to give a two hour talk on some questions and the paper should be selected by [name1] or [name2] [leaders of the project], for example. In this topic there is a lot of interest in optimisation questions; they do not know how to handle them. They have read this type of method, that type of method. Please, read through and tell us, according to your knowledge, whether this is important or not, whether there are better solutions etc. And in that case, if we had seminars, let's say 3 months – that is 6 talks, then we should*

have 6 volunteers who will read 1,2,3 unrelated papers and give a talk. I believe that those 6 people would like to attend, volunteer to give talk, they would easily collect the information. You know, try to read 5 papers - it would take you 10 days, a month. So it is a large effort. But if you in return, you understood 25 more… And in this case it means that the nice part of the topic will be covered not on high level but more deeply. And then with technical keywords, we can write up a proposal. Currently our proposals are all at a very general level' (Participant 33; Interview 37).

The idea of deeper engagement and actively ensuring the development of good fit surfaced in a number of observed events. Another group considered having a database of interesting papers, each of which should contain

'a short memo as why it is interesting / important - not an abstract but a note prepared by the group member who thinks the paper is important for the group – how it relates to the project' (Event 40; Participant 33).

Additionally, the group discussed the idea of having a series of regular seminars

'to explain problems and present outlines of the different fields' (Event 40; Participant 33)

during which, instead of using slides, the group should have discussions and use flipcharts to encourage more in-depth discussion between the members. Furthermore, as he pointed out, this would be a good exercise for all the group members to gain a better insight into the technical aspects of the project and all the involved fields.

These kind of engagements focused on building fit was a main driver of one of the observed groups, which, as a result of the prolonged and focused exercise, ended up with completely

different set of ideas and approaches than those they began the project with. As one of the participants explained:

> *'during the workshops we identified something we didn't know before. You know – [name1] proposed his problem and [name2] proposed his problem – we didn't know how to do it yet. When we went to the detail it seemed different from what we thought it would be – we made a number of assumptions first (...) But it was quite nice to discuss and identify new challenges for [my discipline] and potential use of [my discipline]'* *(Participant 37; Interview 42).*

Finally the group alluded to above, but also other observed groups,

> *'ended up with several lines of research and none of them is on the topic we started with' (Participant 25; Interview 27),*

and hence through devoting enough time and effort to building better fit opened up a range of new opportunities. Thus, the practice itself can often translate into further opportunities and better integration between the different CoPs involved in the process. On the other hand, a lack of the practice can potentially yield results that are of lower value as they are likely based on misfit and just the application of existing tools in a new context. As a result, one of the participants mused over the idea that the support offered by the BTG project should possibly be related to the practice of building fit, as explained below:

> *' it could be a good idea that, first, to be efficient in information collecting, and I can even think about some sort of stimulation – all right, there are 5 people who are working in this seminar-basis for 3 months, and after that if you produce a research review or research paper – then have support from BTG. You arrive to a stage that you need support. Now we can support you-and now you write your proposal.'* *(Participant 33; Interview 37).*

Hence, as the idea above indicates, participants could see the benefit and importance of building fit and could even see it as institutionalised practice that all groups need to adopt.

However, the process of building fit can also be quite challenging to participants, their beliefs, worldviews, and the conceptual boundaries of their native CoPs. As one of the participants explained, by looking at the case from different perspectives, some of the approaches may negate beliefs and tools adopted by one of the CoPs. This can further lead to individuals challenging the epistemological boundaries of their native CoPs in the future. In other cases individuals might just retreat from the collaboration.

Although some techniques and approaches have already been discussed in the practice of *developing fit*, four additional practices of *clarifying*, *posing (stupid) questions*, *negotiating* and *compromising* were identified in this group as prominent in the IDR context.

Clarifying and Posing (stupid) questions

The process of building fit, and hence understanding, between the involved CoPs was usually riddled with assumptions, misconceptions and misunderstandings between the members. Hence, constantly clarifying and ensuring that there was understanding of the various perspectives played an important role in some of the observed examples.

As a part of building fit, clarifying played an important role in ensuring that participants understand each other's perspectives and can build upon the shared understanding. It often required adopting some of the earlier discussed practices related to developing communication, such as up-framing or unpacking the problem. However, these were often triggered by individuals who were not sure if they correctly understood their partners, and

hence they engaged in the practice of clarifying different aspects of the project. For example, the following illustration describes how clarifying and questioning can lead to a better understanding, but also instigate new, often inter-CoP specific, ways of presenting a problem by participants:

> *'I did not understand his first model so I went to him and said 'look [name], I have no background in this level of chemistry. Explain to me why this is the simplest model you are claiming'. And he started explaining to me why this is the simplest model, and once I was asking questions, he says 'well, this is not the simplest model actually'. I was doing nothing – I was just asking questions and I was hoping that I would understand. It took us about 2 hours. But finally he came up with a very very simplified model.'* *(Participant 33; Interview 37)*

The new, simplified model helped the whole group to grasp the concept and, as a result, develop a research question. Furthermore, as later indicated by the presenter, this incident helped them to better understand the assumptions associated with their native CoP and, finally, helped them to further develop the skill of presenting to inter-CoP audiences.

Asking for clarifications closely relates to the second practice of *posing (stupid) questions*. As highlighted by some respondents, this practice is necessary to ensure there are no misunderstandings or preconceptions. As one of the respondents, explained:

> *'you need to ask simple questions people from other disciplines. If there is a presentation and a statement that I didn't understand – I want to understand it. I want to know what they mean. So I ask, I want to ask. But students here – they are just too used to letting the statements go over their heads – even if they don't understand.*
>
> *It's a part of the culture – how willing you are to get to know, to push the boundaries.*

In the US it's more engrained in the institutions, it's a complex network of activities and attitudes. In here it's much more patchy – there are some people who do it but much less then in the US or Europe.' (Participant 14; Interview 15).

Although this might seem a logical and natural activity in any research setting, the example above suggests that it is not always the case. Furthermore, in the context of IDR, questioning can take on a completely new dimension and has been recognised as an important skill. Indeed, as one of the participants noted,

'[name]'s skills are non-trivial. It is unusual to ask questions like that' (Participant 14; Interview 15),

Indeed, as often observed during the research, asking questions that, on the surface appeared simple, often lead to the greater understanding and integration between members, and consequently, lead to better results. However, as simple this may sound, it often proved to be rather challenging for many participants. Partly because of the aforementioned egos of research staff (Amin and Roberts 2008), which often lead to unwillingness to ask what may seem as naïve questions. Indeed, as one of the respondents noted,

'you won't ask a simplistic question to somebody from other discipline not to sound stupid' (Participant 14; Interview 15).

This can be related to the fact that admitting to not understanding the other field may be pushing individuals out of their comfort zones. The paradox is best explained by the following description from a participant who tried to instil this healthy practice among students:

'I tried to get this message to them about asking stupid questions and smart questions. I told them that if you ask a smart question, you probably know the answer to already, then

it's pointless. It's just showing off. It's like an exercise for fun. Students didn't buy this argument – they feel uncomfortable to look dumb. (...) This ability also applies to senior people to admit they are wrong'(Participant 14; Interview 15).

The respondent further perceived this ability as being a prerequisite to having open and productive discussions about research and ideas.

Negotiating and Compromising

Whilst building fit, many of the inter-disciplinary and inter-departmental groups often arrived at the point where different methodological approaches, epistemological stances and values seemed to be incompatible or incommensurable. At one level, *negotiating* related to deciding on the technical aspects of the research, such as: what data should be gathered and why; what methods should be used in the IDR project (e.g. sample size or use of questionnaire rather than focus group); or what should be the procedures for doing certain things (e.g. what details should be included on lab bottles used between technicians from different disciplines). This closely resonates with the notion of developing practices through *negotiating competencies* (i.e. co-constructing norms outlining competence); *authoring boundaries* (i.e. which of the activities should be part of legitimate practice) and *adapting materiality* (i.e. negotiating the meaning and place of artefacts) as proposed by Bjørkeng, Clegg and Pitsis (2009). However, these ongoing negotiations often lead to tensions, and some compromising was usually necessary, as described in the following example:

Discussion about involving more than 50 employees in the research. [name1] comments that comparison would be very difficult as they are very different groups.

[name2] explains the idea of control group and how it works.

[name1] suggests comparison of different groups of older workers only. She further goes into the diversity of the groups, issues involved etc. She also points out that there is a 'need to decide what we mean by older'

[name2] fifty plus?

[name1]: can you justify it?

[name2]: Can't – but why would you?

At that point [name 3] asks [name1] if we should look at 50-60, 60-70, etc? *(Event 32; Multiple participants)*

The process of negotiating the sample values, methods and approaches formed a significant part of the whole procedure of developing a formal research proposal, with all the members having to compromise some of their beliefs in these aspects of the research. After a series of discussions, the group managed to arrive at some compromise that accommodated the needs and beliefs of most of the members, as well as reaching consensus about legitimate approaches and activities. Another interesting aspect of negotiating and compromising in the context of IDR was the observed preference for wider approaches that accommodated more aspects, and often offered the flexibility to discard some of them at later stages.

Maintaining practices

This category includes practices aimed at ensuring sustainability, reproduction and health of collaborative projects and teams. Collaborative relations are well known to be challenging and difficult to maintain (Huxham and Vangen 2005) even before significant epistemic differences are added to the equation. With the added complexity of multidisciplinary backgrounds of partners and the consequent mix of often incommensurable perspectives, paradigms and worldviews (Zahra and Newey 2009) the chances of arbitrariness and

scepticism (Jeffrey 2001) further increase, potentially leading to collaborative inertia (Huxham and Vangen 2005). However, the results indicate that participant groups often adopted a range of practices to aid the development of collaborative engagements.

The following maintaining practices were identified: *cultivating, providing focus*, *project tasking*, *ensuring procedural justice, visiting partners' location* and, finally, *disengaging* and are discussed in the following section.

Cultivating

The first of practices in this group relates to the process of developing successful interdisciplinary teams, often displaying high levels of integration and fit between involved disciplines. A number of respondents, when reflecting on their established interdisciplinary research relationships, pointed out that these have usually grown slowly over time and are based on personal engagement, trust and good understanding between partners. At the same time, many of the BTG initiatives were criticised as being too focused on delivering a quick result, and as a result often sacrificing the development of trust and understanding between partners. As one of the respondents explained:

> *'I think one of the great challenges is to make collaboration from meeting like RP emerge in a natural way – in a way that's really convincing rather then hot-housed. The best collaborations in my mind are those that developed over time because of mutual interest that in a way are shaped and focused. Trying to force collaboration very quickly and in very short times is very brittle. (...) Whereas the collaborations that have worked have involved people coming here or me going there, spending some time just talking about it – not having just this very very fast, rapid burn interaction – but having a slower, measured*

process of trying to identify what are the things that really interest each of us that we can both contribute to' (Participant 8; Interview 9).

Hence, as the example above indicates, investigating and developing fit often require time to grow to fullness. Another respondent, reflecting upon the collaborative link with colleagues from two other disciplines, linked their success to devoting a small, but constant, amount of time and effort to nurturing the relationship over a prolonged period. As they explained:

'So I think at initial stages people are going to give a small percentage of their effort… I mean that's fine if it starts then gaining momentum and the progressively people give more and more effort to the big collaborative project. But with that small bit of time it's easily forgotten. What you have to do I suppose is make sure that it is gaining people's 5% of research energy and that does not slip down to zero because that's going to be easy – from 5% to 0…

But I think that's why the [collaboration] is an example of something that was small, 5% - but we meet regularly, there would be a coffee, somebody would bring a cake or something. It was that small things, things that keep things going – so it becomes a bit more sociable as well rather then – because if it's just a research you may think 'Jesus, it's not going to pay off for a year or two'' (Participant 16; Interview 17).

Indeed, the notion of slower development based on trust and getting to really know and understand the perspectives and tools of partners was often argued to contribute to the success of collaborative engagements. On the other hand, *hothousing* or *engineering* relationships were criticised as often bearing brittle fruits and leading to misaligned fit and relationships resembling projects based on cooperation, rather than collaboration.

Providing focus and project tasking

In some of the observed groups, especially those suffering from attempts to over-accommodate, a lack of focus seemed to be a real problem, often leading to projects that did not have clear direction or ownership. Indeed, interdisciplinary projects appear to be more prone to this problem, and often require a stronger focus to deliver results. As described by one of the respondents reflecting on a past project that did not finally deliver results:

> *'I think we didn't have a goal in mind – we had people who had the willingness to work together, desire to work together. And I guess the problem with multidisciplinarity is that you need a focus. To sit down and discuss' (Participant 16; Interview 17).*

Many of the participants in BTG events seemed to expect a strong focus and a well-defined problem to drive the projects, often looking to problem owners or potential Principle Investigators to provide clear direction and assign roles in the project, as explained by another respondent:

> *'So what I learnt from this was that maybe that if you have a clear direction from the top then the project can work actually quite well. But you really do need one person who is going to drive it forward, take the responsibility for it, has a very clear idea what everybody's role is and how they fit together' (Participant 20; Interview 21).*

However, that would be difficult in discussions that are more exploratory in character, as there was no clear idea and the meetings were devoted to investigate fit but also develop potential research directions. In these situations what often proved to work well was somebody taking the role of moderator to keep some focus within the evolving discussion. As one of the respondents explained,

'It really needs a sort of moderators to… sort of direct discussions, conversations but you cannot come up with a solution. The discussions were sort of drifting. Of course the problem was because people are not familiar with each other's areas so they need sort of discussions to understand the question, and what they talking about. But in general I think it needs more effective moderation' *(Participant 26; Interview 29).*

Interestingly, in some of the groups the moderating role was emergently filled by some of the members who were more experienced in IDR. Another aspect of effective moderation of discussion related to members who skilfully kept clarifying and posing questions that helped the group to develop more focused direction for potential research projects.

In some situations the availability of funding facilitated more focused exploration and provided direction to some of the groups that were already collaborating. As one member explained:

'for about 6 months we were talking and discussing ideas'

however, as soon as they got to know that:

'there would be a pot of money to compete for (…) we started shaping our ideas into something that would be able to kind of compete for the BTG pot of money' *(Participant 5; Interview 6).*

As a result, the group won one of the competitions and was awarded some 'pump-priming' funds to further develop their ideas.

Providing focus closely links to delegating tasks and efficiently managing and organising IDR projects. The role of the PI was not only to delegate tasks, but also more importantly, to have enough trust in participants' capabilities and let them do the best they thought would be

for the project. Hence, recognising the competencies of partners plays an important role in IDR projects. As explained by one of the participants:

> *'the way we work is important. We have clear responsibilities which are complementary. They don't overlap. There is a clear remit, division of tasks. I can't do what David does and he can't – well, he probably can but then I can do it so it's easier that way. And it works'* *(Participant 2; Interview 3).*

However, a complete lack of management and delegation of tasks can be detrimental to the success of IDR projects, as described by another respondent:

> *'I'm aware, I know from my own experience I have known a number of interdisciplinary ventures which have collapsed miserably because nobody knows who was in charge or everybody assumes that other people are doing the work and so on. So it's a great idea but there have been occasions, in my personal view, that I felt that I'd be better off doing it myself'* *(Participant 17; Interview 18).*

Tasks do not necessarily need to be explicitly assigned. What seems to be more important is the clarity and understanding of the task division, but also respect and recognition for others' capabilities and expertise – features that to some extent resonate with the internal workings of CoPs (c.f. Lave and Wenger 1991).

Ensuring procedural justice

Ensuring procedural justice, closely linked to the previous two practices, relates to managing of inter-CoP projects in a just and trustworthy manner. Indeed, whether at the planning or execution stage of the project, this seemed to be an important factor affecting the development and results of the collaborative project, and often the potential for future engagements too. In cases when collaboration was based on personal links, trust and

participants having good rapport, procedural justice naturally formed part of the project's *modus operandi*.

However, things were not always so smooth in less established teams with weaker personal links. Some of the participants preferred to formally establish some rules – especially those linked to responsibilities and issues related to authorship or recognition and rewards – at the outset of the project in a form of contract, as advocated by Boni, Weingart and Evenson (2009). Indeed, in the context of academic collaborations the issue of joint publications seems to be well recognised in the literature (Pettigrew and Knight 2007; Gooch 2005; Neiman 1999), and further identified in this research as one of the potential items to cause grievance, as different disciplines may have various rules. In conjunction with the lack of procedural justice, the problem may escalate to gargantuan levels, as in the following example:

> *'I have a rule for authorship: the most involved person goes first, the corresponding author with a star at the end. So the guy was first, then some more researchers afterwards – with the biology guys in. But then I send it to the biology guys and these three Russian names appeared – they were not even working in Durham at the time. I asked my boss but he was just saying 'just do it'. I thought it wasn't right. So I rewrote the paper a bit, put my name first, the crystallographer at the end as corresponding author, and then all the names of authors, the Russians, all the technicians, admin staff – anyone who did have something to do with the results. Even the guy who ordered a component for us. It looked like a football team. I did that and sent it back to the biology guys – and they just asked what was that all about. I told them that it goes like that or with real authors only' (Participant 23; Interview 25).*

Hence, as the example suggests, inter-CoP collaborations can fall prey to damaging free-riding. Although the participant from the example above decided to engage again in interdisciplinary projects, they became more cautious and driven by *ensuring procedural justice*.

Other participants found inter-CoP engagements challenging due to the differences in regular work practices between different CoPs, leaving them with rather negative feelings towards collaborative work. As pointed out by one of the respondents:

> *'collaboration with theorists may be difficult and frustrating: I did work on a project before and I felt like I was doing all the work: they just developed the theory and it was up to me to find an application for it etc' (Participant 4; Interview 5).*

In another example, a participant vented his frustration with other participants who, as he pointed out were:

> *'impossible to work with; They are always together and trying to be in all groups; even though they were fiercely opposed to our idea at the sandpit – now they are trying to get their names on the proposal!' (Event 32; Participant 45).*

On the other hand, he realised that although somebody may have an opposite view and perspective, it was important to keep one's integrity. Whilst talking about another participant of the same group, they noted that:

> *'with [name] it was completely different – he criticised our approach and did his own – without trying to get involved afterwards when the idea was taking shape'. As a result, they suggested some changes for the future events to ensure that there is 'no running between groups and trying to stick fingers in each of them' (Event 32; Participant 45).*

Visiting partners' location

Visiting partners' location was mentioned by the participants on a number of occasions as one of the techniques to develop better understanding of partners' practices and perspectives, build trust and consequently develop better fit between the two CoPs. For a number of participants this became fundamental part of their regular practices of working across CoP boundaries. As one of the respondents highlighted:

> *'if you are working with something like submarines or nuclear industry – or one of those high consequence industries - you have to know it in some detail. And the only way to do that is to get some hands-on experience. The nuclear [industry project] was the best thing when we worked in the plant. But we did pay visits to 8 different plants. We spent a lot of time in nuclear power plants' (Participant 17; Interview 18).*

Indeed, reciprocal visits (Janowicz-Panjaitan and Noordhaven 2008) have been recognised as a way of learning in inter-CoP contexts, aiding the understanding of perspectives, languages and ways of working of potential partners and thus underpinning the possibility of creating rapport.

Disengaging

The last practice in this group relates to the process of disengaging from inter-CoP collaborations. As already alluded to, not all the engagements always lead to a 'happy ending' and, whether due to the lack of procedural justice, as a result of over-accommodation or a lack of fit, some interdisciplinary relationships required dissolution or the exclusion of some of the members. Interestingly, disengaging might have been used to ensure procedural justice or as the only means to continue the collaborative project – but

with a different configuration of partners. Hence, disengaging unsuitable partners often helped to maintain the continuity of the project and the rest of the team. The majority of the respondents further displayed an awareness that despite the fact that the collaboration was not going anywhere, a certain amount of tactfulness and diplomacy was often necessary to disengage from the inconvenient alliance, as explained by one of the respondents below:

> *'I might have made quite a few mistakes – there are quite a few people I might have wrongly identified as a real expert and realised after the collaboration is under way that they clearly don't know as much as… [what did you do then?] well, I can't just say 'go away, I realised you are…' we continue whatever is committed and then quietly…' (Participant 25; Interview 28).*

In some of the examples disengaging was often proceeded by establishing new projects within a selection of partners, hence refining the fit – both disciplinary and personal – of the collaborative team. By relating to the metaphor of comparing inter-CoP engagements to gardening, disengaging seems to resemble pruning, trimming and weeding the collaborative seedbed.

Summary

As the essence of inter-CoP engagements relies on collaborative processes, the role of collaborative practices is difficult to overstate. As much has been written about collaboration in general (see Cropper et al 2008 for a substantial review), I have focused in this research mostly on inter-CoP specific practices rather than general collaborative practices. This is mirrored particularly in the sections above.

As already mentioned, some of the practices in this group overlap and link extensively, in particular the practices of *building fit*, *engaging* and *accommodating*. Although there are clear differences between these practices, they inevitably link to each other, often reinforcing and complementing each other. Figure 16 demonstrates some of the main overlaps between these particular collaborative practices, as discussed earlier.

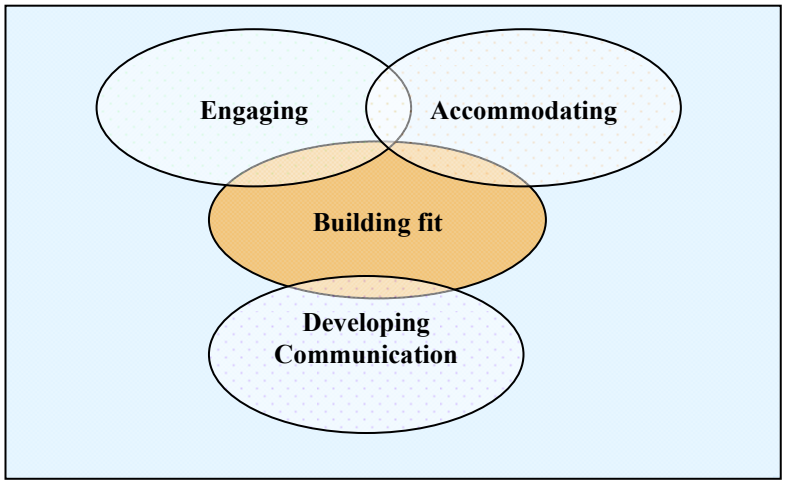

Figure 16: Reinforcing and complementary Collaborative Practices.

Of course, maintaining practices, not included in the figure, further play an important role in the following stages of developing a research collaboration. Another interesting aspect of the findings related to this group of practices is the need to skilfully maintain a fine balance between these practices. As already discussed, building fit, engaging and accommodating often teeters at the boundaries between over-accommodating (and consequently badly aligned groups and projects), superficial multidisciplinary consulting projects and frustration resulting from failed attempts to involve other disciplines. Furthermore, a lack of focus or procedural justice is likely to have detrimental effects on the future willingness and ability of individuals to engage in inter-CoP collaborative projects. Indeed, one could think of the remaining sour taste after a sip of spoilt wine.

REFLECTIVE PRACTICES

The next group of identified practices refers to the ability to reflect upon, and consequently change, the way individuals understand and approach inter-CoP engagements. One of the often observed dimensions of this links to recognising and further challenging limitations related to existing practices or structures. Many of the participants in the observed initiatives demonstrated high levels of reflectivity, questioning the ways their 'home' disciplines were operating and approaching problems, hence often their own ways of doing things including, for example, the ways of presenting to other CoPs discussed earlier. Indeed, in a manner not dissimilar to that described by Sutherland Olsen (2010), their experiences of developing different ways of communication often stimulated further reflection and permanent changes in the practices of individuals. In particular, reflective practices were significant in relation to instigating changes in attitudes, and the development of shared and sustainable practices that enable inter-CoP engagements. Table 13 presents details of the reflective practices identified in this research.

Reflective practices	Number of references	Number of sources
Pushing boundaries	11	10
Reflecting	11	8
Recognising limitation	68	35
recognising own limitations in research	13	11
recognising limitations of home CoP	18	16
Recognising competence	52	25
recognising disciplinary competence	18	14
recognising research competence	13	12
recognising IDR competence	34	20

Table 13: Break down of identified reflective practices.

Table 14 further provides characterisation of each of the practices in this group, subsequently developed in the following section.

Practice	Characterisation		Closely related to
	Activity	**Appreciation**	
Recognising limitations	Comparing one's own competences against the requirements of the problem and considering alternative resources	Realising that practices and knowledge of native CoP, or one's own, are limited	• reflecting • recognising competence • ensuring procedural justice
Reflecting	Consciously engaging in the process of analysing previous IDR experiences	Realising the benefits of reflective practice as a mode of learning	• recognising opportunities • re-presentational practices • recognising limitations • recognising competencies
Recognising competences	Taking notice of signals of competence in potential partners	Developing critical appreciation for expertise of other CoPs	• recognising limitations • disengaging • engaging • searching for connection • building fit
Pushing boundaries	Challenging established assumptions, practices and beliefs	Appreciation for alternative approaches	• recognising limitations • risk taking • recognising opportunities • reflecting

Table 14: Characterisation of Reflective Practices.

Reflecting

Reflecting as a practice was repeatedly observed during BTG events as well as being mentioned during interviews. Some of the respondents displayed high levels of reflection, often analysing their past IDR experiences and looking for better ways to do things next time. Indeed, as suggested by Fay (2006) and Wood (1999), changes in attitudes and acquiring interdisciplinary-related skills often involve some levels of reflexivity. The following example shows how one of the participants would intentionally look back at the previous meeting and question the clarity and efficacy of the presentations and discussions, consequently implementing changes in the following meeting but also trying to learn more about IDR:

Commenting on his own presentation during the first session [name] stated that his initial presentation wasn't clear. When asked if and how he would do it differently again, he confirmed that he would do it differently: 'but I don't quite know how I'd do it next time. Before the presentation I sat down and thought about the way to present the problem in an abstract way for the mathematicians. That lead to questions during the session and what maybe should be done differently. Maths wanted more science in the presentation. I missed out equations because a lot of them were obvious to experimentalist. But then they wanted to know them to understand how the model works' (Participant 25; Interview 27).

Similarly, in one of the examples presented in an earlier section, one of the respondents, after taking part in speed-networking and talking to somebody who was using too technical language, reflected upon their experience and changed the way he was presenting to interdisciplinary audiences.

These examples further confirm some of the findings of Sutherland Olsen (2009: 404), that interdisciplinary interaction '*is causing reflection, which might otherwise not have occurred*'. This reflection further lead to some more permanent changes in the way scientists presented their work.

In another dimension the practice took the form of individuals scrutinising and comparing how different participants engaged in IDR (e.g. the way of presenting to IDR audiences, discussion, asking stupid or enlightening questions), and subsequently adopting the practices that seemed to work the best, or, as described in the next example, criticising the lack of practices that might enable IDR:

'We have lots of collaborative issues at the moment. We are working with scientists who are very good at looking at details – but not so good at looking at the whole picture. It's

difficult sometimes to make them look at the whole and not only on the small detail' (Event 34; Participant 2).

This suggests two further important aspects of reflecting and inter-CoP practices. First, participants engaged in IDR are able to recognise and praise 'good' or efficient IDR practices (or, as often happened, criticise their lack) but also the particular participants possessing these practices. Hence, like in the example of wine-tasting (Gherardi 2009b), there seemed to be an emergent group of practitioners who were slowly acquiring and negotiating both the taste and the practice for savouring the particular form of conducting research. Second, as Geiger (2009) points out, conscious reflection can lead to systematic questioning of the emerging practices, leading to further refinement and legitimisation of practices, a notion further supported to some extent by the example provided by Bjørkeng, Clegg and Pitsis (2009). Hence, in this particular case, reflecting could lead to the normalisation of practices related to inter-CoP collaboration among the practitioners.

Furthermore, in at least one example reflection lead to a realisation of the benefits of engaging in IDR and consequently translated into encouraging and supporting the development of this type of network, and hence practices, within one of the CoPs. This is illustrated by the following example:

'Yeah. I'm making it seen as more conscious, as a given account of how was it in the process but I think this is like that. This is a story I'm telling with hindsight and at that time it was probably much more incremental and accidental but now I have really clear analysis of why this matters so much and why it's so important. And as I spend more time in the department trying to explain and persuade people of the case for them to develop

precisely this kind of network of collaborations, engagements – this sort of reservoir of social capital' (Participant 10; Interview 11).

Hence, reflecting upon one's own experiences and benefits of engaging in the practice can lead to further support for, and adaptations of, this practice within CoPs. Reflecting can further lead to recognising limitations – another practice identified in this category – as discussed below.

Recognising limitations

On a number of occasions reflection in the context of IDR lead to recognising limitations – be it personal research limitations or the boundaries of the home CoP in relation to addressing particular problems – and subsequently often to changes in attitudes towards IDR.

Recognising the limitations of one's own research capabilities is often the first step towards engaging in the exploration of a collaborative interdisciplinary mode of research, as the following reflection shows:

'as soon as I realised that my mathematical skills would not be up to tackling the problem I consulted some colleagues in maths, trying to find out who was the person to talk to' (Participant 10; Interview 11).

In some instances this realisation of one's own limitations can be rather revealing, as described by another participant, when asked how IDR affected his research practices:

'I mean, sometimes I come up and think 'oh my god – what I was doing was absolutely rubbish' (Participant 5; Interview 6).

Being exposed to working in an IDR context had a radical impact on the way they approached and researched the problem, resulting in the development of a new methodological approach. This example further illustrates the second facet of the practice – realising the limitations of the home CoP. This dimension is probably best illustrated by the following explanation from a participant describing a long term research relationship with colleagues from two other disciplines:

> *'I think we work together well because we all recognise that there are limitations in our disciplinary approaches and we see where those limitations are and where other disciplines can add another perspective or fill in something else that the particular discipline cannot explain or can't explain well' (Participant 5; Interview 6).*

And:

> *'In what we are doing here [name] is quite willing to acknowledge that there are limitations in probability modelling in a rational actor approach – in that the rational actor approach to risk does not account for the human factor and peoples' attitudes and beliefs' (Participant 5; Interview 6).*

Consequently, [name] engaged in discussions with other disciplines and together they integrated the human factor into the wider research methodology, thereby further developing the methodological toolsets of the involved disciplines. The two examples given above further confirm the notion that cross-boundary exchanges and relationships can contribute to the development of CoPs (Thompson 2005; Gherardi and Nicolini 2002; Brown and Duguid 1998), or disciplines (Weingart 2000).

On the other hand, a lack of recognition of limitations, whether one's own or disciplinary (although the two are of course often correlated), could inhibit potential collaborations and knowledge development, as in the following example:

'if he presents it as his problem and he has the solution, and even if I believe that I've got a solution that may be better, I wouldn't necessarily be racing to discuss it because that's where this sense of competitive interaction might be damaging. It's not necessarily going to work to go racing and saying 'actually, I think we've got better solution' because the natural reaction from the other side is often to think 'well, who are you to come and tell me how to solve my problem when I've got a solution on my own now I'm quite happy with'' *(Participant 8; Interview 9).*

There also seem to be a link between recognising limitations and the way of presenting a research problem, resonating with the way of asking questions: it appears that just like asking questions you already know the answer to, some individuals may engage in similar way in presenting problems, when they already know the answer. Furthermore, similarly to asking simple questions, recognising and admitting limitations can be challenging, especially in inter-CoP environment as pictured in the following example:

'Because you are naïve in the other discipline. So the problem is you obviously don't want to appear naïve in front of people for whom you are hoping to create the impression of being an expert. So that reduces the incentive to try to grasp the understanding of the other's person discipline because you don't want to expose your lack of knowledge – instead you want to focus where you are an expert' *(Participant 8; Interview 9).*

Recognising limitations can thus influence the successful propagation of the inter-CoP collaborations and, as already discussed, the spread of the 'good' practices among individuals. However, as the discussion above has indicated, the practice of *recognising limitations* often requires that individuals simultaneously recognise capabilities, or 'good' practices among potential partners.

Recognising Competences

Often related to the practice of *recognising limitations*, another reflective practice identified in the study relates to *recognising competencies*. Indeed, the ability to recognise limitations, whether one's own or those of the whole CoP, may further require the ability to recognise the capabilities of other CoPs or potential partners, if these limitations were to be addressed through inter-CoP collaboration. Furthermore, recognising competence, somewhat similarly to recognising opportunities, bears the hallmark of developing an appreciation for practices and knowledge that extends beyond the traditional canons of the native CoP. Competence in this category can further be divided into individual or disciplinary research competences and IDR competence, as discussed below.

The first two types, recognising disciplinary competence and individual research competence mean, in the simplest terms, that for IDR project to materialise the parties need to be able to recognise, but also develop respect for, the competencies of other CoPs or individuals. Since CoPs often display the tendency to seal themselves off from other professional CoPs and protect their practices and knowledge (Ferlie et al 2005), the awareness of what competencies other CoPs possess is often hindered. Indeed, the results of this study suggest that one of the main barriers to engagement with other disciplines was lack of knowledge about what and how other disciplines could contribute. Consequently, many of the BTG events first led to an increased awareness of competencies across different CoPs, which subsequently led to further research engagements. In other words, exposure to other CoPs in order to learn about offerings and realise the value of other disciplines or individuals, was often required. This was best described by one of the participants reflecting on one of the BTG events:

'I had no idea about Management Science and what they do. It would have probably never crossed my mind to go and talk to them – whereas after I spoke to [name1] and [name2] I see how we could work on the problem and where they fit' *(Participant 2; Interview 3).*

Learning about other CoPs and their competencies is one aspect of the above example, however, recognising their competencies is the real core that leads to further inter-CoP collaboration. This often proved to be a real problem as individuals were not sure where to look and how to find the real experts. One of the techniques involved the utilisation of their own network of colleagues to connect to potential and trusted partners. Other techniques observed in the research often involved the use of internet and search through publications for specific terms. The task was further complicated due to not understanding the practices, language or core knowledge of other CoPs, hence making it difficult to firstly, identify potential partners and secondly, to identify the real experts in the field. As some participants pointed out, even running a search through database for a term they think may be relevant is often challenging as the term they know is usually not specific enough, hence yielding either too many or irrelevant results. As the epistemic gap between disciplines grows, so does the difficulty to understand and recognise competencies, as explained by one of the participants:

'It's not easy to find a collaborator where you really understand each other in the interdisciplinary situations. In general we collaborate with mathematicians – because we have common language' *(Participant 37; Interview 42).*

He further pointed out that the range of collaborative engagements is limited by the knowledge about other disciplines and the (believed) competencies these disciplines possess. Indeed, the wider the epistemic gap the more challenging exploration for new knowledge can become (Nooteboom 2009).

Similarly, identifying the real experts in a certain field often proved to be a real challenge and required individuals to develop some techniques and evaluation systems. Although individuals were able to recognise their limitations and competence of other disciplines that could address these limitations, finding the right person(s) in the inter-disciplinary context often proved to be more difficult. As one of the participants describes:

> *'The most difficult thing is always to identify the real expert in the field you want to find an expert in. Because you don't know…the rule of thumb that I adopt is that you start talking to somebody who is possibly, or is thought to be, or certainly is working in that field, if they know all the answers I don't think they are the experts. They are the bullshitters… if they know some of the answers and then they sometimes say – that one is much more difficult, it's not really understood by anyone yet – then I'm much more likely to trust them…' (Participant 25; Interview 28)*

The participant added that:

> *'there are quite a few people I might have wrongly identified as a real expert and realised after the collaboration is under way that they clearly don't know as much' (Participant 37; Interview 42).*

On the one hand, this can not only affect the current collaboration but also discourage any future attempts of engaging in IDR. On the other hand, this kind of disappointment can also contribute to the refining of the practice through developing better ways to find the right partners with the right expertise.

The practice of recognising competencies displayed a wider meaning than just purely identifying and recognising research capabilities of individuals. In a number of cases the practice further translated into respect and trust, especially when the relative distance

between CoPs was greater. As one of the participants from an engineering department explained:

> *'Maths and engineers have a common language – we do a lot of maths in engineering. It's a bit more difficult with biology – but it's still science so after a bit of reading about the tissues and so on it's OK. But with statisticians – the stats stuff we do is far from them. Gets more difficult. Like the Bayesian stuff – I need to rely on [name1] and [name2] on that…'* *(Participant 2; Interview 3)*

On a number of occasions individuals recognised this necessary reliance on others to recognise competencies in IDR contexts. Furthermore, trust and respect for partners' competencies often lead to improved dynamics in the collaborative process. Indeed, a number of respondents linked recognising competencies to clearer divisions of tasks, enhanced levels of delegating and not interfering with the research practices of other CoPs, which, subsequently, had an impact on the structure and dynamics of IDR projects. As further explained by the participant:

> *'we have clear responsibilities which are complementary. They don't overlap. There is a clear remit, division of tasks. I can't do what [name] does and he can't – well, he probably can but then I can do it so it's easier that way'* *(Participant 2; Interview 3).*

Somewhat similarly, another respondent pointed out that the success of one of the IDR projects they were involved in rested on the fact that everybody, including the PI, trusted the expertise of the members and ensuring that '*people do their job and do it properly*'. This, however, often involved a period of building trust and understanding of the bodies of expertise, achieved through negotiating the final shape of the methods and techniques to be adopted in the research. Whether in relation to an individual or a discipline this proved to be an important factor in the process of collaboration and, in particular, the process of integrating different tools, approaches and methodologies. As long as the competencies were

recognised, there also seemed to be a much better chance for those tools and approaches to be accepted and adopted by the inter-CoP team. Hence, recognising competencies in the negotiations process was often the key to progress the IDR project.

In another case described by one of the participants where there was little, if any, recognition of research competencies, the research was riddled with tensions; participants were constantly discarding ideas or methods proposed by other disciplines as invalid; and project leaders constantly interfering and not allowing the team members to do their work at the best they could. Consequently, the project yielded little integration across CoPs and members were not willing to extend the collaboration as they recognised it was impossible to work with some of the partners, who did not recognise their competencies. Instead, after the original project came to a conclusion, a smaller team was formed and continued working together. As the participant of the smaller team explained:

> *' there are probably four people that will work together in various combinations. The good thing – these are quite strong collaborations now and we know each other's strengths and weaknesses and what they can contribute and what they can't contribute. We can work out the logistics – and again, working from the theoretical point of view rather than the 'lets get money, lets get publications point of view'. So the driving motivation would be science rather than the grant' (Participant 20; Interview 21).*

Not only did the members recognise their respective competencies but they also shared similar values that were motivating them to engage in IDR – an important aspect of any inter-CoP engagement. Indeed, as already implied in the earlier literature review, monetary and reward drivers behind IDR can often result in multidisciplinary rather than interdisciplinary engagements (Schummer 2004).

Recognising potential competencies can further have an impact on the way research problems are presented, and how widely the net is cast. For example, in one of the collaborative arenas, seeing how the potential research competencies in a music department could address some space research related problems seemed to lead to higher level of up-framing and a wider exploration.

The other dimension of *recognising competencies* related to recognising those competencies specific to engaging in or managing interdisciplinary projects. On a number of occasions individuals were branded by their colleagues as IDR-capable, often highlighting a number of IDR-related practices and skills that were valued by other participants. For example, as already mentioned earlier, one of the participants was praised for the ability to ask questions that allowed the group to move forward in discussions. As pointed out, these '*skills are non-trivial*' implying that they are both important for the success of inter-CoP interactions and are recognised by the participants. Similarly, as pointed out earlier, other participants recognised the capabilities of their colleagues to effectively present to interdisciplinary audiences as a '*nice skill*' and, consequently, embarked on developing these practices themselves.

At the same time, a lack of IDR capabilities was recognised as a negative aspect that often impaired potential collaborations, even though the research competency was recognised. As one of the participants explained:

> *'But these people who are working in the area are not particularly the people I would imagine working with – not people I can see an easy working relationship with…'* *(Participant 8; Interview 9)*

Similarly, another respondent pointed out that '*there are some* [individuals] *that can't collaborate – it's not insulting them but this is what they prefer*', further highlighting the

importance of recognising competencies in the success of propagation of inter-CoP interactions.

This competence was furthermore signified in relation to the role of Principal Investigators (PI) in interdisciplinary context, highlighting their pivotal role in ensuring that the experience of engaging in an IDR project was both productive and enjoyable for the participants. Interviewees often pointed out that the success of the previous IDR projects they were engaged in was, at least partly, due to certain IDR competencies of the PI. As explained by one of the participants, the PI's:

> *'role was crucial. He was crucial to the whole project. And he was quite good at what he did', further pointing out that 'he was smart enough to realise that whilst keeping an eye on the overall project he needed to let people do their job and do it properly' (Participant 20; Interview 21),*

hence highlighting the importance of recognising competencies in an IDR setting. In another example, a PI that did not recognise the capabilities of the team, lead to rather sour memories for one of the participants:

> *'The PI was a control freak – everything needed to go through him. He would not delegate anything. I asked him if he wanted me to do some of the admin job – it wouldn't add any extra workload to me – but he wouldn't let it go. Everything needed to go through him' (Participant 23; Interview 25).*

The group dismantled and the respondent pointed out that they will never consider working with the particular individual again on a collaborative project.

IDR capability has also been recognised as an important factor in identifying panellists, reviewers and editors for IDR proposals, projects or papers. This capability has been

recognised at the levels of funding councils, universities and separate initiatives such as BTG. While it was regarded to be a challenge to identify the 'right' people, there was widespread recognition of the importance of finding these people with appropriate IDR competencies, as portrayed in the following example:

> *[name] mentioned that some of the problems for IDR proposals EPSRC has got is identifying the right 'referees who won't destroy the bids by being too focused on their own field'. He mentioned using some collaborative courses to address this problem' (Event 3; Participant 30).*

Another respondent further pointed out that:

> *'You need an examiner that would understand it [IDR] – it's not easy because they want novelty in one field and in the interdisciplinary PhDs can see it as recycling what's known already' (Participant 31; Interview 34).*

One of the techniques adopted to overcome these problems was to appoint a panel of reviewers, as explained by one of the respondents:

> *'the problem is to identify the right referee. Sometimes, after the referee, we recommend a panel because there wasn't understanding of the problem'(Event 3; Participant 30).*

However, for a panel to be effective, individuals need to be able to recognise the competencies of the researchers as well as the value of the inter-CoP ideas. A lack of shared appreciation for inter-CoP collaborations, paired with a deficiency of recognition of competencies in other CoPs could have detrimental effects. The following observation from one of the events, reported by one of the participants, vividly pictures the damaging nature lack of recognition for competence of other disciplines, or individuals, can have:

there were some quarrels and misunderstandings –somebody from engineering dept (high rank) calling other research 'non science'. From the conversation it appears that there were some real tensions and some highly regarded people in one discipline were rather unable to objectively judge proposals from other disciplines' (Event 13; reported by Participant 9).

One of the participants of that meeting further pointed out that

'most of the people on that meeting were unsuitable to deal with IDR proposals' (Event 13; reported by Participant 9).

The process of developing and negotiating the practice of recognising competencies by members was also witnessed during some of the meetings devoted to the evaluation of IDR proposals or selecting panellists for IDR events. Participants engaged in long conversations and negotiations about particular individuals' abilities to engage or evaluate IDR projects, slowly building a shared understanding and a profile of IDR-capable individuals. The following extract from one of the observations portrays how the group negotiated who should be involved in the evaluation of some IDR proposals related to another initiative:

Discussion around who should / shouldn't be a judge. One of the concerns was if the person would have sufficient experience and a broad view to judge IDR proposals. There was some concern about who is capable and who is expected to be involved. Some options discussed:

- *Candidate1 – as last year's winner 'he has got experience in both writing and doing IDR'.*
- *Candidate2 (if agrees): as he deals with IDR and BTG he should be able to do that? All agree that they is capable and would make a good panellist*

- *Candidate3: [name1] and [name2] grimacing... NO. The group agrees they would not be a good choice. There is not even need for discussion about this choice. Clear NO. [would that be because he is rather too focused on engineering and that may be not good for social science proposals? Fallout from the previous engagement which was a disaster? Follow up on that with [name2]]*
- *Candidate4: [name1] points out that they definitely have 'wide enough knowledge to do that' both in terms of wide expertise in overlapping with many fields but also knows how to deal with IDR as was involved in a number of initiatives before and always played a central role in the process. Group seems to be pleased and agrees that they should be a good choice and capable to evaluate IDR proposals without being too sided*
- *Candidate5: obvious reasons of being involved in BTG and having experience in understanding / doing IDR. No comments or discussion. YES.*
- *Candidate6: comment that 2 members from the same department may be too much…NO – on the basis of keeping the balance right. Although the group found [name3] to be capable to act as a judge for IDR proposals. (Event 24; quotes from various participants).*

There were also some comments that whoever would be chosen, from whichever department, would have bias and personal interest in voting for the home discipline - a problem often recognised during the meetings. The choices were focused on individuals who would have minimal tendency to do this but also a broad enough understanding of both IDR proposals and some other disciplines; preferably people who previously proved successful in IDR.

As the example above describes, the group could rather easily see the 'good' and 'bad' candidates, further resembling the negotiations of what constitutes a good practice (Geiger 2009, Bjørkeng, Clegg and Pitsis 2009). For this particular group, recognising the competencies of individuals engaging in IDR was a dynamic and ongoing process, in which the practice was constantly in the making (Bjørkeng, Clegg and Pitsis 2009; Carlsen 2006). As will be discussed in the following section, this practice further impacted on the processes of developing and recognising the network of practitioners engaged in inter-CoP practicing.

At another level, recognising competent IDR practitioners resembles the development of a group's shared appreciation of skilled and capable practitioners (Gherardi 2009a). *Recognising competencies*, especially in the case of recognising IDR competency, links to the aspect of recognising a practice as legitimate.

The importance of *recognising competencies* has been further linked to the CoP as well as institutional level. At those levels it was highlighted that a lack of shared appreciation for inter-CoP practices (by the native CoPs) could be detrimental, as CoPs may try to defend what legitimate practices should be and hence not recognise the value in the skills of working across CoP boundaries. This is illustrated by the following example:

> *'It's harder though, obviously 'cause as you do multidisciplinary things it doesn't necessarily mean that your community is used to using these types of solutions. And whether they buy in to them or not – you'd find that a lot of different communities can be quite dismissive of others people work. They don't really see the challenges involved in doing that, there is certain arrogance I suppose that whatever you are doing is making a significant contribution and therefore marginalising other disciplines' approaches. What's interesting for me, because I study risk, risk is studied by all the different disciplines. The*

discipline I'm in I think, tends to be the predominant one, which is the statistical analysis of risk, and it certainly dominates the field. There are really interesting perspectives and criticism of my type of work by the other disciplines like psychology or sociology' (Participant 16; Interview 17).

Rather than recognising the competencies of other CoPs in approaching the same problem, some CoPs may instead categorise these approaches as inferior, hence discouraging members to engage with other CoPs. This problem has been to some extent addressed by initiatives like BTG, where one of the goals was to both identify and develop individuals to be engaged in IDR and IDR evaluations, as described below:

'BTGs are another way for training and identifying referees. But there is another effect: through BTG the structures at universities are being challenged' (Participant 30; Interview 33).

Hence, the practice becomes slowly recognised and embedded within the larger organisational structures. Another practice in this group relates to challenging some of the existing boundaries and structures across CoPs and organisations to enable inter-CoP interactions.

Pushing boundaries

Recognising limitations was often observed to lead to another rather important practice of *pushing boundaries*. In the simplest form this practice involved actively questioning the limitations of disciplines or organisations and, consequently, challenging these boundaries, which were often perceived as limiting further knowledge development. As one of the participants explains:

'You are conditioned to think in a certain way, what problems are interesting, what are the acceptable solutions – those type of... research is easier – getting two people together makes research faster. The downside is obvious that you keep reinventing the wheel in some way…you are not really pushing the boundaries as much as you could' (Participant 16; Interview 17).

On a number of occasions, individuals mentioned how they, or their colleagues, engaged in a crusade to place IDR on the map of recognised practices in their departments or research groups. In another example, a group of individuals decided to challenge the status quo at a higher organisational level and making IDR a recognised form of research in the UK university assessment scheme. As explained by one of the individuals:

'This year we were a bit controversial – we put a building into the RAE [Research Assessment Exercise]. They came back to us saying this is not allowed, not typical. But we insisted and pushed. We'll see what happens – if it comes as accepted we made some difference. It will change the culture and way of thinking. It was hard work…' (Participant 1; Interview 1).

Indeed, as explained by another participant:

'it's a part of the culture – how willing you are to get to know, to push the boundaries' (Participant 14; Interview 15),

and challenge limitations of the native discipline / department (or CoP). Hence, pushing boundaries can change the way of thinking and even challenge some organisational forms, in order to make inter-CoP collaborations a recognised part of the practice landscape.

However, pushing boundaries was often linked to risk taking, with the hazard of becoming an outcast and risking the feeling of 'uprootedness' and 'homelessness' by working across

CoP boundaries (Wenger 2000). On another level, pushing boundaries could be both a revealing and a challenging experience for individuals, as described by another participant:

> *'So that was quite interesting. So what we did we got a case study and we all looked through and put three different perspectives on. Which was quite interesting – you can sometimes [use] your own methodology and not realise some of the serious weaknesses until someone else points out things you never thought about – like how the Marxists would criticise my work…you know – what was interesting was something that [name] came up with, from a sociology perspective, about things that you may take for granted that may not be what every corner of society takes for granted. Like we need to have railways, for example, and there and at the risk level – what is the acceptable risk because we need to have railways. And he would say: why? Railways are just a way of suppressing people (…). Those kind of arguments that are not common in statistical community…' (Participant 16; Interview 17).*

The discussion led to re-assessing the tools normally used by the individual and further trying to bring these somewhat novel perspectives to the home discipline, to challenge the disciplinary boundaries around methods, approaches and questions to be adopted in this particular field (Bruce et al 2004). This could also involve challenging some of the underlying values of CoPs, as described in the following situation:

> *'In the closing remarks [name], who comes from psychology, referred to the philosophical paradigmatic problems with collaboration. In his view, to progress the scientific enterprise we need to move beyond the paradigm bounds that disciplines are embedded in' (Event 5; Participant 46).*

Hence, pushing boundaries can extend the range of legitimate questions and tools within home CoPs, which confirms largely the statements that inter-CoP engagements can lead to

enhancements of both CoPs (Thompson 2005; Gherardi and Nicolini 2002; Brown and Duguid 1998) and disciplines (Weingart 2000), preventing them from '*suffering from the 'epistemic inhibitions of its own paradigm'* (Thompson 2005: 163). This research further identifies a specific practice adopted by individuals aimed at challenging the status quo and ensuring that inter-CoP interactions gain legitimacy and, hence, can continuously contribute to the renewal and further development of CoPs.

Summary

The group of reflective practices discussed above significantly impacts upon the success of inter-CoP interactions, but also their further propagation. On the one hand, *recognising limitations* and *recognising competencies* is the prerequisite for the journey into inter-CoP adventures. On the other hand, *pushing boundaries* and *reflecting* can form an important part of learning and developing capabilities to engage in these forms of cross-boundary interactions for individuals, CoPs and organisations. This set of practices further plays a significant role in the learning processes, both as it relates to individuals and learning related to CoPs. As already indicated, inter-CoP relations can potentiate new knowledge development and the renewal, or emergence, of practices (Thompson 2005; Gherardi and Nicolini 2002; Weingart 2000; Brown and Duguid 1998). Indeed, the results of this study largely confirm the intrinsic link between development of normative aspect of practices and explicit modes of reflection, as explained by Geiger (2009: 140). Practitioners often explicitly questioned '*the underlying norms of a particular practice'* within own CoPs, criticising the limitations imposed by these practices; but also engaged in '*argumentation process in order to agree on revised norms of good practice'*, in this case good interdisciplinary practice. In some of the examples, reflection upon the situations which compromised the ethical rightness of the practice (e.g. a lack of procedural justice) lead to

emergence of new sets of practices and techniques to prevent similar situations happening in the future. Hence, in accord with the extant literature, reflective practices, through potential reconsideration of the assumptions underlying the workings of any CoP, can lead to amendments to the native practices (Blacker and Regan 2009; Berends 2003; Brown and Duguid 2001). Furthermore, the results of this study extend the understanding of the dynamics of emergence of new collaborative practices beyond authoring boundaries and negotiating competencies (Bjørkeng, Clegg and Pitsis 2009) by highlighting the importance of reflection in the successful outcomes of these processes.

Finally, the rather explicit forms of reflection observed in the study indicate that, as suggested by Yakhlef (2010), the mastering of practices contains both situated and reflective, and hence cognitive, elements of learning.

DEVELOPING THE NETWORK OF PRACTITIONERS

This group of practices relates to the process of conscious development and extension of the network of IDR-competent practitioners. As already alluded to, participants engaged in IDR often expressed their recognition of, and sometimes admiration for, skills and practices that were considered as IDR-specific competences or, indeed, IDR competent individuals. Furthermore, this study identified a number of practices that were specifically aimed at developing the network of practitioners engaged in IDR across disciplines, research groups and the university. As the following sections will present in detail, individuals often channelled a considerable amount of resources and energy into growing the network of IDR-competent individuals. The group is made up of eight coding categories, four of which were further clustered into a sub-group under the heading of extending the network. Table 15 provides a detailed breakdown of the coding categories together with the number of instances and sources for each category, whereas short characterisations of each of the practices can be found in Table 16. Each of the coding categories is discussed in detailed in the remaining part of this section.

Developing network of practitioners	Number of references	Number of sources
Communicating capabilities (visibility)	12	8
Exploiting existing network	49	32
Sharing students	17	11
Extending the network		
- Brokering connections	37	21
- Involving others	24	21
- Networking for IDR	14	11

Table 15: Break down of practices aimed at developing network of practice.

Practice	Characterisation		Closely related to
	Activity	**Appreciation**	
Communicating capabilities	Developing ways to present expertise in an understandable and attractive to other CoPs ways	Appreciation of how partners in different CoPs use and relate to particular language	• re-presentational practices • reflective practices • procedural justice • investigating fit • building fit
Networking for IDR	Engaging in networking activities aimed specifically at inter-CoP collaborations to build a network of potential partner	Appreciating the potential value of latent network connections	• communicating capabilities • recognising competence • recognising opportunities • re-presentational practices
Involving others	Identifying, approaching and engaging colleagues in collaborative projects	Recognising the value of inputs offered by other CoPs	• recognising competence • recognising limitations • recognising opportunities • ensuring procedural justice
Brokering connections	Facilitating potential collaborations through connecting and supporting partners	Appreciation that relationships may need support	• recognising opportunities • recognising competencies • sharing students • involving others
Sharing students	Utilising 'disciples' as brokers of knowledge and learning facilitators	Appreciation of the value of experiential learning	• brokering connections • engaging • managerial support • recognising competence
Exploiting existing networks	Utilising existing professional and private contacts to identify and reach potential partners or to identify new collaborative opportunities	Appreciation for expertise and practices of partner CoPs	• brokering connections • communicating capabilities • recognising opportunities • recognising competence • networking for IDR

Table 16: Characterisation of Developing the Network of Practitioners practices.

Communicating capabilities

Although relatively small in terms of the number of identified instances, the practice of *communicating capabilities* was closely related to the group of *re-presentational practices* discussed earlier. The preceding discussions on *recognising capabilities* or *searching for connections* already highlighted the ever-present problems with identifying the right partners

for IDR projects, however, in this study a number of individuals recognised the importance of the ability to communicate capabilities, be it their own research capabilities or those of the CoP, in a way that would appeal to a wider range of potential partners from other CoPs.

Presenting one's capabilities was recognised as requiring a different approach in the IDR context. Respondents often considered attending a wider range of conferences or events, engaging in inter-CoP fora and groups as one of the ways to increase the visibility in the wider research context. More importantly, however, respondents highlighted the need to make sure that potential partners are able to clearly recognise the capabilities on offer. This sometimes involved approaches similar to that of presenting to IDR teams, with the difference of presenting one's own capabilities rather than a research problem or ideas. One of the respondents highlighted the importance of the ability to communicate capabilities, both of individuals and CoPs:

> *'So – the subject that is dearest to my heart because of my responsibility as a research leader in my department, is to what extent is our research here interesting to anybody else in the university and the university management'* *(Participant 10; Interview 11).*

He further continued that engaging in BTG events:

> *'sends a signal that we are a part of it [IDR community]'* *(Participant 10; Interview 11).*

In the explanation provided by the respondent, communicating capabilities had two main dimensions, one of which related to the whole department, as explained below:

> *'when I became deputy head for research, that was pretty obvious to me that we need to make our presence feel more effectively than we had done before. And we had to be communicating certain message about who we are, what our strengths are and what we are about'* *(Participant 10; Interview 11).*

It became a part of the core message and strategy of that department to present themselves to the other departments as potential research partners. Similarly, in the second dimension, the respondent highlighted that this practice should be core not only at the departmental level, but also at the level of individual researchers:

> *'The same applies to individual academics in a way that individual academics need to be very visible in their field. You do that partly through the quality of your publications but you also do it through your presence in your community – at conferences, saying yes to requests to give seminars, or to speak, review papers, review grant applications, give advice – so you build up a social capital. (...) So collaboration in that sense for me means much much more than getting a team together on a specific project. But in fact in the academic business – if that's the right term – the more important form of collaboration is being a part of community of practice, and being an active member of that community and perceived as such' (Participant 10; Interview 11).*

Hence, *communicating capabilities* in the above example forms an integral part of the research practices of any researcher. However, with the increasing importance of inter-CoP collaborations, the message conveyed need to be clear and comprehensible to other CoPs rather than just focused on the own specialised field.

As a result, a number of the participants of the study had, for example, used their existing links and offered to give presentations to other departments on their own research expertise and tools. Furthermore, both the presenters and the hosts, somewhat expectedly, reported both problems and subsequent learning through engaging in this practice, before their presentations became clear to the relevant audiences. Other related techniques, initiated by the BTG team, included the development of departmental research expertise maps to enable departments and individuals to communicate their expertise to the wider audience.

Communicating capabilities to enhance the chances of collaborative engagement has not only been recognised as important in the IDR context, but also in developing links with industrial partners. As put by one of the industrial participants, a research group need to

> *'make itself known as a potential contributor to, let's say the space programme – or any other – the gas industry or the oil industry. You would have to start showing up on symposiums, conferences [of the potential partners]'* *(Participant 18; Interview 19).*

Furthermore they highlighted that the message needs to be adjusted to the audience to be both comprehensible and attractive in a way that it can trigger additional interest and, potentially, new interdisciplinary collaboration.

Extending the network

This group comprises of three practices identified in the coding process of the study that were aimed at, or resulted in, further extension of the network of IDR practitioners. These include *networking for IDR*, *involving others* and *brokering connections*.

Networking for IDR

Although this practice had relatively low number of observed instances, there was an interesting aspect to it as in some cases it was recognised as a somewhat strategic element of a career, as illustrated by one of the respondents describing his efforts of connecting to colleagues in other departments:

> *'I have been here for 3 years and I have collected a group of people willing to engage to this kind of discussion'* *(Participant 14; Interview 15).*

'This kind of discussion' in the example above relates to exploratory discussions aimed at developing common approaches to problems, exploring other fields and searching for new research opportunities in interdisciplinary contexts. In another example, networking for IDR was described as a focused and, to some extent, planned activity. Although there need be no specific project in mind, efforts could be driven with long-term career planning aims, as described by another respondent:

> *'that was a gradual process of building the networks, expanding – the five degrees of separation… some of them actively cultivated, and some of them just good fortune and accident. A lot of conference attendance – which I have enjoyed doing but also, as well as enjoying it I was strategic about it and connected with people at conferences in a semi-planned way, and then emailed them when I got back and kick out an El. Comm.going, so a relationship of some sort was going (Participant 10; Interview 11).*

Indeed, in some cases where IDR formed a significant part of a respondent's job, *networking for IDR* was perceived to be an integral part of their research practice. In many cases the practice required some additional effort in order to actively pursue new connections, as described by another participant of the study:

> *'I now have a good link with physics department – and the reason that came up was because I went to the States to visit someone who worked for NASA who moved to the Monterey Bay Aquarium. I visited him to do some work on marine data. So I came back and wondered if there is anyone interested in work on marine data analysis. I searched the university website, emailed asking if they were interested and it appeared that they were working exactly in the same area. And so we started a new collaboration...' (Participant 22; Interview 24).*

However, a number of respondents admitted that finding people from other disciplines was not easy and often required extra effort and resources, which were difficult to obtain. Furthermore, a number of participants in BTG events stated that they decided to attend in order to find new connections and extent their networks across disciplines, and to see if their expertise can be used in other fields.

Involving others

This practice describes observed instances of individuals who decided to involve other disciplines into existing, or planned, projects. This was especially significant as in many of the situations there was no explicit need to involve other disciplines to address the research problem. The reasons for doing this, then, varied from the willingness to learn about IDR to more general curiosity or interest in seeing what other disciplines could offer. As one of the respondents pointed out in an example discussed earlier, the group was:

> *'trying to find people who were interested in areas of risk – different areas of risk' (Participant 5; Interview 6),*

which finally turned into a long-term relationship involving individuals from three rather unrelated disciplines and successful IDR projects. In another project an individual decided to involve other disciplines mostly to:

> '*see who can have some input*' (Participant 1; Interview 1),

although, as he pointed out, it could have been done '*the easy/fast way*' by including just his native discipline.

In another case, an individual described how the whole department utilises research meetings and seminars to look for additional connections and involve other disciplines in various projects:

> *'so then it is the case of saying 'oh, have you thought of talking to somebody in chemistry department' or 'have you thought that your theoretical work on symmetry detection may be applicable in bio-mathematics'. And then you can have people thinking ''oh yeah, I could go and have a chat with so and so'…'* *(Participant 14; Interview 15)*

In this example the practice had become embedded within the whole CoP, forming a part of their regular research practices.

Because of actively involving others a number of new connections, projects and ideas were forged over the course of the research. The next, closely related, practice in this group was similarly aimed at actively brokering IDR connections, hence also affecting the potential involvement of individuals in IDR projects.

Brokering connections

The act of brokering connections was observed on a number of occasions during the research, with further cases subsequently reported by individuals. Indeed, the observed instances often proved to be embedded practices adopted by certain individuals recognising the value of IDR and willing to consciously proliferate interdisciplinary connections and research. The practice is also closely related to the earlier discussed practices of *recognising opportunities* and *recognising competencies* and the ability of individuals to connect the dots. Indeed, as one of the participants noted, there is a difference between generating an inquiry and actually establishing an opportunity, which translates into actively brokering the

potential connections. For example, after contacting somebody in another department to see if they could help in connecting them to somebody with the right expertise, the respondent noted that the person

> *'had not really seen a potential research connection but just seen a query and passed it to a person who was just doing some teaching' (Participant 8; Interview 9)*

This had detrimental consequences on the potential collaboration between the two parties, highlighting one of the factors that can influence the potential success of IDR engagements. As the respondent further explained:

> *'So one thing that I think is a real lack at the moment is that if you have a problem that you think may be related to an area outside your own expertise it's not clear who is the right person to go to try to pursue that. And also if you connect to somebody it's not clear whether the response that you getting is an active response or rather just 'go away and shut up' kind of response. And I've got a distinct feeling that it was just this 'thanks for your enquiry but we are all right here – thanks' response. And it's a shame because I think there's some scope for work in that area but without having a connection to somebody who can actually talk sensibly about it it's very hard to see how to pursue it (Participant 8; Interview 9)'.*

Not recognising opportunities lead the individuals to dismiss the inquiry as unimportant or not fitting with the CoP's interests. In another example an individual further criticised the lack of 'brokering connections' practice displayed by a colleague:

> *'he sent me an email on Wednesday or Thursday [meeting was on Tuesday] – and I show you the email and explain why': the email says more-less: I have spoken to professor [name1] and [name2] and [name3] and asked them to get in touch with you if they are interested (Participant 7; Interview 8).*

The respondent criticised the rather passive approach, which caused the link to dwindle, hindering the potential for IDR collaboration. As he explained:

> *'I'd have done it in a different way. I would set up a meeting and then let the guys decide if they want to take it forward'* *(Participant 7; Interview 8).*

Hence, brokering connections often meant more than just passing the details to somebody who may be the appropriate and possibly interested person but, instead, requires treating the enquiry as an opportunity and walking the extra mile to connect the parties together. A number of instances, mostly involving individuals who were more active and experienced in IDR, were observed in this research.

Similarly to the recognition of (IDR) competency, some of the individuals were recognised by their colleagues as skilled brokers of connections. For example, one of the respondents described another colleague as

> *'a hub, a person who can work with anyone. He came from life sciences and brought a lot of contacts with him'* *(Participant 4; Interview 5).*

Some individuals further perceived their own role in some of the initiatives to be that of a broker and a translator between the involved CoPs. This is how another respondent described his role in a project:

> *'In this case I see my role more of a translator between biology, chemistry and management science. I plan to convey a meeting on that soon. I already found one interested biologist, then plan to bring [name] along and see if the discussions suggest that we should take it forward'* *(Participant 25; Interview 27).*

Brokering was perceived as vital for success of IDR, but also for the development of knowledge both within and across disciplines. The role of brokers seemed to be especially important in connecting the specialised streams of disciplinary expertise to the IDR projects, with some individuals playing a particularly important brokering role. As one of the respondents explained:

> *'I'm not saying that it's necessarily a bad thing to have people who are real specialists in a very narrow field (…). But then there are all these people who are making these bridges. Both are needed. Some of the big successes are quite often obtained by a team with a leader who is more-less knowledgeable in his field and in what's' going on in the other fields, and a specialist who could really make it happen' (Participant 28; Interview 31).*

He continued by pointing out that, although there were some concerns emerging about the same group of people being involved in the BTG initiatives, this actually could mean that there was a core network of 'brokers':

> *'It's not bad actually that the same people are not coming – so these are the people who are actually open to this kind of new projects which are kind of blue-sky research quite often' (Participant 28; Interview 31).*

The above example somewhat confirms, but also explains in more detail, the paradoxical and parallel nature of interdisciplinarity and disciplinary specialisation, in which the two strategies are reinforcing each other (Weingart 2000: 40), leading to further knowledge creation. In a similar vein the example also resonates with the notion of complexification of CoPs as an enabler for inter-CoP interactions and renewal of CoPs (Tagliaventi and Mattarelli 2006), suggesting that brokering is one of the practices enabling the simultaneous process of complexification and renewal of CoPs.

As a practice, brokering sometimes took another form in this study by being assigned to 'shared' research students, as discussed in the next section.

Sharing students

Although it may sound rather de-humanising, *sharing students* has been often mentioned as an efficient way to learn about existing expertise across the university, facilitate knowledge exchange, build relationships and enhance the likelihood of identifying new opportunities. At one level, IDR projects often decided to employ a research student (RA) to help with the project. However, the role of the student rarely was perceived as to master the knowledge of all involved disciplines. Instead, their role in the project was more often perceived as that of a broker of the existing expertise. As one of the members of interdisciplinary group explained:

> *'I look at her [Research Assistant] role as sort of connecting the disciplines together. So by talking to me, and then understanding what I'm doing, and then going to talk to somebody else- and she already knows what I'm talking about, the guy already knows what I'm doing and then he comes back to me – so it brings people closer together' (Participant 26; Interview 29).*

Hence, one of the ways to utilise 'shared' students is to broker further connection between partners. However, in another example sharing students became a mean to facilitate and catalyse interdisciplinary collaborations. As one of the respondents explained:

> *'To do collaborative projects you need time – so students can help. The best way to do collaborative research is to find a collaborative project. Supervisors can meet occasionally but the student(s) sitting in the same room develops much deeper*

understanding of the other discipline. And passes it on to supervisors' (Participant 31; Interview 34).

Hence, sharing students offers continuous monitoring of the expertise developments in the other field – something that would be difficult to achieve just by trying to keep up with what is happening in other fields. As the respondent further explained:

'We also have a research student there – so he is continually using their research in our research domain. It helps to constantly monitor and understand. You could have a student and some meetings every 6 months but that does not engage you enough. Having somebody sitting there – even for a few days a week – helps' (Participant 31; Interview 34).

In a slightly different form, supervisors arranged to cross-examine the doctoral research theses of their students in order to develop a deeper understanding of each other's field, as explained below:

'In the meantime [name] was an external examiner for my PhD student and I was for one of theirs – and that helped in understanding the other's research and what they are doing' (Participant 31; Interview 34).

However, one of the risks identified with this practice related to the complexity and difficulty of mastering two or more fields of knowledge. Not only was that perceived as particularly challenging for any RA, another individual recognised the risk of re-applying existing knowledge in new fields rather than developing new knowledge, and hence impinging on multidisciplinary cooperation or simple borrowing of tools. As he explained there is a

'trade off between getting a student and actually developing new theories and staying in the forefront of own research domain. You guys don't want to be using off-the shelf tools' (Event 45; Participant 35).

Hence, in adopting the practice some balance needs to be kept between just re-combining knowledge and actually leading to knowledge transfer and further development.

Exploiting existing networks

The exploitation of existing networks was often one of the ways of extending the network of practitioners observed in the study. Although related to searching for connections and opportunities, in this case individuals focused on the existing network of practitioners to reach and involve other members in the IDR projects. For example, this is how one of the respondents described how they became involved in one of the IDR projects:

'And the reason that they approached me I think is because through some of the connections with people I worked with who knew my work, so personal recommendations. They read some of my papers and knew the kind of work that I was doing. So I think they were quite careful with choosing who to work with and making sure that, academically at least everyone was well matched, even if we didn't get on personal level they could be sure that at least everyone will be able to get their job done' (Participant 20; Interview 21).

Furthermore, the same respondent provided yet another example describing how the availability of an existing network led to further involvement in IDR projects:

'I knew [name1] because I was working with bioengineering, and teaching there as well. And [name2] worked with [name3] on the previous grant application. I think this was really driven by [name3] who worked with [name1] and [name2] was interested in getting psychology involved – so they contacted me... So previous work and previous

collaborations. But also that we know that we all worked in similar area before' (Participant 20; Interview 21).

The reason for opting for exploiting an existing network could be linked to the difficulties with finding and approaching potential partners, as discussed earlier. Indeed, utilising existing contacts to identify IDR-competent partners with the required expertise, combined with personal recommendations, seemed to be a safer and more efficient option. Sometimes the existing connections could be the reason for extending the project by involving more partners from other disciplines, as portrayed in the following example, where one of the respondents describes the process of transforming a research idea into an IDR venture:

'then they said 'hey, we make it bigger because we would like, need to have mathematics and physics there' – physics for imagining, mathematics for modelling. And they had connections with these people so I said 'perfect, that's exactly what we need'. (Participant 21; Interview 22)'

For some individuals extending the network and being able to broker the required connections became part of daily work practice. As one of the respondents explained:

'when somebody from industry comes in and say 'I have a problem with this and that', even though we may not have the expertise, we will say 'we can do that'. Because we know where to look for it or we know who is doing it already' (Participant 32; Interview 35).

The same individual attended some of the BTG events to further extend their network and tap into new fields of expertise when the need arises.

In other examples individuals were using their existing non-professional networks to find partners from other disciplines. One of the examples involved finding participants for a high-profile event through tapping into an existing network of researcher-musicians, as described by another participant:

> *'[name] plays [instrument] in the Big Band that I [am involved in other way] in it. And after one of the concerts he said 'did you know that there are people from NASA coming to this workshop?' And I said no so he said get on the web and put your name down – there are things there for you. So I got it accidentally from [name]. And very grateful I was as well…'* *(Participant 17; Interview 18)*

Additionally, as already discussed in the brokering section, exploiting existing networks does not necessarily need to involve the specialised experts in their field. Instead, the role of the brokers who can create bridges to and leverage the expertise found elsewhere can play a significant role in IDR projects, through exploiting existing networks.

Summary

The above group of practices identified in the study leads to two main inferences. First, it suggests that many of the individuals were aware of a network of IDR-competent practitioners (which will be discussed in more detail in the next section), and second, it demonstrated how individuals and CoPs ensure the existence and further development of the network. Moreover, the results highlight some of the mechanisms adopted by individuals and CoPs that, to some extent, explain the synergetic relationship between two, somehow contradictory, knowledge development strategies: one based on disciplinary specialisation and the other favouring interdisciplinary collaboration (Weingart 2000). Indeed, a number of

individuals identified either themselves or their colleagues as brokers that often link their community to those outside – be it another discipline or industrial partners, highlighting the significant role they played in knowledge transfer and development. Furthermore, the role of these individuals, often having some experience in other discipline(s), was often linked to acting not only as a broker but as an interpreter between CoPs. Indeed, one of the individuals described himself as a bridge between different specialisations, with the main task in IDR projects to translate and interpret languages and practices of the different involved disciplines. The existence of well-connected and well-recognised individuals within knowledge networks resonates with the concept of 'keystone advantage', in which well-connected individuals, who understand the ecosystem of knowledge, can leverage this understanding as a tool for enhanced knowledge development (Iansiti and Levien 2004).

Practices aimed at developing the network of (IDR) practitioners took various forms, ranging from communicating capabilities to ensure the visibility of expertise in the inter-CoP context, through adapting networking practices to suit the IDR context, to actively involving new members – both by utilising existing networks or brokering new connections. This group of practices, together with some of the practices discussed earlier (such as recognising capabilities), indicated not only that some form of inter-CoP network of practitioners existed, but, more importantly, the group of practitioners is well aware of the network, and actively negotiates the validity of IDR practices within it (c.f. Geiger 2009). Thus they ensured that the network grew, consequently propagating IDR practices as well. To expand on this, the next section will present findings related to the existence of the network of practitioners followed by a brief analysis of the learning aspects in the context of inter-CoP practices.

COMFORTABLE WITH THE DISCOMFORT: DEFINING THE NETWORK OF PRACTITIONERS

A number of interesting findings related to the emergence and characteristics of an IDR network surfaced during the data analysis. The results related to the existence of the network are not as rich or extensive as the results presented in the previous section; however, I believe that the results do enrich and further develop the picture that has been presented in the main section devoted to practices. Hence, the aim of this section is not to provide a detailed discussion on network theories in relation to inter-CoP engagements – as the subject is far too broad for the limited scope of this thesis – but to focus on the most relevant and interesting aspects related to the dynamics of the inter-CoP network of practitioners.

In total five coding categories emerged during the process of data analysis, which were clustered under the heading of IDR network, details of which are presented in Table 17.

IDR networks	Number of references	Number of sources
Existence of the network	12	8
IDR competencies	14	12
Reciprocity	7	3
Structural factors	11	7
Limiting factors	6	3

Table 17: Breakdown of coding categories under the IDR Networks group.

The first coding category in the group contains data that suggest the existence of the network of practitioners. In the second group, some additional aspects of the IDR competencies (already discussed) are captured, whereas the next category depicts one of the commonly observed mechanisms driving the development of the network of practitioners. The two last categories captured some interesting data related to the structural properties of the network.

DEFINING THE NETWORK

Contrary to expectations based on the extant literature (Lindkvist 2005), the results substantiate the existence of a network of individuals engaged in IDR projects and initiatives, further suggesting that the network is defined by shared practices, IDR-competencies and, as will be presented below, certain attitudes. Furthermore, as already discussed earlier, a number of practices developed and shared by participants were deliberately aimed at further development of the, somewhat elusive, network.

Indeed, on a number of occasions individuals engaged in IDR initiatives provided some, often rather nebulous, description of a network of practitioners; they also referred to certain attitudes and practices as the distinct component, or hallmark, of the network. For example, one of the respondents noted that:

> *'it's always the same people who collaborate - certain type of people do collaborate, people with similar mindsets' (Participant 35; Interview 40),*

This indicated a pro-IDR attitude and mindset of individuals, which was often demonstrated through the earlier discussed practices of *risk taking*, *recognising limitations* and *pushing boundaries*. In a similar spirit, whilst describing endeavours to collect a network of colleagues to engage in IDR, another respondent highlighted the importance of attitudes and shared culture among practitioners:

> *'It's a part of the culture – how willing you are to get to know, to push the boundaries. In the US it's more engrained in the institutions, it's a complex network of activities and attitudes. In here it's much more patchy – there are some people who do it but much less then in the US or Europe. One of them is [name]. It comes to personality here. I have been here for 3 years and I have collected a group of people willing to engage to this kind of*

discussion. The workshop collected the same type of people – comfortable with this sort of discomfort' (Participant 14; Interview 15).

Hence, the above examples indicate that the network structure contains or enables certain practices, but also similar attitudes. The above example further suggests that inter-CoP collaborative engagements can lead to development of these positive attitudes, which indicates that, although individuals are likely to stay loyal to their native CoPs (Lindkvist 2005), there is an aspect of becoming an 'interdisciplinarian' that can exert pressures on the home CoPs, thereby potentially preventing CoPs from remaining sealed off in the manner described by Ferlie and colleagues (2005). However, this often remains in the hands of individuals who are willing to engage in research practices that can sometimes be uncomfortable. Another respondent, for example, noted that support across the university can help to identify the 'right people', however, as they describe below, in the end the success of IDR depends on attitudes of individuals:

'The conducive environment is good, it's important – but not sufficient, not enough for IDR to happen. It may help to identify the right people and get them together. It was difficult first to find people like that when I came here – after I was introduced to some people the network grew. It's down to the individuals' (Participant 14; Interview 15).

Indeed, as pointed out by another respondent, the network is not only based on shared practices but on personal compatibility and shared desires to engage in IDR:

'In the BTG – we identified a group of people and I think I like these people – they seem to me like each other and have the desire [to work across the boundaries]' (Participant 37; Interview 42).

The above examples further highlight that working across disciplinary boundaries is often perceived to be rather challenging, risky and a somewhat suspicious endeavour (Massey et al 2006; Bruce et al 2004; Kincheloe 2001; Weingart 2000). Hence the strong individual commitment and the ability to bear the consequent discomforts, identified in this study, help to show how this mode of research can nevertheless be successful.

Another important aspect unearthed by the study relates to the existence of a core group of participants in the events, hence suggesting that attitudes and practices related to working in interdisciplinary contexts are developed through repeated engagements. As the research progressed, a core group of participants became evident and prominently visible within the BTG programme. This was apparent to both the facilitators and the network itself. Indeed, as one 'regular' participant pointed out, there were '*lots of the same faces'* coming to these initiatives. Thus some participants became fairly familiar with each other, subsequently leading to a better understanding of the expertise and tools mastered in their respective CoPs. One of the participants at the beginning of one of the events noted that it is:

'*good to see some familiar faces here'* (Participant 28; Interview 31),

indicating there were people they already met before in other IDR initiatives. In another example, the steering group members noted that:

'Lots of the same faces who are coming to these initiatives – [name1] or [name2]… people from earlier initiatives or last year organisers' (Event 1; Participant 35).

However, he further noted that '*there are some new people though – never met them before*', highlighting the fact that although there was recognised core of the network, the network further grew, involving new members, further indicating the dynamic nature of the emerging network.

The network, and its value, had also been officially recognised at the level of university and funding councils. Indeed, during some of the BTG board meetings a number of individuals were recognised as 'IDR competent' in the process of selection of reviewers for IDR proposals and projects. Furthermore, some institutions developed and adopted a number of techniques aimed at

'building a community of referees for interdisciplinary projects'

– a network of individuals who need to

'be able to appreciate the [IDR] ideas' (Participant 30; Interview 33).

Once again this resonates with the wider concept of practice as suggested by Gherardi (2009b), indicating that the network is built on the premise of shared appreciations, attitudes and values, which are further translated into particular practices.

As the above discussion already alluded, the identified network of practitioners to some extent can depend on the group of core practitioners, which in turn indicates certain structural aspects of the network.

LIMITING FACTORS OF THE NETWORK

The aforementioned practices aimed at development of the network of practitioners indicate the importance of renewing and extending the network beyond the core group identified in the study. Many of the core participants recognised the necessity, with one of the participants noting that:

'extending this network is important…maybe involving the post-docs or young lecturers is the next good step to extend the collaboration-prone network' (Participant 14; Interview 15).

The reason for that can be found in the perceived risk of reaching the point of saturation of the network, with many of the core members becoming overcommitted and overloaded. As one 'core' practitioner explained, there is a need for continuous extending of the network:

> *'the problem is that people get quickly saturated – they have no more time. In the US they often run on full capacity – and they are efficient. In the UK, in here there are too few people like that – the network gets easily saturated. I have a friend in another department – we started working together a few years back, we have a project together – but now he's got so much work that I find it difficult to see him'* *(Participant 14; Interview 15)*

The issue was also recognised by the BTG steering committee, with the realisation that the number of new participants joining BTG initiatives was in decline, whilst the 'regular' participants were slowly becoming overloaded and could not find more capacity for IDR engagements. The reasons often mentioned were the amount of 'regular' work to be performed in home disciplines and the extra time and effort required in the context of IDR projects. Indeed, excessive existing workloads in conjunction with the perceived extra time and effort needed for IDR projects were often mentioned as one of the main barriers preventing individuals from engaging in IDR projects. Furthermore, a lack of recognition for IDR as a valuable mode of research within some departments and university structures in general (Lam 2007; Boix Mansilla and Gardner 2003) often meant that for some individuals engaging in IDR meant performing 'double duty' (Lattuca 2002).

Another limitation of the growing network of practitioners was ensuring that the right individuals were joining for the right reasons. Since many of the initiatives were offering some financial grants, there was an inherent risk of attracting individuals who were mostly motivated by economic gains, hence unlikely to share the same attitudes or practices with the

other participants of IDR projects. This could be detrimental to the collaboration, as portrayed by the following observation:

> 'Group talking about contributions and what the proposal should include. At that point they started discussion about involvement of other disciplines: how and who. *[name1]: 'would be good if we could justify the need for other disciplines – I don't think we can cover all the problems'*. Computer and Information Sciences [CIS] was mentioned. [name2] explains that *'none of them wanted to come to the meeting'*. Somebody suggests that CIS can be approached later (when funding is awarded). *'That would make them more interested'*. [name3] points out that *'you want commitment, not just somebody coming because of few grants' (Event 45; various participants).*

In another observed example some participants were described as

> *'trying to be in all groups' and 'even though they were fiercely opposed to our idea during the [event] – now they are trying to get their names on the proposal' (Participant 45; Event 35).*

Consequently, these participants were labelled as '*impossible to work with'* and the project failed to deliver. Indeed, financial or career drivers often lead to rather superficial engagements, often based on re-applying and borrowing of existing tools and techniques, with little evidence of real integration between the involved pockets of expertise or change in systems of values of involved individuals. Indeed, there was little evidence of *recognising limitations* or *pushing boundaries* in these situations.

PRACTICES AND NETWORKS: CO-EVOLUTIONARY DYNAMICS

As the above discussion indicates, real commitment to the collaborative project was highly valued by individuals engaged in IDR. Consequently, developing the network was perceived not only as accessing the required expertise but, more importantly, accessing individuals with the right skills and attitudes to working across CoPs – in particular, perhaps, participants sharing similar practices and driven by similar motives to engage in the IDR. As in some of the earlier discussed examples, financial motivations, lack of procedural justice or a lack of commitment often resulted in individuals deciding to disengage from, or groups excluding, certain members from the 'unhealthy' research collaborations.

Hence, the results suggest that the network and the practice are being co-developed and refined simultaneously, with individuals re-assessing and refining existing practices and behaviours, hence developing shared normative values in relation to the emerging practices and network (c.f. Bjørkeng, Clegg and Pitsis 2009; Geiger 2009; Gherardi 2009b). However, as the members of the network recognised the importance of renewal and sustainability of the network, a group of practices aimed at developing the network was developed. Similarly, a number of practices, relating to shared norms and values, were developed to ensure the health of the network and the collaborative engagements; the prime examples were *ensuring procedural justice* and *disengaging*. Simultaneously, as new members engaged in the collaborative research, they also became active actors in shaping the norms and values of the network, much as like in the examples provided by Bjørkeng, Clegg and Pitsis (2009) or Gherardi (2009a). Figure 17 outlines a simplified model of the co-evolutionary dynamics of inter-CoP practices and the network of practitioners, as observed in the study.

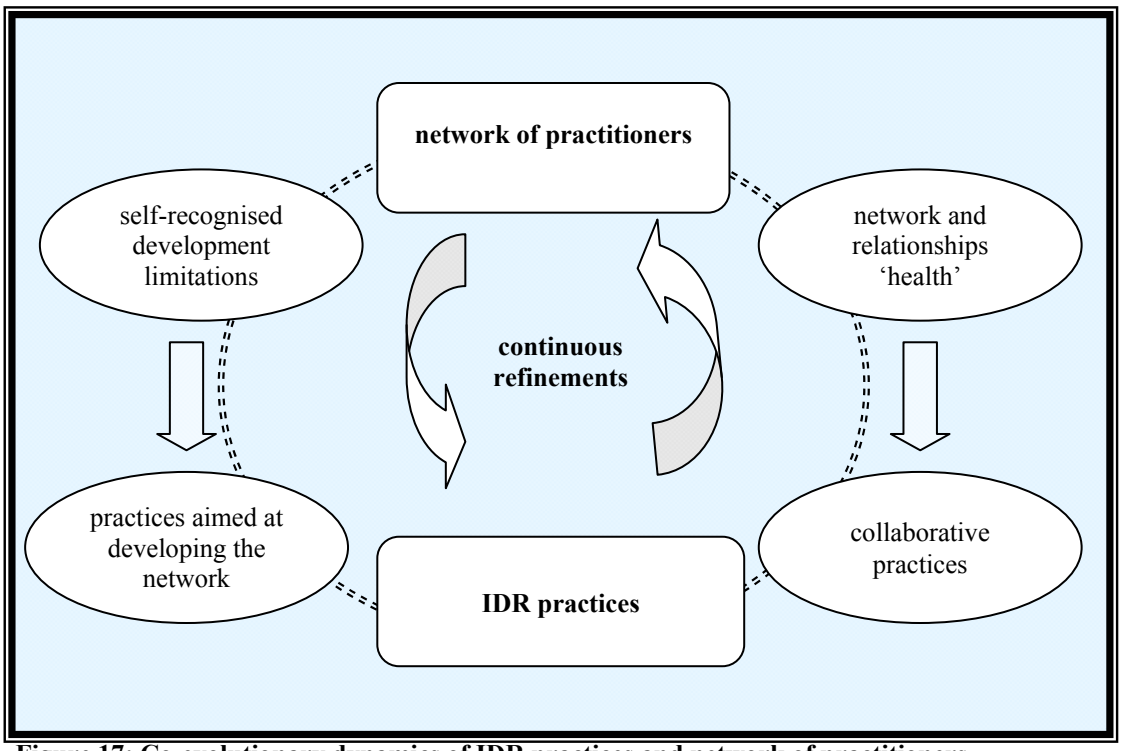

Figure 17: Co-evolutionary dynamics of IDR practices and network of practitioners.

I will return to these dynamics in the following section, which will provide an integrated discussion of the findings presented in this chapter so far after briefly outlining the most relevant aspects of the findings related to the remaining themes.

DETERMINANTS OF PRACTICE AND NETWORK DEVELOPMENT

Determinants of practice and network development, the largest theme in terms of the number of coded items, proved to be large and rich enough to form a core of another, separate study, however, as it is intrinsically linked to the focal point of this study, it provides additional understanding of the dynamics of IDR practices, and consequently network development. Hence, although it deserves some more detailed treatment than the remaining themes uncovered in this study, I will focus on the most relevant to the preceding discussion aspects of this theme. As already indicated earlier in the discussion, although all the themes are

inherently interconnected and paint a larger picture of the dynamics of IDR practices and network of practitioners, hence contributing to the body of knowledge on CoPs, each of the themes separately addresses distinctive, and well defined, body of knowledge, including theories on learning, identity or networks.

Determinants of practice and network development contains data that have been identified as different aspects that can determine the potential development of both IDR practices and, consequently, emergence of the network of practitioners. Majority of the identified determinants, although interesting, are affirmative to the existing theories within the domains of inter-CoP engagements or IDR and thus do not contribute significantly to the extant literature and, hence, do not merit extensive discussion. The list of the coding categories grouped under this theme are presented in Table 18, whereas Appendix II contains a graphical representation of the theme.

Determinants of practice and network development	Number of references	Number of sources
Cultural norms	34	23
Disciplinary norms	107	50
Gapsize	27	18
Informality	13	8
Measures of success	11	9
Partners information availability	10	9
Policy drivers	11	9
Pragmatism	19	16
Recognising preconceptions	39	28
Trust	33	17
Understanding other's perspectives	100	38
Drivers of emergence of IDR practices and network		
Efficiency	2	2
Application driven	28	19
Collaborative space	10	6
Co-location	7	7
Career drivers	15	9
Creating supporting structures	54	37
Developing knowledge	28	24
Encouraging	58	32
Funding drivers	41	26
Integrating knowledge	20	14
Management support	17	14
Multidisciplinary career	13	11
Personal compatibility	38	20
Personal interest	41	22
Problem driven	12	10
Serendipity	22	14
Shared facilities	2	2
Strategic drivers	22	13
Barriers		
Process related barriers		
competing	11	8
frustration	6	6
engineering / hothousing connections	12	9
Inertia	3	3
Increased complexity	5	4
Communication problems	34	20
language barriers	42	25
Expectations	12	8
Guarding boundaries	8	7
knowledge validity	5	5
Lack of engagement	28	21
extra effort	19	13
IDR lag time	3	3
time constraints	17	16
Lack of structures	10	7

Table 18: Determinants of practice and network development identified in the study.

As presented in Table 18, a number of coding categories have been grouped under the headings of *barriers* and *drivers of emergence of the practice or the network of practitioners*, with the remaining categories potentially acting as either. For example, *disciplinary* or *cultural* norms were identified as (potentially) impeding IDR engagements of individuals in certain groups (CoPs), however, in other communities the norms were often considered as catalyst for IDR engagements. Rather unsurprisingly, this was often linked to the existence of *managerial support* or *encouraging* IDR within these groups. For example, as one of the participants explained the relative success of the research group in pursuing IDR:

> *'I guess it comes down to encouraging people to look more broadly and how their ideas may be applied' (Participant 22; Interview 24).*

Hence, the first steps in IDR often depend on helping individuals to extend their vision and see the opportunities and linkages to other disciplines. Furthermore, *encouraging* was often perceived as intrinsically linked to support from the management (e.g. Heads of Department or Directors of research groups and centres). For example, one of the participants reflected on the role of the previous head of department in encouraging wider engagement with industry partners but also creating research links with other departments:

> *'Partly it was [name], previous head of department, who did that. He came in and made things happen. I came from a traditional academic setting and since I came here, I learnt a lot. [name] was always looking outside and made people do the same. Then a lot of cliché of "success breeds success" happened – we got more and more projects through the ones we were doing', (Participant 32; Interview 35).*

Similarly, the example below presents how one of the individuals, with a managerial role, perceived her role in encouraging IDR practices within the research group:

'We have no formal process for it [encouraging IDR] but because I'm the Head of Department and people know I'm keen on cross-disciplinary work, if they have thoughts any that their work may have cross-disciplinary applications then they would come and talk to me' *(Participant 22; Interview 24).*

Indeed, a number of respondents confirmed that encouragement and support often played a significant role in facilitating IDR engagements and development of certain IDR practices within groups (e.g. in the earlier discussed example of weekly seminars during which individuals were encouraged to explore links to other disciplines and go and 'talk to such and such'). This, however, often meant that these individuals needed to be able to recognise the value of IDR, hence needed to share the appreciation for this mode of research. Furthermore, to be able to support and guide others, these individuals often needed to be recognised as IDR competent practitioners by other members of the group.

At another level, *encouraging,* often was linked to *creating supporting structures,* identified as another driver for emergence of IDR practices and network. The 'supportive structures' identified by the respondents in the study included, but by no means were limited to, creating new work spaces to encourage interdisciplinary engagements (e.g. advanced study institutes, shared labs, collaborative research spaces, etc), funding mechanisms, changes in evaluation and promotion policies, or frameworks and initiatives to support early and wide engagements between partners (e.g. University Research Day; cross-faculty seminars) across institutions. However, many individuals realised that overfocusing on structural aspects of supporting IDR was often not enough for IDR practice to emerge. As one of the participants explained:

'[you] need to be careful – it's the balance between institutionalism and fun; between structure and helping and enabling. No initiative can really create anything – it is a

vehicle to drive it. But then you need drivers with a similar way of thinking to drive the vehicle' (Participant 14; Interview 15).

Hence, the support should involve both creating structures and, perhaps more importantly, facilitating the development of IDR practice and practitioners, especially in the area of developing shared mindsets, understanding and appreciation of this mode of research. However, individuals often perceived that, as in the case of 'supporting' development of CoPs, the focus is often on the structural aspects of the concept, with practice being rather overlooked, confirming the extensive discussion by Thompson and Walsham (2005). Indeed, a number of individuals pointed out that the existing support often lead to the tendency towards "*hothousing*" of IDR collaborations – a process perceived to lead to frustration, lack of engagement or multidisciplinary engagements focused on quick delivery of results. As explained by one of the respondents:

'[initiative's name] is kind of saying we are institution and we want people to work internally. So let's create conditions in which people can collaborate. To extend my organic metaphor and stretch it, it's kind of like making sure you've got the right compost and soil and humidity and watering everything- making sure the conditions are favourable for the things to grow. But does the thing exist? Is the seed there already? Or are we sort of forcing the seed into the soil. If you compare it with the normal situation of meeting somebody on a conference – you may have a great level of seeds, an idea you develop, and you may have very very adverse conditions – like living on different continents or only ever communicate by email or neither of you have any time – and yet, because the seed is so strong and interesting to you both, you still make it grow' (Participant 10; Interview 11).

On the contrary, a lack of suitable supportive structures, especially a lack of appropriate funding or appraisal structures or lack of mechanisms for evaluating success were perceived as inhibiting IDR, largely affirming the extant literature on interdisciplinarity (Pettigrew and

Knight, 2007; Carayol and Nguyen Thi 2005; Leshner 2004; Boix Mansilla and Gardner 2003). In a similar manner, barriers identified in the study endorse the obstacles discussed in the existing literature on IDR (for example see Welsh, Gavaghan and Jirotka 2006; Bruce et al 2004; CoFIR 2004; Lattuca 2004; Rhoten and Parker 2004; Frost and Jean 2003; Bromme 2000; Naiman 1999), inter-CoP engagements (Buanes and Jentoft 2009; Ferlie et al 2005; Lindkvist 2005) or more generally collaboration (Huxham and Vangen 2009; Cropper, Ebers and Huxham 2008). Indeed, *communication problems, extra time* and *effort* required in IDR projects were often linked to *inertia* and *lack of engagement* and, consequently, stifling any collaborative efforts. Similarly, incompatible *expectations*, whether in relation to the levels of funding, potential research outcomes or required effort, often led to further frustration and lack of engagement in IDR. As a result, on a number of occasions individuals considered managing expectations as an important part of the IDR process. However, for some individuals willing to really *push the boundaries* some of the existing interdisciplinary initiatives proved to be below their expectations, further demonstrating the potential mismatch of expectations related to IDR engagements. As explained by one of the respondents:

> *'I just kind of thought they weren't really bridging too much of a gap. They were doing multidisciplinary work – no doubt about that – so they were bringing different perspectives to the risk research. I didn't think that they were pushing out the boundaries of what risk research could be about.' (Participant 5; Interview 6).*

Hence, the participant, and his research partners, perceived some of the BTG initiatives to be multi-, rather than interdisciplinary, and the relative disciplinary gap being rather narrow.

The aforementioned *cultural* and *disciplinary norms*, and more precisely the effect of the relative difference between these, relate to the determinant labelled as *gapsize*, and

indicating the cognitive distance between disciplines, research groups and approaches, CoPs or individuals. Indeed, the greater the distance the more challenging the potential collaboration, but also potentially requiring more developed IDR practices, especially the ability to recognise opportunities or competencies. This is probably best illustrated by the following two examples:

> *'With the two leads in maths I could follow it up because I know the field and I can just ring them and talk about it. As a mathematician I can see both sides and the link. It's more difficult with [name] – I can only see some broad linkages there and can try to match them but it is a close or good match – I don't know'* *(Participant 32; Interview 35)*

and:

> *'management science, even though its operational management so lots of maths – these are self-selected mathematicians who are working with business. It's easier to work with them. With maths and stats we need to be more active – we need to recognise the connections. And we probably can – it is easier for us to be amateurish mathematicians or statisticians then for them to be amateurish chemical engineers'* *(Participant 14; Interview 15).*

Indeed, as the cognitive distance between CoP increases, the more challenging and demanding the collaboration is likely to become (Nooteboom 2008). However, with the increasing cognitive distance the chances for more creativity and radical innovation are also likely to rise (Nooteboom 2008; Gooch 2005), hence, making the effort worthwhile.

The drivers of IDR practice identified in the study tend to mirror the drivers discussed in the extant literature, as outlined and systemised in the preceding chapters. Indeed, this study confirmed that many of the IDR engagements were driven by existing problems (Balsinger 2004; Duncker 2001), willingness to progress knowledge (Duncker 2001; Marcina 1995), personal career development (Luukkonen, Persson and Siverstein 1992), as a means to

increase research efficiency (Knight and Pettigrew 2007; Gooch 2005; Amabile et al 2001) or for personal reasons, such as personal compatibility or enjoyment (Knight and Pettigrew 2007; Beaver 2001). Furthermore, in many of the observed cases the success of propagation of IDR depended on the ability to *recognise limitations* (Aboelela et al 2007), and, consequently, developing better understanding of partners' perspectives and own preconceptions. For example, this is how preconceptions caused many frustrations, potentially inhibiting potential IDR collaborations, as described by one of the participants:

> *'It acts as a gyration, which is just 1% efficient. But when you say that to people: 'oh my goodness, 1% - that's nothing!', That may mean nothing, but for nature 1% is actually very efficient. But when you want to relate it to a device, obviously, you do want it to be 77% efficient or something. When you say that to people you have to explain that is because in nature 1% is actually very very efficient. It depends on area you work on but when you say to experimentalist or engineers "this is 1% efficient, this is phenomenal"! And they are like "OK – Bye Bye…" They don't understand that.(…) Sometimes you have to explain a lot' (Participant 48; Interview 43; Event 46).*

The above example highlights the importance of *recognising preconceptions* and *understanding others' perspectives*, determinants closely linked to the reflective practices of *recognising limitations* and *recognising competences*. On the other end of the spectrum, inability to recognise one's own preconceptions and the perspectives of other disciplines can lead to defensive behaviours and guarding of disciplinary boundaries (Ferlie et al 2005), and hence inhibiting potential IDR collaborations. At one of the levels *guarding boundaries* further related to the aspect of what different disciplines considered as valid knowledge and what are the valid approaches in that discipline. As one of the participants explained:

> *'You are conditioned to think in certain way, what problems are interesting, what are the acceptable solutions' (Participant 16; Interview 17),*

hence, confirming that the socialisation processes associated with each discipline are often responsible for outlining the boundaries of knowledge validity and appreciation for certain problems or approaches, as discussed in the existing literature (Ferlie et al 2005; Frost and Jean 2003). Understanding own preconceptions and perspectives of others, however, often requires some levels of learning to occur. Hence, the next section will briefly outline the most relevant findings under the theme of learning and the intrinsically connected notion of becoming – which in this study has been captured under the heading of IDR attitudes.

LEARNING AND BECOMING

Learning and "becoming", which has been conceptualised as socialisation or 'enculturation' of individuals into the practices of given community, from the very beginning have been central concepts in the theories of CoPs (Amin and Roberts 2008; Handley et al 2006; Lindkvist 2005; Aanestad 2003; Brown and Duguid 2000; Brown et al 1989). Indeed, the seminal work of Lave and Wenger (1991) was focused on the aspects of situated learning, soon becoming a bedrock for emergence of some useful critique to substantive approaches, which viewed learning as predominantly associated with cognitive and mental processes (Gherardi, Nicolini and Odella 1998). Hence, two remaining themes originating from the data analysis in this study are focused on the aspects of learning and formation of certain IDR attitudes. Table 19 provide details of the coding categories for the theme of learning, followed by a brief discussion of the most interesting and relevant findings further linked to the theme of IDR attitudes.

Learning	Number of references	Number of sources
Learning (about) other disciplines	76	40
Learning about collaboration	21	20
Learning to present to IDR audiences	10	10
Experiential learning	62	32
Learning through examples	5	4
Mentoring support	23	16
Organisational learning	11	9
Secondment learning	6	6
Situated curriculum	25	17
Unlearning	9	8

Table 19: Breakdown of coding categories under the theme of learning.

Findings related to learning largely mirror theories proposed by the extant literature on CoPs and/or that focused on learning in collaborative settings. Indeed, the learning observed in this study can roughly be divided into learning from and about other disciplines (e.g. learning or developing new methodologies or tools and techniques) and learning about collaborative processes (e.g. learning techniques to effectively communicate in IDR setting or to ensure procedural justice). Furthermore, as IDR projects are likely to have different goals and have varied compositions of disciplines from one case to another, there also was some additional, local, learning observed, hence largely confirming the framework proposed by Hibbert and Huxham (2005). Indeed, *learning (about) other disciplines*, consisting mostly of substantive learning related to the development of the understanding of techniques, methodologies and knowledge characteristic to other disciplines. However, on some occasions *learning (about) other disciplines* involved learning, and assimilating, some of the practices from fellow researchers (e.g. different way of labelling lab bottles in the context of collaborative research, in which the different disciplinary practices first caused frustration among participants, followed by adapting the way of labelling by both groups to accommodate the different needs and expectations), hence closely resonating with the concept of 'intertwined practices' as introduced by Sutherland Olsen (2009). Indeed, on some occasions participants assimilated practices and knowledge from other disciplines, hence extending their own repertoires of research practices.

The second identified aspect of learning relates to both transferable and local collaborative process learning (Hibbert and Huxham 2005). For example, as one of the respondents noted, the initial months of involvement in BTG were focused on the goal of collaboration, whereas the following few months provided more general learning about (doing) IDR and collaboration:

> *'For the first 6 months I was learning what BTG was – but then for the last 4-5 months it was a good learning about collaborating. And now we can help others. I want to see more people getting involved in our department'* *(Participant 24; Event 8)*

Learning the ropes of IDR collaboration often focused on the aspects of the dynamics of the process itself or learning the shared IDR practices. As one of the respondents explains how practices of *ensuring procedural justice* related to publishing collaborative work were gained by some of the participants:

> *'That [order on names on the paper] was agreed upfront. So the PI again called a meeting and said 'we need to talk about this. We need to have a strategy and we need to take different strategies.' And I'd say in all collaborations (...) always make sure to decide upfront.'* *(Participant 20; Interview 21).*

The examples above not only illustrate the different aspects of learning in collaborative settings (i.e. learning about the specific projects and about IDR collaborations), as proposed in Hibbert and Huxham (2005), but further links learning back to the development and propagation of the IDR practices and the network of practitioners, casting some additional light on the already discussed aspects of *managerial support* and *encouraging*. Indeed, *mentoring support* formed another, separate category, highlighting the prominence of this type of learning in the successful propagation of shared (IDR) practices. As one of the

respondents explained the difference between mentoring and developing practitioners as opposed to just providing them with space or training:

> *'the way you encourage, mentor and support your staff [is important]. So it's not all about rating, not about giving them space to write and giving them training to enable them to be as excellent as they can be. It is also about helping them to develop strategies, networks and relationships, get to conferences and be visible, develop reputation, engage with the field. These are social skills that social workers [i.e. academics] ought to be good at.' (Participant 10; Interview 11).*

Another aspect of learning identified in the study relates to presenting to IDR audiences – a skill that was often recognised as part of the IDR competence, but also frequently observed as significantly affecting potential outcomes of IDR initiatives at all stages – from exploratory to final stages of presenting the results of the study to wider audience. The importance of the skill was further recognised at the level of departments and the University, with introducing a number of mechanisms to ensure the skills are gained by the new members of staff, as in the following example:

> *'We actually teach our students how to do that [present to IDR audiences] by giving them some feedback saying that 'this was too jargonised, you know' or 'you didn't explain that very well'. So I think in departments tutors and PhD supervisors should teach that' (Participant 20; Interview 21).*

In another instance presenters, prior to one of the university-wide events, were offered coaching sessions by external consultants to ensure they are able to present their work to wider university audience but also 'intelligent lay people', hence already indicating the existence of a situated curriculum as well as some levels of organisational learning taking place. Indeed, there were numerous examples of different initiatives being introduced and

often formally structured at departmental or the University levels as a way of supporting development of the IDR practices. These included introducing new provisions of formal training (e.g. communicating to other disciplines), semi-formal training sessions in some departments (e.g. away-days to encourage communication between members from different disciplinary backgrounds), creating new funding lines or evaluation structures to support development of IDR, and, finally, attempting to create cultural change across the whole University. As one of the members of the BTG steering group explains the purpose of one of the initiatives:

> *'I think is a part of the change to the research culture at the University and the collegial atmosphere. And it's less tangible output from it. So it's more about changing the culture and people's attitude to collaboration, opening people's minds to, educating as a whole, creating opportunities.' (Participant 35; Interview 39).*

This emergent goal of the BTG initiative was often termed as 'creating a new research ethos' at the University, hence indicating not only structural but also cultural changes to form part of the (organisational) learning.

Finally, learning, especially from the perspective of CoPs, is often linked in the literature to *permanent* changes in identities and, hence, the process of *becoming* a practitioner. Indeed, as put by Handley et al (2006: 644), *'[l]earning is not simply about developing one's knowledge and practice, it also involves a process of understanding who we are and in which communities of practice we belong and are accepted*'. This notion was mirrored in the results of the study on a number of occasions, when individuals perceived themselves as being part of the emerging IDR network of practitioners; part of the *like-minded* community of individuals *'comfortable with this kind of discomfort'*. Indeed, as one of the participants explained:

'those two things are obviously connected – learning and changing perceptions. You always learn about new people, another discipline and potential for collaboration. And about the university strategy and the bigger university context. But also as you learning about these new things your perceptions are changing' *(Participant 10; Interview 11).*

Indeed, individuals recognised themselves as interdisciplinarians, however, at the same time they stayed loyal to their home department or discipline, as suggested by extant literature (Ferlie et al 2005; Lindkvist 2005). The results of the study further suggest that individuals sometimes needed to be able to suspend their own disciplinary identity (and, hence practices) whilst operating in IDR context, as pictured in the following example:

'Each time I have to change the frame of mind when I write [with colleague from other discipline]' *(Event 29; Unidentified participant).*

Similarly, as in the example of negotiating the meaning of the word 'planning' discussed earlier, individuals sometimes needed the ability to suspend their cognitive frames to allow the perspectives of other disciplines in. This further suggests, that rather than one IDR identity that the adaptation and learning in this regard needed to be crafted according to each specific IDR context. Furthermore, the results suggest that individuals (regularly) engaged in IDR collaborations usually shared a number of specific attitudes, rather than permanent identities as suggested by the literature on CoPs. For example, as one of the respondents explained:

'it takes certain type of person and attitude to go round, spread the word and look for opportunities. It is not a function just for everyone' *(Participant 31; Event 1).*

Indeed, on a number of occasions respondents would refer to certain attitudes that, in their opinion, were necessary for IDR engagements to be realised. Table 20 provides details of the coding categories within the theme of IDR Attitudes as captured in the data.

IDR attitudes	Number of references	Number of sources
Flexibility	2	2
Openness	23	12
Openness to learn	6	9
Listening – ability to listen	8	1
Curiosity	5	5
Determination	6	5
Persistence	8	6
Respect for others	5	5

Table 20: Breakdown of coding categories under the theme of IDR attitudes.

Although just acknowledging these attributes provides better understanding of the dynamics and learning of IDR engagements, this research did not engage with the topic of identity and attitudes at detailed level, as it was not a central focus and this will be further explored in later research work. Hence, I will now turn back to the more detailed discussion on the implications of the findings presented across this chapter, with a particular focus on the themes of *IDR practices* and the *network of practitioners*.

CHAPTER VI: INTEGRATIVE DISCUSSION AND CONCLUSIONS

INTRODUCTION

The aim of this chapter is to summarise and integrate the findings presented above, connect these with the literature explorations provided in the first two chapters, and present the outcomes of the process of theorising and theory development. While the previous chapter provided a detailed discussion and systemisation of the IDR practices, the discussion here focuses on the more holistic aspects of the impact of this research on the existing theories. I should stress here that both the categorisation of the observed practices discussed earlier, and the integration discussed here, are argued to be equally important.

This chapter will therefore progress in three parts. First, the implications of the presented findings on the extant theories, In particular, how this thesis furthers understanding of: the nature and dynamics of inter-CoP engagements; the development of (IDR) practice; and how the new inter-CoP practices integrate with the existing practices of the constituent communities. Second, I will summarise how this thesis contributes to the theory development. Finally, the chapter will discuss the implications of the findings, consider the limitations of the study and provide suggestions for further research.

INTER-COP PRACTICES AND NETWORKS: THEORY DEVELOPMENT

There are three main areas where the findings lead to further theory development: the characterisation of inter-CoP practices; further deliberations on the dynamics of practice emergence; and how the new inter-CoP practices relate to the 'native' practices of CoPs in terms of integration and assimilation. I will discuss each of these aspects in the following sections.

FURTHER THOUGHTS ON THE NATURE OF INTER-COP PRACTICES

The previous chapter has already indicated a number of areas of theoretical development offered by this research. The first, and most obvious, is the identification and systematisation of inter-CoP practices, which seems particularly important in relation to understandings of the organisation of work and knowledge development. Indeed, although it has been recognised that work in contemporary organisations is increasingly '*enacted by groups that fade, intermix and are reconfigured in contexts where uncertainties and contradictions have become ever more visible*' (Blacker and Regan 2009: 162; see also Engeström 2008 and Czerniawska 2004). However, the extant literature on CoPs remains rather underdeveloped, if not pessimistic at times, in providing explanations or frameworks of the dynamics of this type of collaborative engagement. Fischer (2001: 2) notes, that '*a profound mutual suspicion and incomprehension'* often hinders inter-CoP collaborations, making it increasingly difficult for different (epistemic) cultures to develop sustainable rapport. To a large extent, these problems are attributed to incommensurability, if not irreconcilability, between the differing paradigms and worldviews (Zahra and Newey 2009; Nooteboom 2008), and consequently practices characteristic to these communities (Nooteboom 2008; Brown and

Duguid 1998; Gherardi, Nicolini and Odella 1998). Ferlie et al (2005) further note that collaborations between professions are at best challenging, as different professional CoPs are likely to defend their turf and, consequently, retard successful learning, knowledge development or transfer that originated in other communities, or indeed through inter-CoP engagements (Haas and Park 2010; Scarborough and Swan 2008).

On the one hand, the results of this research confirm the negative perspectives outlined above, as suggested by observed instances of interdisciplinary groups operating on minimal basis of understanding and individuals remaining loyal to their native CoPs, in particular in relation to the conceptualisation of barriers including *defending boundaries* and *knowledge validity*. Thus, in those examples, collaboration was unlikely to lead to the emergence of shared practices and new, well developed CoPs (or NoPs), as suggested by Lindkvist (2005). On the other hand the results presented in this study are largely affirmative of the notion that transient and inter-organisational, interdisciplinary or inter-CoP collaborations may lead to the emergence of 'intertwined' shared practices (Sutherland Olsen 2009) and, potentially, some form of a community sharing these new practices (c.f. Bjørkeng, Clegg and Pitsis 2009; Gherardi 2009a). The results discussed in the previous chapter add to the literature by providing characterisations of what these inter-CoP practices actually are, and showing how for some individuals and CoPs they can become a part of their 'normal' work and a recognised source of learning. Furthermore, the findings showed that in such CoPs an appreciation or 'taste' for inter-CoP engagements developed, as suggested by Gherardi (2009a); the findings of this study add to the importance of that understanding by showing how this was linked to the recognition of limitations and a developing respect for others (c.f. Sutherland Olsen 2009), which in this study was conceptualised as *recognising limitations* and *recognising competences*.

Furthermore, as a number of participants actively engaged in propagating IDR-specific practices (e.g. examples described earlier in the group of *re-presentational practices*) among their colleagues and students, the results suggest that these individuals invested in assimilating these collaboration-oriented practices into their home CoPs. This contradicts – at least to a degree – the notion that CoPs are likely to seal themselves off from cross-boundary working and reject 'alien' practices (c.f. Scarborough and Swan 2008; Ferlie et al 2005; Lindkvist 2005). Instead, the results suggest that these practices, and the underlying shared appreciation (Gherardi 2009a), can occur at both individual and CoP levels and become a relatively permanent characteristic of an established CoP.

Finally, building upon the wider definition of practice as proposed by Gherardi (2009a), the results of this study shed some additional light on the intrinsic relationship between the tangible and intangible aspects of practice. Indeed, as discussed in the previous chapter, the appreciative values should not be regarded as separate from the more tangible 'activities' or 'actions' often associated with the concept of practice (Geiger 2009; Pavlin 2006). Focusing on the 'actions' without understanding the motives can be deceiving as the results of the study suggest that engagements initiated by individuals who did not share the same systems of values often led to disappointments and/or shallow and artificial engagements – based on the dynamics of consulting rather than knowledge integration and common learning – and rarely lead to subsequent collaborations. Furthermore, there was no evidence of development of new shared or intertwined practices (Sutherland Olsen 2009). Instead, engagements where requisite values were absent were often characterised by a clear division of labour strictly linked to the expertise and practices of involved CoPs or individuals, who would usually deliver a specific part of the project without engaging with the parts that formed the responsibility of other partners.

At the same time, somehow paradoxically, some individuals involved in such engagements displayed some of the inter-CoP practices, including *searching for connections, seeking opportunities,* different forms of *re-presentational practices* or *investigating fit* (although usually at the level of appropriateness of expertise or tools in the given research context), hence projecting the image of being interested in inter-CoP collaboration and knowledge development. However, due to the lack of the shared more tacit aspects of inter-CoP practices (i.e. systems of values, appreciations, respect for and recognising the competence of others) these engagements were often condemned by the partners for various reasons, including: personal incompatibility (e.g. partners labelled as impossible to work with); procedural injustice (e.g. in relation to authorship); lack of consideration or flexibility in the course of the collaboration (e.g. the example of lack of trust in capabilities of partners). Hence, it could be asserted that these engagements were – at best – cooperative rather than collaborative (Jeffrey 2003) and the basic activity-based level of practice did not guarantee inter-CoP integration. Furthermore, in accordance with the process of shared practice emergence proposed by Bjørkeng, Clegg and Pitsis (2009), it became evident that the activities of these non-integrating individuals were finally perceived as deviating from what the rest of the participants considered to be legitimate (authoring boundaries), and the individuals were then regarded as not competent to engage in IDR (negotiating competencies). Ultimately, such individuals became excluded from further engagements through the practice of *disengaging*. Overall, then, the findings of this research show how activities and values are tied together in characterisations of collaborative practices, and shows how these can have implications for the development of IDR communities of practice.

However, the relation between activities and appreciations are not straightforward and, as presented in the summarising tables, often span and overarch a number of practices understood as activities. As the practices are dynamic, the boundaries remain fuzzy and

changeable and it may remain difficult to clearly distinguish between different practices or make a clear cut between the implicit and explicit aspects of IDR practices. Furthermore, tensions and trade-offs are likely to exist between different practices being situated in different contexts (e.g. between *negotiating and compromising* and *providing focus*). Consequently, in each context a different mix of practices is likely to emerge, with varying proportions between appreciations and activities. Nevertheless, understanding the dual and dynamic nature of inter-CoP practices can aid overcoming many of the tensions and help in fostering sustainable cross-boundary collaborations.

DYNAMICS OF EMERGENCE OF INTER-COP PRACTICES

The extant literature provides a rather limited analysis of the dynamics of emergence of inter-CoP practice. Whereas Bjørkeng, Clegg and Pitsis (2009) propose an interesting conceptualisation of the process, their analysis is focused on an inter-organisational collaboration that, first, was somehow imposed upon the participants (i.e. this was not a freely formed group of practitioners, hence the groups was presumably under pressure to deliver) and, second, comprised of individuals originating from similar professional communities, hence offering a limited understanding of the dynamics of practice development in the inter-CoP context, especially in a voluntaristic context (or at least a context that has a climate of motivation rather than control). This study, in contrast, focused on voluntary collaborative engagements (both spontaneous and catalysed but never imposed on any of the participants) among members from different epistemic communities (c.f. Sutherland Olsen 2009).

The results of this study largely confirm Sutherland Olsen's (2009) findings that interdisciplinary interactions can support the development of 'intertwined' practices, but also significantly extend this view in a number of ways. The main focus of Sutherland Olsen's (2009) study is on intertwined practices understood purely as activities, arising as a result of frictions between practices of different CoPs[3]. Although similar dynamics were observed in this study, the results of this study also suggest a number of other mechanisms that can lead to emergence of shared inter-CoP practices, in three ways. First, some individuals reported that they engaged in inter-CoP collaborations as a result of disappointments and frustrations

[3] The described examples further resonate with the three main processes of emergence of shared practice as proposed by Bjørkeng, Clegg and Pitsis (2009).

with the existing practices within their native CoPs. As a consequence, these individuals often challenged the native CoPs and, in some cases (as discussed in the finings chapter), embarked upon *pushing boundaries*, potentially resulting in emergence of new practices aimed at inter-CoP collaborations. Hence, not only frictions between practices originating from *other* CoPs, but also frictions *within* CoPs can lead to the emergence and adoption of new (inter-CoP) practices. Second, as discussed in previous chapter, reflective practices were often responsible for development of appreciation for the expertise and worldviews of other CoPs, leading to emergence of pro-collaborative practices and systems of values among individuals. Finally, in some of the observed and discussed examples the development of shared inter-CoP practices was linked to integrative and collaborative processes rather than 'friction'. In particular the emergence of practices such as *recognising competence*, *listening*, *sharing students*, was not underlined by frictions but rather by synergies resulting from a climate of productive dialogue (rather than combative discussion) that supported opening the minds and changing the perceptions of individuals,

The results of this study further confirm that, as suggested by Gherardi (2009a), the different levels of practice need to be taken into account when analysing the dynamics of practice emergence. Indeed, the different mechanisms responsible for practice emergence listed above are likely to have different effects on the observable (i.e. activities) and tacit (i.e. systems of values and attitudes) aspects of practice. Whereas friction can result in the emergence of new actions, the potentially negative character of the mechanism (e.g. underlying frustrations) may have an opposite effect on development of attitudes or appreciation towards inter-CoP collaborations. On the other hand, reflecting is more likely to have a greater impact on the shared values of individuals (Raelin 2001), hence leading to more permanent changes in the systems of values. This might not necessarily immediately translate into visible activities, such as *adapting presentations relationally* or changes in

communicating capabilities. Figure 18 summarises the above discussion in a conceptual model picturing the observed different emergence mechanisms and their (potential) impact on the different levels of practices.

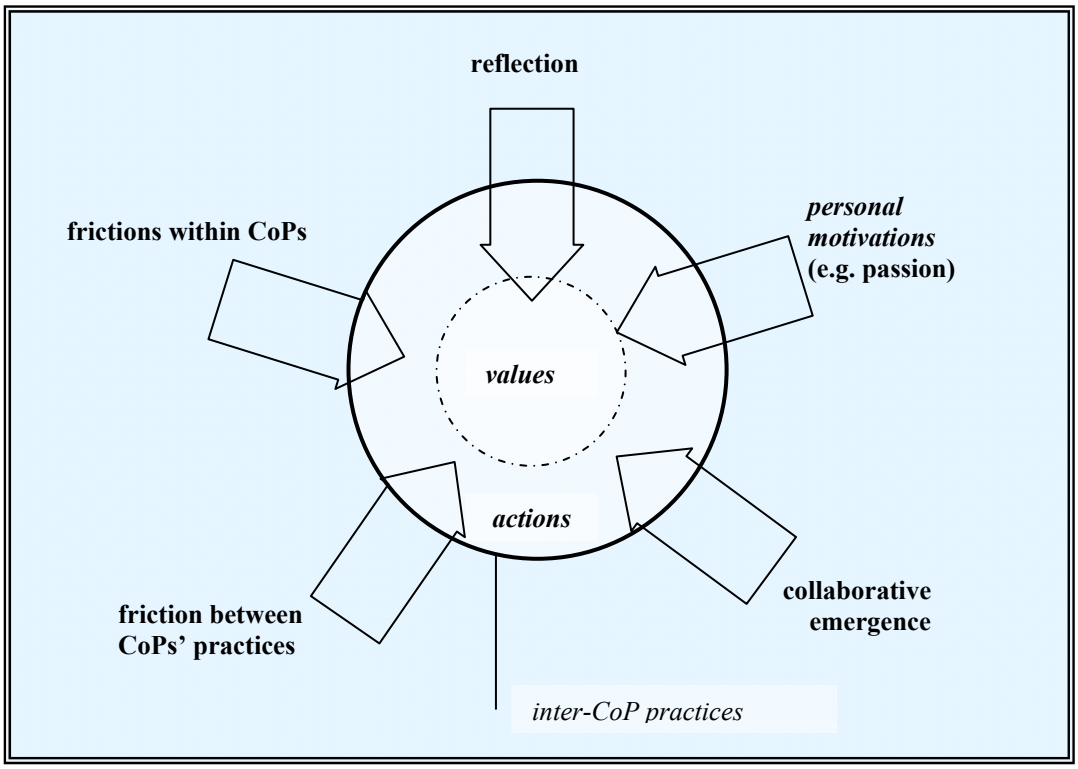

Figure 18. Conceptual model of nature and emergence of inter-CoP practices.

Thus the observed emergence of IDR practices in this study was a composite of different forces, including frictions resulting from disciplinary differences, but also frictions originating within individuals' native CoPs, often linked to personal motivations and actions, individual reflection or synergetic engagements between members of different CoPs. On many occasions there was not just one single mechanism that lead to the emergence of new practices but rather the different modes appeared to be entangled. Indeed, reflection could be linked to friction but also to collaborative emergence. Similarly, productive and synergetic collaboration often led to frictions and the emergence of new practices (or the renegotiation

of existing IDR practices) as individuals became immersed in collaborative research. Hence, this integrative model provides a more holistic view of the dynamics of the emergence of inter-CoP practices.

LEVELS OF INTEGRATION OF INTER-COP PRACTICES AND NETWORKS

Both the extant literature and the results presented earlier paint a somewhat polarised picture in relation to the existence of inter-CoP practices. On the one hand, the literature provides examples of (emerging) shared collaborative practice between members of different CoPs (Bjørkeng, Clegg and Pitsis 2009; Sutherland Olsen 2009; Scarborough and Swan 2008), and this notion has been extended and better characterised by the results of this research. On the other hand, the extant literature provides an abundance of examples of cross boundary engagements, which did not lead to emergence of (sustainable) shared practices among partners (Amin and Roberts 2008; Ferlie et al 2005; Lindkvist 2005). The results of this study are helpful here, in showing how a lack of shared, legitimate IDR practices in the collaborative research context can lead to disengagements and the exclusion of individuals from potential future IDR projects. Hence, two important observations can be made in relation to the existence of some failed IDR projects, in the literature and this research.

First, in many of the collaborations, some participants were driven either by financially related factors (accessing money; increasing the ratings of the department; increasing chances for promotion through bringing more money to the department, etc) or by a search for application for existing tools. As a result, these groups, or individuals, did not attempt to develop shared systems of values or understanding between the participants, but instead were often working at the minimal basis of understanding and engagement (Lindkvist 2005) reduced to the simple borrowing and applying tools across disciplinary boundaries. Thus there was limited integration and these collaborations instead resembled the concepts of Collectivities of Practice (Lindkvist 2005) or Communities of Interest (Fischer 2001). While in many of the instances individuals displayed a number of IDR practices in the form of

certain activities (e.g. *seeking opportunities*, *searching for connections*, *communicating capabilities* – although usually in the form of possessed expertise and tools), the deeper level of practices in the form of values, respect for other CoPs (and so on) was apparently missing. Hence, these interactions hardly lead to real knowledge integrations and more often resembled what the literature on IDR would consider as multidisciplinary *cooperations* (Petts et al 2008; Balsinger 2004; CoFIR 2004; Schummer 2004; Jeffrey 2003; Morillo, Bordons and Gomez 2003).

Second, the results provide a number of examples of collaborative research where individuals engaged in the processes of developing shared IDR practices, often through authoring boundaries and negotiating competencies (Bjørkeng, Clegg and Pitsis 2009), as well as developing shared systems of values and an appreciation for this mode of research (Gherardi 2009a). As a result, in some instances the newly developed IDR practices were integrated back within the native communities of the participants, often forming a part of the fabric of practices of those CoPs. Hence, higher levels of integration of the new inter-CoP practices occurred at both individual and group levels. Overall, this suggests that inter-CoP engagements can be placed on a continuum based on the levels of integration between the existing practices of involved CoPs. At one end of the continuum participants engage in the simplest cross-boundary exchanges and remain loyal to their native CoPs and practices (Amin and Roberts 2008; Lindkvist 2005), and often defend native practices from 'contamination' (Scarborough and Swan 2008; Ferlie et al 2005). However, at the other end of the spectrum much greater appreciation, and hence the development of relevant system(s) of values is characteristic. Figure 19 summarises the above discussion, depicting the relation between inter-CoP collaborations and emergence of inter-CoP practices.

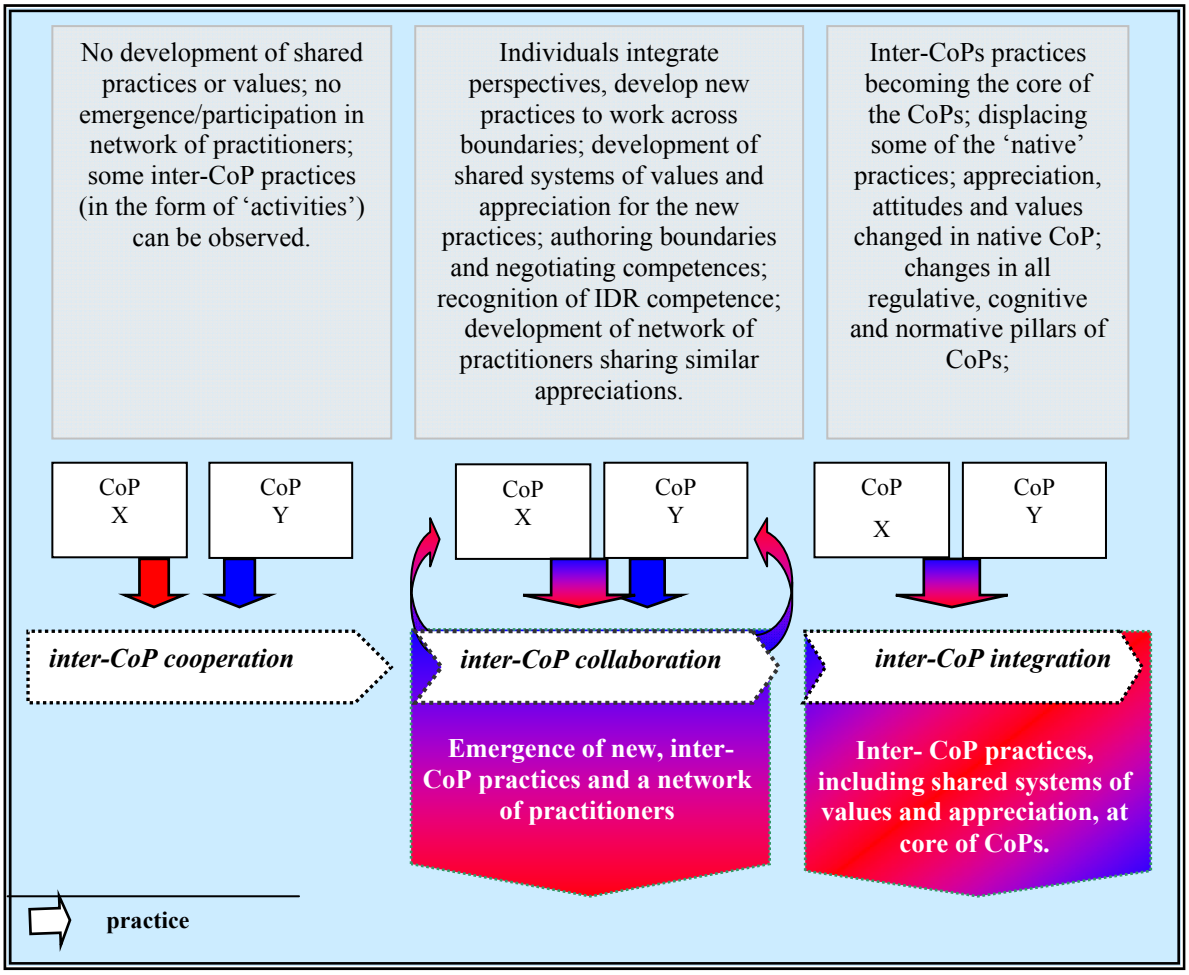

Figure 19: Inter-CoP practice continuum.

As Figure 19 suggests, at cooperative levels of engagement, individuals are likely to display some rather mechanistic and action-oriented (e.g. *exploratory* or *re-presentational*) practices that enable them to identify and engage in inter-CoP projects, find potential partners and build some inter-CoP relationships. However, as the shared understanding is likely to be at the rather minimal level, these types of engagements are likely to be hindered by misunderstandings, a lack of procedural justice and, consequently, conflicts and frustrations. In the light of the extant literature, this category is likely to hinder spread of innovation among professional groups (Ferlie et al 2005; Lindkvist 2005), with the practice integration being limited to rather *instrumental* levels.

On the next level individuals engage in developing more coherent understandings but also a set of higher level shared inter-CoP practices, including collaborative or reflective practices, and practices aimed at further developing the network and negotiating what constitutes good IDR practice within it. As the practices at this level are often related to integration with the systems of values and integrity (e.g. engaging in inter-CoP exchanges for personal and knowledge development reasons) of individuals, this level can be referred to as *integral*.

Finally, at the next level, which I will refer to as *epistemic*, inter-CoP practices are being adopted and woven into the fabric of native practices of a given CoP. Hence, the systems of values, appreciations and changes in attitudes applies not only to individuals, but to CoPs, and affects their native practices. In this way, the new inter-CoP related practices are recognised (i.e. legitimised). Hence some mechanisms of support and learning may be developed and implemented within CoPs (c.f. the notion of situated curriculum, Gherardi, Nicolini and Odella 1998). Some norms, but also evaluation systems, for 'good inter-CoP' practices are therefore likely to develop over time, further legitimising the new set of competences. Indeed, the dynamics of the process can be compared to the example of the development of a CoP around a new school of thought, as described by Landri (2007: 410):

> *'the fabric of mathematics develops within an epistemic community; it unfolds through the differentiation of schools of mathematics implying differences in terms of practice, and reflects diversities in aesthetic judgments on the objects of knowledge',*

However, rather than a new school of (for example) mathematics, the appreciation and practices in the context of this study will be directed towards inter-CoP collaborations as a prevailing mode of knowledge development and sharing.

To summarise the above discussion, it can be argued that the three levels discussed above can be arranged as a potentially cumulative development 'pyramid', as shown in Figure 20.

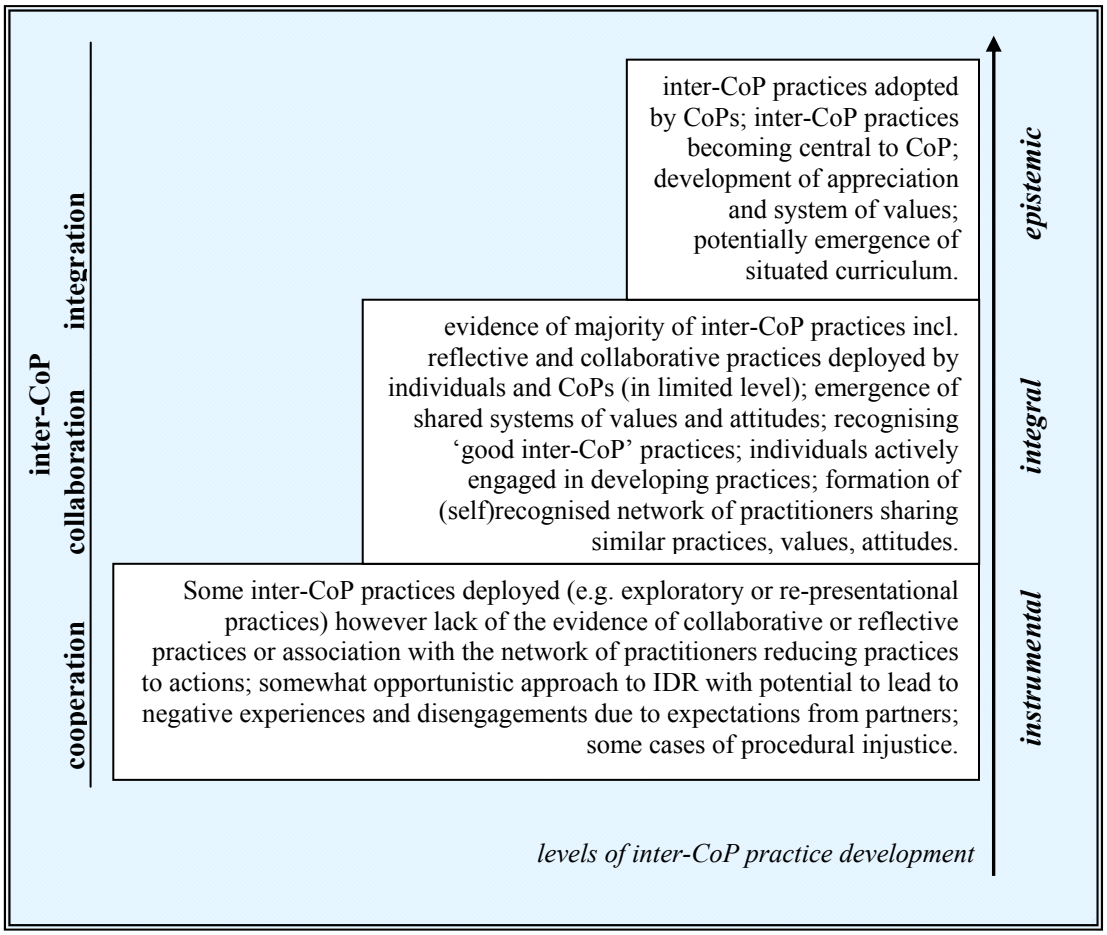

Figure 20: Inter-CoP practices development pyramid.

The conceptualisation provided in Figure 20 might also apply to different forms of 'communities' of practice, where the levels of shared values can indicate emerging community. This provides an additional dimension for the conceptualisation of CoPs by addressing some of the recent criticism of over-focusing on structural aspects (Thompson and Walsham 2009; Duguid 2008; Thompson 2005), thereby responding to calls for a renewed focus on practice (Bjørkeng, Clegg and Pitsis 2009; Blacker and Regan 2009;

Geiger 2009; Gherardi 2009a; 2009b; Miettinen, Samra-Fredericks and Yanow 2009). In addition, the framework addresses some of the problematics related to distinguishing between multi-, inter- and trans-disciplinary research collaborations (e.g. see Petts et al 2008; Aram 2004). Indeed, approaching IDR from the perspective of practice and adopting the above framework can shed some additional light on the dynamics of this mode of research and, hence, potentially address the policy needs outlined in earlier chapter. In particular, it potentially offers a better tool to operationalise the concept (c.f. Huutoniemi et al 2010) by distinguishing between instrumental, integral and epistemic levels of IDR practice development and integration.

IMPLICATIONS, LIMITATIONS AND FURTHER RESEARCH

IMPLICATIONS FOR THE POLICY AND PRACTICE

The results of this study further have implications for both practitioners and policy makers. First, by shifting the focus to practice when analysing IDR engagements, it sheds additional light on the drivers and dynamics of conducting and learning IDR, and consequently in supporting IDR as a legitimate mode of research. Indeed, the results confirm that policy makers and organisations may need to move away from approaches solely focused on the structural or instrumental aspects of IDR (including creating new collaborative spaces or institutes for advanced studies, providing research grants devoted to interdisciplinary proposals, or detailing step-by-step guidelines for conducting IDR (Boni, Weingart and Evenson 2009; Bozeman and Corley 2004; Schummer 2004; Szostak 2002; Newell 2001). Instead, this research suggest that there should be a focus on developing more effective mechanisms for the dynamic development of the desired practices, in the wider meaning of the concept. Similarly, for (potential) practitioners understanding the nature and dynamics of IDR can offer guidance and prepare them better for the journey, whilst offering a number of practical tools and mechanisms (e.g. collaborative practices) to ensure that the cross-boundary collaboration is as smooth and productive as possible, other things being equal.

Second, approaching IDR from the perspective of practice can offer a more reliable framework for distinguishing between the different modes of cross-disciplinary engagements, including interdisciplinary and multidisciplinary research (see Figure 19). Hence, such frameworks can offer more insightful tools for assessing levels of integration and collaboration in the development of policy. Indeed, focusing on practice can bring the

approach closer to '*what people do in their workplace*' (Nicolini 2009: 1391), and so provide a better understanding of the dynamics and motives driving – or retarding – uptake of IDR research.

IMPACT OF THE RESEARCH FINDINGS ON BTG PROGRAMME AND IDR AT THE UNIVERSITY OF STRATHCLYDE

As discussed in the methodology chapter, the funding arrangements of this research further implied elements of Action Research in the overall research design, hence meriting additional reflection on the influence this research had upon the BTG programme, the participants and interdisciplinarity at the University of Strathclyde in more general terms.

The impact of this research upon the BTG programme can be categorized in two ways. First, direct impact, mostly in the form of implemented changes in the BTG programme and initiatives and, second, indirect impact in the form of more settled changes in attitudes and understanding of IDR processes by BTG members and programme participants. Some of the examples of the impact include:

- *Defining the role of the departmental BTG Champions*: one of the first initiatives I undertook was to interview the departmental Champions (i.e. individuals to represent and aid BTG efforts in the core departments) to develop better understanding of the attitudes towards and provide an overview of the current state of IDR across the BTG core departments. This phase helped to identify a number of diverse barriers and drivers to IDR as perceived by different disciplines and, consequently, develop a better idea how to engage Champions in the future initiatives. Some direct changes in the initial plan were made, with a number of following initiatives aimed at including champions in

the research. On another level the discussions carried on with Champions had potential impact on their understanding of the practices characteristic to other disciplines (i.e. I acted t some extent as a broker of knowledge) and their general perspectives on IDR. Indeed, on a number of occasions some Champions admitted that they did not think about certain aspects of engaging in IDR; be it some barriers perceived by other disciplines or differences in approaching research problems. This changes in understanding the dynamics of IDR would further impact on their pivotal role as departmental Champions, hence having an influence on the BTG project.

- *Changes of the initial design of initiatives:* a number of initiatives were re-designed to implement some of the findings originating from this research. For example, feedback gathered whilst following the themed retreats and sandpits helped to develop a better understanding of the dynamics of these initiatives, highlighting a number of problems arising from the initial design (e.g. timing, moderation of the meetings, selection of participants). As a result, the design of these initiatives was significantly revised to utilise the learning that was presented to the board.
- *General changes across all BTG initiatives:* as a result of a number of reports and discussions with the board, a stronger focus on learning and nurturing IDR collaborations was placed on all the initiatives (e.g. a shift of focus from simply focusing on developing proposals to inclusion of softer measures of success in the evaluation process). This change was an effect of the numerous interim reports and conversations with the board during the project.
- *Advancing the understanding of IDR by the board and other participants:* through presenting a number of reports based on the extensive literature review on IDR the board was introduced to the different reconceptualisations of and perspectives on IDR. This lead to changes in the rhetoric, with the board members increasingly focusing their

attention on the '*need to build interdisciplinary ethos of interdisciplinary research at university*' and to '*nurture, nurture and nurture*' collaborative groups and ideas. Other observed changes included increasing focus on involving PhD students and early career staff in IDR initiatives, focusing on long-term relationship development rather than simply providing

- *Dissemination of the results during IDR initiatives:* some of the results and recommendations presented to the board formed a part of introductory presentation during some of the BTG initiatives, hence exposing the wider audience across the university to the learning achieved through this project, highlighting some of the major barriers and drivers and gauging the expectations of the participants prior to the initiatives.
- *Learning and teaching IDR:* the results of this research had further impact on the understanding of the learning (and teaching) IDR across BTG initiatives as well as across the university. First, the feedback generated after the University Research Day lead to establishing formal couching sessions for students to aid them in developing the required presentation skills prior to the forthcoming University Research Days. At another level, based on the findings from the research, we have developed and delivered as a 3-day elective module for Masters in Research Methodology in Business and Management students at the Strathclyde Business School. The module was further offered as a one-day course for early career researchers across the whole university, with a shorter version of the course being later developed and offered as a Professional Development Workshop during the Academy of Management annual meeting. Finally, the underlying principles of this course were presented during the European Workshop for Research Directors of Business Schools.

Hence, as the examples above demonstrate, this research project had both immediate and long-lasting impact on the BTG programme, but also on the uptake of IDR at the University level.

LIMITATIONS OF THE STUDY

As with any research project, this research has some limitations. First, by being limited to one case organisation and a limited period of time, generalisability of the results needs to be further confirmed through research in other case contexts. However, this problem is partly mitigated by the strong connections between the results of this study and debates in the extant literature – the conceptual development is logically coherent in relation to this.

Second, the adopted interpretative approach to data collection and analysis bears certain limitations related to subjectivism and reliance on the personal understandings and perspectives of the researcher. Although a number of steps were undertaken to ensure maximum validity of the research (as discussed in the previous chapters), this issue cannot be completely mitigated. Indeed, my ethnographic sensibility –and sensitivity – are largely influenced by my background and previous experiences, which further influence my perceptions of what is important and what is not. However, the interpretations I have drawn have been developed and challenged: through the application of a systematic methodology; by review and comment within the university (including colleagues and research participants); and by peer review and discussion at international conferences.

FURTHER RESEARCH

Further limitations relate to the scope of the study as well as the breadth and richness of the collected data, which opens some additional avenues for future research that could potentially extend and reinforce the findings presented in this thesis. First of all, as already alluded to, it would be useful to extend the study into different settings, including both

industry and academic contexts. In addition, extending the study to a non-UK setting would shed additional light at the similarities and differences in different cultural settings.

Due to the focus, and consequent limitations, of this thesis not all the data collected during the research project could be utilised in this research. Indeed, as a result of adopting the principles of grounded theory (Strauss and Corbin 1998), a large body of data related to different aspects of IDR was collected as at these stages of the project the final theoretical focus was not yet decided. The some of the examples of the areas of additionally collected data include, but are not limited to, the aspects of identity or the learning processes underpinning the development of inter-CoP practices; differences in disciplinary perspectives on barriers and drivers of interdisciplinary research collaborations and how they are tackled; etc.

Further analysis and development of this part of the data could potentially add to the understanding of individual and organisational learning from the perspective of multi-membership in different CoPs, but also how the processes of socialisation are structured and managed in the context of an inter-CoP network of practitioners. Similarly, the aspect of identity in the context of inter-CoP engagements forms an interesting research avenue that requires further exploration in order to deepen our understanding of the dynamics of IDR as well as other inter-CoP engagements. These additional data will be further analysed and developed into subsequent publications, which hopefully would inform both theory and practice related these fields.

Furthermore, I believe that, although in the process of writing this thesis I have made some decisions as which data are important and why, the '*ethnographic research yields observations that are relevant to many points of theoretical interest*' (Feldman 2004: 298),

hence new ‘strands of threads’ that may be of interest from other theoretical perspectives are likely to be interwoven in, and hence discovered through additional analysis of, the existing data.

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APPENDICES

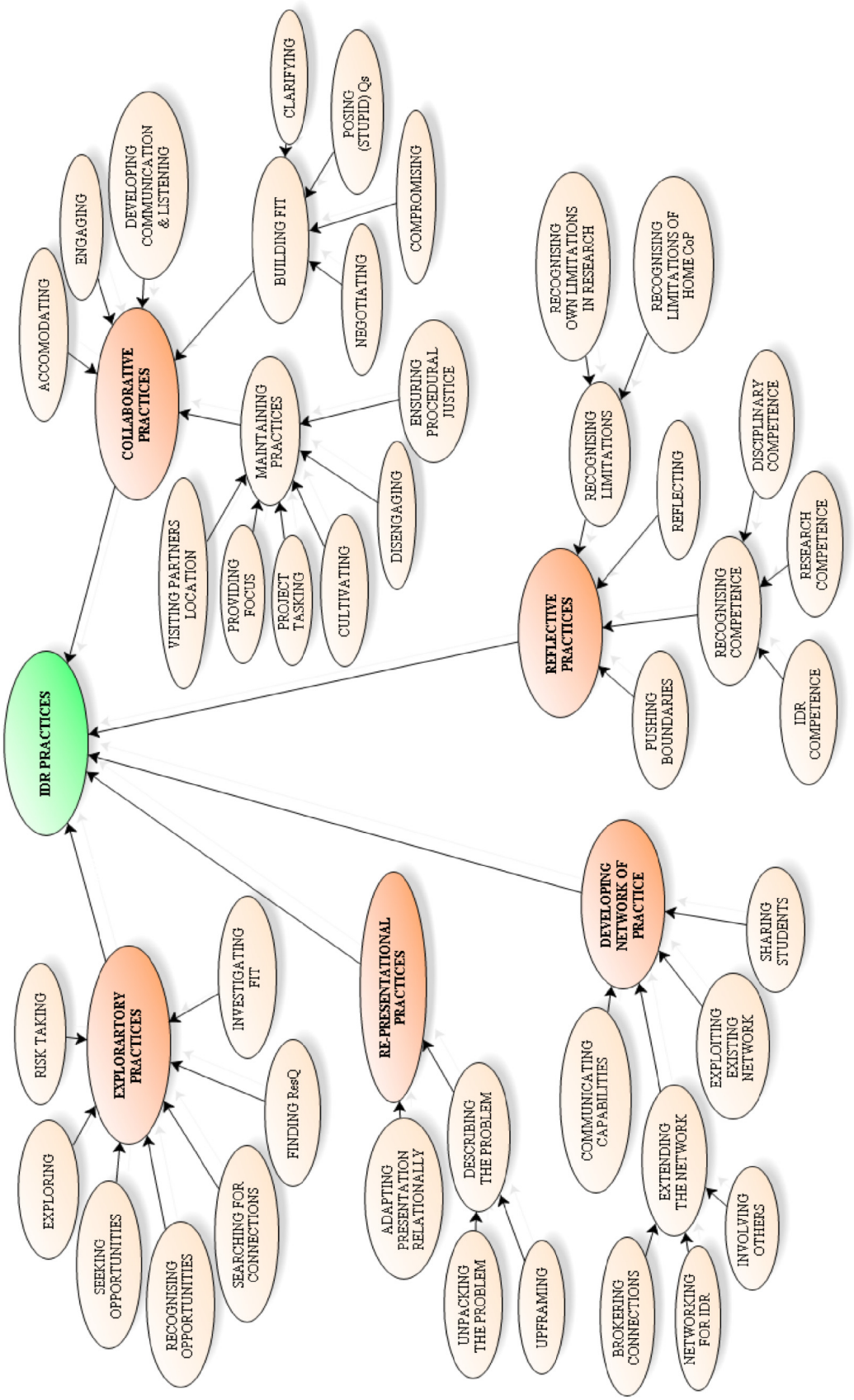
APPENDIX I: CODING CATEGORIES AND FINAL TREE STRUCTURES

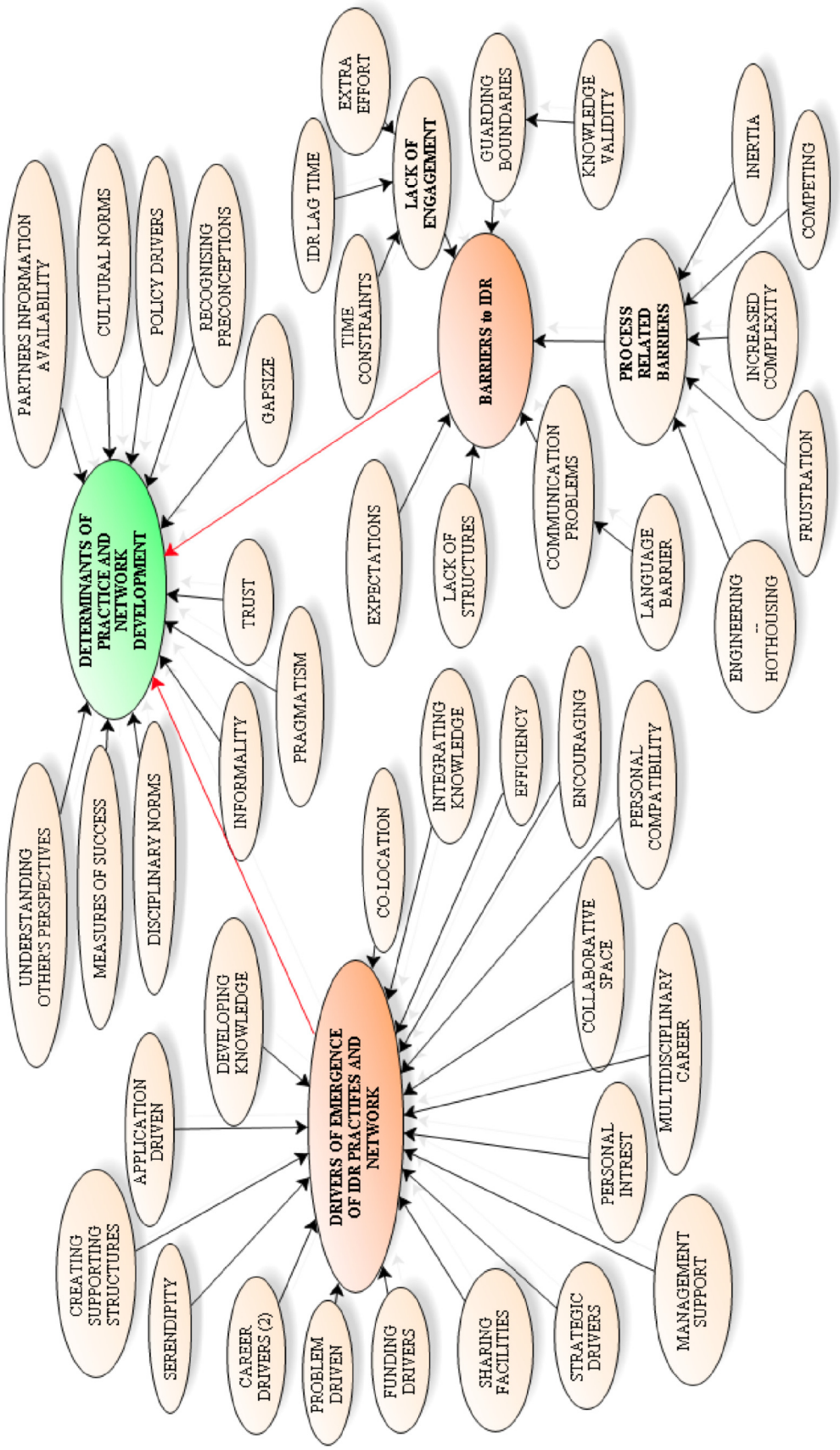
CODING CATEGORY	NUMBER OF SOURCES	NUMBER OF CODED ITEMS
ACCOMODATING	16	22
ADAPTING PRESENTATION RELATIONALLY	16	21
APPLICATION DRIVEN	19	28
BROKERING CONNECTIONS	21	37
BUILDING FIT	27	47
CAREER DRIVERS (2)	9	15
CLARIFYING	11	12
CO-LOCATION	7	7
COLLABORATIVE SPACE	6	10
COMMUNICATING CAPABILITIES	8	12
COMMUNICATION PROBLEMS	20	34
COMPETING	8	11
COMPROMISING	9	9
CREATING SUPPORTING STRUCTURES	37	54
CULTIVATING	8	11
CULTURAL NORMS	23	34
CURIOSITY	5	5
DESCRIBING THE PROBLEM	27	41
DETERMINATION	5	6
DEVELOPING COMMUNICATION & LISTENING	22	50
DEVELOPING KNOWLEDGE	24	28
DISCIPLINARY COMPETENCE	14	18
DISCIPLINARY NORMS	50	107
DISENGAGING	6	6
EFFICIENCY	2	2
ENCOURAGING	32	58
ENGAGING	37	64
ENGINEERING -- HOTHOUSING	9	12
ENSURING PROCEDURAL JUSTICE	12	16
EXISTENCE OF NETWORKS	8	12
EXPECTATIONS	8	12
EXPERIENTIAL LEARNING	32	62
EXPLOITING EXISTING NETWORK	32	49
EXPLORING	30	41
EXTRA EFFORT	13	19
FINDING ResQ	18	22

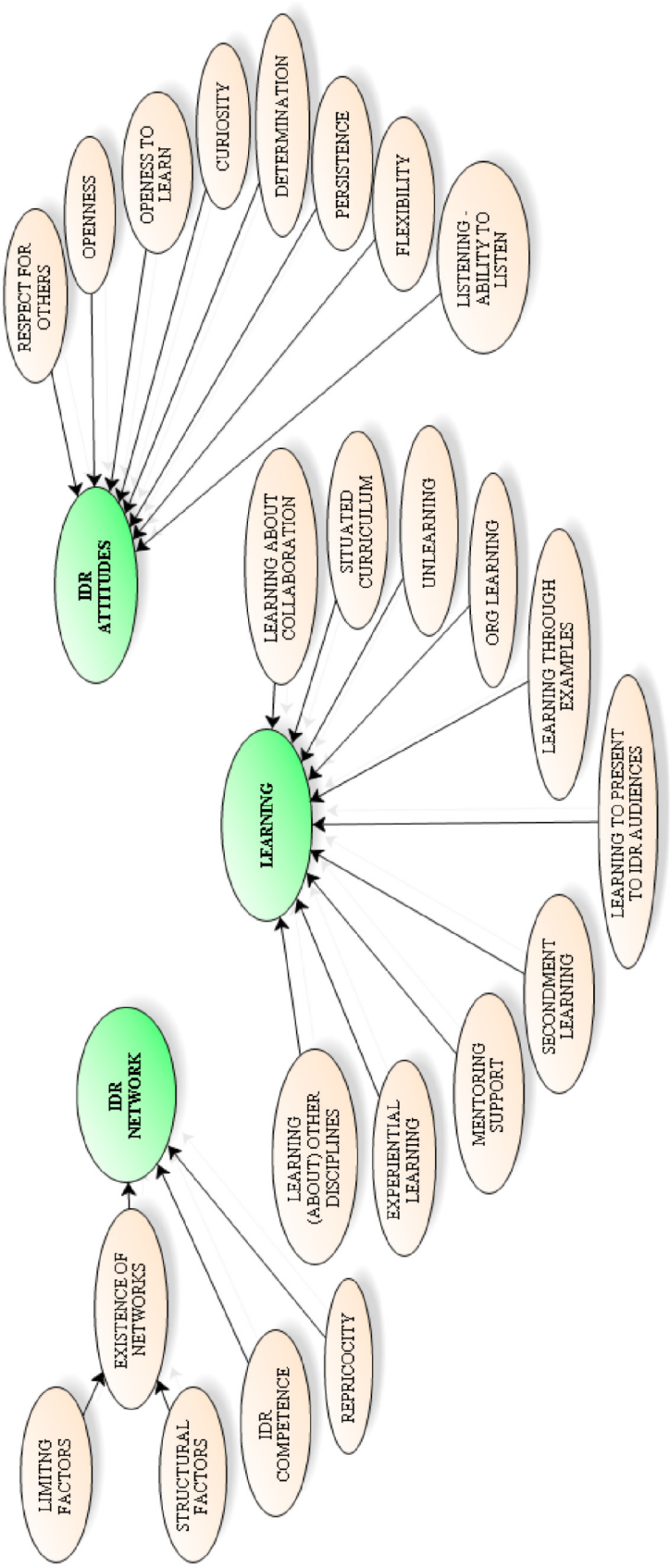
FLEXIBILITY	2	2
FRUSTRATION	6	6
FUNDING DRIVERS	26	41
GAPSIZE	18	27
GUARDING BOUNDARIES	7	8
IDR COMPETENCE	20	34
IDR COMPETENCE	12	14
IDR LAG TIME	3	3
INCREASED COMPLEXITY	4	5
INERTIA	3	3
INFORMALITY	8	13
INTEGRATING KNOWLEDGE	14	20
INVESTIGATING FIT	26	39
INVOLVING OTHERS	21	24
KNOWLEDGE VALIDITY	5	5
LACK OF ENGAGEMENT	21	28
LACK OF STRUCTURES	7	10
LANGUAGE BARRIER	25	42
LEARNING (ABOUT) OTHER DISCIPLINES	40	76
LEARNING ABOUT COLLABORATION	20	21
LEARNING THROUGH EXAMPLES	4	5
LEARNING TO PRESENT TO IDR AUDIENCES	10	10
LIMITING FACTORS	3	6
LISTENING - ABILITY TO LISTEN	1	8
MANAGEMENT SUPPORT	14	17
MEASURES OF SUCCESS	9	11
MENTORING SUPPORT	16	23
MULTIDISCIPLINARY CAREER	11	13
NEGOTIATING	17	21
NETWORKING FOR IDR	11	14
OPENESS TO LEARN	6	9
OPENNESS	12	23
ORG LEARNING	9	11
PARTNERS INFORMATION AVAILABILITY	9	10
PERSISTENCE	6	8
PERSONAL COMPATIBILITY	20	38
PERSONAL INTREST	22	41
POLICY DRIVERS	9	11
POSING (STUPID) Qs	5	8
PRAGMATISM	16	19
PROBLEM DRIVEN	10	12

PROJECT TASKING	7	9
PROVIDING FOCUS	11	15
PUSHING BOUNDARIES	10	11
RECOGNISING COMPETENCE	25	52
RECOGNISING LIMITATIONS	35	68
RECOGNISING LIMITATIONS OF HOME CoP	16	18
RECOGNISING OPPORTUNITIES	33	60
RECOGNISING OWN LIMITATIONS IN RESEARCH	11	13
RECOGNISING PRECONCEPTIONS	28	39
REFLECTING	8	11
REPRICOCITY	3	7
RESEARCH COMPETENCE	12	13
RESPECT FOR OTHERS	5	5
RISK TAKING	7	9
SEARCHING FOR CONNECTIONS	27	48
SECONDMENT LEARNING	6	6
SEEKING OPPORTUNITIES	27	44
SERENDIPITY	14	22
SHARING FACILITIES	2	2
SHARING STUDENTS	11	17
SITUATED CURRICULUM	17	25
STRATEGIC DRIVERS	13	22
STRUCTURAL FACTORS	7	11
TIME CONSTRAINTS	16	17
TRUST	17	33
UNDERSTANDING OTHER'S PERSPECTIVES	38	100
UNLEARNING	8	9
UNPACKING THE PROBLEM	13	18
UPFRAMING	11	18
VISITING PARTNERS LOCATION	6	9

THE FINAL DATA STRUCTURE UNDER THE MAIN 5 THEMES


IDR PRACTICES
COLLABORATIVE PRACTICES
ACCOMODATING
ENGAGING
DEVELOPING COMMUNICATION & LISTENING
BUILDING FIT
CLARIFYING
POSING (STUPID) Qs
NEGOTIATING
COMPROMISING
MAINTAINING PRACTICES
VISITING PARTNERS LOCATION
PROVIDING FOCUS
PROJECT TASKING
CULTIVATING
DISENGAGING
ENSURING PROCEDURAL JUSTICE
REFLECTIVE PRACTICES
RECOGNISING LIMITATIONS
RECOGNISING OWN LIMITATIONS IN RESEARCH
RECOGNISING LIMITATIONS OF HOME CoP
REFLECTING
PUSHING BOUNDARIES
RECOGNISING COMPETENCE
DISCIPLINARY COMPETENCE
RESEARCH COMPETENCE
IDR COMPETENCE
EXPLORARTORY PRACTICES
RISK TAKING
EXPLORING
SEEKING OPPORTUNITIES
RECOGNISING OPPORTUNITIES
SEARCHING FOR CONNECTIONS
FINDING ResQ
INVESTIGATING FIT
RE-PRESENTATIONAL PRACTICES
ADAPTING PRESENTATION RELATIONALLY
DESCRIBING THE PROBLEM
UNPACKING THE PROBLEM
UPFRAMING
DEVELOPING NETWORK OF PRACTICE
COMMUNICATING CAPABILITIES
EXTENDING THE NETWORK
BROKERING CONNECTIONS
NETWORKING FOR IDR
INVOLVING OTHERS
EXPLOITING EXISTING NETWORK
SHARING STUDENTS


DETERMINANTS OF PRACTICE AND NETWORK DEVELOPMENT
PARTNERS INFORMATION AVAILABILITY
CULTURAL NORMS
POLICY DRIVERS
RECOGNISING PRECONCEPTIONS
GAPSIZE
TRUST
PRAGMATISM
INFORMALITY
DISCIPLINARY NORMS
MEASURES OF SUCCESS
UNDERSTANDING OTHER'S PERSPECTIVES
BARRIERS to IDR
LACK OF ENGAGEMENT
EXTRA EFFORT
IDR LAG TIME
TIME CONSTRAINTS
GUARDING BOUNDARIES
KNOWLEDGE VALIDITY
EXPECTATIONS
LACK OF STRUCTURES
COMMUNICATION PROBLEMS
LANGUAGE BARRIER
PROCESS RELATED BARRIERS
INERTIA
COMPETING
INCREASED COMPLEXITY
FRUSTRATION
ENGINEERING -- HOTHOUSING
DRIVERS OF EMERGENCE OF IDR PRACTIFES AND NETWORK
CO-LOCATION
INTEGRATING KNOWLEDGE
EFFICIENCY
ENCOURAGING
PERSONAL COMPATIBILITY
COLLABORATIVE SPACE
MULTIDISCIPLINARY CAREER
PERSONAL INTREST
MANAGEMENT SUPPORT
STRATEGIC DRIVERS
SHARING FACILITIES
FUNDING DRIVERS
PROBLEM DRIVEN
CAREER DRIVERS (2)
SERENDIPITY
CREATING SUPPORTING STRUCTURES
APPLICATION DRIVEN
DEVELOPING KNOWLEDGE


IDR ATTITUDES
RESPECT FOR OTHERS
OPENNESS
OPENESS TO LEARN
CURIOSITY
DETERMINATION
PERSISTENCE
FLEXIBILITY
LISTENING - ABILITY TO LISTEN
LEARNING
LEARNING ABOUT COLLABORATION
SITUATED CURRICULUM
UNLEARNING
ORG LEARNING
LEARNING THROUGH EXAMPLES
LEARNING TO PRESENT TO IDR AUDIENCES
SECONDMENT LEARNING
MENTORING SUPPORT
EXPERIENTIAL LEARNING
LEARNING (ABOUT) OTHER DISCIPLINES
IDR NETWORK
REPRICOCITY
IDR COMPETENCE
STRUCTURAL FACTORS
EXISTENCE OF NETWORKS
LIMITING FACTORS

APPENDIX II: AN EXAMPLE OF MEMO NOTES

14/10/2009 12:00

DEVELOPING COMMUNICATION

* links to Communication Problems; language problems; learning (about) other disciplines, Understanding other's perspective; personal compatibility; trust;
* part of Practices: A-Firming? or separate group?
* part of network: integrating partners?

* links to personal compatibility and building trust:
But if you have a problem, you identified people with the right skills to solve the problem, you made the decision that they can help – then the language is not a barrier anymore. It's still an issue but not a barrier. I don't tend to worry about the language too much.

* links to understanding other's perspective, describing the problem; part of building fit. Also can constitute part of extra effort required by IDR / inter-CoP collaborations.

* in the process some respondents recognised the risk of "false" understanding: developing communication is an incremental process requiring prolonged time:

there are other problems – such as vocabulary. You each use terms in number of context and you never quite sure what the other person means. So you need a period when you learn what each of you mean. There needs to be a period when you adjust to working with each other. So it's not good trying to create collaboration or get funding or publish a paper in a very short period of time.

* links to unlearning as sometime individuals need to shed what they understand by certain words - or at least acknowledge the difference and temporarily retreat from the understanding shared by the CoP you in:
The problem is that when I use planning I'm going to carry on using what I mean by it – even if you tell me what you mean by it all it means is that I understand that you have a different interpretation of the word but it's not going to change the way I use it because it's too embedded in my everyday work. So the best that we can hope for is that I realise that when I use the word planning it's not going to mean the same thing that it means to you. But it's not going to be easy for me to overcome that gap of the use of the word – just by explaining what it means by the word. Somehow you've got to connect what you mean by planning to something that the other person understands and has some different terms for – or can construct new set of terms for it. So it's not enough to tell you what I mean by planning – you've got to understand it in concrete terms by seeing how it applies to a problem.

* two major ways of developing communications in the data: organic way through working together on a number of projects and supported (organised) way through conversion courses, away days, seminars etc and often setting up some grand rules for meetings:

Another important thing - There're no stupid questions. We have found out that problems arise when people use different ways and words to describe the same thing. By asking q u can clarify and dev common language.

* through reflection and adapting own presentations becomes part of practice (DL reflections on communicating with others - becomes certain way of developing new language / practices)

16/10/2009 14:21
FRUSTRATION

* with lack of engagement, lack of response; lack of commitment whilst trying to extend the network. Links to experiential learning.
We also talked to physiology: "yes, I can do it. I'd like to do it" - but then it went nowhere.
And you just don't understand why things didn't progress….

* with understanding and integrating other's perspectives or being misunderstood by other disciplines:
When you say that to people you have to explain that is because in nature 1% in nature is actually very very efficient. It depends on area you work on but when you say top experimentalist or engineers "this is 1% efficient, this is phenomenal! And they are like "OK – Bye Bye…" They don't understand that.

* with just passing the message rather than actively brokering connections

* with extra time and effort required to find a ResQ or for rewards.

21/10/2009 21:28

PRESENTING TO OTHERS

divide into:
> learning to present to others
> adapt presentations relationally?

* focus on the larger picture
And if you have 10 minutes and don't know the audience – should really just show the big issues. Convince rather then waste their time…

* need to account for language barriers
the real key to get across to people – especially on the science side – is that they not communicating with scientist and it's their job both in the poster and in the oral presentation of it to find a way to communicate it to intelligent, lay audience in a way to communicate significance.

* understanding other's perspective - and adapt relationally - **!!!!**
For example when giving a presentation – you need to talk to the audience. If the audience is interdisciplinary not everyone would know what you are talking about. Some of them may not get 90% of it. But then you give them a primer, something that shows the bigger picture – and that's what it all is about: a greater good.
You need to be honest with what you are doing and link to different audiences. You can simplify and generalize but not take the technical terms. People don't like to be looked down on, especially students.

* involves learning and situated curriculum:
So I think this is a skill during the workshop – even if it's just 10 minutes so we learning. You need to learn to explain yourself in a simple language so other people will be able to understand you. This is important. Otherwise you won't be able to find a partner to work together.

APPENDIX III: FURTHER PARTICULARS OF THE STUDY RESPONDENTS

BREAKDOWN OF THE KEY RESPONDENTS OF THE STUDY			
BY POSITION (incl. secondary position)	**Number of respondents**	**BY DEPARTMENTAL AFFILIATION**	**Number of respondents**
Professor	20	Computer and Information Sciences	6
PhD student	9	EEE	5
Senior Lecturer	8	Mathematics	4
Lecturer	7	Management Science	4
Reader	6	Statistics and Modelling Science	3
Visiting Professor	1	NaME	3
Research fellow	1	Bioengineering	3
Programme manager	1	Psychology	2
Learning Technology Advisor	1	Mechanical Engineering	2
Interdisciplinary Project Manager	1	Management	2
Director of research	1	Civil Engineering	2
Centre Director	1	Chemistry	2
Head of Department	3	Chemical and Process Engineering	2
Deputy Head of Department	1	Strathclyde Institute of Pharmacy and Biomedical Sciences	1
Director of Research	1	Sociology	1
Departmental BTG Champion	7	Pure and Applied Chemistry	1
		Physics	1
		National Centre for Prosthetics and Orthodontics	1
BY INSTITUTIONAL AFFILIATION	**Number of respondents**	Glasgow School of Social Work	1
Strathclyde University	52	Marketing	1
Bath University	1	Human Resource Management	1
Bristol University	1	Architecture	*1*
Newcastle University	1	Education	1
Industry	1	Economics	1
EPSRC funding council	1	DMEM	1
		CAPLE	1
		Engineering	1
		EPSRC	1
		Research and Innovation	1
		Vice president (commercial organisation)	*1*