'TECHNOLOGY TRANSFER' THROUGH HIGH TECHNOLOGY CORRIDORS: A STUDY OF MULTI-AGENCY PARTNERSHIP LEARNING

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This thesis was completed as part of the Doctoral Programme in Educational Research

Declaration

This thesis results entirely from my own work and has not been offered previously for any other degree or diploma

Signature

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Abstract

The research explores the implementation of a 'technology transfer' policy in High Technology Corridors (HTCs), which responded to a critical incident in the West Midlands. The policy was a direct result of the crisis at the Rover Automotive Plant in 1999, when it was threatened by possible closure with the potential loss of 27,000 jobs. This was a catalyst for the region to change from dependence on traditional manufacturing by developing a regional 'knowledge economy'.

HTC policy was based on the premise that change would happen by bringing together communities of business 'users' and research 'developers' with no prior history of working together. My research challenges current theories and tacit assumptions about how complex business and university multi-agency partnerships 'work in practice'.

Expansive learning theory is an evocative heuristic device that has been used in recent studies of innovation in complex organisations. It is applied in this study of multi agency learning because it frames the relationships between individual and collective subject perspectives. Human relationships are mediated by tools, social rules and divisions of labour orientated towards an object of activity and collaborative outcomes.

Three hierarchical levels of policy enactment evolved during the implementation process, but because this happened in an ad hoc way, mechanisms to link the levels

were not fully considered. My research reconstructed HTC as *meta-activity systems*, or networks in which sub activity systems collide and interact in two dimensions.

Collaboration between experts involves crossing horizontal boundaries between activity systems. Special tools called *boundary objects* can link communities with no previous experience of working together. They act as bridges across the horizontal boundaries between activity systems, separating different cultural practices. They enable people operating at the same level to learn from one another by expanding the 'object of their activity' towards collaborative activities. In the HTCs, boundary objects such as web sites, act as tools or bridges across cultures to mediate between individuals and groups from different 'communities' or activity systems.

However there is a gap in theory because collaboration does not adequately describe learning between levels. The vertical communication between activity systems is impeded by boundaries defined by political power and agency. Vertical boundaries between activity systems separate three levels of HTC policy enactment and these resist movement between levels. These boundaries restrict the upward flow of communication from the operational to strategic levels so feedback from the micro HTC project level cannot percolate to the more powerful upper levels.

To overcome barriers special people act as *boundary mediators* or human bridges spanning the vertical boundaries between levels. Yet mediation and the capacity to travel freely between levels is successful only if the individual acting as a *boundary mediator* is recognised as a member of the strategic macro level of HTC policy enactment.

My research suggests that multi-agency learning has horizontal and vertical dynamics that are not yet fully conceptualised in expansive learning theory. An appreciation of the impact of power as a structural constraint to multi-agency learning is relevant to the enactment of similar policy initiatives elsewhere.

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I am grateful to my Supervisor, Professor Murray Saunders for his unfailing enthusiasm and advice.

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Glossary

AfA. Agenda for Action, a regional policy document for economic development.

Agency. The term is used in two ways, in the context of this study 'agency' means the capacity to act, but can also refer to a type of institution or organisation such as the Regional Development Agency.

ANT. Actor Network Theory was developed to explain how technologies have agency and can interact with humans to achieve their effect.

AWM. Advantage West Midlands (The Regional Development Agency).

Boundary Object. A tool to link two or more activity systems, often bridging a cultural divide between different communities of practice.

Co-configuration. Expansive learning theory uses this term synonymously to mean co-construction of the object of activity by multiple activity systems.

Conscription Device. Enrols people into an emotional commitment to a community of practice or activity system.

Collaboration. The term used in expansive learning theory to denote organisational learning.

Collective Zone of Proximal Development (ZPD). The gap between old and new organisational practices in complex activity networks (see Zone of Proximal Development).

Consensus. Agreement by voluntary basis without financial or other forms of coercion.

COPT. Communities of Practice Theory belongs to the family of socio-cultural theory and describes human action within its social context. It describes the induction of a new member, such as an apprentice, into a community of practice as 'legitimate peripheral participation'. The theory has been widely used in understanding small group interactions in the workplace. (Chapter Two)

Developmental Transfer. Describes expansive learning by large organisations or institutions.

Division of Labour. Describes how work is divided up according to tasks and roles.

DTI. Department of Trade and Industry in UK Government.

ERDF. European Regional Development Fund is usually linked to capital projects and expenditure on infrastructure such as land and buildings.

ESF. European Social Fund provides revenue to address training needs to meet skills gaps in socially or economically disadvantaged communities. It was part of the Rover Task Force funding package and imposed complex eligibility rules.

Expansive Learning. This describes an outcome when several activity systems share an emotional commitment and motivation towards a shared goal.

FRESA. Regional policy document called the Framework for Regional Employment and Skills Action.

Horizontal Learning. Describes polycontextuality or learning across cultures.

HTC. High Technology Corridors are geographically pre-determined sites of interaction between sources of research and commercial exploitation, that aim to drive a sub-regional Knowledge Economy as described in the West Midlands Regional Innovation Strategy.

Knowledge Economy. The term used to describe a broad family of policies linking economic growth to a skilled workforce and their intellectual resources for wealth creation. The term 'Knowledge Society' also appears in policy documents but it is associated with a focus on social networks and has a less instrumental emphasis.

Knowledge Transfer. Describes the application of research or new technology in a new commercial context.

Mediation. A key concept in expansive learning originating in activity theory that proposed that artefacts can mediate between a subject and object.

Object. The object encapsulates the motivation and trajectory of activity and its orientation towards achieving a shared goal.

Outcomes. In expansive learning theory, outcomes are the results of the interaction of six elements of activity within an activity system.

Practices. These are routine sets of actions and interactions that can be observed in behaviour and are associated with tacit knowledge.

Polycontextuality. A term denoting horizontal learning, often used when experts contribute complementary skills to a demanding problem.

RDA. Regional Development Agency (see Agency).

RTF. Rover Task Force was set up in 1999 as a macro level regional forum for public and private sector organisations to work together to address the Rover Automotive Crisis.

Rules. Refer to the explicit and tacit rules or norms that structure social relations in an activity system.

Situated Practice. Within the larger family of socio-cultural theory it emphasises the situating context of human actions.

Socio-Cultural Theory. A category of social theory that has shifted the focus of discussions of 'knowledge management' away from issues of information and technology towards those of human capabilities. Within this family some theories focus on the dynamics of everyday life and the relationships between people and institutions (*situated practice)* whilst other theories emphasise the influence of institutions, rules and norms (*theories of social structure)*. Activity theory is an example of a socio-cultural theory that includes elements of both within its conceptual framework (see Chapter Two).

Subject. A term used in activity theory and used somewhat ambiguously in expansive learning theory to refer to the individual, or small group, or collective body in an activity system.

Technology Transfer. Similar to knowledge transfer, but more specifically concerned with scientific and technological knowledge and skill.

Third Mission. The third task of Universities (in which first and second missions are research and teaching) addresses interaction with industry, commerce and the wider community.

Tools. Tools act as cultural and historical mediating artefacts in an activity system (such as language).

Vertical Learning. Refers to learning between activity systems of varying agency, and limited by dynamics of politics and power. Vertical relationships between activity systems are uneven and hierarchical. These relationships are different in character to the horizontal relationships between activity systems, which are at the same level.

Zone of Proximal Development (ZPD). A Vygotskian concept describing the optimal distance between an old and a new concept that offer the best opportunity for a child to learn[1]. (see Collective ZPD)

[1] Vygotsky developed Cultural and Historical Activity Theory in the 1920-1930s and applied this to conceptual development in children. He described how cultural artefacts such as language act as tools to mediate between the subject and object of activity. Engeström developed the idea of a collective ZPD from this work.

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1. Introduction

1.1 Situating Context

The rationale for this research is my interest and professional involvement in regional policy development. The 'High Technology Corridor' (HTC) policy is an example of an attempt to enhance the impact of Higher Education Institutions on the economic regeneration of an English Region. The policy describes a mechanism for Universities to contribute to the so called 'knowledge economy'. From the perspective of Universities, this belongs to a type of activity known as the 'third mission'[2], described variously as 'knowledge transfer' or 'technology transfer'. High Technology Corridors are geographically pre-determined sites of interaction between sources of research and commercial exploitation, that aim to drive a sub-regional Knowledge Economy as described in the West Midlands Regional Innovation Strategy.

In my professional role these issues are of significant interest and recent experience led me to question theories of policy development, which describe a smooth and rational process. In practice, policy development and implementation is often a turbulent and conflictual process. (This is discussed in detail in Chapter Two). In many ways the implementation staircase model describes the process more realistically (Reynolds & Saunders, 1987). The implementation staircase articulates a problem that is often ignored, namely the dissociation of discourse from practice. It recognises stages in the process of negotiation between practitioners and policy makers. It describes the possibility of movement upwards and downwards in the

[2] The first and second university missions are assumed to be research and teaching. The third mission includes interactive projects with business and the wider community. Higher Education Innovation Fund (HEIF) and Higher Education Reach Out to Business and the Community (HEROBaC) are examples of funding streams, which support so-called 'third mission' activities.

hierarchy of decision makers at strategic and operational levels. In the implementation staircase model the interests of different social groups are clearly recognised despite variations in 'apparent status and power' and the policy outcome is subject to many diverse influences. This inquiry will explore gaps between theory and practice in policy development and implementation.

The High Technology Corridor policy was the direct result of the imminent loss of 7,000 jobs at the Rover Factory in Birmingham and 20,000 more in the automotive supply chain in 1999[3]. This galvanised the West Midlands to reconsider its reliance on automotive production. When BMW took control of the Rover plant at Longbridge in Birmingham, the company immediately decided to cut jobs in the production line and to impose new quality procedures on the automotive supply chain. As a result, the Department of Trade and Industry (DTI) and the Regional Development Agency (RDA) commissioned the Rover Task Force (RFT) to devise a solution to the problem. The RTF was a formal mechanism for aligning the interests of regional stakeholders from the public and private sector, some of whom were working together for the first time. The idea for HTC policy was first described in a report to the Secretary of State, which influenced the decision to provide DTI funding to the West Midlands (SQW, 2001). The consultants who wrote the report proposed the creation of three HTCs to respond to characteristically different problems and potential partnerships in their sub-regional contexts.

The concept of 'HTCs' assumes that providers of research, including both universities and private research institutes, can *transfer* new technologies to local companies. The

[3] The Rover Task Force was set up in 1999 to address the 'Rover Crisis' and commissioned reports to inform the local strategy. The final version of the report was published in 2001(SQW, 2001)

assumption is that this will enable the economic regeneration of the region by stimulating diversification, and exploitation of new technologies by local companies.

The policy identified three corridors because they corresponded to geographically defined areas each with a concentration of companies that were dependent on the automotive industry and at immediate risk due to the 'Rover Crisis'. The other key factor was the proximity of a research capacity to stimulate and support the diversification of these companies. The policy assumed that the research capacity of local Universities would attract new high technology companies to locate in the HTCs and that this would also attract inward investment. The research examines specific tacit assumptions about the way in which complex business and university partnerships work in practice. The implementation of the HTCs policy is investigated through *three case studies* with cross cutting themes and which describe the structural mechanisms that shaped the enactment of the policy.

Globalisation and rapid technological change persuaded Governments to adopt policies that improved national competitiveness. Competitiveness in the new 'knowledge economy' is dependent upon innovation and a skilled workforce. The human capabilities of nations are therefore seen as a crucial resource for competitiveness. Consequently 'knowledge' is treated in policy documents as if it were a national resource. European policy is driven by the need to compete with the knowledge economy of the United States of America (USA). It urges closer relationships between regions and their Universities and recommends more intensive interactions between universities and industry in the dissemination of knowledge and

technology transfer. It even specifies mechanisms for achieving this, such as spin-out companies and consultants from academia working for industry.

> *Europe needs excellence in its universities, to optimise the processes, which underpin the knowledge society and meet the target, set out by the European Council in Lisbon, of becoming the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion (EU, 2003).*

In Britain DTI documents speak of a new focus on skills and innovation and of increased regional control of the resources allocated to higher education. The policy documents make the assumption that discretionary funding of Universities by RDAs will benefit regional innovation. The DTI have been strongly influenced by the work of Professors Michael Porter and Christian Ketels of Harvard University. Their work has underpinned the UK Government's response to the challenge of innovation.

> *We find that the competitiveness agenda facing UK leaders in Government and business reflects the challenges of moving from a location competing on relatively low costs of doing business to a location competing on unique value and innovation. This transition requires investments in different elements of the business environment, upgrading of company strategies, and the creation and strengthening of new types of institutions (DTI, 2003d).*

Although it is sometimes presented as a logical process, policy is not usually developed in a linear rational way. Policy documentation can be regarded as a *story outline*, whereas the implementation is more like an ensuing struggle, in which the

dynamics of politics and power are played out. The UK Government commissioned a review of the effectiveness of 'third mission' activities and evaluated the impact of the first round of discretionary funding known as the Higher Education Innovation Fund (HEIF1). It recognised that Universities are playing an increasingly important role in regional economic development, and RDAs are taking an active role in 'building bridges between business and universities across the regions' (Lambert, 2003). The Lambert Review shows that Universities are working together with local and regional agencies to develop regional science-based clusters. It recommends that the DTI should shift the pattern of regional support away from job creation schemes and towards more value-added programmes, including collaborative research and development (R&D) projects with Universities (Lambert, 2003).

However, the review noted some significant contradictions in policy that would frustrate the policy intentions of a second tranche of 'third mission' funding known as HEIF2. The Lambert Review noted that a great deal of effective 'technology transfer' was carried out at a regional level by the post 1992 (ex-polytechnic) Universities. At the same time as encouraging this in HEIF2 the Government introduced a policy to concentrate research funding in a few research-intensive Universities. This reduced the capacity of the broad spectrum of Universities to engage in applied research and conduct the type of activities encouraged in the Higher Education Innovation Fund policies.

> *The Review accepts that public funding should be concentrated on world-class research. But the increased selectivity of funding will create a tension within the system. Research departments which are doing work that is of real value to*

business but which does not rank as world-class will get little support from the dual support system and may find it increasingly difficult to sustain themselves (Lambert, 2003).

The distinctions between the different types of Universities and their capacity to attract funding, has been reflected in the differential funding and status of the three HTCs. Lambert expressed the tension between two opposing aspirations for regional technology transfer as follows:

In addition, proximity matters when it comes to business-university collaboration. SMEs, in particular, find it difficult to work with research departments on the other side of the country. If resources are increasingly concentrated on a small number of world-class research departments, there is likely to be a negative impact on the level of business-university collaboration in the UK (Lambert, 2003).

For example one local University was under pressure from the RDA to focus on the local rather than their global role, which made it difficult for the University to balance the tension between the various demands. However since allocating a huge sum to one particular institution, the question of 'value for money' is an issue some three years later. The opportunity cost of dispersing their resources more evenly across the region's Universities is a current concern for the regional policy makers.

University Alpha has been very successful, particularly in the field of automotive related activity. The new project, the International Automotive Centre, has recently secured £70m to deal with the latest technology developments. So it's about ... within the universities expanding the knowledge base there, but also at the moment Alpha as

an example, is globally advising the automotive supply chain around the world. But what we're trying to do through our partnership is to get them to link more closely with local businesses so that the local economy develops[4].

The University managed to successfully address both global and local economic development issues. To reduce the University's exposure to risk and to ensure a clear distinction, it set up separate structures and strategic business units to deal with the regional and local issues.

Playing on the strengths of the organisation within the global marketplace of higher education requires a particular strategy that seems incompatible with a sense of social responsibility to the local community. This illustrates the conflicting demands upon Universities and also exemplifies the 'organisational response' of the University to this dilemma.

1.2 Theoretical Perspective: the Conceptual Framework

Expansive learning theory has gained currency in postmodern studies of organisations. It has been used as a framework to understand how agencies connect in an organic way and in most cases research has focused on innovation within large complex organisations. Several well-referenced and recent studies have used activity theory to inform their understanding of innovation and organisational change in which previously disparate work teams have devised ways of collaborating (Blackler, 1995, 2000; Blackler, Crump, & McDonald, 1999, 2000; Engeström, 1999; Engeström, 2000, 2001, 2004; Engeström, Miettinen, & Punamaki, 1999; Kerosuo & Engeström, 2003; Ludvigsen, Havnes, & Lahn, 2003; Toiviainen, 2003).

[4] P 5: Category B Respondent: Director of HTC 2

Many of these studies have been conducted in structured and facilitated environments in which researchers have intervened to influence the dynamics and trajectory of change[5] (Engeström, 1999; Engeström, 2001, 2004; Engeström et al., 1999; Hasu, 2001; Miettinen & Hasu, 2004; Toiviainen, 2003; Tuomi-Grohn & Engeström, 2003).

This study of HTCs takes place in a naturalistic setting in which 'expansive learning' is used to problematise the issues and provide a focus for data collection and analysis. The distinctions between naturalistic and structured research contexts are discussed in Chapters Two and Nine. Expansive learning theory is used as a heuristic tool to study practices in the HTC steering groups and in HTC projects, which can be described as concrete work packages.

Of particular interest to me is the capacity of 'expansive learning theory' to provide a coherent and consistent account of the emergence of collaborative practices in the HTCs. In this sense the theory is also treated as an object of study. It is used to frame the tensions and dilemmas arising within and between activity systems. The ontology of the inquiry assumes that prior understanding and assumptions shape reality for individuals and the stakeholder groups to which they belong. This orientation is consistent with finding out how a High Technology Corridor is 'experienced' by individuals representing major stakeholder groups. Social constructivism is often termed 'critical realism' or 'fallible realism' and the inquiry adopts this approach. It aims to 'account for events rather than simply document their sequence...and to provide a causal description of the forces at work' (Miles and Huberman 1994: 4).

[5] Researchers in the Change Lab in Helsinki deliberately intervene to shape change outcomes.

The research addresses the ontological, epistemological, and methodological problems of 'seeing organisations' by adopting the notion of practice as the trajectory of organisational learning. The concept of practice enables organisations, such as complex multi-agency partnerships, to be perceived in terms of relationships between concrete practices. Practices can be defined as 'sets of acts and interactions' involving language and objects (Giddens, 1993; Saunders, 1995; Yanow, 2000).

Social theories can be seen as sensitising frameworks for empirical research in the social sciences. In this sense they can open out 'ways of seeing and analysing social phenomena', and at the same time mould and change our self-understanding (Reckwitz, 2002, p.257). Practice theory regards agents as carriers of bodily routines of behaviour, mental routines of understanding and knowing embedded in the use of objects. Carrying out a practice very often means using particular things in a certain way.

> *'A specific social practice contains specific forms of knowledge' it is more complex than 'knowing that'. It embraces ways of understanding, knowing ways of wanting and of feeling that are linked to each other within a practice (Reckwitz, 2002, p.253).*

A practice is a routinized type of behaviour, which consists of several elements, interconnected to one another, including *know-how*, states of emotion and motivational knowledge. A practice such as a way of cooking for instance cannot be reduced to any one single element. For example a professional chef carries out social practices and as such they are neither autonomous nor constrained to conform to norms (Reckwitz, 2002, p.256). The relationship between practices encompasses

relationships between individuals and communities mediated by artefacts, social processes and structures.

Innovation involves changing and breaking familiar structures and habitual routines. In expansive learning theory, innovation occurs when traditional ways of doing things prove to be inadequate to the challenges of new situations. This results in tensions that drive the development of new practices. The subsequent tensions between the old and new ways of doing things then drive further change and innovation.

The HTCs can be considered as an experiment in social engineering aimed at economic regeneration through innovation. Each HTC is conceptualised as an 'activity network' or *meta-activity system* composed of sub-activity systems in which new practices evolve and are in tension with old practices.

My research reconstructs the developmental history of HTCs as the practices adopted by actors. It contributes to the debate on technology transfer by focusing attention on mechanisms, which connect the 'perspectives' of individuals and organisations and expand the object of activity towards a new and shared perspective.

1.3 Research Aims and Questions

The research has an overarching aim and a theoretical aim. The overarching aim is to depict the implementation of the HTC policy and its enactment at sub-regional levels and in the form of projects carried out at the local micro level. Four questions are derived from this aim: -

Research Question 1

What was the context for the introduction and implementation of the HTC policy? (Chapters One, Two and Four)

Research Question 2

What technology transfer practices were evident prior to the enactment of HTC policy? (Chapter Four)

Research Question 3

What knowledge transfer practices were evident amongst key stakeholders? (Chapters Four and Five)

Research Question 4

How influential were policy enacters at each level of the implementation of HTC policy? (Chapters Six and Seven)

The theoretical aim is to use expansive learning theory as a conceptual framework for the analysis of collaboration across different organisations and between levels in the implementation of the HTC policy [6]. Four research questions address the theoretical aim:

Research Question 5

What were the different 'objects' at different implementation levels at regional (macro), sub regional (meso) and local (micro) levels? (Chapter Six)

[6]The term 'object of activity' encompasses the notion of ' interest' in the sense of motivation and the goal to which the activity is orientated.

Research Question 6

How do boundary objects connect activity systems? (Chapters Two and Five)

Research Question 7

Are boundary objects equally effective across cultures and between levels distinguished by agency? (Chapters Five and Six)

Research Question 8

What are the benefits and limitations of using expansive learning theory to analyse the development of multi agency learning? (Chapter Nine)

One final research question links the overarching and theoretical aims together:

Research Question 9

What insights from expansive learning theory and from the analysis of collaboration in the HTCs can be applied to similar policy initiatives[7]*? (Chapters Five, Six, Seven Eight, Nine and Ten)*

This set of research questions links the theoretical ideas with the data collection and analysis and shaped the development of questionnaires used in the fieldwork and desk based research and is discussed in the methodology section in Chapter Three.

[7] When 'expansive learning theory' is applied to the study of organisations the 'multi agency learning outcomes' are described as collaboration. Empirical data describes both the process, as experienced by key individuals, and specific examples of collaborative practices.

1.4 Structure of the Thesis

The thesis is written as ten chapters. The first chapter is an introduction to the research problem situated in the local and national policy context.

Chapter Two outlines the theoretical underpinning of the research. The logic for prefacing the research methodology with theory is to show how the theoretical considerations suggested a way of eliciting the data. It frames a rationale for my methodology, which is described in Chapter Three. My second chapter discusses the international policy context for the 'knowledge economy' and the assumptions made in global and local policy. There is a tacit assumption that knowledge and 'technology transfer' is a logistical problem, to be resolved by unblocking the flow of knowledge from Universities to industry. By contrast socio-cultural theory emphasises the process of knowledge creation and the significance of consequent changes in the dynamics of human relationships. Following this line of argument leads towards a conception of innovation as collaboration and organisational learning. Consequently, the third chapter outlines my research design and methodology, linking this to the heuristic framework of expansive learning theory.

Chapter Four draws on the empirical data to reconstruct subject perspectives in relation to changing conceptions of the 'object of activity'. Variation in perspectives show how key individuals and organisations in the HTC partnership were influenced by various competing 'objects of activity' that emerged during the policy implementation process.

Chapter Five draws on the empirical data to reconstruct collaborative practices in HTC projects. I focus on the capacity of boundary objects to act as tools to mediate *learning across* different activity systems. I present the data as vignettes that sketch the different ways that material artefacts and 'conceptual models' act as boundary objects. Vignettes describe how boundary objects are instrumental in collaboration and act as a bridge between the distinctive perspectives of the users and developers of new technologies in HTC projects[8].

The sixth chapter recreates the object of activity at three levels in the implementation of HTC policy and reconstructs a vertical hierarchy of linked activity systems. Activity at macro, meso and micro implementation levels is considered in terms of characteristically different relationships of power and politics. Examples from the empirical data illustrate contradictory sets of rules operating at different levels of policy enactment, which confounded the *espoused policy aim* to bring the public and private sector closer together. As in Chapter Five, I present the data in vignettes to illustrate the developmental history of collaboration between activity systems. Two vignettes depict miniature expansive cycles, which seemed to contribute to fuller expansive cycles in healthcare. The collaboration between activity systems in healthcare was unusual because it connected activity systems in two dimensions. In combination, boundary mediators and boundary objects mediated across boundaries separating horizontally and vertically arrayed activity systems.

Chapter Seven draws on key insights from the data analysis to encapsulate how particular incidents and practices were 'experienced' by different individuals and

[8] My definitions of vignettes and boundary objects follow in Chapter Two.

groups. A thematic discussion of dilemmas and unresolved tensions in HTC activity highlights some implementation problems.

The eighth chapter provides a policy overview of the findings in relation to the context in which the HTC policy was enacted. It discusses characteristic differences in the perspectives of the so-called partner organisations in relation to their horizontal and vertical organisational positioning in the enactment of policy.

Chapter Nine discusses the findings in terms of the theoretical questions. The heuristic capacity of expansive learning theory is critiqued with reference to the inherent ambiguities in the emotional and motivational regulation of collaboration. Some specific issues associated with the terminology of expansive learning are discussed alongside the overall benefits and limitations of using expansive learning theory as an analytical framework and includes a discussion of some practical difficulties associated with using activity theoretical tools in naturalistic settings.

The tenth and concluding chapter reflects on the risks and limitations of the research process. It suggests directions for future research including consideration of the effects of globally networked work environments. My research reflects on the current gaps in expansive learning theory, which make it difficult to differentiate the *quality* of collaborative practices. I discuss circumstances that inspire individuals and organisations with a shared passion and commitment and the potentially positive role of *configuration devices*. My findings suggest that used in combination *boundary mediators* and *boundary objects* optimise the potential for multi agency learning. Finally I highlight some insights about what worked well and what was most

problematic in the HTCs. In identifying effective strategies and potential hazards I hope that all the people who contributed to this research, by sharing their experiences, may help similar policy initiatives to be implemented more smoothly and with less anxiety.

Turning now to Chapter Two, I set out the theoretical underpinning of 'knowledge economy' policies and describe the theoretical rationale for my methodology and my approach to data collection and analysis.

2. Policy Enactment by Partnerships: Theories and Issues

This chapter describes the theoretical assumptions that influenced the development of knowledge economy policies. The chapter examines how the HTC policy was grounded and suggests that policy formation was influenced by a rather weak theory of change. It highlights contradictions and inconsistencies in the policy assumptions, which resulted in a loose assemblage of theoretical concepts rather than an integrated and coherent approach to policy implementation.

I describe alternative perspectives on knowledge and innovation from socio-cultural theories. The chapter concludes with a discussion of expansive learning theory and how this shaped my research methodology, which is explained in Chapter Three.

2.1 Situating Theories of Policy Change and Implementation

Theories represent the stories that people tell about how problems arise and how they can be solved. Stories can arise from stereotypes, myths or research knowledge and they are potent forces in policy discussion. Policies that seem to violate the assumptions of prevailing stories (dominant discourses) will receive little support (Weiss, 1995). Policy change is likely to be most successful when informed by robust theory and evidence. However the regional policy makers may not have fully appreciated that complex innovations are difficult to implement especially when the innovation is undertaken by a multi-agency partnership (Fullan, 1999).

The regional HTC policy text sets out an ambitious programme of cultural change. The successful enactment of HTC policy depends on developing the ability of individuals and communities to learn and change. It relies upon the effective communication of 'what seems to work' and the acquisition of 'new practices' in the adoption of new technologies. It involves complex cultural change, which involves much more than simply aligning public and private sector agencies to support the process.

Change happens at local levels during the implementation process. HTC policy is not unusual in embracing a vast range of sites of action and discourse. It is normal for policy to pass through many long and elaborate implementation chains (Halpin & Troyna, 1994). Haphazard approaches to change are likely to be frustrating, partly because they do not prepare innovators for the experience of the implementation gap (Trowler, Saunders, & Knight, 2002). Implementation can be described as 'what really happens in practice' (Fullan, 1993). The process of change is inherently volatile and dynamic because as each change is introduced it brings about further unpredictable changes.

The change process can be smoother if policy makers think carefully about what they are trying to achieve and appreciate the limits of top-down efforts to create change. It involves persuading people to abandon familiar, comfortable routines and the process of creating new practices can be slow, incremental, and unpredictable (Trowler, Saunders, & Knight, 2002). Change is constructed by people in specific contexts and it can be difficult to '*unfreeze* practices' in order to make way for new ones. (Trowler

et al., 2002). Ambitious and significant changes, such as those envisaged in HTC policy take much longer to embed than anticipated.

Although policies are attempts to create a new reality, a policy vision is often distinctly different from its effect and there is a risk in being too rigid in prescribing for change (Fullan, 1993; Ozga, 1999 , p.94-5). The process of policy evolution and practical change is analogous to the notion of sense making. The implementation process needs to allow flexibility for aspects of the policy to be rejected or modified by experience. When the impact of a new practice is understood it is important to be able to adjust the practice based on an evaluation of its actual effect compared with the desired effect. This flexibility allows 'practitioners' to contribute to a shared process of sense making and helps to ensure that the innovation is sustained and assimilated.

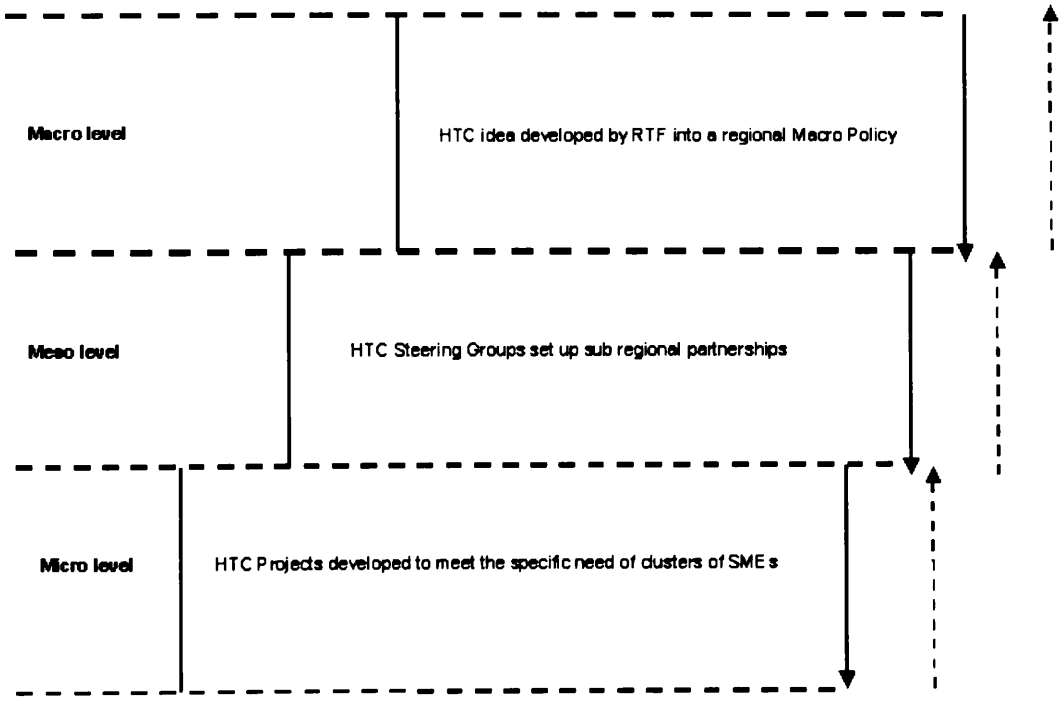
To avoid organisational 'blind spots', a pilot project can help to test out the actual effect of a policy before a full-scale launch. Making sense of change involves placing individual elements of the change into frameworks, and understanding their implication and potential impact. People can pursue mutual understanding and potential patterns in the likely outcomes of change, which involves making sense of an uncertain situation that initially makes no sense at all.

Change involves loss, anxiety and struggle (Fullan, 1993 p 30).

Policy aims are not transmitted and received in a one-off process because negotiations and reconceptualisation occurs between agents and at different levels despite the

unequal power relationships (Reynolds & Saunders, 1987 p 213). The Implementation Staircase model suggests that policy enactment is capricious and is affected by people and factors at various positions and levels in the process. It models how policy is 'transformed', as the policy is enacted by local practitioners. It focuses upon the subtle and often invisible ways policy 'changes' to make it 'workable' in a specific local context. It shows how feedback and reflection on practice affects the development and the trajectory of the policy as it takes account of various levels including those above and below the key agents. Initially I adapted the implementation staircase model to depict three predominant levels of HTC policy enactment as shown in the figure below (Reynolds & Saunders, 1987).

Figure 1: Locating HTC Policy Enactment on the Implementation Staircase



The Implementation Staircase model suggests that policy is modified as it moves down and up the staircase

A similar understanding of the adaptation of policy as it passes down and up the implementation staircase is adopted in an analytical concept called policy refraction. It depicts the way policy is re-conceptualised and adapted at different levels and sites and acknowledges the key role played by practitioners in policy development (Higham, Sharp, & Yeomans, 2002 p 10). This flexibility and openness to policy adaptation by people closest to the ultimate beneficiaries of policy is important.

From another sociological perspective, the concepts of bridging and provisional stability offer a similar analysis of responses to change. The rapidity of change means that those involved in complex change need to respond creatively in order to survive during periods of change because they are associated with 'chronic' anxieties. The concept of provisional stability refers to circumstances and tools that create a temporary degree of stability. It offers a temporary solution to changing practices and reduces angst by helping to crystallise a new way of doing something, which is necessary in order to move from potentially destructive instability to a new framework for action (Bonamy, Charlier , & Saunders, 2001; Fullan, 1993). The quest to transform traditional manufacturing economies into 'knowledge economies' has become an international policy imperative. The financial risk of failing to develop ambitious policies contributes to a tendency to take urgent policy action without fully considering the nature of knowledge itself.

2.2 The Theorisation of Knowledge and Knowledge Transfer in Policy

Global and national innovation policy makes the tacit assumption that knowledge can be treated as a *commodity*, and can be traded, stored, managed and transferred like

consumable goods. There is also an assumption that knowledge is a stable and material entity. The discourse of knowledge management combines this notion with the idea that knowledge can be controlled. It locates knowledge in the senior managers in an organisation so that 'knowledge' is treated as a strategic resource. The notion of 'intellectual property' further reifies knowledge on the assumption that knowledge has a monetary value and can be traded. This misrepresents knowledge as if it is something independent of the 'knowledge creating interactions' between people (Hellström, 2004, p.643).

The project management model takes this idea one step further and aligns relationships between actors, groups, tasks and responsibilities and assumes that contextual and tacit knowledge can be made explicit. These assumptions shaped the HTC *policy discourse*. However the so-called transfer of research between Universities and other stakeholders is a complex process. The potential of scientific and technological discoveries requires a vibrant innovation system. The premise of 'knowledge economy policies' is that research in science and technology must be connected with developments in market demand and social needs (Goddard & Chatterton, 1999).

> *Explicit mechanisms through which research is transferred between HEIs and regional stakeholders include research centres, spin off companies, incubator units, advice and training services, science parks and mechanisms to exploit intellectual property rights (IPR) (Goddard & Chatterton, 1999, p. 86) p86.*

Many policy documents use the term *innovation* interchangeably with the term *technology transfer* and assume that the diffusion of innovation can occur by mechanisms such as the licensing of University intellectual property and spin off companies without distortion (EU, 2003). Recent European funding policies have encouraged Universities to take a leading role in working directly with local companies to enhance skills and deploy new technologies in commercial processes.

> *European structural funding encourages many universities to participate in ERDF and ESF projects aimed at enhancing local skills or assisting local SMEs to develop in capability or technological sophistication (Goddard & Chatterton, 1999, p.36).*

The HTC *policy discourse* regards research and knowledge transfer as a simple linear model. However in practice this is more like a spectrum where a number of simultaneous flows occur between groups of stakeholders and Universities.

2.3 A Discourse on Knowledge from Socio-Cultural Theory

A discourse can embody the position from which an individual or group speaks. In daily life discourses compete for dominance and strong discourses are often backed by money and power. Discourses 'work and compete' within social practice. Policy documents can be described as *discursive objects* because they are formed by social practices such as making and obeying rules. Discourses have a social basis and can embody the power relationships between individuals and institutions that encourage or constrain them.

Discourses are partial and positioned, and social differences are manifest in the diversity of discourse within particular social practices. Evaluating discourses means setting them against shifting understandings of what material possibilities there are in the practical domain concerned- discourses are not evaluated against 'absolute truth' but in terms of 'epistemic gain' (Fairclough, 1999, p.74).

Postmodernism[9] recognises the importance of 'local' discourses. Different discourses are associated with specific perspectives or mindsets which reflect the 'positioning and interests' of the organisation or community to whom an individual owes allegiance. Foucault stressed that local discourses are affected by global and national discourses and so policy documents can be used to enrol and govern individuals and groups[10] (Foucault, 1972).

Foucault proposes that discourse is not to be treated as a mere 'document' of the metal qualities 'behind it', but as a sequence of external events in which symbolic structures (formative rules) are manifested (Reckwitz, 2002, p.248).

In this sense the HTC policy can be considered in terms of the social relations it can draw people into, and the individuals and organisations that stand to gain or lose. The social constructivist discourse in sociology represents knowledge as a process. Within Sociology, there has been much recent interest in theories of practice, and consequently organisational routines are of significant interest.

From a socio-cultural perspective, *situated practice theories* focus on the dynamics of everyday life and the choreography of relationships between peoples and agencies.

[9] The Post-Modern Condition: A Report on Knowledge (Lyotard, 1984, p.60)
[10] Michel Foucault was a French Post Modern Philosopher and Social Critic.

Taking a different approach, *theories of social structure* focus on institutions, rules and norms. Their interest lies in analysis of social systems, discourses and history, and in the most extreme cases they deny that individuals are 'knowledgeable' and have *agency* in the sense of the power to act independently of social structures and group norms.

Cultural theories, including practice theory seek explanations for action, in symbolic structures of meaning and language, discourses and conceptual tools and technologies. Although practice theory is an example of cultural theory, not all cultural theories are practice theories. Models of practice draw on the ideas of Wittgenstein, Giddens, Latour, Foucault and Bourdieu among others and are interested in the 'everyday' and 'life world' (Reckwitz, 2002, p. 244).

Weick's theory of 'sense making' shares a phenomenological focus and speaks of social activity as grounded in 'physically situated routines'. The process of 'sense making' happens when 'people make retrospective sense of the situations in which they find themselves and it is this process that shapes organisational structure and behaviour (Weick, 1995)[11]. In Giddens' structuration theory, and Lave's situated learning theory organisational routines are emergent and enacted (Giddens, 1993; Lave, 1993; Weick, 1995). Giddens introduced the notion of the 'trajectory of the self' in which people reflexively reconstruct their self-narratives, to create coherent relationships between the various sequential and disjointed influences on their lives, suggests that individual identity is an emergent self-image. Self-identity is crafted and emergent, and mediated by changing cultural factors of various social groups to which

[11] Karl Weick describes 'sense making' as a developing set of ideas with explanatory possibilities, rather than as a body of knowledge.

the individual belongs (Giddens, 1993). The problem of distinguishing between individual and collective identity is discussed more fully in Chapters Four, Six, Seven and Nine in relation to the empirical data, and the emphasis in expansive learning theory on the depiction of tensions in activity systems between the individual and their social context.

Cultural and Historical Activity Theory on which expansive learning theory is based has been used in studies of organisational change to emphasise the interplay between individual and collective action. Organisational culture can be seen in terms of processes created by individuals and groups whose activity and motivations are shifting and ambiguous. Within expansive learning theory it is possible for both individuals and organisations to learn and this is consistent with the view that knowledge is constructed by a complex interaction between individuals and communities.

Knowledge cannot therefore be transferred because it is not a stable material but deeply contextual. It is located in time and space and is constantly constructed and recreated by people. A recent report on innovation commissioned by the Organisation for Economic Co-operation and Development (OECD) describes the need to transport the knowledge from the researchers in Universities to industry where it can be applied in commercial settings (Goddard & Chatterton, 1999). Although it differentiates between codifiable (know-what) knowledge and tacit (know-how) knowledge, there is no adequate explanation of how to transport tacit knowledge. Much research has shown that it is difficult to gain access to tacit knowledge (Blackler, 1995; Fox, 2000; Gherardi, 2000; Robertson, Scarbrough, & Swan, 2003; Yanow, 2000). For instance,

even though 'organisational routines[12]' can be carriers of tacit knowledge, it is not easy to transplant routines or 'know how' from one work environment to another (Giddens, 1993).

Socio-cultural theory has shifted the focus of discussions of 'knowledge management' away from issues of information and technology towards those of human capabilities (Wenger, 1998, 2000). During the last century organisations have moved from a focus on mass production towards mass innovation. Continuous processes of innovation and mass customisation are moving closer to experimentation (Ludvigsen et al., 2003). However, much of the knowledge of innovation is difficult to articulate because it is locally generated 'professional knowledge' and tends to be not only local but also tacit (Colville, Waterman, & Weick, 1999).

Expansive learning theory proposes a conceptual framework for knowledge creation that embraces both the concerns of *situated practice* and *social structure* orientations. When activity systems learn from one another, expansive learning theory describes the process as collaboration. In this sense 'knowledge' can be treated as a shared social construction by organisations working together.

2.4 Innovation as Collaboration and Expansive Learning

In Scandinavia expansive learning theory is becoming a common paradigm for analysing complexity in the workplace and claims to bridge the traditional divide between practice and theory (Blackler et al., 1999). It conceptualises innovation as a process of collaboration instead of the unproblematic movement of information from

[12] In activity theory these routine practices are termed operations

one location to another. The term co-configuration is used to describe the shared co-construction of new practices (Tuomi-Grohn & Engeström, 2003). Expansive learning theory has been used to conceptualise the ways in which experts can work together by applying complementary expertise to a new problem that they could not have tackled independently. Recent studies have depicted this as interactions between equally important but distinctive activity systems. It is described as a process of *horizontal learning* in which good communication is essential to the negotiation of expanded practices. (Hasu, 2001; Kerosuo & Engeström, 2003; Ludvigsen et al., 2003; Toiviainen, 2003; Tuomi-Grohn, 2003).

Within the last three years 'complex organisations' have been the subject of study by researchers associated with the Change Laboratory at the University of Helsinki (Collins, Shukla, & Redmiles, 2004; Engeström, 2004; Hasu, 2001; Ludvigsen et al., 2003; Miettinen & Hasu, 2004; Toiviainen, 2003). Researchers traced and visualised disturbances and breakdowns in everyday work practices in order to reformulate or expand work practices.

These studies were conducted in professionally facilitated environments in which the researchers made deliberate attempts to develop collective work practices. Researchers intervened to help people to visualise tacit knowledge and emerging practices to support and accelerate a smooth transition towards the development of expansive learning (Engeström, 2004; Kerosuo & Engeström, 2003). Engeström's recent studies of innovation in California involved analysis of videotapes of team meetings and interactions at work, which allowed:

very detailed data driven analysis of the discursive processes, practical actions and mediating artefacts that are employed in the step-by-step production of an innovative solution or idea (Engeström, 1999, p.377).

In developing expansive learning theory Engeström applied Cultural and Historical Activity Theory to new contexts some distance from the original focus of Russian psychologists on concept development in children. During the 1920s and 1930s Vygotsky's pioneering work in activity theory was concerned with individual learning and development. Activity theory was influenced by insights of Marx and Hegel that tools could shape the progress of cultural evolution, and could help to create more advanced ways of doing things[13]. In the concept of *practical consciousness* Marx makes an important connection between action and thinking of relevance to innovation.

a division of labour between thinking and working risks creating a social production of knowledge that grossly misrepresents reality (Hellström, 2004, p. 641)

At the heart of activity theory is an interest in the capacity of tools to *mediate* in the relationship between the 'ideal' and the 'concrete'. In other words 'what is imagined' can be realised with the help of a tool. Leont'ev designed a triangular diagram to show how a tool mediated the relationship between the subject and object of activity[14]. Later, Vygosky's work in the field of education, focused on the use of language as a mediating tool in human activity. Engeström adopted and changed the model and arrayed collective elements within an activity system in which the mediating artefact

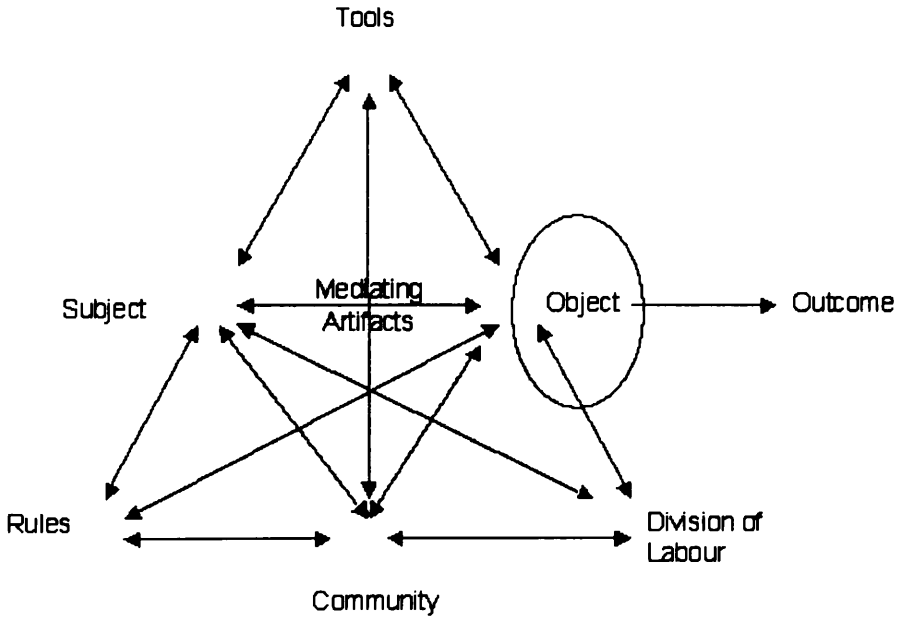
[13] An idea conveyed in the political philosophy of G.W.F Hegel and K. Marx.
[14] In the evolution of three generations of activity theory, the work of Leont'ev is first generation, the work of Vygotsky is the second and expansive learning is third generation activity theory.

could be a physical object, a mental model or symbol system, such as language. Engeström moved beyond the original focus on individual learning and mediation of human consciousness to re-orientate Cultural and Historical Activity Theory (CHAT) towards studies of organisational learning.

> *Activities are social practices oriented towards objects, motivated by a human need (Fichtner, 1999, p.380).*

The figure below depicts the structure of an activity system and situates individual action within a social context. It shows how tools such as concepts and technologies mediate the interaction between the individual and the emerging object. At the same time, a division of labour mediates the interaction between the community and the emergent object of activity leading to an eventual outcome[15].

Figure 2: The Structure of an Activity System



[15] Adapted from (Engeström, 2000) but originally published in 1987 as Figure 2 - The structure of a human activity system on page 78 (Engeström 1987).

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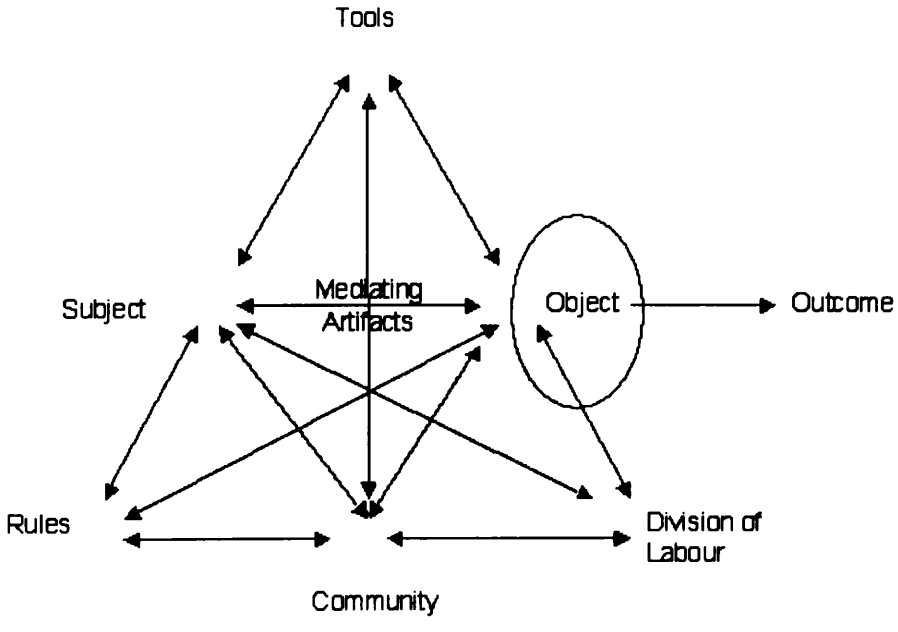


[15] Adapted from (Engeström, 2000) but originally published in 1987 as Figure 2 - The structure of a human activity system on page 78 (Engeström 1987).

Expansive learning theory encapsulates the idea that as a result of people working and thinking together, organisations have the capacity to change. Organisations have a developmental trajectory in so much as future activities are created by past activities. It suggests that conflict is creative because new and better ideas push the developmental trajectory towards a more comprehensive understanding. Crossing the boundaries between the surrounding worlds or activity systems brings various subjects and objects into creative tension and the tension between old and new practices drives the innovation process (Hellström, 2004, p.639-640).

> *Innovation is not just the conception of a new idea, nor the invention of a new device, nor the development of a new market. The process is all those things acting together in an integrated fashion (Hellström, 2004, p.634).*

Innovation involves both mental and physical activity; it concerns a problem and its solution and involves the creation of something new. The notion of innovation as a creative and conflictual process is influenced by a theory of dialectical action introduced by Hegel. Innovation from the point of view of Hegel's dialectics implies that progress does not happen in a smooth and orderly way (Hellström, 2004, p.639-640). A new idea is created in opposition to existing ideas and practices, in which conflict and power struggles play a central role. This contrasts with notions of innovation as 'a linear model of continuous improvement' popularised in the Japanese concept of 'Kaisen'. The conception of innovation as a disembodied 'thing' detached from human activity is misguided.

A result of the reification of innovation and the emphasis on innovation management rather than innovation dynamics product developers become 'cogs' in the machinery of the innovation system (Hellström, 2004, 643).

As a result, relations and selves become more 'thing like' and the social relations of innovation more manipulative (Hellström, 2004, p.643). In descriptions of activity systems the 'subject' sometimes refers to an individual acting as a representative of a small group and sometimes the term 'subject' denotes a collective body. It is this contradiction that expansive learning embraces and I discuss 'subject perspectives' in detail in Chapter Four.

From the perspective of expansive learning theory innovation involves meaningful social action. It is radically different from *knowledge management* approaches, which *reify* innovation as if it is a disembodied thing that stands apart from people. Expansive learning theory stresses that people have agency and can actively shape their future activities. In other words, people create organisations and not the other way around.

Recent research into organisational change and innovation claims that by using the analytical framework of expansive learning it is possible to uncover 'the invisible battleground' of interacting agencies and to focus on the aspects of the system that impede or assist collaboration and the reconstruction of 'knowledge' in a new social context (Hasu, 2001; Toiviainen, 2003).

An activity system is by definition a multi-voiced formation. An expansive cycle is a re-orchestration of those voices, of different viewpoints and approaches of the various participants (Davydov, 1999 , p35)

An interesting observation about the sustainability of change relates to its perceived value for those involved. As suggested in the previous section, complex change requires people working insightfully on the solutions and committing themselves to concentrated action together (Fullan, 1993 p 34). This suggests that clarity of communication and shared purpose is vital for success, and arguments and debate are healthy as encapsulated by Davydov.

The sense of a person's action lies not in the action itself but in its relation to other members of the group (Davydov, 1999 , p.73).

When applying the theory of expansive learning to the organisational learning and to *innovation* in the workplace, Engeström uses the term *developmental transfer* to describe the collaboration between diverse groups of people at work (Engeström, 2000, 2001, 2003). At Engeström's web site at the Centre for Activity Theory and Development Work Research[16] a major section is devoted to Workplace Learning and Developmental Transfer. It recognises the difficulty of developing 'conceptual tools' to understand organisational dialogue, multiple perspectives, and networks (Engeström, 2000, 2001). The concept of an activity network evolved to describe the complicated relationships between multiple activity systems, in which the smallest *unit of analysis* is an activity system. Innovation is described as 'collaborative interaction in which activity systems learn something from each other'. The term

[16] Web site reference is http://www.edu.helsinki.fi/activity/pages/research/transfer.

developmental transfer distinguishes 'organisational learning in the workplace' from other forms of expansive learning (Tuomi-Grohn, 2003, p.226).

Engeström appropriated and adapted Vygosky's notion of the 'Zone of Proximal Development' (ZPD), which was originally used to explain how children acquire a new concept. The ZPD is the ideal space in which a child can learn and represents the optimal distance between the old and new concept. If the gap between the old and new concept is too wide it is difficult for the child to learn. Engeström adapted this insight to develop the concept of a Collective Zone of Proximal Development to explain the optimal distance between routine activity and new forms of societal activity.

Organisations can learn new ways of doing things when the gap between old and new practice is not too large.

> *The study of an activity system becomes a collective, multi-voiced construction of its past, present and future* ***zones of proximal development****. (Davydov, 1999 , p10)*

This suggests that when ambitious change is proposed radical leaps from old to new ways of doing things may be risky. Consequently studies of knowledge creation in complex organisations focus on the relationships between personal and institutional change. From this theoretical perspective researchers attempt to trace the evolution of the object of activity.

2.5 Methods of Visualising Interactions Between Activity Systems

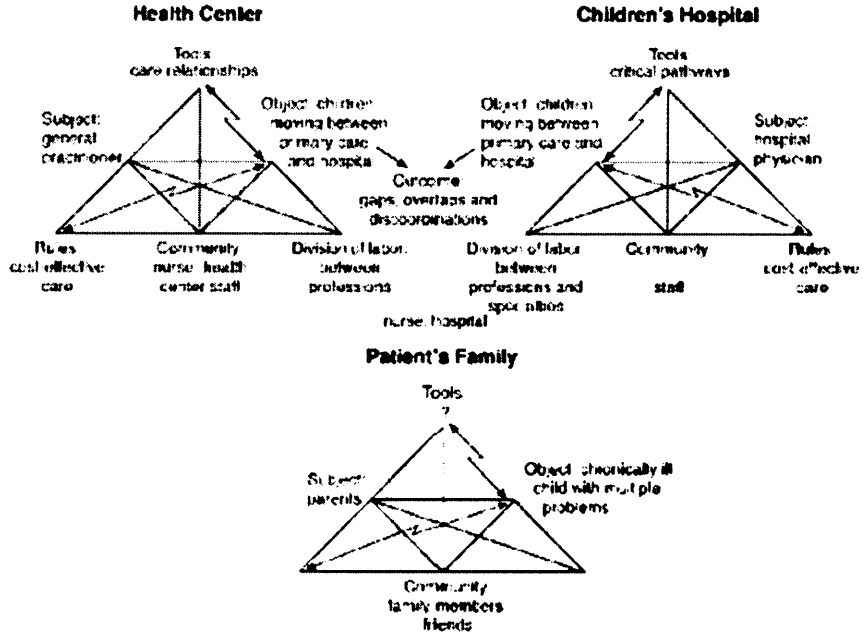
Depicting both the structure and dynamics of activity systems presents a continuing challenge for activity theorists. Engestrom's most persuasive illustration of the interplay of multiple activity systems describes the development of a new policy to improve the care of chronically ill children.

Expansive change occurs when a policy is developed to bring together all those responsible for the child's welfare in a holistic way to improve the treatment by understanding the motivations of the parents and the responses of the medical professions to specific symptoms and events in the child medical history. If the new practices and the old practices are not too different they will fall within the Collective Zone of Proximal Development and the proposed change is likely to be adopted. The new *patient care agreement* represents an improvement in care for the child and the family and a more coherent approach from the medical care team with less wasteful cross referrals.

However, it could be argued that the complex interaction of activity systems is not evident to scrutiny because what remains is simply the change in practice. In other words the policy itself remains, whilst the description of activity systems afford a complicated way of explaining how the change happened.

The next figure depicts the three activity systems that most affect the healthcare for a chronically ill child and illustrates the complex interactions between three activity systems (Engeström, 2001, p.155).

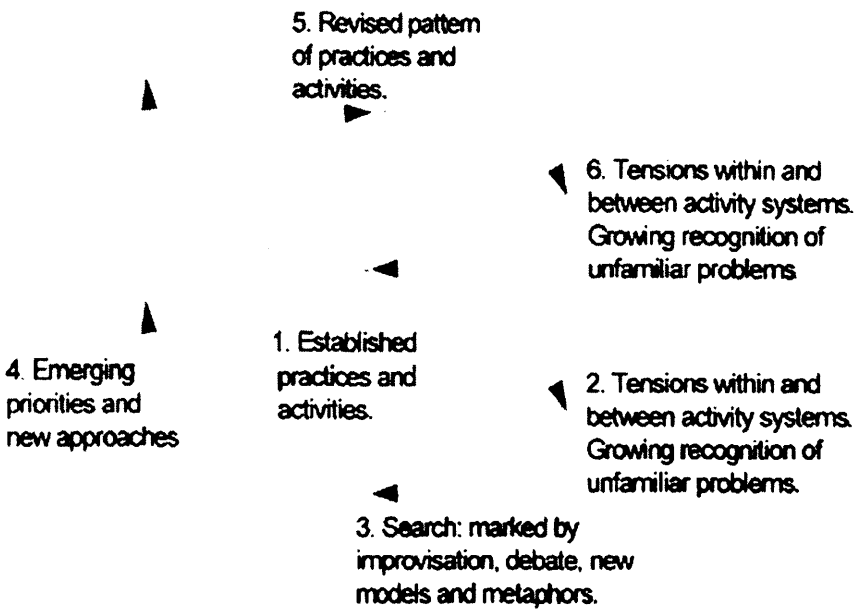
Figure 3: Depicting Structure and Contradictions Between Activity Systems



Depictions of interactions between three or more activity systems soon become impenetrable and I found it impossible to use this diagrammatic format to depict the vast array of complex interactions in the HTCs. It is difficult to illustrate the structure of relationships within and between activity systems at the same time as conveying a sense of a dynamic process.

Alternatively it is possible to depict activity as a dynamic process of change. Expansive learning theory searches for internal contradictions as the driving force behind innovation and change and analyses the activity historically. Tensions within and between colliding activity systems drive expansion of 'the object of activity'. This is shown in the next figure which is adapted from a process model developed by Blackler (Blackler et al., 1999, p.5).

Figure 4: Dynamic Tensions in Activity



Activity systems and their interactions are unstable and transitory and consequently it is very difficult to depict in graphic form, the continual dynamic flux of activity. The expanded object of activity arising from the collaboration of two or more activity systems represents a temporary cessation of change. The notion of *provisional stability* was introduced in section 2.1 in relation to theories of policy change and implementation (Bonamy et al., 2001). Provisional stability describes a conceptual bridge between old and new ways of doing things and this is similar to the way in which activity theory resolves uncertainties and tensions during the expansion of the 'object of activity'.

Both these theoretical perspectives share a commitment to reflection as an important part of the process of change. The idea of 'provisional stability' suggests a respite or a

'pause for thought' prior to decisions for future action. In activity theory the inherent instability of an activity system is rebalanced when a new expanded object connects the old and new way of doing things. Stabilising and adjusting the activity system is a constant battle because new dilemmas and tensions keep arising and the expanded object can create a 'breathing space' for reflection and a respite from continuous flux.

> *People construct their institutions and activities above all by means of material and discursive, object oriented actions (Davydov, 1999 , p10).*

From this theoretical perspective a discourse can be created as an outcome of activity. Expansive learning theory adopts the concept of a boundary object from the sociology of science. Boundary objects are agreed and shared between communities, yet satisfy the informational requirements of each of them (Star, 1989, p.46). They act as tools to link two or more activity systems.

> *A boundary object acts as a basis for negotiation and knowledge exchange between differentiated communities of practice or activity systems. Its virtue is its capacity to accommodate local 'dialects' (Sapsed & Salter, 2004, p. 1519)*

This suggests that discourses can be both global and local and yet be understood to mean the same thing to different communities or activity systems.

2.6 Overview

Although it is not 'predictive', expansive learning theory draws attention to the 'learning potential' for those engaged in implementing HTC policy. Expansive

learning theory provided an action-orientated framework that shapes my data collection and analysis, my overall methodology and research design. This is discussed fully in Chapter Three, which outlines the theoretical foundations of my methodology.

Public policy implementation is dominated by the discourse of partnership and 'knowledge economy' policies assume that partnership arises from collaboration between private and public sector organisations. Expansive learning links a theoretical perspective to an action-orientated framework in which to interpret multi-dimensional relationships between activity systems.

Chapter Three describes how inter-organisational learning can be visualised as cooperation between activity systems in a *collective zone of proximal development.* It explains how expansive learning theory is used as a heuristic device to guide the collection, and analysis of empirical data and to interpret the dynamic tensions between old and new practices as they evolve during the implementation of HTC policy. My next chapter begins with a description of my methodological journey into socio-cultural theory.

3. A Natural History of my Research Methodology

3.1 My Methodological Journey

An HTC is a policy concept, in which multi-agency partnerships are created to catalyse three sub regional knowledge economies. My research started in the midst of experiences and events, which made more sense in retrospect than they did at the time. As explained in Chapter One, my work role brought me into the regional policy arena and made me aware of the ambitious HTC policy and the assumption that it would galvanise technology transfer in the West Midlands.

Three things intrigued me. Firstly, progress in the HTCs seemed to have stalled, and because many people were involved it was difficult to work out who to talk to and who took responsibility for the implementation of the policy. Secondly, at the outset of the Rover Crisis, the Rover Task Force report had been instrumental in the initial development of the policy concept[17]. Although a great deal of money was spent regionally on reports from consultants, there was no focus on diagnosing implementation problems. Thirdly, despite the time and money spent on the analysis of regional issues, opportunities to consider feedback from the people implementing the policy were missed. In other words a reflective evaluation of progress could have created insights and modified the developmental trajectory of HTC policy.

I began my research by talking to people who had influenced the development of HTC policy and who understood its roots in the Rover Crisis of 1999 and the response of

[17] The circumstances surrounding the threatened closure in 1999 of the Rover Plant in Birmingham were described in Chapter One.

the Rover Task Force. I was interested in the anomalies between the theory and practice of using *multi-agency partnerships* as a vehicle for developing a regional knowledge economy with sub-regional focal points for technology transfers activities.

I wanted to get an insight into the experiences of those involved in implementing the policy and decided to use socio-cultural theory as a theoretical framework for comparison of the development of the three HTCs. Social practice theory has particular relevance to the operation of Technology Corridors because the primary 'unit of analysis' is neither the individual nor social institutions but rather the informal 'communities of practice' that people form as they pursue shared enterprises over time (Wenger, 1998).

Socio-cultural theories offered an alternative to organisation theories that focused exclusively on decision-making and on the notion of 'strategic rationality' (Blackmore & Lauder, 2005, p. 97-8). The rational model ignores the inherent complexity and ambiguity of the social practice dimension of organisations and their environments as discussed more fully in Chapter Two. The interests of stakeholders in organisations strongly influence discursive practices and multi agency practices do not seem to evolve in any predictable linear way. From a social practice perspective 'organisational culture' can be defined as a patterned system of perceptions, meanings and beliefs about the organisation which facilitates 'sense-making' and guides the behaviour of people at work (Bloor & Dawson, 1994; Weick, 1995).

I was interested in the way different variants of social practice theory focus on the process of 'sensemaking', which is what happens when people make retrospective

sense of the situations in which they find themselves. The attention to the social dynamics of organisations suggests that 'sensemaking processes' shape organisational structure as well as individual and group behaviour. I was particularly interested in three theories, which were orientated towards studying organisational practices. My initial thinking was influenced by the work of Lave and Wenger and recent applications of Communities of Practice Theory (Lave, 1993; Wenger, 1998, 2000). This was appealing because of differences in the organisational cultures and practices of the so-called partners in the HTC policy experiment. Community of Practice Theory (COPT) focuses on small group interactions in the workplace, but the unit of analysis seemed too imprecise. It does not distinguish sufficiently between the centre and the periphery. COPT hints at the significance of power and influence but never really addresses the issue of power even when discussing the interactions between multiple communities of practice (Wenger, 1998, 2000).

I was also attracted to Actor Network Theory (ANT) because it spoke of technological and human '*actants*' and their capacity to act in *networks* to drive technological change and innovation (Law, 1992; Law, 2000; Law & Hassard, 1999; Miller, 1997). Actor Network Theory recognises the significance of technology itself as an agent for change and considers practices over a broader canvas and over a longer time frame. Consequently, ANT is concerned with change in whole industries spanning decades or even longer (Fox, 2000). By contrast Community of Practice Theory (COPT) is concerned with small group interactions at work and builds upon notions of situated learning, it takes a small unit of analysis in contrast to ANT, which adopts a much larger unit of analysis.

I was at first undecided about which one of the relevant socio-cultural theories would provide the strongest theoretical basis for my research. However recent studies of innovation in complex organisations used E*xpansive Learning Theory* (ELT) in very interesting ways and this convinced me that it was appropriate for my study of multi-agency learning in the HTCs.

My research methodology aims to clarify how tools mediate the interactions of organisations to shape practices related to the enactment of HTC policy. For example, the 'knowledge economy discourse' and the Rover Task Force funding package are powerful mediators of activity. Discourses can be persuasive, they are tools that embody accumulated social wisdom and can act in two ways to model thinking. Tools have agency and can embody thought and can actively shape thought. Recent research has shown that new tools and technologies can influence our thinking in unpredictable ways (Cole, 1999; Cole & Engestrom, 1993; Cole & Wertsch, 1996; Davydov, 1999; Engeström, 2001, 2004; Engeström et al., 1999; Hasu, 2001; Ludvigsen et al., 2003).

Expansive learning theory conceptualises organisational learning as collaboration, which can be seen in the emergence of new practices resulting from working 'across' culturally distinctive activity systems. In studies of phenomena where the boundaries are unclear, the case study method is a well-established approach. It offers flexibility in researching evolving multi-agency partnerships where there is uncertainty about when the activity begins and ends (Yin, 1993, p.3). Even though the boundaries of the HTC phenomena seemed very unclear each HTC could be treated as a *meta-activity system* with a *developmental history* that can be described.

Gradually I appreciated that there were more interesting ways to study the HTCs than as three straightforward *case studies* of a policy implemented simultaneously at three different sites. I considered each HTC as a multi faceted organisational case study.

Although expansive learning theory does not specify a particular type of data, it suggests that the experience of HTC policy could be understood and analysed from different subject perspectives. The term '*subject*' can refer to an individual person, to a member of a small group and also to a representative of a large collective community. It is possible to gather interview data from an individual subject, positioned in relation to their membership of particular communities and cultures. Similarly interview data could reconstruct the location of the subject in the tripartite implementation structure of the HTC policy. (This is addressed more fully in Chapter Four, which reconstructs a number of subject perspectives from the data).

Subject positioning is depicted in relation to membership of multiple communities of practice and in relation to overarching communities or social worlds. At first I thought that macro, meso and micro levels in the HTCs could be visualised as hierarchically linked social worlds and arrayed like Russian nesting dolls, one inside the other. As my research progressed I realised that the data showed that interactions within and between levels are even more complicated.

I thought it seemed fruitful to analyse the cases in various ways. I decided to make a multi-faceted study of HTC development by tracing the experiences and changing practices described by individual subjects in interviews. It was possible to locate individual subject perspectives on a two dimensional matrix with a vertical axis and a

horizontal axis[18]. Interviews could capture the subject's perspectives in relation to the level at which they were located in the policy implementation structure. This data could also co-locate their position in relation to a particular organisational culture.

I realised that I could focus on three aspects of interaction and collaboration. Firstly, I could look at variation across different sites based on the geographical focus of the HTCs. Secondly, I could consider the cases as studies in terms of variation in stakeholder practices. Thirdly and most importantly I could analyse the data to reveal differences in the practices adopted at the three levels of policy enactment.

Each case could be treated as a *meta activity system,* in which several sub-activity systems interacted horizontally across organisational cultures. Expansive learning theory describes this as *polycontextuality.* At the same time sub-activity systems interacted between levels and these *vertical interactions* were different in quality.

Expansive learning theory offers a stronger analytical framework than Communities of Practice theory because it focuses on a dynamic transition in learning by individuals embedded in activity systems in pursuit of an object. Nevertheless it does not resolve questions about the impact of power differences between activity systems. It cannot depict as 'collaboration' the conflict between competing objects and discursive practices in the vertically arrayed levels of policy enactment. These dynamics are characterised by differences in agency and power and vertical interactions between activity systems cannot be described in the same way as *polycontextuality.*

[18] This is explained in detail in Chapter Four.

I experienced a good deal of anxiety about using an evolving theory. During the course of the research I began to realise that although expansive learning theory had been used in studies of complex organisations it did not offer a robust explanation of issues of power and agency. This was a gap in *expansive learning theory*, which I decided to pursue in my research, by pushing the theory to its outer limits. I have outlined these complexities and limitations at the outset, so that the claims for the data analysis are seen within this context.

3.2 My Research Design

My research design links the theoretical methodology with the data analysis. My approach to data collection is consistent with the conception of knowledge as a social construction, which is dynamically created and reconstructed as individuals and groups interact. The research questions stated in Chapter One (Section 1.3) focus on emergent collaborative practices and link the heuristic device of expansive learning theory with the data collection and analysis.

Organisations are composed of people who act and interact and can describe their practices. This is consistent with my ontological position described in Chapter One. It suggests that experiences described by interviewees in my research can be captured and represented in transcripts. Regardless of the status or expertise of the respondent their descriptions of events and practices are informed by prior assumptions, cultural practices and discourses that 'shape their perspective on reality' (Ball, 1994; Beach, 2003; Lincoln & Guba, 2000; Miles & Huberman, 1994; Ozga, 1999; Silverman, 2001; Yin, 2003).

I gathered my primary data in interviews in which respondents described their 'stories of the development of the HTC'. I interviewed thirty people working at three levels of HTC policy implementation and used respondent triangulation to identify consensus and contradiction. I analysed the interview data to uncover the 'interests' of individuals and their 'organisational positioning' (Ball, 1994). The interview transcripts positioned the respondents within the policy process, both explicitly and implicitly (Ball, 1994; Troyna, 1994). On one level I treated the interview transcripts as strong realist stories, and on a second level I considered them as *discourses,* as sophisticated 'representations' rather than 'guileless descriptions' of events.

Secondary data comprise public documents such as policy statements, reports and web sites. My secondary data reflects three different 'organisational' perspectives. At the macro level I drew on regional policy documents, at the meso level I used strategy documents produced by HTC steering groups, and at the micro level I took information from project outlines. By producing a text such as a strategic plan or web site the HTC makes available to analysis the origins, nature and structure of the discursive themes that influenced the production of the text. The new discursive position can be compared with previous and separate positions, which arise from the interests of the separate partner organisations. In this sense the evolving HTC discourses are both outcomes and tools of activity (Prior, 1997).

At the macro level this includes European and National policy documents on the knowledge economy. Both the Department of Trade and Industry (DTI) and Department for Education and Skills (DfES) publish policy documents on innovation and competitiveness (DfES, 2003a, 2003b, 2003c; DTI, 2002, 2003a, 2003b, 2003c;

EU, 2003). It also includes the Regional Innovation Strategy, the Regional Economic Strategy and the Agenda for Action[19](AWM, 2003; AWM & AfA, 2002; AWM & WMES, 2003; UUK, 2003; UUK & HEFCE, 2001; WMiE, 2003; WMiE & ESF, 2003; WMRA, 2003).

I used a snowball sampling technique and I began with a sample of eight key strategic actors who had strategic influence at the inception of the HTC policy in 1999. Initial respondents in the first wave of interviews led me to other interview subjects. In Phase One I carried out interviews with a sample of macro actors from the top regional level of HTC policy implementation. At this level the HTC policy aim was their *espoused* object of activity, which I reconstructed in a *meta-activity system.*

I used *expansive learning theory* to depict the developmental history of the HTCs. The interconnectedness of all the elements in an activity system suggests that by understanding an individual subject perspective, it is possible to construe their relationship to other elements in the system. This seems possible where some elements are constant and such as the policy documents that embody the discourse informing the *espoused object of activity.* The term *espoused object of activity* is used to convey the idea that although policy was intended to be coherent it was interpreted differently at particular places in the implementation chain where *competing* objects of activity emerged.

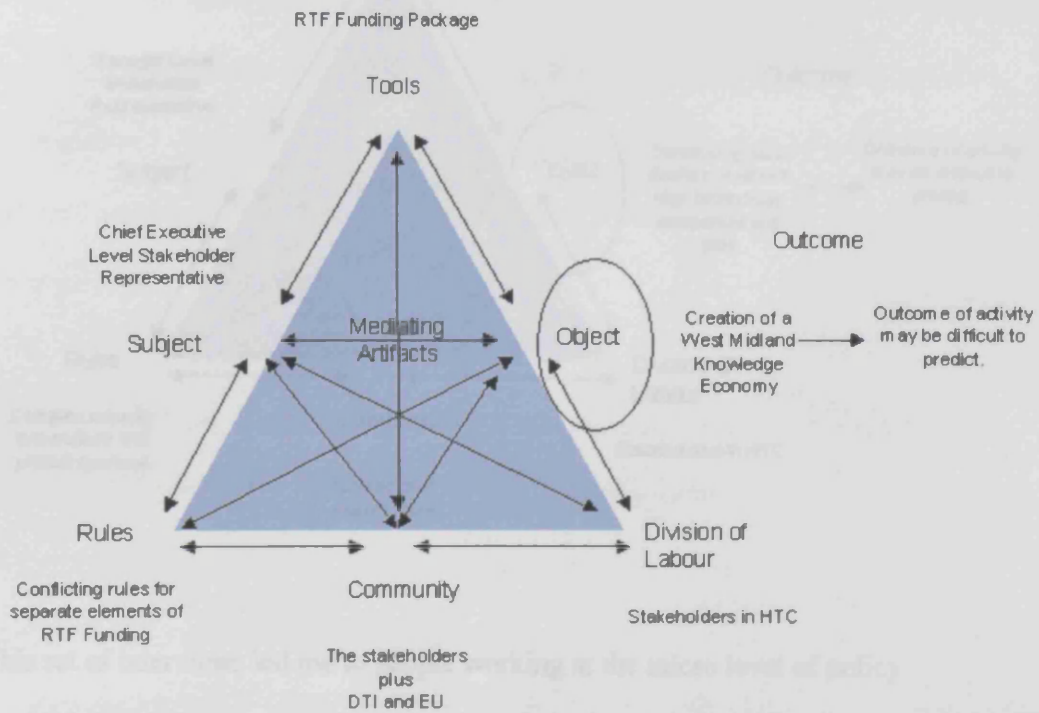
At the macro-level 'HTC policy' was somewhat abstract and described the development of a regional knowledge economy. A strategic vision of innovation and

19 Each English region is tasked to produce a local version of this to a standard format determined by the UK Government.

diversification is the espoused 'object of activity'. This was reiterated in published policy documents and reports, and it was as close as policy makers could get to theorising about their intended outcome. The focus of effort was orientated towards regional development of a knowledge economy.

The next figure illustrates part of my process of data mapping and shows how the model of a *meta-activity system* is used as a tool for thinking about the macro level data (see Figure 2 Chapter 2). It depicts elements in the macro level activity system from the first phase of the data collection cycle based on interviews with eight key individuals. It illustrates the *espoused* object of activity at the macro level.

Figure 5: Mapping Relationships within the Macro Level HTC

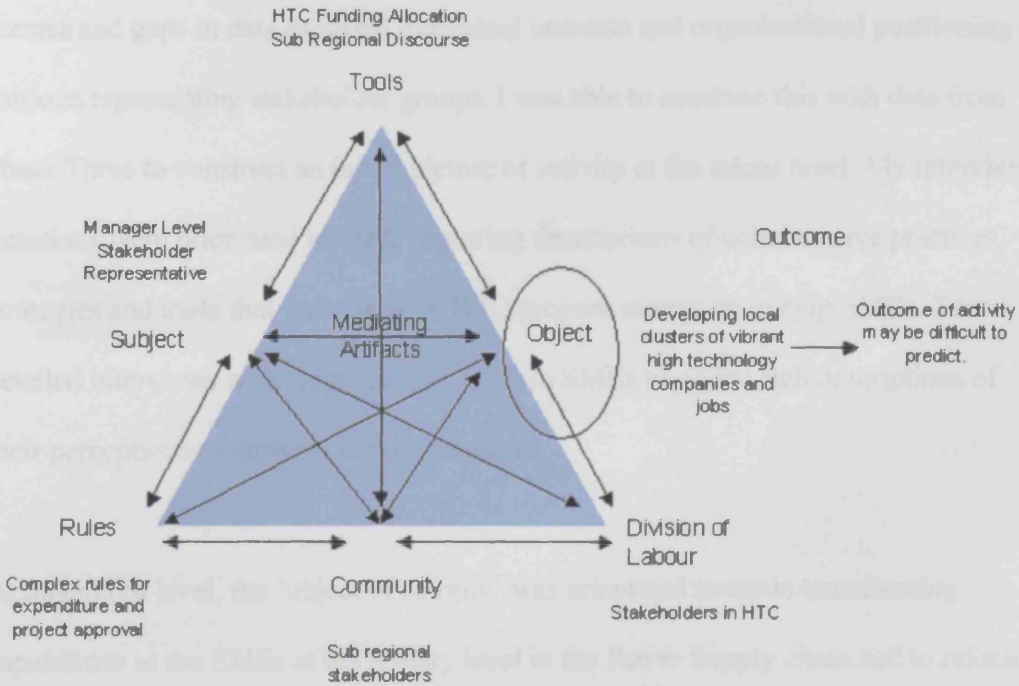


In Phase Two I interviewed fourteen members of the HTC steering groups. For these individuals the object of their activity was orientated towards sub regional priorities.

The meso-level object of activity for each HTC Steering Group was orientated towards aligning the partners to address sub regional problems.

Secondary data such as project plans and 'headlines' from the individual HTC web sites were triangulated with interview data describing individual 'experiences' of the HTC policy implementation process[20]. The next figure shows how the data was mapped to elements of a *meta-activity system* at the meso level and shows the *espoused* object of activity at this level of HTC policy implementation.

Figure 6: Mapping Elements of Activity at the Meso Level



This set of interviews led me to people working at the micro level of policy implementation who were responsible for delivering practical technology transfer

[20] http://www.centraltechnologybelt.com
http://www.cswp.org.uk
http://asp.wlv.ac.uk/Level3.asp?UserType=11&Level3=1008

projects to SMEs. In Phase Three my interviews focused on the practical strategies that projects adopted to make technology transfer happen for particular groups or clusters of companies with similar needs, interests or dependence on specific markets. At this level the communication between users and developers of new technology became really interesting. This data was triangulated with secondary data such as excerpts from reports from 1999 to 2004 analysing local problems. I also included published aims of HTC projects and materials from each HTC web site.

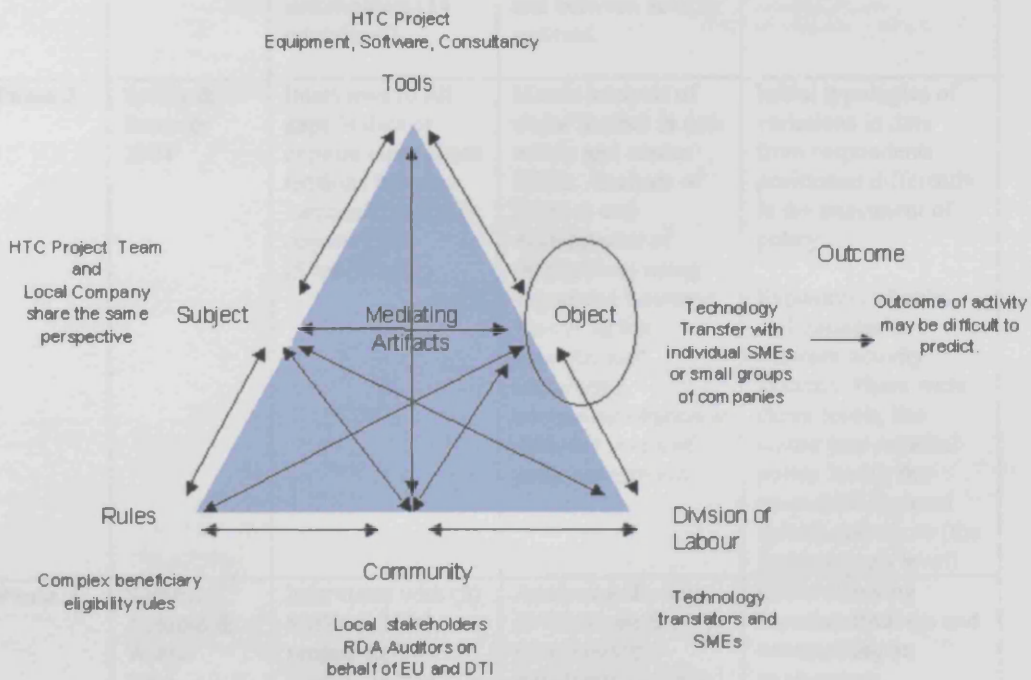
During Phase Four I pursued my interest in the *quality* of relationships between developers and users. Five more people were interviewed and my questions pursued themes and gaps in data to reveal individual interests and organisational positioning of subjects representing stakeholder groups. I was able to combine this with data from Phase Three to construct an initial picture of activity at the micro level. My interview questions were orientated towards capturing descriptions of collaborative practices, strategies and tools that were used by HTC projects managers to help SMEs. Two detailed interviews with technical managers in SMEs provided rich descriptions of their perceptions of changes in their practices.

At this micro level, the 'object of activity' was orientated towards transforming capabilities in the SMEs at the tertiary level in the Rover Supply chain and to refocus the skills of their workforce on the development of new products. However, the regional policy may not have fully appreciated that complex innovations are difficult to implement (Fullan, 1999). These difficulties were increased because innovation was undertaken by newly formed multi agency partnerships. The policy assumptions about public policies delivered by multi agency partnerships are discussed in Chapter Two

and a detailed consideration of the nature of collaboration and the theory and practice of partnership is made in Chapters Four, Six, Seven, Eight and Ten.

In particular the notion of partnership was different at each of the three levels of policy enactment and this had consequences for what could be achieved and explains why three characteristically different objects of activity emerged at each level. The next figure illustrates the inter-relationships between the elements of this *meta-activity system*, and depicts the 'object' of activity at the micro level.

Figure 7: Mapping Elements of Activity at the Micro Project Level



The table on the next page summarises the research design and data collection and analysis cycles. It makes the link between Chapters Two and Three, in that it explains how the theoretical drivers shaped my research methodology.

Figure 8: Research Design including the Data Collection and Analysis Plan

	Timing	Data Collection	Data Analysis	Data Exposition
Phase 1	Winter 2003	Semi Structured interviews with **8** key individuals.	Identifying patterns and themes in the data. Mapping tensions between rules and divisions of labour as they emerged from the data.	Initial matching of data against elements within an activity system. Initial analysis of interviews as stories, representations of interests, and discourses. Using the Implementation Staircase model to think about policy implementation.
Phase 2	Spring 2004	Semi-structured telephone interviews with HTC steering group members including public and private sector stakeholders (**14** interviews).	Searching for relationships and patterns in the data. Using Atlas ti software to map the tensions between elements of activity, and between activity systems.	Initial analysis and reconstruction of practices in the HTCs as complex Activity Networks of embedded activity systems.
Phase 3	Spring & Summer 2004	Interviews to fill gaps in data or explore ideas about tensions between 'espoused and tacit objects' (**5** individuals)	Matrix analysis of major themes in data within and across HTCs. Analysis of practice and development of propositions using Expansive Learning Theory as the heuristic tool. Identifying competing **objects** at different levels of policy enactment.	Initial typologies of variations in data from respondents positioned differently in the enactment of policy. Exposition of links and boundaries between activity systems. There were **three** levels, the macro (top regional policy level), the meso (sub-regional levels) and micro (the local projects level).
Phase 4	Summer, Autumn & Winter 2004	Interviews with (**5**) SMEs or HTC project staff to illuminate 'the facilitation' of dialogue between developers and users most effective in changing practices within SMEs	Analysing the data to illuminate the role of technology translation projects, and the use of boundary objects, and mediators.	Cross-checking tentative findings and constructing an explanatory framework in terms of boundary crossing and expansive cycles. Writing up the conclusions.

Table developed from (Miles & Huberman, 1994)

ELT= Expansive Learning Theory = a heuristic tool and an object of study
SMEs= Small and Medium-sized Enterprises (employing less than 250 people)
HTCs= High Technology Corridors

Throughout the data collection and analysis cycles I considered the data in various ways and looked for patterns and anomalies in: -

- Tensions between elements of activity
- Tensions across activity systems at the same levels
- Tensions between meta and sub activity systems at different levels

To analyse these tensions I extended an analytical device used by Blacker to summarise the patterns in the data and emerging forms of expansive learning in the HTCs (Blackler et al., 2000, p.290). A generalised example of the analysis is shown in the table in below: -

Figure 9: Emerging Forms of Expansive Learning in the HTCs

Analysis of HTCs	Activity Networks at Three Levels	Multi-voiced ness	Developmental History	Contradictions	Expansive Cycles
Who are learning?	Public and Private Sector Partners	There are tensions between Organisational cultures and voices. Collisions between activity systems of 'partners'	Individuals and organisations are learning to work together at all three levels	Tensions between the rules governing each meta activity system correspond to division of labour at three key levels	Learning across levels or polycontextuality happens at various times in different levels
Why do they learn?	Tensions between activity systems drive change and collaboration	Dominant discourses prevail	Discourses change over time and the dominance of these varies	An object is created at each level and these three objects compete with one another	Tensions between objects at three levels drive collaboration between levels
What do they learn?	They value the complementary perspectives of individuals and each partner organisation	They find shared solutions to problems	They learn to take more risks and to trust the other partners	Tensions between old practices and new practices	They appreciate that they can do more together than by working independently
How do they learn?	Individuals move back to influence their home organisation	Dialogue and argumentation drives learning	Boundary objects help partners move across activity systems	Mediators can help learning between levels separated by agency	Confidence in the new practices grows and expands into a co-operative partnership
Notes	Each meta activity system (or activity network) is made up of sub-activity systems. HTC Policy is enacted at three levels, Macro, Meso and Micro in which an activity system is the smallest unit of analysis.				

3.3 My Method of Data Presentation

I present the data not as three separate case studies, but integrate it into a thematic discussion and analysis within the narrative. Data is presented in the next four chapters, interspersed as quotes within the text to ground the theoretical analysis and to illustrate the interpretation of empirical data. I present my data in vignettes to evoke a vivid impression of actions and interactions. Vignettes are constructed to depict key situations and interactions in context and are created from accounts of experience described in the interview data.

It is important to clarify that I did not use vignettes as a data elicitation technique. I did not need to use vignettes to collect data as described in studies where researchers deal with vulnerable interviewees and highly sensitive subject matter such as in cases of abuse and violence[21]. I have used vignettes simply as a presentational device to illustrate the complex theoretical implications of unfolding activities as they occurred in a particular location at a particular moment in time.

Even the most recent applications of expansive learning theory in studies of innovation focus on polycontextuality or collaboration between activity systems operating at the same level. This gap in theory and the absence of a precedent for my research makes an integrated analysis in two directions unmanageable. Consequently a horizontal analysis of interaction precedes a vertical analysis and these two analyses made in parallel are then combined at a later stage.

[21] Vignettes can be used as a methodology for data collection, often in circumstances where sensitive areas of inquiry make it difficult to explore perceptions and beliefs. Responses to vignettes used in this way may elicit something more anonymised and abstract and less threatening than a personal account. This is a specific technique and is discussed at http://www.soc.surrey.ac.uk/sru/SRU25.html

Inevitably, discrepancies arose and contradictory data is included in thematic discussions throughout the thesis (Denzin 1988). Despite these practical difficulties, the inquiry generated insights about the tacit assumptions of HTC policy and the inherent contradictions between theory and practice. The insights from my research are relevant to future policy development in the English regions. They may also be useful to people thinking about implementing comparable technology transfer initiatives elsewhere. The potential to generalise from my research is discussed in Chapters Nine and Ten.

3.4 Discussion of Ethical and Political Issues

Although this inquiry is not an evaluation, I adhered to ethical and procedural guidance published by the UK Evaluation Society guidelines. In the interview data many of the respondents gave frank and 'politically sensitive' perspectives and interpretations of events and practices. I made clear the academic purpose of my inquiry, and assured the respondents that the data would be treated in confidence.

The interview data includes transcripts containing 'opinions' from staff at the Regional Development Agency, Advantage West Midlands (AWM). Although some individuals consistently adopted the 'organisational perspective' and rhetoric of their employer, sometimes opinions were given 'off the record' and these revealed some interesting tensions within the organisation. Interviews captured the various 'perspectives' of partners and stakeholders who were willing to express opinions on the implementation of the HTC policy. Most people were able to describe how they had 'experienced' the process of implementation and could describe what it felt like to work in an evolving partnership.

Although it is important to protect the confidentiality of the data, there is a corresponding need to attribute remarks to the speaker and to place the individual perspectives within a context of organisational positioning. For instance the empirical data captured clear divisions of labour within the RDA, in which two different sets of rules and cultures operated. The visionary and inspirational role in the development of policy can be seen to be in tension with their practice of rigorous monitoring and fiscal management of HTC projects and this is explored more fully in Chapter Seven.

In order to set realistic claims for the 'credibility' of the primary data, I shared the interview transcript with each respondent. They were asked to check them for accuracy of content and interpretation. Notes of conversations were likewise checked to resolve ambiguities and in some instances I interviewed a respondent more than once. Sometimes I framed the issues or the question slightly differently to detect changes in their view perhaps influenced by reflection on events. My methodology recognised the possibility that a respondent over a period of months may have reconsidered a 'taken for granted' position, as a result of an earlier conversation. Tracking changes in 'the views expressed' over time was consistent with the social constructivist orientation of the inquiry. This strategy aimed to strengthen the transferability, and confirmability of the data (Bauer & Gaskell, 2000; Kress & Van Leeuwen, 1996; Mason, 1996; Silverman, 2000). I also used respondent triangulation within and across the HTC cases and between primary and secondary sources of data, aimed to ensure the 'credibility' of the data.

Much research celebrates the distance between the researchers and respondents. Some researchers associate this issue with notions of 'objective truth' and get involved in problematic issues such as the relative legitimacy of their truth claims (Beach, 2003). However my research uses a range of tools to check and validate data. A good deal of effort has gone into checking the 'constructions of meaning' and assuring the provenance and authenticity of the primary data with the interviewees. All the respondents had an opportunity to check the accuracy of their interview transcripts[22]. They were invited to inform me of any misinterpretations of their comments and to make additional observations. My intention was to strengthen 'confirmability' of the data in this study (Lincoln & Cannella, 2004).

After each data collection cycle my analysis identified patterns and gaps so that the next cycle of data collection was informed by puzzles or interesting themes as they emerged. I triangulated the interview data across levels and between levels as a method of internal validation. I also triangulated the primary interview data with secondary data. Individuals act on behalf of their employer organisation to deliver the policy as espoused and agreed at a strategic level by senior officials.

In some studies of organisational innovation conducted at the Change Lab in Helsinki, the environment was structured to enable the researchers to reflect findings back to the participants. Under these conditions researchers intervened to shape the desired change and claimed that 'communicative validity involves testing the validity of knowledge claims in a dialogue' (Hasu, 2001). However dialogue with respondents

[22] With only one exception the respondents welcomed this and confirmed the accuracy of these transcripts or notes. In the case of the single exception, the respondent had been extremely reluctant to give a tape recorded interview and made only grammatical corrections to the transcript, which made him feel more 'in control' but did not affect the meaning in any way. I retained both versions.

was not realistic or practical given the naturalistic setting in which this research was carried out. There were sensitive issues concerning the expenditure of large sums of public money. Also it was too difficult to share my interpretation of the data with respondents because the terminology and abstractions in expansive learning theory are central to the data analysis, and yet very difficult to communicate (Collins et al., 2004). This issue is discussed in Chapters Nine and Ten.

To communicate the complex findings of the inquiry, stories with rich contextual detail, but limited attribution were constructed from the empirical data. The research sought to strike a balance between protecting the anonymity of respondents and presenting the data in its 'context'. Nevertheless there is some risk that a reader with local knowledge may have sufficient background information to identify respondents despite the disguise of the referencing system. It has been difficult to resolve this dilemma because comments selected from the interview data only 'make sense' when considered in the context of 'their organisational positioning'. In some instances comments and 'interpretations of events' are critical of various agencies and are therefore 'politically sensitive'. This may be a potential weakness and limits the capacity of the research to be credible and informative to the key respondents and other practitioners.

An ethical dilemma became evident in balancing the need to contextualise and validate the empirical data, and at the same time to protect the anonymity of the respondents. The need to resolve this problem of attribution became most acute when referencing the data in Chapter Six. Consequently I adopted a referencing system to

ensure that sensitive and confidential comments were anonymised whilst retaining sufficient empirical data to embed it within its context:

- Category A respondents are defined as members of the top strategic level of HTC policy implementation,
- Category B at the meso level and
- Category C at the lowest micro implementation level.

All the quotations have a footnote bearing an identification number that links it back to the individual respondent. Each number is prefaced by the letter P, which refers to a primary document containing the interview transcript located in a qualitative data analysis software programme[23]. An illustration of the data analysis matrix is given in the Appendix.

3.5 Overview

The research design recognises that expansive learning theory proposes an explicit focus on the interaction between actors and their surrounding environment. Activity is a socio-cultural construction and the meaning of activity in any particular context is shaped in relation to the activity systems in which it is embedded.

Four chapters draw on the empirical data to characterise patterns in the relationships and practices as they emerged in the HTCs. Chapter Four reconstructs the subject perspectives of key individuals and agencies. It explores how this affected their interpretation of HTC policy and its implementation. Chapter Five describes interactions across the cultures of the various agencies involved in HTC development

[23] All the documents were stored, coded and analysed using Atlas ti software. The reference numbers are PD1 to PD32.

and focuses on the horizontal relationships between users and developers across the multi-agency partnership. Chapter Six depicts hierarchical interactions between three key decision-making levels in the implementation of the HTC policy. It discusses the dynamics of power and agency in terms of tensions between three characteristically different 'objects of activity'. Chapter Seven describes dilemmas and contradictions in HTC activity.

Turning now to Chapter Four, this draws on the empirical data to explore the issues of subject perspective and organisational positioning and its impact on key individuals responsible for implementing the HTC policy. My next chapter includes fragments of stories, told from different positions and perspectives in the implementation process. The location of the perspective of the 'subject' in these stories can be visualised as points on a graph with an x-axis representing the horizontal collaboration between partner agencies and the y-axis representing the hierarchical positioning of the subject in terms of the agency of three key implementation levels. My aim is to capture fragments of individual or shared experience and interpretations of events that reveal something about the overall dynamics of relationships in the HTCs.

4. Reconstructing Subject Perspectives in the HTCs

4.1 Introduction

Although expansive learning theory does not suggest or prescribe any particular type of data, it does offer a heuristic framework to set individual actions within a broad social context of stakeholder interactions in the HTC policy environment. It is possible to think of policy as a story outline adapted at the operational levels to make it 'work in context'. Expansive learning theory reconstructs policy stories as interpreted by different people working at different levels in the implementation process.

A subject can speak as a member of a community at a particular level of HTC policy enactment or from their usual organisational perspective. They can describe practices influenced by the dynamics of local relationships and contexts. It is not realistic to interview every possible individual subject enacting the HTC policy. Consequently I interviewed a sample of those subjects and checked for internal validity by searching for differences and similarities in their accounts of events by triangulating the responses.

4.2 Subject Positioning and Identity within the Policy Process

I found the task of identifying *subject perspectives* very challenging because interview *subjects* are positioned in two dimensions. A subject is positioned along a horizontal axis where different organisational cultures interacted. The same subject is also

positioned on the vertical axis at macro, meso and micro levels of HTC policy implementation.

The identity of an actor in one activity system is influenced by their identities in other contexts. The accounts that respondents gave of events and practices were treated as discourses that embodied organisational values, cultures and attitudes corresponding to particular locations on the vertical and horizontal axis of activity, which influenced their overall identity and *subject perspective*. The methodology aimed to ensure the interpretation of interview data was credible and transferable to other contexts.

In the HTCs the data showed that an individual may simultaneously be the subject acting as a representative of a small group in an activity system, and at the same time may be a member of a community mediating the interaction of the group with the object of activity. Multiple memberships of different activity systems made analysis of interactions between related activity systems a complex task for which no precedents were available in terms of how to deal with multi faceted and multi level analysis and interpretation. The risks of working with an evolving theory are discussed more fully in Chapters Nine and Ten.

The key concept in expansive learning that is pursued throughout this investigation is the elusive and changeable nature of the 'object of activity'. The 'object' is influenced by the location of the subject on a horizontal axis (characterising the different cultural perspectives of partners organisations). The subject is collocated along a vertical axis (corresponding to the three key layers of decision-making in the implementation of the HTCs) and the 'object' is also influenced by vertical as well as horizontal positioning

of the subject. From these two dimensions the subject conceptualises the 'object of activity' depending upon who they are, where they are positioned in the implementation process and when they were studied.

All this changes over time throughout the implementation process. In other words, horizontal and vertical dynamics influence *who* (the self-identity of the subject), *where* (the context of the subject's engagement, and their organisational positioning) and *when* (the position of the subject in the chronology of the development of the HTC). The study traces the evolution of individual and collective conceptions of the 'object of activity'. Throughout the following chapters, interactions between complex institutions as they enter into relationships with other organisations in the enactment of HTC policy are visualised as collisions between activity systems, and activity networks. These create new dilemmas that continually reshape the object of activity.

In a sense each of the three HTCs can be visualised as a *meta-activity system* composed of sub activity systems. An HTC is more appropriately described as a network rather than a system because of the scale and complexity of the interactions. By treating each HTC as a complex network of activity systems, it is possible to use expansive learning theory to analyse the relationships within and between activity systems 'through the lens' of specific stakeholder perspectives. The research methodology recognises the risk of imprecision in the units of analysis and the tendency in recent studies of innovation in organisations to use the word *subject* to refer sometimes to an individual, a small group or a collective body such as an organisation (Blackler, 2000; Blackler & Kennedy, 2004; Engeström, 1999; Tuomi-Grohn, 2003).

In Chapters Four, Five and Six the empirical data is used to reconstruct *subject perspectives* in relation to both expert communities and a level of policy enactment differentiated by agency. Therefore each HTC was conceptualised as an activity network in which activity systems interacted both vertically and horizontally.

> *Vertical complexity relates to changes at individual, local and regional community levels, and the interactions between these levels. A host of other political, demographic and geographic factors also applied (Connell, Kubisch, Schorr, & Weiss, 1995, p.2).*

The vertical interactions are expressed as being at macro, meso and micro level, to distinguish between three different levels of decision making about HTC policy. The enactment of HTC policy is characterised by a tripartite structure of regional, sub regional and local project levels. These interactions are visualised as layers in a sandwich or cake in which the top layer has more agency than the bottom layer. The horizontal relationships are expressed in terms of interactions between different organisations where there are no distinctive hierarchies in agency, but significant variations in culture and expertise.

> *Horizontal complexity is about working across systems or sectors and agencies and it is difficult to measure this complex array of activities, which have social, economic and physical dimensions. (Connell et al., 1995, p.2).*

The object of HTC activity relates to what people understand to be 'the project in hand' (Blackler & Kennedy, 2004). Therefore the object is described differently

depending on the position of the individual in three dimensions. Positioning relates to organisational culture, the level of policy enactment and the point in time. It was very difficult to be precise about the 'object of activity' because of the inherent difficulty of grasping the meaning of an object to the various 'subjects' at any single instant. For instance:

> *It's a very broad agenda. Where technology transfer stops innovation ends. Innovation and technology transfer are often used as interchangeable terms. Essentially it's about taking knowledge from one place (a University or research agency) to the business base. It's about how the knowledge is applied to increase profitability*[24].

Subject positioning is depicted in relation to membership of multiple communities of practice and in relation to overarching communities or social worlds. In the HTCs it is as if social worlds are arrayed like Russian nesting dolls, one inside the other, but data showed that interactions within and between levels are even more complicated.

Three issues made implementation of the HTC policy extremely challenging. Firstly, the scope and ambition was unprecedented and it was driven by a local crisis, rather than by a sustained analysis and theoretically robust rationale for change. Secondly, the policy was so complex and abstract that it was impossible for local companies to relate to it, so it had to be broken down and translated into meaningful components. Breaking the policy into deliverable parts was important. The whole picture was too difficult for SMEs to grasp and it was not important that some aspects of the policy

[24]P25: Category B Respondent: Manager of a Science Park and member of an HTC steering group.

were not fully understood. It was the role of the upper level to aggregate separate work packages into a coherent whole as illustrated in this data extract: -

> *Whilst the corridor is concerned with all sorts of technology, we can put this on the back burner and for the purposes of communicating a* ***simpler story*** *to the SMEs we can focus simply on one thing at a time. A theme such as transportable treatment is a case in point* [25].

Thirdly, the stakeholders in the HTC multi-agency partnerships had no history of working together. The region had no tradition of collaboration between the public and private sector, and in some instances some of the key regional organisations did not enjoy cordial relationships. There was no history of multi agency collaboration in the region prior to the Rover Crisis.

> *This is the first time that X City Council and Y City Council have worked together on a major initiative. - Rover was a 'wake-up' call to the region and we are now more aware of the untapped potential of the region*[26].

By implementing the policy via sub regional steering groups it was assumed that approaches would meet local needs most appropriately. It was especially important to engage SMEs and this involved telling them about opportunities to catch their attention. Stories of what could be done with research and development helped to make the HTC relevant to their current needs.

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[25] P15: Category B Respondent: Head of Innovation in a rural local authority and actor in HTC 1.
[26] P 2: Category B Respondent: Manager in public sector business support agency and member of the HTC 1 Steering Group.

*We have decided to work with a **cake and slice** model. This gives us the possibility to present one of four main sub sets of high technology* [27].

4.2.1 Sub-Regional Priorities

The 'Rover Crisis' focused the agencies in the region on concerted action. The corridors were originally chosen partly because they were seen as having some potential to attract and develop more high-tech, 'high value-added' businesses by virtue of the presence of universities, research institutions or property opportunities. HTC policy became the centrepiece of the West Midlands Regional Innovation Strategy (RIS) and each HTC was linked to the resolution of sub regional problems and the development of new opportunities. The policy aimed to align the private and public sector and in particular aimed to change the basis of interaction between the region and its Universities and hospitals.

Originally the ambition had been to set up Technology Networks, but as it turned out three HTCs were proposed in the report, linked to geographical boundaries and in close proximity to research capability[28]. This was influenced by the successful development of a 'knowledge economy' in Cambridge and by the model of a *Technopole* (Oakland, 2003). This is discussed in more detail with reference to *policy borrowing* in the next section.

[27] P15: Category B Respondent: Head of Innovation in a rural local authority and actor in HTC 1.
[28] P 1 Head of Regeneration at University Hospital and CTB Board Member.

AWM and Regional Economic Development staff favoured the concept of Technology Corridors, because they had a geographical location and fitted in with their notion that economic regeneration takes place in geographic areas[29].

The original Rover Task Force Report in 1999 highlighted a complex raft of factors that made an impact on the success of HTC policy but nevertheless only some of the recommendations in the report were implemented. There were discontinuities, inconsistencies and lacuna in policy that in aggregate caused major difficulties as implementation of the policy proceeded and the delays described below were typical and had a detrimental effect (SQW, 2001).

Although the main focus of our work was on initiatives within the corridors, there are also a number of ***generic issues****, which should be addressed regionally in order to support growth of new, high technology activities... A priority is to increase the resources available for commercialisation, including expertise and funding. ... More should be done to* ***increase capacity*** *both within the institutions themselves and in* ***firms*** *that are potential recipients of technology (SQW, 2001, p.12).*

The HTCs were uneven in their potential to act as a catalyst for a sub regional knowledge economy. They had different research strengths and industrial activity and resources from the RTF funding package were not allocated equally.

HTC 1 attracted the greatest share of the resources because of the presence of two research-intensive Universities, a national research centre for Defence Medicine and a

[29] P 1 Head of Regeneration at University Hospital and CTB Board Member.

University Hospital[30]. These factors influenced substantial investment in the development of medical technologies, the creation of mediparks and new medical technology and photonics clusters. The Rover Plant was located within the boundaries of HTC1. It was also the location of a supply chain of small engineering companies that depended on the fortunes of Rover. The ambitious plan was to re-orientate these companies towards the design of medical instruments.

HTC 2 focused on serving the needs of two large ICT and telecommunications companies to develop further an existing sub regional strength. An objective was to strengthen that and at the same time diversify towards the development of a strong digital games cluster[31].

HTC 3 focused on the practical expertise in working with the SMEs at the tertiary level of the Rover supply chain. The Advanced Engineering cluster in the Black Country aimed to assist SMEs towards development of new products and markets, which utilised more profitably the skills and capability of the workforce. The Polymer Cluster in Telford focused on assisting polymer manufacturers to look beyond supplying components to the automotive industry. They sought to utilise the private sector research capability in rubber and polymers towards creating new products and markets[32]. Both these projects were specified in the Rover Task Force report (SQW, 2001).

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[30] DIRA (Defence Industry Diversification Agency) and QinetiQ.

[31] There was an interesting relationship between Coventry University and Jaguar and between Ford and Warwick Manufacturing Group (WMG) given the decision by Ford to close the Jaguar plant in Coventry in September of 2004. Choices were made in terms of strategic priorities. Automotive design expertise and Continuing Professional Development (CPD) facilities at Coventry, was not considered to be capable of changing the trend for design to be located at Head Office outside the UK, which was increasingly seen as a centre for assembly.

[32] Private sector research and training centres for Polymers and Rubber technologies are located within HTC3, namely the PTA and RAPRA.

4.2.2 Practical Experience of Technology Transfer versus Policy Borrowing

Naturally there were different ideas about how to set up HTCs. They were tasked with the creation of a 'knowledge economy' that could re-orientate the future ambitions of the region and at the same time address the problems faced by traditional manufacturing companies. No one in the region had experience of tackling an issue of this dimension or significance. Although some small, experimental technology transfer initiatives had been successful in the region over a number of years, there was little to prepare the stakeholder organisations for ambitious 'technology push' on such a huge scale. With the exception of the Universities, most of the regional stakeholders were inexperienced in technology transfer. Consequently many of the key figures involved in the development of the HTC policy were influenced by second hand accounts of successful initiates elsewhere.

> *A group was established at AWM who were frankly a little bit* ***clueless*** *about what to do with this. Although they had 'so called' policy officers, people with responsibility for policy, I think they really needed the assistance of people who were nearer to the technology than they were. They needed people who could make some suggestions about how the investment could take place. So three groups were established one for each of the corridors, which evolved in the process of the debate, I guess, and the three corridors established their own steering groups - and then the policy framework evolved from there*[33].

[33] P 7 Category A Respondent: Pivotal and strategic actor in regional innovation and HTC 3

The concept of *policy borrowing* was a strong influence on the development of the HTCs (Halpin, 1994, p.199). Successful examples of universities driving regional innovation have persuaded policy makers that 'what can work in Massachusetts' can work equally well in an English region. To encourage the establishment of high-growth, high-value companies along the main communication routes around Massachusetts Institute of Technology (MIT) is a very different proposition to connecting rural and urban areas in the West Midlands, in which the economic climate and contexts for innovation were quite different.

> *Although there have been good experiences in the States, of technology driven universities, such as* ***Silicon Valley****, driven by the surrounding defence industries as well as the Universities. In* ***Boston*** *Route 128 is a development linked to Massachusetts Institute of Technology (MIT) and it works. But there are very good reasons for these strong 'corridor developments' in the States (and other similar regions elsewhere)* [34].

For instance the private investment and public funding regimes were dissimilar. Traditionally private sector investment in research in the West Midlands has been very low and recent surveys indicate that this will not improve in the near future. The complexity of mixing public and private resources in the Rover Task Force funding package complicated the operational decision-making for HTCs. Conflicting rules about eligible activity for the expenditure of European Social Fund (ESF), European

[34] P27: Category B Respondent: Manager of a Science Park and member of the HTC1 steering group.

Regional Development Fund (ERDF) and DTI and resources from the RDA created difficulties and slowed progress[35].

HTC policy was based on the assumption that local companies would be willing to engage in the process of change. Success in the long-term depended on changing deep-rooted attitudes to risk and private sector investment in research. It depended upon companies wanting to work in partnership with researchers through the 'research and development phase'[36]. The difficulty of making such a significant cultural change was not fully understood. It turned out to be an uphill struggle to give local companies confidence in research as a source of profit, instead of just a cost to the business. Companies were not convinced that 'their investment in research would diminish at the point when their profits rose'[37].

The HTC policy was influenced by a recent OECD study of regional development (Goddard & Chatterton, 1999). This suggested that innovation could be achieved by increasing competitiveness of companies by clustering. Under the influence of clustering theory devised at Harvard Business School, the DTI had urged the RDAs to adopt this approach[38]. AWM pursued the business clustering experiment with both the HTC policy and a parallel programme that developed ten regional 'high growth' clusters of companies. Substantial resources were committed to these parallel activities over a sustained period of time[39].

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[35] ERDF funds capital developments such as building and site preparation whereas ESF funds training for disadvantaged communities. Each specifies deliverable outcomes such as jobs protected or created some of which are geographically specific.
[36] P 6: Category A Respondent: Pivotal and strategic actor in regional innovation.
[37] P 6: Category A Head of Innovation at Regional Development Agency.
[38] This was discussed in Chapter 1.
[39] From 2003 –2008.

It was significant that no resources were dedicated to facilitating communication and collaboration between the HTC and cluster staff. A recent DTI evaluation of the implementation of 'clustering policies' in the nine English RDAs and in Scotland is discussed with reference to my findings in Chapters Seven and Eight.

It was assumed that by bringing resources and the private and public sector together, that they would somehow be able to agree common goals and that HTCs would be a focus for the development of collaborative partnerships. The HTC policy set out an ambitious programme of economic change. Understandably there were different conceptions of the problems faced by the region and the solutions to those problems.

> *The recently developed task force group had expected the investment to be predominantly associated with Rover - but I think that myself, and others, persuaded AWM that for every job in Rover there were 3 or 4 jobs in the supply chain. It actually had a significant effect not just upon Rover but upon the automotive supply chain* [40].

The threatened closure of the Rover manufacturing plant was the 'tip of the iceberg' and it focused the attention of the region on its over dependence on traditional manufacturing and in particular on automotive production.

> *I think the region was looking at its two big core problems. One was around regeneration. We had to build something really new that was going to provide high growth for the region (and had) the option of looking at combining property opportunities linked to a knowledge transfer opportunity in some way*[41].

[40] P 7 Category A Respondent: Pivotal and strategic actor in regional innovation and HTC 3.
[41] P 6: Category A - Head of Innovation at Regional Development Agency.

The policy was influenced by the intention to map research expertise in the Universities and use this to attract new companies or persuade existing companies to relocate in HTC areas[42].

4.2.3 Subject Positioning at the Policy Implementation Level

Although there may be the same *espoused commitment* to involvement of a stakeholder organisation, the three levels of policy enactment are governed by different sets of rules. Commitment may vary because at each level the actor representing any given organisation is a unique individual with different personal enthusiasms and preoccupations.

At meso and micro levels this accounts for the emergence of variation in the *espoused object of activity* from that originating at the macro level. This suggests that the whole *meta-activity system* shapes motivation and orientation towards an object of activity, and policymakers cannot predetermine this, nor can it be imposed in a simplistic way.

The data captured interesting tensions in the comment of an HTC steering group member who spoke from a sub-regional focus in terms of her role with the development of the HTC, but was influenced by the regional perspective she adopted during her usual work role. As a member of an HTC steering group, the object of her activity related to sub regional skills gaps. This was in tension with her professional role as a senior manager at the LSC, responsible for outcomes in the West Midlands as a whole where the object of her activity was orientated towards regional outcomes.

[42] P 6: Category A - Head of Innovation at Regional Development Agency.

I think that as a region we can't just rely on offering high technology, we need a broader West Midlands perspective that includes City A and Sub Region B. I think HTC2 is very territorial. To date I am not much involved with the other corridors- It feels a bit like a vacuum in terms of communication - I feel they are working in isolation- a bit like "the people's republic of Anonymoushire", not looking at the West Midlands as a whole or considering the national picture. I think they will eventually miss opportunities because of this[43].

4.3 Some Consequences of Competing Objects of Activity

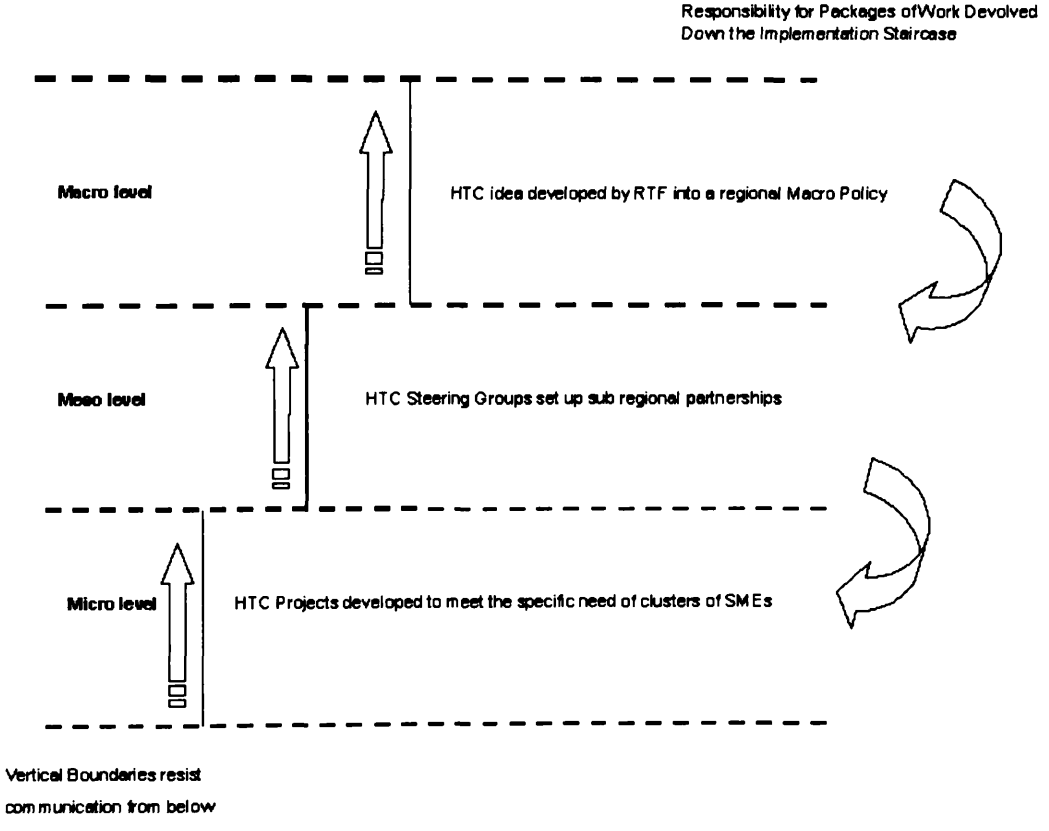
Expansive learning theory conceptualises organisational learning as horizontal collaboration between one or more activity systems of relatively equal agency. This occurs in innovation where individual experts make contributions of equivalent value, which tend to be complementary.

However the gap in theory makes it difficult to depict relationships between organisations where there are differences of power. Currently the theory does not offer an adequate explanation of what happens when activity systems with degrees of agency interact vertically. The term collaboration does not encapsulate interactions between activity systems where the power dynamics are imbalanced. Vertically linked activity systems in policy implementation are akin to the vertical relationships between manufacturers and the companies located at the secondary and tertiary tiers in the automotive supply chain.

[43] P30: Category B Respondent: Manager (representing the Chief Executive Officer) in a public sector organisation and member of an HTC2 steering group.

Hierarchical levels of power and politics are embodied in these relationships, and the greatest degree of agency tends to be located at the top level. The figure below is adapted partly from the implementation staircase model and partly from a diagram used in a Scandinavian study depicting learning between production and management levels (Reynolds & Saunders, 1987; Toiviainen, 2003). It depicts the restriction on feedback from the lower levels caused by the hierarchical three tier structure of HTC policy enactment.

Figure 10: A Depiction of Agency at Three Levels in the Enactment of HTC Policy



The model of the implementation staircase, and the original diagram designed by Toiviainen suggest that learning flows in both directions. The previous figure shows that different patterns emerged from my data. The flow from top to bottom is unrestricted but the boundaries between levels constrain the flow in the other

direction, from the bottom to the upper levels. Theory has not yet been developed to depict competition between objects of activity of unequal agency.

The figure depicts a tendency for those at the top level of HTC policy implementation to resist learning from other levels[44]. In other words feedback from people at the operational or lower levels in the HTC implementation hierarchy tends to be disregarded. This issue is discussed more fully in Chapter Six. The empirical data captured instances where there were problems in communication at the boundaries between macro, meso and micro layers. Although the levels did not seem to be hermetically sealed, the empirical data indicated that communication flowed downwards more easily than it flowed upwards. It showed that decision-makers at the macro level were reluctant to be influenced by the micro level.

There was awareness at *meso level* that steering groups would be instrumental in building consensus and linking perspectives of organisations that had no experience of aligning themselves towards achieving common goals and outputs.

> *In HTC2 it is important to understand the cross-sectoral agendas – and demystify the issues. I think it's about partners helping each other*[45].

> *There was probably a gap between what the corridor wanted to do and what the corridor was.*[46].

[44] Adapted from Figure 7.6 in (Toiviainen, 2003) and based on the implementation staircase model (Blackler, 1995; Reynolds & Saunders, 1987).
[45] P31: Category B Respondent: Head of Development in public health sector organisation - late involvement with HTC2 steering group and Head of Regeneration and Development of the new super hospital.
[46] P 9: Category A Respondent: Senior public sector officer responsible for regional innovation contracts.

At the meso level of an HTC steering group there were powerful factors at work, which shaped the meso object of activity into solving urgent practical problems and saving the jobs in local communities.

> *Major threats to the area ...there has been a lot of media speculation about whether the Jaguar factory will still be around. Similarly, Peugeot has 800 employees in the city of Y. They have just set up a state of the art plant in Eastern Europe and one of these is joining the EU in May next year. Again that's a major threat to the livelihood of the people that work in the Peugeot factory, which will have a big impact on the local supply chain.* [47]

It was understood that flexibility and complexity could not be represented as straightforward and tidy. The overwhelming impression was that people at meso and micro levels, and in particular project staff from Universities, accepted the inevitability of working with multifaceted complexities.

> *Reality does not correspond to a tidy plan. It is difficult to describe the flexible way we interact with businesses. Consequently the approach we adopt looks more like an amoeba than a structured business plan. The approach could be described as* ***'leading from below'*** [48].

The *micro-level object* of activity was orientated towards developing concrete mechanisms to interact with SMEs. The HTC projects were experiments in '*pushing*' innovation and technology transfer opportunities towards SMEs (Goddard &

[47] P 5: Category B Respondent: Director of HTC 2.
[48] P32: Category C Respondents: Managers of projects in HTC2.

Chatterton, 1999, p.83). Projects were developed to raise awareness and improve the capacity of specific groups of SMEs for innovation.

> *Although there was a corridor steering group to formulate strategy and the corridor operations group that brings the ten HTC2 projects together... Each project has its own steering group and a lead partner organisation responsible for delivery and their contract with AWM or GOWM*[49].

The object of activity for an HTC project tended to be more concrete than the object for the HTC steering group as a whole. Micro-cluster projects were devised in one HTC to target assistance to SMEs.

> *We have taken the 'High' technology focus down a notch. We provide the expertise, not of the original developers, but of people dedicated and outward looking who are able to meet the needs of the local SME*[50].

The urgency of the need to take the funding opportunity available from the Rover Task Force Funding hastened the development of policies, that otherwise may have taken many years to develop. The discontinuity of practices between different levels limits the potential *vertical expansion* of the object, and interaction between the three competing objects can be facilitated by mediation.

[49] P 5 : Category B Respondent: Director of HTC 2.
[50] P14: Category B Respondent: Director of HTC 3- project level detail.

4.4 The Implementation Gap

Given that the success of the HTCs depended on lengthy and complicated implementation chains, it was dangerous to assume that what was described in policy documents, would happen as the policy makers intended. The contrast between the espoused policy vision at the top regional level and the pragmatic objectives developed at project level illustrated the problem of the '*implementation gap*'. However the extent to which the policy vision was informed by robust theory, and was shared by the major partners is an interesting question.

> *What intrigued me at the time and what intrigues me in retrospect is that the corridor policy emerged and came to the centre of the economic policy stage in the region* ***without too much serious debate or evaluation*** *and the regional economic strategy as it was emerging had* ***major lacuna.*** *- The corridor notion fitted it well and we saw in really quite a short time, the germ of the idea being translated into one of the central points of regional policy*[51].

Key strategic actors believed that the lacuna in policy could not have been addressed at the time of policy formation, because they were revealed gradually in the developmental history of the HTCs. Their precise location and impact were unpredictable. The vision of the Rover Task Force out of which the HTC policy emerged was driven by research carried out very quickly by consultants, and in which solutions to the region's problems were proposed. These were later adopted with little dissent or time for reflection. The success of HTC policy is to some extent dependent

[51] P10: Category A Respondent: Mediator and key regional actor for innovation and HTC1.

upon the accuracy of the original analysis and the effectiveness of the solution proposed in 1999.

> *Once the idea had taken root AWM in typical style, decided that it would brief consultants to undertake an evaluation to make sure that the idea was robust and then if it was- as it turned out to be- to begin to lay out* ***an implementation plan*** *which was essentially - driven by the requirement to make the best of European funds, of the monies we had made available through the Rover Task Force, and AWM's resources. That drove the second stage of the consultancy report, which was, if you like, the first go at an implementation plan*[52].

It is possible to view change as a process that begins with an analysis of the 'pre-change situation'. This is often called a 'situational analysis' (Trowler et al., 2002). In the instance of the HTCs, consultants SQW were commissioned to produce a report for the Secretary of State on the probable impact of the Rover Crisis. This was in effect an analysis of the circumstances that prompted the policy change. The report analysed chronic features of the situation and long-term concerns.

The analysis of 'conjunctural features' took place later in response to the allocation of new funds from the DTI to address the problem. It outlined how key people, and new sources of funding would help the region to resolve the crisis[53]. So an immediate change was to assist local SMEs (employing 20,000 people in the Rover Supply Chain) to diversify from manufacturing automotive components. The HTC policy was a crucial mechanism for transforming the West Midlands. The policy assumed that a knowledge economy could be created through regional public and private partnerships

[52] P10: Category A Respondent: Mediator and key regional actor for innovation and HTC1.
[53] The Rover Task Force was set up on the basis of the first SQW report.

and that local action would be more effective than 'big government' solutions (Connell et al., 1995).

The policy was informed by fragments of ideas rather than by a coherent theory of change. In particular *policy borrowing* from the USA and some EU regions was evident in the references in the empirical data to successful examples of technology transfer. The urgency of the response to the Rover Crisis made systematic theorisation and testing of the approach difficult. Consequently, a highly complex and ambitious change programme was launched very quickly, with little opportunity to test the approach in a small-scale pilot study. Although there was some clarity about goals, there were very limited opportunities to engage all stakeholders in the process of thinking about change (Connell et al., 1995). Therefore it is not surprising that the empirical data showed that particular stakeholders had different tacit theories and directed their attention to divergent, even conflicting, means and ends.

4.5 Overview

This chapter showed how key people acted as agents of change in specific local contexts. Consequently there were competing discourses that shaped assumptions about technology transfer and how the HTC policy could achieve the desired impact in the West Midlands. The theoretical concept of *policy borrowing* was used to discuss the implications of adopting a policy that has been successful in a specific regional context, and expecting it to achieve the same results when it is transplanted into a different environment.

Complementary skills can be combined when separate work cultures move closer together. The next chapter explores the relationships and interactions across these diverse cultures, which are depicted as horizontal relationships between experts. It was evident that many of the individuals and groups, on whom the success of the HTC multi-agency partnerships depended, had no previous experience of working together. They had previously existed in discrete worlds and had very little experience of collaboration on which to build.

Chapter Five draws on the empirical data to recreate strategies adopted by experts working across the horizontal plane of activity in the delivery of HTC projects. Interviews capture changes in SME practices resulting from their involvement with HTC 'technology transfer' projects.

A series of *vignettes* illustrate the various ways in which boundaries between cultures were crossed. They include descriptions of the development of mediating tools called *boundary objects* to link the perspectives of two or more activity systems. The vignettes describe miniature expansive cycles, that illustrate how new practices were created across the communities involved in each HTC.

5. Horizontal Expansion of the Object of Activity

5.1 Introduction

The term 'collaboration' implies a voluntary agreement of purpose and action between equal partners. Engeström's theory of expansive learning can articulate the horizontal relationships across cultures rather well. In contemporary work environments, knowledge tends to be highly specialised. Expansive learning theory gives a convincing explanation of horizontal collaboration between experts with complementary skills, which is described as 'polycontextuality' (Tuomi-Grohn, 2003, p.202-3).

Communicating with experts from other domains (with their own specialised cultures and vocabulary) can be difficult, and *boundary objects* are instrumental in making it easier to connect perspectives (Ludvigsen et al., 2003)[54]. However because expansive learning theory is relatively new and evolving, it has only recently been used in studies of innovation. The development of boundary objects as tools to connect activity systems are discussed with reference to vignettes describing HTC projects.

5.2 The Role of Boundary Objects in Innovation

Recent studies of innovation in complex organisations, investigated large-scale transformations in activity systems, often spanning a period of several years. These

[54] Boundary objects are communication tools to link activity systems and are discussed in the next few pages.

studies treat organisations as evolving networks of interconnected communities of practice. Although my research adopts the terminology of expansive learning theory, it recognises that 'communities of practice theory' exists in its own right and has been colonised by some activity theorists in pursuit of the collective dimensions of activity systems. Both theories support the idea that communities exert a considerable influence on what individual actors do.

> *An activity system is a complex and relatively enduring 'community of practice' that often takes the form of an institution (Tuomi-Grohn, 2003 , p 202-3).*

Seen as activity systems, the HTCs contain more expertise, resources, intellectual and social capital than any individual member does (Trowler et al., 2002). They can achieve more together than they can by working independently. When experts need to bring their various different perspectives together, boundary objects can help to facilitate communication across hitherto discrete communities of practice in the various activities. Boundary objects act as tools or bridges between different perspectives to mediate collaboration in a complex activity network that help to construct a shared object[55]. When boundary objects are developed as collaborative tools to support the implementation process they can be very effective. In complex work situations agents have to move between activity systems.

> *It is a collaborative process in which different perspectives and voices meet, collide and merge. The different perspectives are rooted in different communities and practices that continue to coexist within one and the same collective activity system (Davydov, 1999 , p.382).*

[55] Zager describes boundary objects as 'pseudo collective objects' (Zager, 2004 , p. 36) but I have avoided using this term because it makes a simple idea too complicated.

The term perspective is as close as *expansive learning theory* comes to acknowledging the impact of power and agency. Engeström used the term perspective to encompass the impact of discourses and interests associated with organisational positioning and power.

> *The different perspectives are rooted in different communities and practices that continue to coexist within one and the same collective activity system. Perspective is a hedge against simplified views of context that ignore the unsettled and conflicted relations between different positions and actors. (Fichtner, 1999 , p.382).*

Studies of horizontal learning or polycontextuality have shown that a boundary object works as a communication tool between multiple activity systems. It can be used as a shared basis for co-operation between individuals and groups from different activity systems.

> *Horizontal expertise is often developed through boundary objects by virtue of different perspectives that merge through dialogue and create more advanced knowledge and work practices. (Tuomi-Grohn, 2003, p.203-204).*

A *boundary object* is flexible enough to mean something specific to each activity system and yet stable enough to be understood by multiple communities of practice. This concept was adapted from the work of Star whose ideas are now prominent in various theories of organisational knowledge sharing (Star, 1989, p. 46). Boundary objects can mediate between multiple activity systems, and this mirrors the central idea in activity theory that tools can mediate between the subject and object of activity. By mediating between routine practices and a new idea of '*how to do things*

better' a boundary object can connect the imaginary and the concrete and catalyse the process of innovation[56]. In particular boundary objects such as computer software can help SMEs to imagine what product designs might be possible even if they do not yet own the equipment to make such a product. Some examples of this follow later in this Chapter and in Chapter Six.

Recent research has shown that *boundary objects* can rebalance technology *push* and technology *pull*. A boundary object such as a technical drawing, or a computer-generated image can help consumers to articulate what they want. It is often very difficult for someone to describe a new product, but if they can see a 'mock up' or prototype this can be used as a boundary object around which discussion can take place (Ludvigsen et al., 2003).

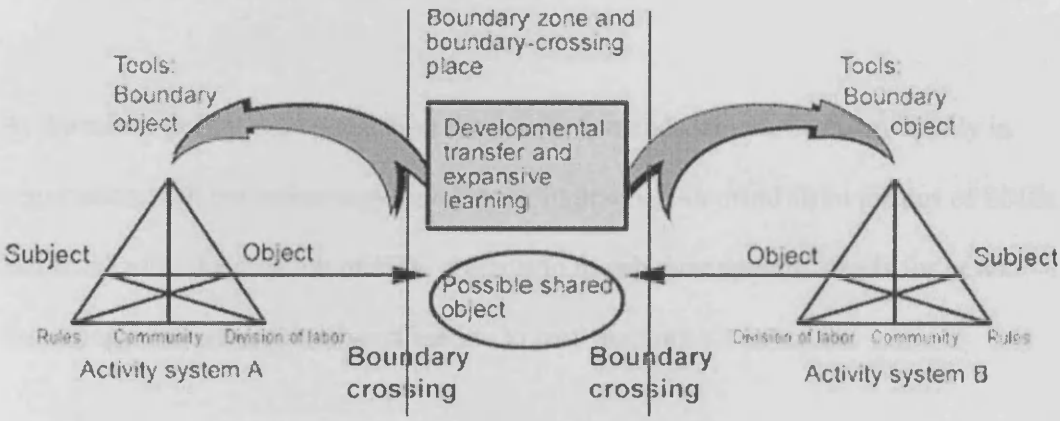
> *Boundary crossing focuses on the practical tools that can be used to facilitate change. Boundary objects are thought to emerge over time from the interaction between different communities, (including colliding worlds) (Tuomi-Grohn & Engeström, 2003, p.5).*

A discourse can also work as a tool in an activity system or as a *boundary object* in a complex activity network by linking two or more activity systems in an HTC. Discourses can also vary in their dominance in an HTC when the dynamics of power and politics are aligned in their favour. Therefore the development of each HTC is also an object of study, in terms of the dynamics of political power and persuasion that affect collaborative practices.

[56] Engeström claims this relates to the dialectic between theory and practice.

Expansive Learning Theory depicts boundary activity in various ways and the figure below shows how Engeström and his colleagues illustrate the complexity of interactions at the interface between activity systems[57].

Figure 11: A Depiction of Boundary Crossing and Expansive Learning



This figure has some sequential ambiguities and it is unclear if the boundary object facilitates developmental transfer or the other way round. This is one of the challenges of using diagrams to illustrate dynamic activity. Most recent studies suggest that boundary objects are created as special tools that help to link the cultural perspectives of two or more activity systems (Hasu, 2001; Ludvigsen et al., 2003; Toiviainen, 2003; Tuomi-Grohn, 2003). Innovation is a classic example of the benefits of linking communities of experts and aligning them towards a shared task that could not be done by any of them separately.

5.3 How HTC Projects Act as Boundary Objects

The empirical data showed that 'demand' for technology transfer was varied and that 'users' wanted a variety of practical help and information from 'developers'.

[57] Engeström's web site at the *Centre for Activity Theory and Developmental Work Research.*

Although the policy rhetoric speaks of the need to strengthen the voice of the demand side for technology transfer, this assumes that demand would be homogenous. However, experience suggests that depending on the size and type of companies they would want different things from research. For this reason technology *pull* from users was unlikely to be in the same direction.

At the micro policy implementation level, user demands were articulated locally in negotiation with the technology developers. In practice, demand from groups of SMEs had resulted in the creation of HTC projects to match their specific needs for new technology and advice on diversification to new markets.

Given that the West Midlands has a lamentably low record of industry investment in research, the capacity to recognise the value of new technologies to local companies seemed questionable (Brown, 2004a, p.1)[58]. In the absence of a strong commitment to research by local companies, the public sector was 'left to drive the technology transfer agenda'. The task fell to the Universities, the RDA and QinetiQ [59].

Connecting local initiatives to achieve complementary effects was done at project level and this helped to engage the enthusiasm of SMEs. For instance an HTC project helped polymer manufacturers to develop new products and markets, because demand from the automotive industry was declining rapidly. Another HTC project assisted

[58] Included in a presentation of the key findings from the Research and Innovation Audit for the West Midlands (Brown, 2004b).
[59] QinetiQ are a Government Funding Research Agency for the Ministry of Defence and located in HTC 1

small engineering companies by bringing new technologies and processes into the local SMEs, at the tertiary level of the Rover Supply chain.

In the process of 'new product development' the developer perceives the artefact as the *object of activity*, whereas the user sees it as a *tool*. Bridging communication between developers and users involves linking different perspectives. Working across boundaries between diverse activity systems can be challenging because there are few precedents and little recognition of the problems encountered. Interaction between actors and social groups in the HTC involved working in a 'contested terrain' because 'technology transfer' is neither the domain of research or commerce but a *hybrid* of both. Setting up HTC projects created a context for interaction, which encouraged fluidity in identities and social interactions.

Individuals who are members of both communities, understand the perspective of both worlds and can act as translators. They can make sense of things and explain in the language and conceptual vocabulary most easily understood by scientists or by industry. In this interface social relations are characterised by insecurity as a consequence of multiple identities and strategies (Ludvigsen et al., 2003 , p.307).

However in the HTC projects the key individuals who acted as 'technology translators' interpreted a new technology so that a small local company could understand how it could be applied in a commercial production process. This led to expansion of the activity network so that the users become involved in the co-construction of a new expanded object of activity. Some HTCs devised projects to deliberately involve users and developers in co-construction of new products.

Developers and users do not work together particularly well at the moment. It is probably a challenge for the future. We're trying to take a holistic view; we talk to companies about clustering and about how Universities can help them to tackle technology transfer[60].

In expansive learning theory co-configuration is a shared creative process. To work together successfully on the shared creation of a new product, comfortable routine practices have to be abandoned and this requires changes in the rules, the division of labour and other tools of the old activity systems (Hasu, 2001 , p15-17). The notion of mediation is at the heart of activity and of co-configuration. In one HTC project a great deal of time and effort was invested in gaining a better understanding of co-configuration.

A working group is considering the ***push*** *(by Universities) versus the* ***pull*** *(exemplified by the Business Links on behalf of the local companies). We don't yet have the structures to understand how this process could work better. We know that there is SME demand and SME need. We are interested in how practitioners see this and we want to understand practices that would make this work better*[61].

Each HTC devised different strategies and specific projects to capture the interests of local SMEs and to make the HTC concept relevant to them. The HTC project teams realised that they would need some tools such as rapid prototyping equipment to motivate SMEs to change their behaviour.

[60] P17: Category C Respondent: Manager of an HTC project HTC 3 .
[61] P13: Category B Respondent: Director of HTC 1 - Director CTB – clarification and project information

You are not very interested in modernising or diversifying until external pressure makes that a necessity. Engaging particularly with the SMEs in this process has been very problematic[62].

In the following sections vignettes are reconstructed from the data to sketch the different stories of HTC projects and how these overcame the reluctance of small companies to invest time and effort in innovation. However before moving on to specific HTC projects at the micro level, I will describe two collaborations at the meso level, which involved the creation of a boundary object. The following vignettes describe two virtual or electronic tools that were developed in a collaborative process and also acted as tools for further collaboration.

5.3.1 Vignette 1: Collaborative Projects to Develop Electronic Tools

After the initial formation of the HTC steering groups, attitudes amongst individual members of the HTC steering group began to change rapidly. Initial suspicions and tendencies towards self-interest evaporated as confidence in the evolving relationships grew. Along the way the HTC1 steering group decided to create a web site. This acted as a *boundary object*, which helped to forge allegiance and a shared identity for their members.

Where I would have been fighting for funding for Phase 3 of the Malvern Science Park- we have together (the HTC1 Board) put in an action-planning bid with better leverage with AWM and GOWM[63].

[62] P 7: Category A Respondent: Pivotal and strategic actor in regional innovation and HTC 3.
[63] P28: Category B Respondent: Senior Manager in public sector business support organisation and member of the HTC1 steering group.

In HTC2 the steering group decided to create an electronic database as a shared resource. The process of making the database connected perspectives and the artefact itself it was used as a communication a tool by the partner organisations, so the project acted as a *boundary object* in two ways. The project was instrumental in building trust, which then forms the basis of confidence in accepting more difficult challenges involving greater degrees of risk. It changed 'organisational behaviour' and people became more open to innovation with each positive experience of multi-agency learning.

> *The corridor has learnt the value of making partners aware of all that is going on in the region, and of connecting things up by facilitating electronic communications between the partners at steering group and project level. In particular an electronic tool to link the databases of the 'partner organisations' has been effective. This tool can find out which companies have been helped by the various schemes and identify gaps in provision and access* [64].

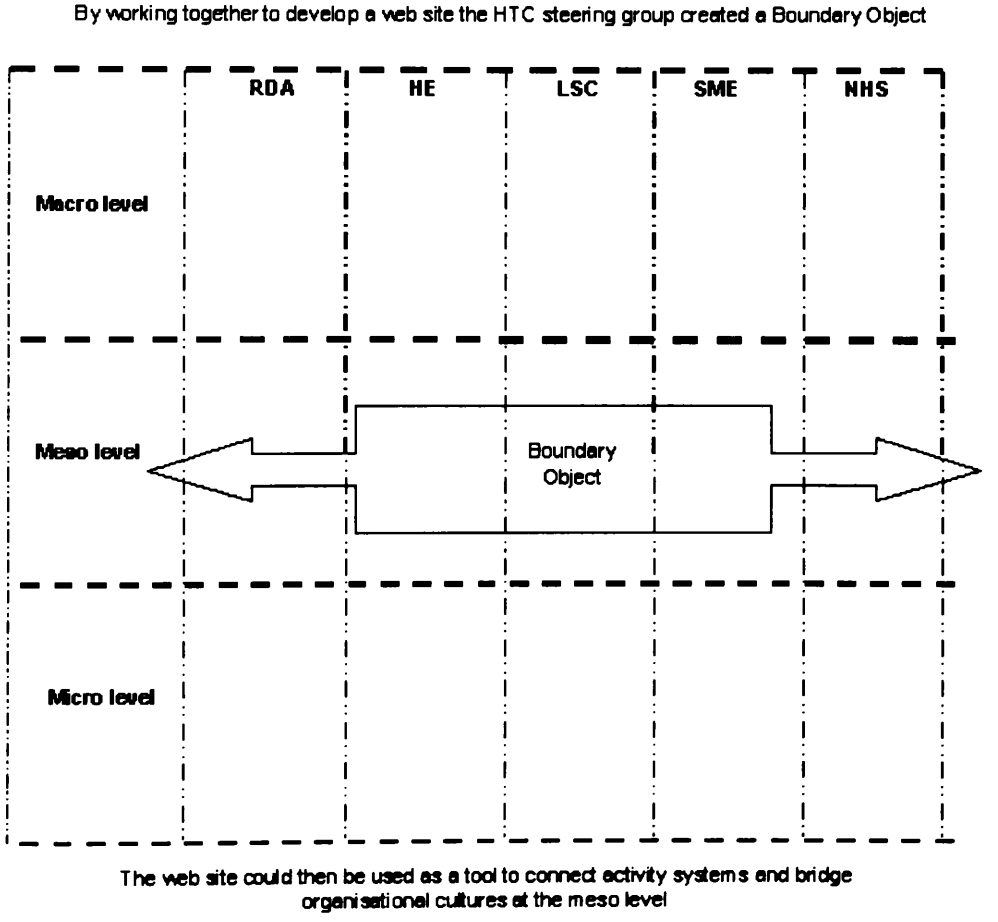
The database became a valuable tool to bridge the boundaries between organisational cultures. In the process of creating the boundary object and using it as a tool horizontal collaboration or polycontextuality at the meso level of HTC policy implementation grew.

Although there had been no involvement of people from other policy enactment levels in the creation of the database, it could be used by anyone but it was the commitment to the task and the understanding that resulted from working together that made the

[64] P12: Category B Respondent: Director of HTC 2- project level interview data.

'cultural change' towards expansive learning. In other words the boundary object creation process was more significant than the database artefact. The figure below illustrates the value of the web site and the database tool as a boundary object, by first instigating and then sustaining the active co-operation of members of an HTC Steering Group[65].

Figure 12: The Creation of Electronic Tools as Boundary Objects



5.3.2 Vignette 2: Collaborative Research Project

An HTC project was devised to address innovation and skills issues in local information and communication technologies (ICT or IT) companies. These

[65] The diagram is simplified to show a sample of public and private sector partners, the Regional Development Agency, Higher Education, Learning and Skills Councils, Small Medium-sized Enterprises, and the National Health Service. Each has its own organisational culture or activity system.

companies were encouraged to share their expertise and collaborate to expand their technological know-how and capacity. A collaborative research project acted as a boundary object to identify skills gaps across the companies, and to identify complementary capacity. The research addressed a problem experienced by the local ICT companies. Many jobs for skilled technicians were unfilled and the 'skills gap' was a growing problem, but the solution was not clear.

> *Coincidentally the New Technology Institute was commissioning a study by the Sector Skills Council, e-skills UK, to research the supply and demand of ICT skills, so it was agreed to combine resources and to devise a joint action plan on the basis of this research* [66].

To clarify the situation, the HTC2 steering group joined forces with the regional ICT cluster group and the New Technology Institute (NTI) to develop a collaborative approach to commissioning a piece of research.

> *The training managers of IBM, Oracle, Marconi (and a representative from the local SME community) have been asked about the key skills shortages. The outcome is that the NTI has developed new curricula to meet those needs via FE and HE courses to remedy those skills shortages*[67].

Three hitherto separate communities or activity systems worked towards a shared object. Combining resources and aims helped to coalesce a shared understanding of the contribution each of the partner organisations could make to address the region's economic and innovation challenges. It was also the catalyst for more extensive co-

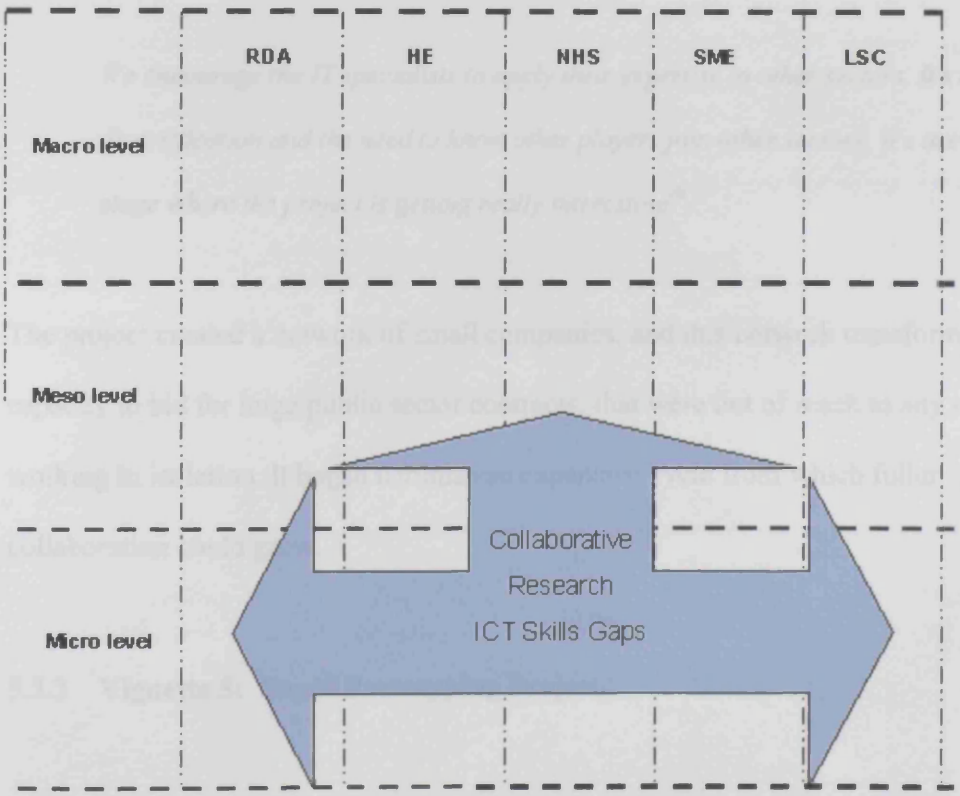
[66] P21: Category C Respondent: Manager of an HTC2 project.
[67] P12: Category B Respondent: Director of HTC 2- project level interview data.

operation between the local companies. They decided to work with the HTC on a bigger project to identify local expertise and additional capacity. A network of companies was created that had the confidence and trust to help each other.

The figure below shows how the research into skills gaps crossed boundaries to bring together sources of funding, expertise and the users and beneficiaries of the study.

Figure 13: Collaborative Research into Sub-Regional Skills Gaps in ICT

ICT Labour Market Research was an example of a project with broad practical support



The Research expanded its scope and its brief by combining funding from the HTC steering group the New Technology Institute (NTI) and the Sector Skills Council.

The project formed the basis of more extensive collaborations, which drew down funding and connected the project beneficiaries to the meso policy enactment level and to a funded cluster network.

It is valuable to call on one another because the Information Technology (IT) industry has lumpy workloads. Swapping business opportunities and looking for synergy, where companies can combine complementary skills can make a real difference to the size of contracts that can be handled. Sharing resources, and specialist skills such as 'C++' expertise is a good thing for the region[68].

The companies were encouraged to enter new markets based upon their combined skills and capacity.

We encourage the IT specialists to apply their expertise to other sectors. It's about diversification and the need to know other players join other sectors. We are now at a stage where the project is getting really interesting[69].

The project created a network of small companies, and this network transformed their capacity to bid for huge public sector contracts, that were out of reach to any of them working in isolation. It began a miniature expansive cycle from which fuller collaboration could grow.

5.3.3 Vignette 3: Rapid Prototyping Project

In some circumstances collaboration is instrumental rather than expansive and may be more accurately described as a strategic alliance. In such circumstances individuals and social groups agree to work together for mutual benefit and so the collaborative practices can be characterised as pragmatic and temporary in nature. This vignette

[68] P20: Category C Respondent: Manager of an HTC2 project.
[69] P20: Category C Respondent: Manager of an HTC2 project.

illustrates how something that began as pragmatic, self-interested collaboration, transformed itself into something deeper and more sustained.

Initially, a large engineering company wanted to use rapid prototyping equipment available through HTC3 and associated with the Advanced Engineering (AE) Cluster Project. The aim of the project was to demonstrate how to create prototypes for manufacturing new components in polymers instead of using the traditional pressed metal. The Managing Director was disappointed when he discovered that the company did not qualify for assistance. The funding rules governing the HTC project limited them to assisting only SMEs employing less than 250 people. Although the funding rules for the project made it impossible for the AE team to help the company directly, common sense prevailed and some indirect help was proposed. Conversations with the HTC 'AE project team' led to a mutually advantageous outcome where the very small companies in their supply chain were able to join the AE cluster project.

> *The project brought the AE's rapid tooling machine to the attention of small engineering companies who tend to be conservative and traditional in adopting new ways of doing things.*[70].

Through the use of rapid prototyping equipment and access to specialised machinery in the University's Advanced Engineering Unit the AE project was instrumental in changing the culture of SMEs working in the tertiary level of Rover's automotive supply chain.

[70] P24: Category C Respondent: Technical manager of a SME and beneficiary of a project in HTC 3.

In the past most research and development was done at the first tier by the manufacturers, the second and third tiers of SMEs who supply components, are increasingly getting involved in product development work [71].

The access to specialist tooling equipment and expertise in the Universities was beneficial to the small companies who had virtually no budget for research and development. They were suddenly able to develop new products using new equipment and by learning to use new technologies.

It has changed the way we handle product development, which always used to be done in house as we were at the top level in the 'pyramid' [72].

The technical director of the large engineering company realised that he could spend less money on 'in-house' research and development because he was now able to pass some of this down the supply chain to the smaller companies. The large company benefited from 'lower piece costs', and lower 'tooling costs' which improved efficiency and profitability because the SMEs in their supply chain gained the capacity to do their own product development. The SMEs in the supply chain also benefited because they had access to the tools to enable them to innovate and they had the opportunity to work with like-minded firms to develop new products and new markets.

These deeper levels of cooperation strengthened relationships between the larger company and the smaller companies in its supply chain and the University. The project moved the relationship from an instrumental alliance towards a self-sustaining

[71] P24: Category C Respondent: Technical manager of a SME and beneficiary of a project in HTC 3 .
[72] P24: Category C Respondent: Technical manager of a SME and beneficiary of a project in HTC 3 .

'partnership'. The *emotional commitment* to the object seems to be crucial to the development from instrumental collaboration towards more sustained expansive learning and co-operation. In terms of expansive learning theory the rapid prototyping equipment acted as a *conscription device* to enrol small companies into collaboration with the University that developed the HTC project.

This supports the findings of a study of innovation in an engineering company two years ago, which reported that conscription devices, such as emotional ties to new work teams, helped to ensure a process of co-configuration. In the development of new engineering products 'various design expert' and user perspectives were integrated in the overall design (Ludvigsen et al., 2003 , p.307).

Co-configuration requires trust and the confidence to exchange views, which may not always concur. New insights were created so that the partners had faith in their capacity to achieve more together than would have been possible independently. In other words there was agreement that they could achieve more by working together towards a new, shared goal. This could be described in terms of expansive learning theory as a process by which the boundary object was the tool that started chain reaction of small collaborations leading towards more ambitious expansion and new objects of activity.

However it is significant that the funding rules caused a problem that confounded the espoused policy aim. Only by working around the rules in an imaginative way could the HTC project team fulfil the spirit of the HTC policy. This illustrates the points raised in Chapters Two and Four about the policy implementation gap.

5.3.4 Vignette 4: Collaborative Visualisation Software Project

The next vignette describes the development of a *boundary object* to connect two activity systems and its subsequent transformation as it was used more widely. Traditionally if a new product does not meet the needs of users, it becomes a problem and the *object of the activity* for a community of users (as discussed earlier in this Chapter). The problem hinges on the tensions between two different conceptions of knowledge and two distinct objects of activity. The challenge is to connect the two perspectives and find a communication tool, in other words a *boundary object* that helps the two communities to work together on the problem.

If that object is shared and expanded the *developers* and *users* can work on new solutions together so that the object is a co- construction and becomes a tool in a new expanded activity system. Co-configuration has the potential to accelerate the development of new products in a single integrated process, because user needs and consumer aspirations are considered at the start, rather than towards the last stages.

> *Possibly, it's about helping the customer to specify more clearly what they need and want, when unfortunately they probably don't 100% know themselves until they've got what they* ***didn't*** *want, and also it's not always the obvious problem that's in front of them that is blocking their future prosperity* [73].

An engineering company devised a software tool as a *boundary object* to link the expertise of marketing and design teams with engineering teams. The tool aimed to

[73] P17: Category C Respondent: Manager of an HTC project HTC 3

combine the *user perspective* with engineering expertise to improve the process of new product development.

> *OPM is a virtual collaboration tool with visualisation tools, such as a three-dimensional computer aided design viewer and the facility to upload drawings*[74].

It turned out that the tool had multiple uses and benefits not only for themselves but when it was adopted by an HTC project (known as the *Advanced Engineering or AE project)* they realised it had enormous potential benefits for all the local engineering companies. The AE project hosted the software on their web site and made it freely available as a tool for a 'micro cluster' of local companies.

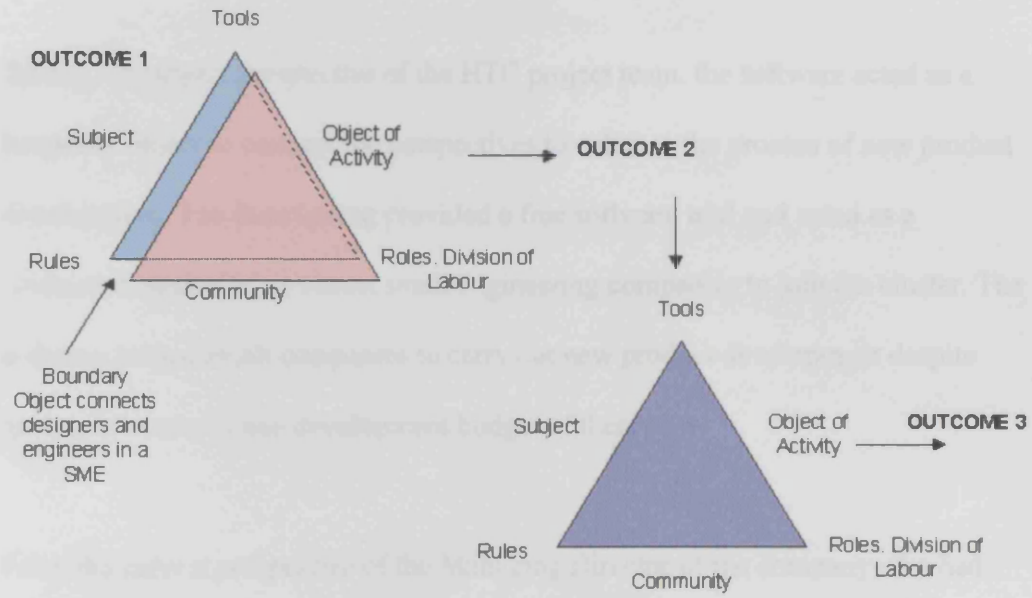
Although the software was first used as a boundary object, it was transformed by being used in new contexts or circumstances. When it was adopted as a tool in an HTC project it was used by a wider group of very small companies who lacked their own research and development facilities. It was used as a tool in an activity system of small companies operating in the tertiary level of the Rover supply chain. By making the software available for Beta testing via its web site, the project enabled small companies to use the software to undertake new product development. The use of the collaborative visualisation tool created unforeseen opportunities. It opened up new potential markets for small engineering companies who could act as a 'network' because of the HTC project.

The figure below depicts this story in terms of expansive learning theory and illustrates how a boundary object originated from the need to connect designers and

[74] P23: Category C Respondent: Technical manager of a SME and beneficiary of a project in HTC 3.

engineers (Outcome 1). It was then used as a tool to help very small engineering companies undertake new product development (Outcome 2). In Beta testing the software with these small companies, the commercial potential of the software was realised and an international product opportunity was seized (Outcome 3)[75].

Figure 14: Transformation of a Boundary Object by its Use



Expansive learning theory suggests that multi-level analysis is important. Taking the *subject perspective* of the company, OPM acted as a boundary object for collaboration between their designers and engineers orientated towards the object of new product development. The adoption of the boundary object as a tool by the HTC project was an opportunity to Beta test OPM software. At the same time the software was made freely available to small engineering companies to help them to create their own new products.

[75] The pink triangle represents the activity system of the design and marketing team and the blue triangle is the engineers. Beta testing of the software in a cluster of small engineering companies is represented by the lilac triangle, which is the activity system of the HTC project.

*It developed as an in-house facility ... but through working with the Advanced Engineering Cluster Project (AE), we saw the potential to develop it into a commercial product. Without AE we may not have had the courage to develop the software commercially. We now have a proven **'tool'** through operating a free product trial with the small companies in the AE cluster*[76].

Taking the *subject perspective* of the HTC project team, the software acted as a boundary object to connect the perspectives to enhance the process of new product development. The Beta testing provided a free software trial and acted as a '*conscription device*' to attract small engineering companies to join the cluster. The software helped small companies to carry out new product development despite having no research and development budget of their own.

From the *subject perspective* of the Managing Director of the company who had created the software, a new object had emerged serendipitously, in that a new commercial product could be launched as a direct outcome of their involvement with the HTC project. Although this HTC project began as an instrumental strategic collaboration it grew into sustained co-operation.

We work closely together. We use the AE cluster fairly extensively, the relationship is evolving and we keep talking to one another. AE are developing their understanding of the requirements of industry, reaching out to more companies in the area. Sometimes the SMEs don't initially see the potential benefits of the software and its

[76] P23: Category C Respondent: Technical manager of a SME and beneficiary of a project in HTC 3.

value to a company - We've simply got more structured through working on projects together[77].

As a result of the HTC sponsoring the Beta testing of OPM software, small engineering companies changed their behaviour and their capacity to carry out research and development. Although the company's initial motivation may have focused on developing their in-house capacity for product design, they were also able to see a new market and seize new commercial opportunities. In other words working together on shared goals changed individual attitudes so the perspectives and motivations of the company expanded as new objects of activity emerged.

5.4 Overview

Expansive learning theory describes expanding the horizontal partnership and infers a voluntary collaboration between partners, each endowed with a similar degree of agency. A *boundary object* can connect perspectives and might take the form of an artefact, a discourse, or process[78]. Typically a boundary object might facilitate collaboration between communities of experts from different cultures, but with complementary skills (Tuomi-Grohn, 2003 , p.202-3) .

The empirical data described discrete projects that act as miniature expansive cycles. These projects acted as catalysts for change sometimes leading towards a fuller and sustained expansive cycle.

[77] P23: Category C Respondent: Technical manager of a SME and beneficiary of a project in HTC 3.
[78] Engeström appropriated and developed Star and Griesemer's (1989) concept of *'boundary objects'*.

Vignettes illustrate how particular projects change practices and in some cases boundary objects can be transformed in use. When adopted by a different activity system and used in a new context a boundary object can transform into a different element of activity. When the software is launched as a commercial product it is an *outcome* in an expanded activity system.

The next chapter describes the impact of boundaries between levels. It explores the tensions between the 'espoused object' and various 'conceptions of the object' at the macro, meso and micro levels of policy enactment. Chapter Six focuses on the vertical interactions between activity systems. Learning between levels is complicated because the boundaries between levels exhibit special characteristics. Boundaries between levels are less permeable than those separating different cultures or horizontal relationships described in Chapter Five. The next chapter focuses on role of the individuals, who can act as *boundary mediators*.

6. Vertical Expansion of the Object of Activity

6.1 Introduction

My research ventures now into a complex and uncertain realm where activity systems interact vertically as well as horizontally. In applying expansive learning theory in two dimensions, I risk working at the edge of an evolving theory and in uncharted territory.

To summarise a point, 'horizontal complexity' is about working across systems or sectors and agencies. 'Vertical complexity' relates to changes at individual, local and regional community levels, and the interactions between these levels (Connell et al., 1995, p 2). This chapter concentrates on crossing boundaries between levels where the activity systems had asymmetrical status and agency.

Where there are strong dynamics of power and agency, expansive learning theory cannot adequately conceptualise relationships in terms of *collaboration*. The empirical data showed crossing vertical boundaries was constrained by agency and positioning in the implementation hierarchy. The boundaries appeared to be different in quality from those described in Chapter Five. There was no evidence that boundary objects were created between levels. The boundaries in the tri-partite implementation structure on the vertical axis seemed to be selectively resistant. There was little motivation for those at the upper levels to want to connect with those below.

Nevertheless it was clear that in the HTCs a few key individuals had both status and power could move between levels. Depicting the complex social, political, economic and physical dynamics simultaneously and in both dimensions was extremely complicated. It is a problem I have been unable to solve in my research, nor is it adequately resolved in previously cited studies of innovation (Hasu, 2001; Toiviainen, 2003).

6.2 Connecting Levels and Activity Systems of Unequal Agency

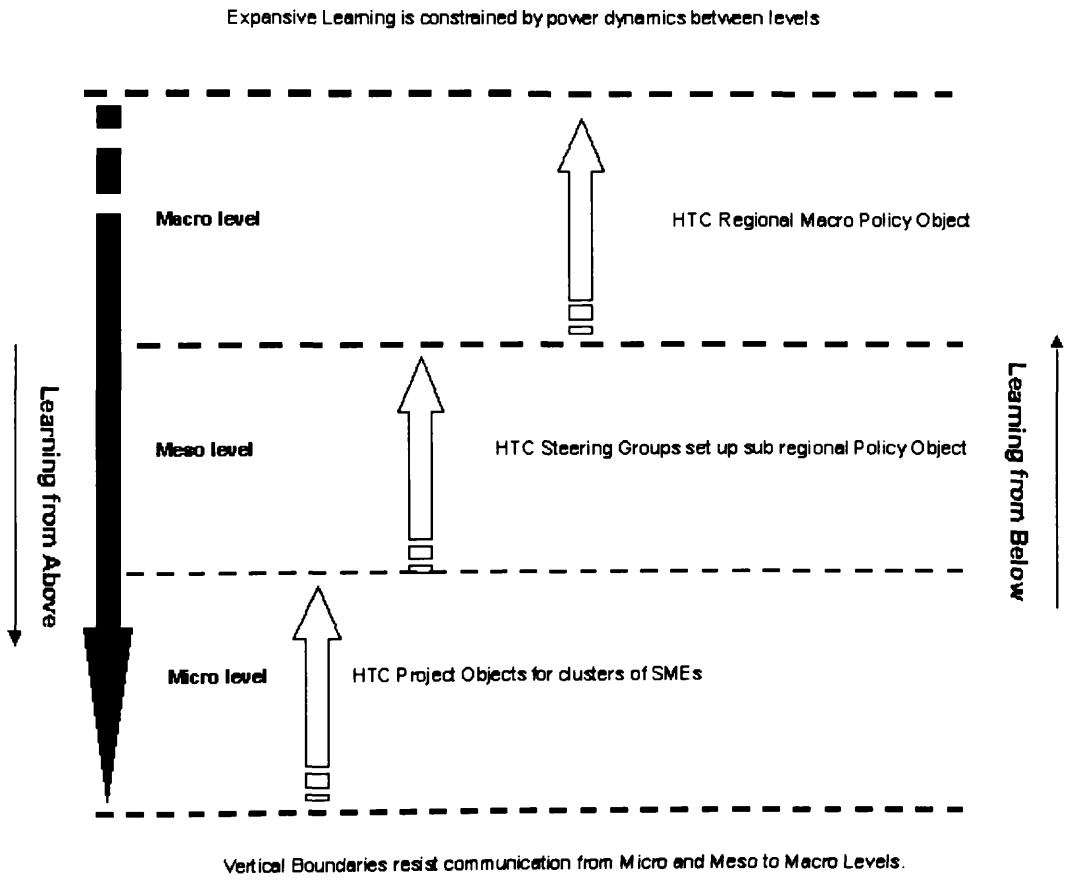
The communication between activity systems operating at different levels is uneven and almost uni-directional. Communication with key strategic actors at the macro level in the HTC is most effective where a *boundary mediator* acts as a bridge between the levels. Their role is most valuable where they connect and expand competing objects of activity at the three-implementation levels.

Vertical boundaries seemed to be experienced differently by various people attempting to move between levels. In these instances when someone influential acted as a boundary mediator they fulfilled a crucial role by bridging communication gaps between three implementation levels. They joined up thinking between the people delivering the projects and working with SMEs as the 'end users' of new technologies, with the people who wrote the strategic plans who were located at the top or macro level. A boundary mediator is a member of multiple communities and activity systems without losing a coherent sense of self-identity.

The next figure depicts the different ways in which the boundaries between levels resist communication from micro and meso levels. Not only does this restrict

expansive learning, it highlights the lost opportunities for the policy trajectory to be informed by feedback from the people who work most closely with SMEs. Given the importance of SMEs to the modernisation of the regional economy the figure below points to some serious problems in adapting policy in the light of practical understanding of its effect on those it seeks to help. The structural characteristics of HTC policy implementation block feedback from the practice at the micro level.

Figure 15: Constraints on Expansive Learning Between Levels



The data showed that key individuals were able to act as '*boundary mediators*'. If they belonged to the strategic upper level they were not repelled at boundaries separating levels. Engeström describes mediators as 'boundary crossers'.

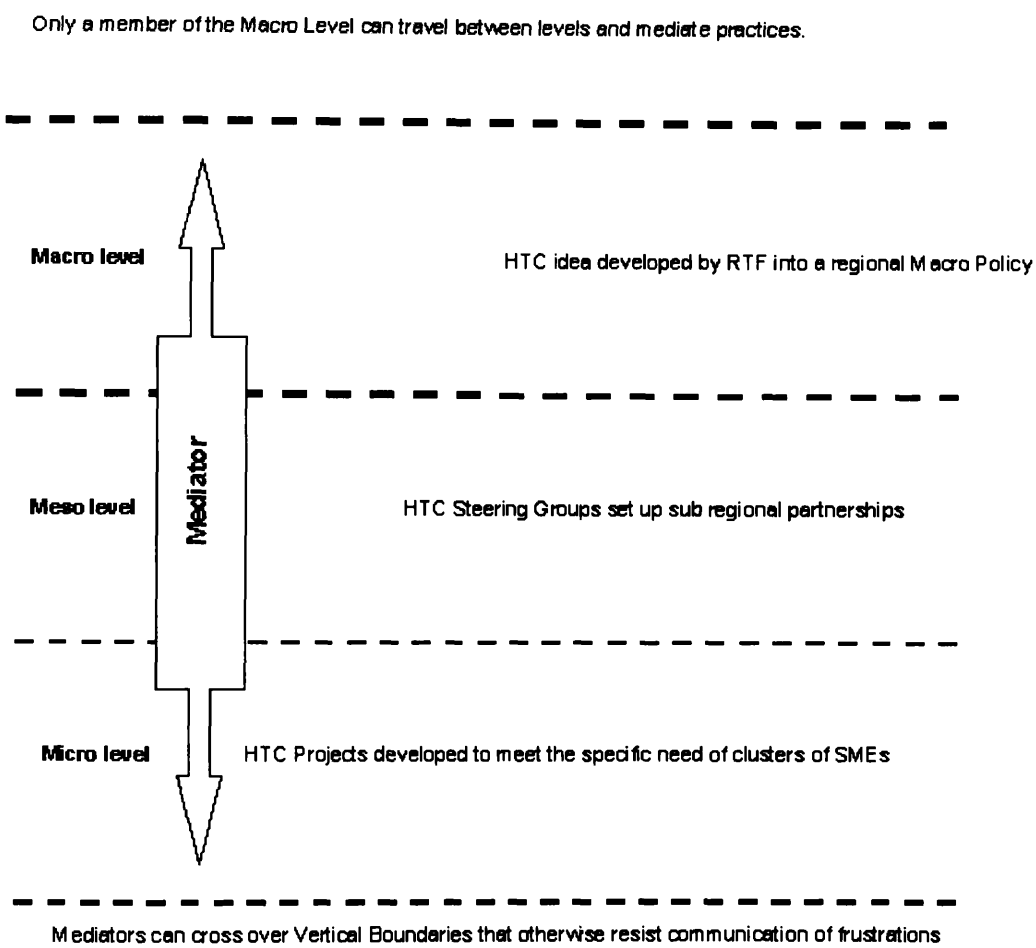
Boundary crossers are people who move from one activity system to another and work in two or more activity systems simultaneously, 'sharing the boundary object and the work based on it' with some partners in the other activity system (Tuomi-Grohn, 2003, p.203).

Given the conceptual borrowing and cross-fertilisation between activity theory and community of practice theory, it is not surprising that Wenger introduced the idea of an individual who moves between different communities of practice. In Community of Practice Theory (COPT), this role is embodied in the concept of a 'broker'[79]. A 'broker' can act as a bridge between boundaries that separate communities so that 'new knowledge can then be applied and expanded in new projects, and so the cycle goes on (Wenger, 2000, p.237). However most discussions of the role of a broker or boundary crosser are in the context of polycontextuality.

The next figure illustrates how the special *status* enjoyed by boundary mediators, allows them to travel through boundaries in either direction, connecting perspectives along the way. They have the unique capability to bring to the attention of the strategic level, issues from operational level of policy enactment that would not normally reach them. Imagine their progress in a game of 'snakes and ladders' as being advantaged by possession of their personal own ladder.

[79] Engeström colonised Communities of Practice Theory (COPT) and describes an activity system as a relatively stable community of practice

Figure 16: A Depiction of the Vertical Levels Bridged by Boundary Mediators



The data from the HTCs showed that a key individual can act as a 'boundary mediator' to connect the practices and facilitate learning between levels. This is perhaps a more appropriate term for the role because there is an important sense in which a mediator arbitrates and facilitates negotiation. Boundary mediators have agency and when they act in a mediating role they share some characteristics with boundary objects. Without somebody acting as an intermediary, differences between levels in terms of power and agency were not conducive to 'expansive learning. Like a boundary object a 'boundary mediator' maintains a constant and recognisable identity

and yet understand and 'are understood by' communities from different activity systems.

Unless a boundary mediator can move upwards they have little influence or value and are not capable of facilitating negotiation between levels. Without the agency and kudos associated with membership of the macro level of policy enactment, they were unable to range freely between levels.

6.3 Increasing the Agency of Boundary Mediators

Boundary mediators do not depend on boundary objects for their privileged position and agency to communicate messages from the micro level to the top level that were otherwise ignored or blocked. Nevertheless people who act as *boundary mediators* can use *boundary objects* to make their task easier. This can happen to a greater or lesser extent and does not seem to be a black and white issue. However in the case of HTC development it is important to consider how mediation could bridge vertical levels, where a boundary object was not at first evident.

Boundary mediators are most effective if they belong not only to activity systems at the macro level, but have commitment to micro and meso levels of policy implementation. Consequently the issue of multiple identifies and coherent self-identity is interesting. Tensions in self-identity might be traced to the contradictions between different cultural practices associated with membership of activity systems at different levels. References to dilemmas and conflicts of interest were evident in the comments of some of the interviewees.

As a representative of a particular organisation, an actor does not necessarily speak on behalf of the various individuals and interest groups in the home organisation. As a subject in multiple activity systems the individual can feel allegiance to more than one community, some of whose practices may be contradictory. This suggests that there are tensions between the roles that a given individual may adopt, which would need to be reconciled into a coherent and fully integrated self-identity. This was discussed in some depth in Chapter Four.

Two key actors in the HTCs exemplified the multiple roles an individual mediator can play in moving between levels. One key actor was a member of the board of the RDA, a consultant to the DTI, an owner of a high technology company, and the deputy chair of an HTC board. His personal preferences for 'experimental projects' may have contributed to the vast array of short-term projects in the region and the lack of a sustained innovation trajectory that could be understood by local companies.

> *Even Business Angels networks need active 'brokering'. I'm a fan of considering new mechanisms and institutes (to fill the gap)*[80].

He was instrumental in championing the interest of small high growth technology companies and was influential in funding decisions that would make innovation a priority in the region.

Another key actor was an expert on regional policy development and a pivotal member of various activity systems operating at different levels. Given his complementary roles as a very senior figure in a large research intensive University,

[80] P29: Category A Respondent: Mediator with pivotal regional innovation role .

the Chair of an HTC board and a member of the Regional Assembly he was a powerful mediator. He was instrumental in bridging the conceptual divide between policy and practice.

> *It hasn't always pointed in the right direction. It hasn't always meant quick action but the commitment of AWM, of the GOWM and of the major local authorities to the idea, has been an essential component in driving it forward. All sorts of things have got in the way but that commitment has been there all the way through*[81].

Despite recognising the difficulties he was consistently positive about the way in which the three local HTC partnerships had held together. The role he played throughout the implementation of the HTCs illustrated how mediation between the operational and strategic levels of micro and macro decision-making balanced the tensions between the various contradictory 'objects of activity' emergent at each of the three key implementation levels.

The following vignettes reconstruct from the data instances of two-dimensional collaboration between levels. They sketch the characteristic qualities and longevity of new practices [82]. This issue is discussed in depth in Chapters Seven and Ten. At the highest level, co-operation involved the key actors and organisations in shared commitment and passion for the object of activity. The HTCs adopted practices that reflected their commitment to the view that they could do more together than could be achieved separately. This is conceptualised in expansive learning theory as their

[81] P10: Category A Respondent: Mediator and key regional actor for innovation and HTC1.
[82] Co-operation captures the essence of expansive learning and '*partnership*', associated with a commitment to shared values and a vision that motivates and sustains shared work.

common appreciation of the developmental trajectory of their activity systems (Blackler et al., 2000, p.293).

6.3.1 Vignette 5: Novus Project

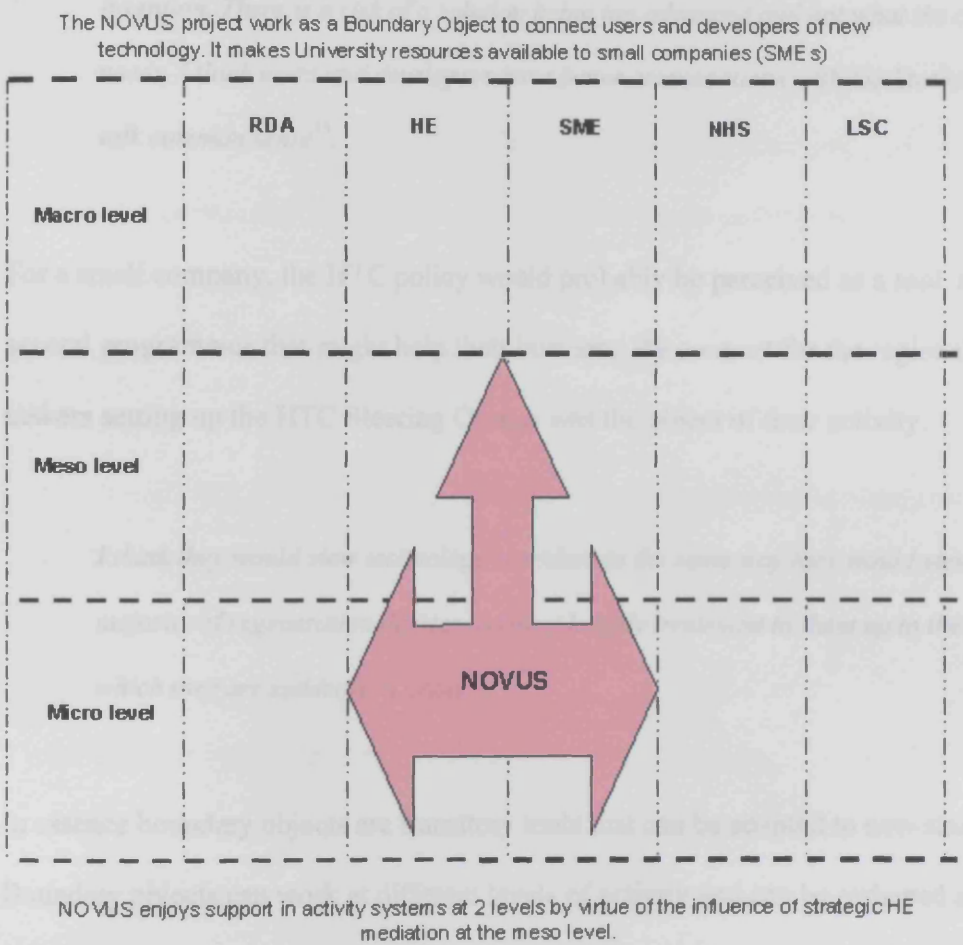
Boundary mediators were integrated into the NOVUS project from the start. Skilled individuals were employed by Universities to act as 'technology translators'. Their role was crucial in creating a bridge between the micro and meso levels. Although the boundary mediators did not sit on the steering group, they communicated issues and problems upwards to the macro level via strategic colleagues in their University. The *agency* of a boundary mediator is not necessarily a black and white issue and a 'network of strategic support' can enhance their effectiveness.

> *NOVUS acts as a* ***translator*** *between the expert inventor and the beginner or new user, in terms of the technology*[83]*. Sometimes that involves asking naïve questions and also the 'what if?' question. Getting both parties onto the same wavelength is important*[84]*.*

Boundary mediators had access to a suite of NOVUS project tools including financial resources and concrete technological demonstrations, and access to University research facilities. Boundary objects can bring the perspective of SMEs and of the RDA and the Universities closer together. The next figure shows how NOVUS combined the use of boundary mediators and boundary objects to cross boundaries and link communities of experts in the SME and the University activity systems.

[83] NOVUS is simply the brand name of an HTC technology transfer project.
[84] P16: Category C Respondent: Manager of an HTC1 project.

Figure 17: How NOVUS Projects Links Users and Developers



The boundary mediators were alert to the risks of presenting a company with a technical solution completely outside their *Collective Zone of Proximal Development* to use the terminology of activity theorists (as discussed in Chapter Two.) If the change proposed was too far from their current practices it failed to engage them, if it was too close it failed to challenge them to innovate. In developing effective mechanisms for helping SMEs it was often successful to propose modest changes initially and until the personal relationships were well founded and robust.

It's about keeping your mind open and not being blinded by the novelty of the invention. There is a risk of a solution being too advanced and not what the company needs. I think users and developers have better conversations with facilitators who talk common sense[85].

For a small company, the HTC policy would probably be perceived as a *tool*, as one of several programmes that might help their business. By contrast for the regional policy makers setting up the HTC Steering Groups was the object of their activity.

I think they would view technology corridors in the same way they would view the majority of regeneration devices as being largely irrelevant to them up to the point at which they are suddenly in crisis[86].

In essence boundary objects are transitory tools that can be adapted to new situations. Boundary objects can work at different levels of activity and can be reshaped and moulded by new practices as a result of crossing boundaries (Ludvigsen et al., 2003, p.308). So as HTC projects crossed boundaries they changed the relationship within and between activity systems. It is possible to think of 'the NOVUS concept' as acting as the object of activity in one activity system, but at the same time it acts as a tool in a related activity system. Indeed the transformation of one type of element of activity into another can seem bewildering.

[85] P16: Category C Respondent: Manager of an HTC1 project.
[86] P 7: Category A Respondent: Pivotal and strategic actor in regional innovation and HTC 3.

6.3.2 Vignette 6: Consultancy Project

HTC2 devised a project to provide customised multifaceted business development advice and resource to small and vulnerable SMEs. A comprehensive package of business diagnostic tools and practical support was designed to cross boundaries of expertise to reduce the challenges facing the company. A holistic analysis of needs aimed to reveal 'in-house' weaknesses in knowledge and experience.

> *It might help with finances or... market research or reviewing the management structure of the company.... to fund Field and Beta testing, or to develop prototype and get through the proof of concept stage, prior to full commercialisation.*[87].

The project customised for each SME an integrated support package, which included financial assistance, expert advice and practical help from experts in technical aspects of production or marketing. Using the terminology of expansive learning theory, it brought together discrete communities of experts to work towards a shared object in collaboration with each company. This approach set aside the usual divisions of labour to focus concerted effort from different experts on the needs of each individual SME. Unusually this was related to a suite of complementary projects in the HTC and it was therefore well connected to the meso level, although not to the macro strategic level.

[87] P22: Category C Respondent - HTC2 Project Manager.

6.4 Conscription Devices and Emotional Commitment to the Object

The emotional commitment to an emerging and expanded object seems to be the key to enacting complex change. Expansive learning theorists, particularly in Finland, have researched the healthcare sector intensively.

For a multi-agency partnership such as the HTC the emotional commitment to change anchors it to future practices and influences its long-term viability. It also relates to the emphasis in expansive learning theory on the capacity of *conscription devices* to enrol people with an *emotional commitment* to the object of activity. (The implications of this are discussed later in Chapter Ten).

> *Change is not necessarily sustainable and a project may not be 'anchored' in the organisation ...Anchoring depends upon the investment of time and energy and a conviction that the project has developed improvements worth maintaining(Tuomi-Grohn, 2003, p.228).*

Medical and healthcare issues seem uniquely capable of aligning motivation and activity systems towards a common object. It is very easy to understand why different experts would be able to work together towards improving patient health and well-being. It is possibly more emotionally engaging than motives associated with profit, or technological improvement.

One HTC had a particular focus on the development of medical technologies and this required cultural change in the private and public sector because success depended on

finding new ways of working together to utilise new technologies and product development strategies. In particular this challenged traditional procurement practices in the healthcare sector. They had never before considered commissioning medical product design from local SMEs. It also involved shifting the 'mindset' of local SMEs and altering the attitudes of healthcare professionals to align public sector agencies to support them in the process of change.

It was an *expansive realisation* that another sector could assist with product development because it was better equipped and had unimagined expertise. Through involvement with the HTC steering group a key person in a major NHS Hospital saw untapped potential.

> *To me it's about taking technology from one firm to another - improving awareness of the latest technologies. It can also be about transferring technology between sectors. An example of this is medical technologies that could be far better developed in the car industry because of their capacity in new product development*[88].

The possibilities to create new knowledge were evident in descriptions of individual perspectives that have changed irrevocably. The National Health Hospital Trust perceived the HTC partnership, not as a constraint but as something they would not want to be without.

[88] P 1: Senior figure in public health sector, responsible for regeneration issues and a member of the HTC 1 Steering Group.

6.4.1 Vignette 7: Collaboration Between Physicians and Automotive Designers

As a direct result of the Rover Crisis automotive designers were invited to work with a medical team to see if they could adapt some equipment. An HTC project was a mechanism for collaboration to re-design a machine to the special needs of patients suffering physical trauma. This was an example of co-configuration by experts with complementary expertise. Doctors and physiotherapists collaborated with industrial designers from the automotive industry who used their skills and equipment to solve a new problem.

> *The available NHS exercise machines used in Occupational Therapy or in Physiotherapy are designed for healthy athletes and not for patients with physical problems. The seat of an exercise machine could be developed using car manufacture capabilities to build in a power-assisted function. This could be combined with diagnostic software and optical technologies to visualise the muscle usage and skeletal problems experienced by the patient*[89].

This was an example of co-configuration where automotive designers worked with medical professionals. They were able to develop a new exercise machine by adapting existing products using new technological processes and manufacturing techniques.

> *It's about applying engineering design to new medical technologies, and finding out if the patient is working to capacity and how to adjust their therapy*[90].

[89] P 1: Senior figure in public health sector, responsible for regeneration issues and a member of the HTC 1 Steering Group.
[90] P 1: Senior figure in public health sector, responsible for regeneration issues and a member of the HTC 1 Steering Group.

The redesign of standard equipment was beyond the reach of medical professionals acting alone. In this instance of co-configuration the 'object of activity' was to combine expertise to help patients with disabilities.

6.4.2 Vignette 8: Collaboration Between Defence Industry and Physicians

The growth of sustained co-operation was most evident in the blossoming relationship between the public health sector (users) and scientific research communities (developers). Practical collaboration in an HTC project changed perceptions about the value of the HTC to local hospitals. A joint project with the researchers in Defence Medicine at DIRA, enabled the medical staff in a large hospital to develop mobile medical equipment which could be taken out to patients and save them from making unnecessary hospital visits[91].

> *This is about providing mobile medical technologies in the home rather than in hospital. QinetiQ have expertise in setting up mobile field hospitals with electronic data being communicated over great distances. Also we can bring in designers and engineers to develop a mobile kit*[92].

Experience in this project created interesting new insights and expanded the horizons and ambitions for more extensive collaboration with potential partners for innovation. In other words possibilities for more intensive and ambitious collaborations came to the attention of a major University Hospital.

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[91] QinetiQ is a newly privatised research facility at Malvern, although it continues to be funded by the UK Government. It is a centre of excellence in liquid crystal displays, microwave technologies and for research into defence medicine. It used to be called the Defence Industry Research Agency (DIRA).
[92] P15: Category B Respondent: Head of Innovation in a rural local authority and actor in HTC1.

QinetiQ at Malvern has the lead in developing imaging systems and is a centre for defence medicine [93]. QinetiQ is not on the Board but we need to make contact between the NHS and QinetiQ and indeed other firms in the UK and have global links [94].

When people began to see the potential of expanding their horizons it did not take long before they valued the 'partnership' because it could offer more than the sum of the parts.

We have been too myopic in the NHS and we should use HTC1 as the means to make that communication happen. MEDICI has encouraged us to train clinicians to be more entrepreneurial[95]. We are much more interested in engagement in partnership working and technology joint ventures have been a catalyst for this. I think HTC1 helped to orientate the NHS to thinking in this direction.[96]

A radical change of perspective seems to have occurred as a result of working with University partners and recent evidence shows enthusiasm for stronger engagement between three new hospitals and their local Universities. This pattern of growing confidence based on step changes in collaborative practices concurs with findings from Engeström's recent studies.

The occurrence of a fully-fledged expansive cycle is not common, and it typically requires concentrated effort and deliberate interventions. With these reservations in mind, the expansive learning cycle and its embedded actions may be used as a

[93] University Hospital Birmingham is the second largest hospital trust in the UK.
[94] P 1: Senior figure in public health sector, responsible for regeneration issues and a member of the HTC 1 Steering Group.
[95] Medici is a University project to encourage academics engaged in biotechnology and medical research to spin out research and become entrepreneurial.
[96] P 1: Senior figure in public health sector, responsible for regeneration issues and a member of the HTC 1 Steering Group.

framework for analysing small-scale, innovative learning processes (Engeström, 1999, p.384-5)

Expansive learning is otherwise known as co-configuration and it shifts the relationships of power and responsibility and relies on the effective communication and accommodation of different perspectives. Although HTC policy designates medical technologies as a high priority for the region, progress is built on small expansive cycles. These build confidence and help to reorientate local engineering companies towards collaboration with healthcare professionals to co-configure innovative medical instruments and technologies. Successful collaboration in HTC projects creates new opportunities and helps people to reflect on the expertise of partner organisations. This builds a conviction that they can do more together than could be achieved separately.

> *Involvement in the High Technology Corridor changed the National Health Trust's* ***perception of its own expertise****. Before it would have said it was good at everything, but let me give an example. The Leukaemia Centre Programme is to be funded via AWM – This is a real culture change and very different from previous approaches. It has been a change in practice regarding how we regard excellence*[97].

The NHS hospital trusts and the Universities are sharing their research agendas and becoming more focused in specialist fields of medical research and medical technologies as a result. There is a growing awareness of the mutual advantage in synchronising agendas and effort.

[97] P 1: Senior figure in public health sector, responsible for regeneration issues and a member of the HTC 1 Steering Group.

6.4.3 Vignette 9: Aligning Boundary Mediators in the MEDILINK Project

In Scandinavia healthcare issues have been the subject of recent studies in which expansive learning theory helped people to understand processes of innovation and change (Engeström, 2004; Engeström et al., 1999; Tuomi-Grohn, 2003). Studies focused on interactions between activity systems in which healthcare professionals had previously worked in isolation.

Although HTC1 adopted the strategic priority of building a sub regional *knowledge economy* based on medical technologies, and examples of collaboration such as Vignette 7 were important. As a result of the success of such modest HTC projects the West Midlands entwined several policy strands and devised an ambitious regional *Medilink* network. The *Medilink* connect communities of designers of medical instruments, with physicians and with engineering and manufacturing communities. It brings together new sources of expertise such as in automotive design with new markets in NHS hospitals. It supports diversification into new 'public sector' markets through the creation of innovative medical products informed by expert groups of users working in collaboration with product developers.

Medilink extends beyond HTC boundaries, but nevertheless works as a boundary object to connect engineering and medical perspectives to create new medical instruments as the object of activity.

> *In terms of Medical Technologies it's about getting doctors talking to inventors. It involves saying what they need from new instruments, based on their experience. It*

specifies to the technology developers, the information they need to design appropriate instrumentation matched to user needs[98].

There is an important sense in which 'boundary mediators' can amplify the power of boundary objects by reducing the effect of the dynamics of power in the implementation of the HTC policy that had impaired the development of collaborative practices and expansive learning between levels.

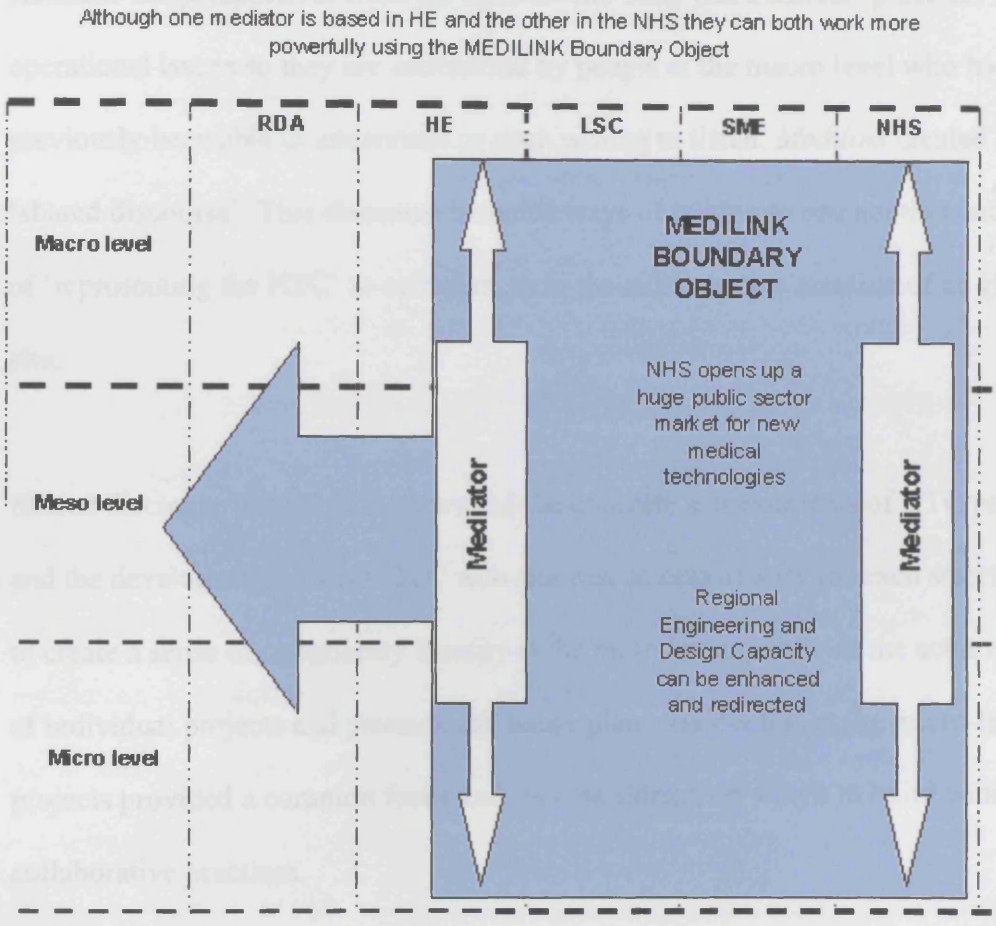
Two key individuals act as 'boundary mediators' in HTC1. They are instrumental in bridging perspectives, one is a senior figure in the University sector and the other is responsible for innovation in an NHS Hospital Trust. Together they can link a University Hospital with medical research teams and a raft of small engineering companies with the capability to work with them to design new products, that applied their skills in automotive engineering to solve medical design problems and address new markets. The boundary mediators can use the *Medilink* as a boundary object to communicate this important message.

> *People who have different approaches to what they do can coordinate their activities around an object, which gives some common meaning across the settings where activities take place. Tensions in regard to the meaning of the boundary object are part of what actors have to take into account in their attempts to coordinate their different interests (Tuomi-Grohn & Engeström, 2003, p.5).*

The next diagram illustrates how the *Medilink* project acts as a more powerful boundary object, when it is used as a tool by 'boundary mediators'.

[98] P21: Category C – HTC Project Manager and also LSC Workforce Skills Manager.

Figure 18: The Power of a Boundary Object When Used by Boundary Mediators



The diagram illustrates how boundary mediators 'passed through' boundaries *between levels* and how the Medilink boundary object helped movement *across cultures*. In combination the human 'boundary mediators' act with the *Medilink* boundary object to open channels for communication. They can 'range between' a vast array of activity systems. In the process of passing through various sites of activity they change the relationships between people who had previously worked separately.

Projects that combine the agency of a boundary object with that of *boundary mediator* seemed to achieve the best results. Because the 'boundary mediator' has status and

influence as a member of the macro levels of HTC policy implementation, they can change the character of relationships between levels. They have the capacity to reconcile the perspectives from the three levels. They can translate 'practical operational issues so they are understood by people at the macro level who had not previously been able to understand or even willing to listen. *Medilink* created a 'shared discourse'. This discourse included ways of talking to one another and ways of 'representing the HTC' to outsiders, as in the collaborative creation of an HTC web site.

Shared discourse tended to form around the concrete achievements of HTC projects and the development of each HTC web site was an opportunity for each steering group to create a sense of community identity at the meso level, publicise the achievements of individual projects and promote the future plans. Below this at the micro-level, the projects provided a common focus and success stories, on which to build wider collaborative practices.

This example of expansive learning in the field of medical technologies illustrates that individual conceptions of the object can change, and that the object itself evolves over time, and expands as the activity systems learn from one another. The *Medilink* project is the strongest example of an expansive learning cycle leading to a sustained collaborative partnership.

At the same time the discourse engendered by *Medilink* became a tool and an exemplar for good practice. It was used as a model of good practice. In this sense a discourse was created as an outcome of an HTC project that could be carried across

boundaries by a mediator. By virtue of their membership of activity systems at different levels, a mediator is able to situate individual events in a larger surrounding context, and facilitate the expansion of perspectives.

6.5 Overview

The data shows that boundary mediators have *agency* and can connect the perspectives of activity systems operating at different levels and usually separated by the dynamics of power and politics. They can mediate between perspectives from more than one level, because they understand the *object of activity* from these different positions. Yet, there is no evidence in the empirical data of a mediator being influential if they have no strategic role, in the uppermost level of macro policy enactment. A mediator can be most effective if they are actively involved as members of the activity systems operating at all three levels of policy implementation. The capacity of a mediator to balance the three contradictory 'objects of activity' seems to depend on their ability to resolve internal tensions between their various identities and motives when acting at different levels in the policy implementation process.

My research suggests that small collaborations at 'project level' can create the foundations of trust for more expansive learning and collaboration. This constructs a history of collaboration on which the HTC steering group can reflect. In turn successful projects can drive more extensive and sustained collaboration as in the healthcare sector.

Chapter Seven discusses some strong contradictions that emerge in the empirical data. These are presented as stories of dilemmas and how the tensions within and between activity systems are rebalanced.

7 A Thematic Depiction of Dilemmas in HTC Activity

7.1 Introduction

Expansive learning theory focuses on the creative power of tensions within and between activity systems to drive change (Engeström, 1999, p.377). Apparently contradictory phenomena can act as catalysts to change the depth and sustainability of collaborative practices.

The next section describes stories of dilemmas as 'experienced' by the individuals responsible for implementing HTC policy. Reconstructions of 'experience' from the interview data refer to contradictions between the espoused policy process and what happened in practice.

However the creative power of such contradictions to drive expansive learning is realised only if the contradictions are acknowledged. The following sections explain why recognising contradictions and reflecting on problems is difficult for the policy makers.

7.2 Tensions Between Levels: Espoused and Actual Autonomy

An allocation of resources to each HTC was intended to encourage sub-regional collaboration for mutual benefit. Yet it also fuelled tension between regional and sub-regional activities. The HTC steering group yearned for more autonomy and financial independence from the macro level group, who in fact made all the important

decisions. The macro level controlled the flow of funding to the lower levels and constrained their capacity for practical action.

Serious problems arose from complex and conflicting rules in the EU funding packages, which underpinned the capital and revenue expenditure on HTC projects. For instance, the partial coverage of some parts of the corridor by geographically focused packages of ESF and ERDF support from the EU made it difficult to decide how to ensure that some geographically defined parts of the HTC were not disadvantaged[99]. The complex cocktail of ERDF, ESF, DTI and AWM funding made clashes between rules inevitable. The complexity of the private and public funding package had a negative impact at micro level because 'nested rules of eligibility' make it difficult to provide timely and appropriate help to SMEs.

At the top level in the hierarchy the RDA was the 'accountable agency' for public expenditure on the regional HTC policy. The 'project management model' adopted at macro level, focused on the fine detail and did not reflect a holistic view of the issues. It was experienced as unhelpful interference in operational activities and confirmed that the locus of power remained entrenched at the top level in the implementation hierarchy.

Although funding rules were outside the control of the regional policy makers, communication between the levels could have been smoother. There was a contradiction between the policy rhetoric of espoused autonomy for the HTC steering

[99] ERDF funds capital developments such as building and site preparation whereas ESF funds training for disadvantaged communities. Each specifies deliverable outcomes such as jobs protected or created. They also state different eligibility criteria, some of which are geographically specific.

groups and what really happened in practice. In practice the meso-level experienced very limited autonomy. Individual projects at the micro level were monitored in great detail and there was little flexibility to adjust them once they had started. If the implication of the funding rules had been communicated to the micro level at the outset, expectations could have been modified.

A polarised 'us and them' culture could have been avoided if the complexity of the funding rules and division of labour had been clearly articulated and discussed. Even if people were not empowered to change the rules, at least they could understand what was happening and why. Opportunities for expansive learning were missed, and a culture of blame and anxiety developed. This exacerbated the separation between the micro and macro implementation levels. Seemingly the boundaries between levels became stronger in order to protect the top strategic level from what they felt was a barrage of unfair criticism from the operational levels. This further reduced vertical communication between activity systems. Consequently the capacity to make mid course policy corrections based on feedback was reduced. There was little reflection on how policy was experienced by the 'beneficiaries'.

It was as if the *meta-activity system* at the macro level isolated itself and sealed up communication channels to protect themselves from engaging with practical operational issues. They refused to listen to operational problems, because they simply did not know how to solve things, because the RTF funding rules allowed very little flexibility.

Instead of openly sharing the problems and having transparent discussions with the operational teams, progress stalled and those at the macro level, who understood the reasons for this, remained silent. The failure in communication fractured relationships of trust. This wasted time and dissipated enthusiasm and with hindsight sustainable collaboration occurs on the basis of openness and shared understanding.

By contrast the policy rhetoric raised expectations about 'working in partnership' and increased agency at the meso-level by passing the responsibility for financial decision making down the implementation chain to HTC steering groups[100]. This caused frustration because the devolution of autonomy for decision-making to the sub-regional steering groups was slow and partial.

> *Nothing much has changed as yet. For instance it took two and a half years to negotiate the NOVUS project. It was a cocktail of funding packages that made it difficult to operate out of the Objective 2 areas of the CTB*[101].

The practice of '*working in partnership*' was at odds with the rhetoric of '*partnership*' espoused in regional policy documents, in publicity brochures and the public web sites, which described the HTCs as autonomous partnerships. In this instance acquiescence to the dominant partner was misrepresented in public as *consensual praxis*, and the foundations of expansive collaboration were undermined.

In other words the macro level constrained the emergence of new practices at the micro level, which were proposed because of practical experience with local

[100] One steering group was transformed into a company limited by guarantee.
[101] P27: Category B Respondent: Manager of a Science Park and member of the HTC1 steering group.

'beneficiaries' of the policy. Consequently the object of activity at the macro level was in tension with the local operational practice based on detailed knowledge of the context and circumstances in which SMEs worked. This disempowered people working at the operational (meso and micro) levels from implementing the HTC policy in the way that fitted the local context best.

There was a contradiction between the strategic plans produced at the macro level in the policy implementation hierarchy and the need for operational flexibility in the HTC projects. It was difficult for local discourses and feedback from SMEs to percolate upwards.

There was no evidence that boundary objects had been created in the HTCs to bridge the vertical gaps between the perspectives (and objects) of decision makers at macro, meso and micro levels. It is difficult to depict and explain the problems with vertical communication in terms of expansive learning theory, because the concept of 'organisational collaboration' is not well suited to depicting 'a chain of command' [102].

7.3 The Victory Narrative and Reflective Evaluation

Evaluation was not perceived as an opportunity for learning. A culture of anxiety and blame seemed to have contributed to a reluctance to evaluate and reflect on what happened in order to inform future plans (Vince & Saleem, 2004).

[102] A recent study depicted communication between hierarchal levels in diagrammatic form (Toiviainen, 2003). These depicted upward and downwards patterns of learning and transfer between worker and management levels in a Scandinavian manufacturing company, but similar patterns were not evident in my research.

Lack of collective reflection undermines the practice of communication between hierarchical layers and across the boundaries of organisational sub-systems (Vince & Saleem, 2004, p.145)

The capacity to reflect on experience is enriched by metaphors because of their capability to visualise juxtapositions between the different elements of that experience. The creative power of metaphors frees up our capacity to imagine new ways of doing things in the future. Some metaphors spoke indirectly of problems, which tended to be difficult to articulate directly. There is an inherent contradiction between recounting a success story justifying the time, effort and cost of the HTCs, and reflecting on mistakes and lessons that needed to be learned.

Blame undermines the ability of managers to reflect. Lack of collective reflection undermines the practice of communication between hierarchical layers and across the boundaries of organisational sub-systems (Vince & Saleem, 2004, p145-6).

Evaluations of complex programmes such as the HTCs are complicated because of horizontal and vertical complexities. It cannot be assumed that when activity systems are of equal agency and arrayed in parallel they will interact in the same way as activity systems arrayed vertically where this is a distinct pecking order. The impact of evolving contexts and the breadth of potential outcomes make interpretation problematic. Political, demographic and geographic factors indicate the unprecedented complications of the task (Connell et al., 1995, p.2). There were no published studies of comparable research contexts, nor was it possible to use a control group for comparison purposes.

> *Politics can inhibit theorising. It can limit the scope to concentrate on issues and options that fit the current political agenda and fail to articulate and test alternative sets of assumptions-or alternative causal stories - in which case we are likely to 'know more but understand less' (Weiss, 1995, p.11).*

It is possible that reluctance to evaluate stemmed from a realisation that there was little opportunity to make any meaningful changes because all the money had been profiled. However a full account of the development of the HTCs, with reference to the difficulties as well as the achievements could be an invaluable resource for policy makers and for the people implementing it in practice.

An illustration of the value of a detailed evaluation that aims to fulfil this role is the recent DTI sponsored evaluation of cluster development across the nine English Regions (Ecotec & DTI, 2004). It articulates some fascinating changes in conceptualisation of the problem of technology transfer. The evaluation report describes links between firms as both *vertical*, and *horizontal*. Companies may have *horizontal* links through complementary products and services, the use of similar specialised inputs, technologies or institutions.

> *Most of these linkages involve social relationships or networks that produce benefits for the firms involved (Ecotec & DTI, 2004, p4-5).*

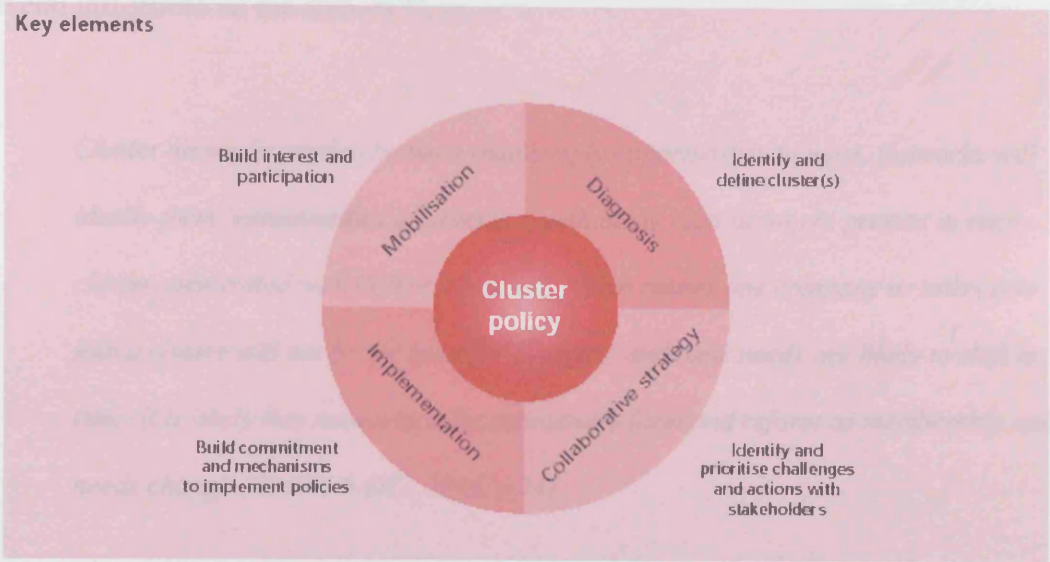
On the other hand companies can be linked *vertically* through buying and selling chains. As in the relationship between Rover and its secondary and tertiary suppliers, these relationships are characterised by the uneven distribution of power.

The report described the benefits clustering can bring to both business and the wider economy. It was based on interviews with practitioners across the UK, many of whom had learned a great deal since the HTC experiment was initiated. The 'lessons' presented in the evaluation of 'clustering behaviour' could equally apply to HTC policy, but it predated the report by four years and there has as yet been no comprehensive evaluation of the implementation of HTCs.

> *The aim of measuring cluster development is so that we can learn from our experience in order to improve the actions that we are taking. Unsuccessful actions should be ended, successful actions continued, replicated where relevant or discontinued where no longer appropriate. New actions should be adopted where information suggests that weaknesses are emerging or opportunities present and things should be left well alone where no actions are needed. Monitoring and evaluation is part of the policy cycle and information gained from measuring cluster development should be fed back into the policy process to inform future policy development. This requirement may itself influence the timeframe adopted for the monitoring of cluster development. (Ecotec & DTI, 2004, p 19).*

It is remarkable to note the change in the conceptual framework and vocabulary. Some reference is made to considerations central to socio-cultural perspectives and which have hitherto been missing from the various theoretical concepts that inform policy makers in the UK. The report focuses on 'clustering behaviour' and the experiences described by practitioners as a resource for mid-cycle policy adjustment. The next figure illustrates this change in terminology and attitude.

Figure 19: Guidelines on Clustering 2004



The report seems to value both social networks and individual agents of change, and there is some use of terminology that has not previously been evident in UK Government sponsored reports.

> *Networks that generate formal and informal flows of knowledge and information throughout a cluster provide the gel that binds success over time. Access to* ***tacit knowledge*** *can support* ***collective learning*** *and more competitive performance. The value of informal networks, based on social relations and even job-moves, is that it enables a transfer of knowledge around the cluster. Such 'untraded' means of information dissemination such as informal collaboration and extensive contact networks can create a* ***'knowledge community'****.*

The evaluation report refers to clustering activities and to a 'knowledge community' rather than to a knowledge economy'. Given that the report was commissioned by the DTI, the shift in language is remarkable. It describes the process of clustering in

terms not dissimilar to those used in activity theory, although this is clearly one of several influences on the authors[103].

> *Cluster networks need to be more than simply opportunities to meet. Networks will ideally form '**communities of practice**', with many such networks present in each cluster, associated with different interests. What causes one company or interest to join a cluster will not be the same for everyone and their needs are likely to shift in time. It is likely that networks will continuously form and reform as membership and needs change (Ecotec & DTI, 2004, p 24).*

Despite the espoused mission 'to facilitate regional innovation', the 'organisational culture' and performance measures constrained the capacity for reflection, self-criticism and expansive change. By recognising inadequacies in current practice it is possible to identify better ways of doing things and drive progress. The difficulty (or to use Engeström's term, the double bind) for public sector organisations is the dilemma of 'being seen to make mistakes'. The cumulative 'weight' of the bureaucracy tended to deter policy change on the basis of sustained reflection, local knowledge and operational experience.

The ability to bring controversial issues to the 'surface' is a prerequisite for reflection. There is an understandable reluctance 'to be seen to have funded' a failed experiment with public money (Vince & Saleem, 2004). There was no evidence of attempts to develop consensual theories of change. Similarly there were no opportunities for

[103] The inference about the significant role of 'communities' draws on both activity theory and communities of practice theory. The mutual influence of these two theories has already been discussed in Chapters Two and Five.

evaluators to help people to work together by developing techniques to measure the extent to which each step has taken place, or to consider: -

> *Have agencies adapted their procedures in ways that enable them to function in a multi agency system? (Weiss, 1995, p.11) and*
>
> *Have practitioners reinterpreted their role to be advocates for the client, rather than enforcers of agency rules? (Weiss, 1995, p.11)*

The empirical data suggests that RDA staff did not reinterpret their role to be *advocates for the client*, instead they remained focused on enforcing the agency rules. There did not seem to be any systematic method of evaluating progress and trying to comprehend how barriers might be overcome. Staff focused on making sure spending profiles were accurate and exhibited 'risk averse behaviour' which stemmed from a culture in which accountability and 'auditability' usurped the intended outcomes of HTC policy in importance. The corollary of this was 'much frustration' at the meso and micro levels and a waste of human and financial resource.

In target driven or project management driven cultures it is very difficult to acknowledge problems and to reflect on current practices. HTCs may have fared better if they had been recognised as 'high risk' experiments, which carried potentially high rewards for success. A positive attitude towards risk may have encouraged reflection and adjustment to policy, informed by local insights. The logic of embedding an element of qualitative analysis and evaluation from the outset seems compelling since it allows not only for rich narrative but also for modification of causal assumptions as things happen in the field (Weiss, 1995, p. 11).

When we come to the longer term policy, we hope not to have just a series of catalyst projects which get done, and then the thing dies and they say 'Fine we've had some money for projects now we move on to something else'. Unless the corridor has got a long-term aspiration then it will have ***failed***[104].

The HTCs continue to be an interesting experiment in which empirical and theoretical knowledge could helpfully reconstruct one another. Expansive learning (or collaboration) seems to progress when there is open discussion of difficult issues. The lessons learned in this ambitious and 'high-stakes' policy initiative would be relevant and transferable to similar technology transfer initiatives elsewhere, but only if a complete story is told. This would include the difficulties and tensions that arose in the implementation process.

My impression would be that its like all the partnerships we set up, that AWM got going, that it takes time to bed down and it takes time for people to realise what their roles were, what was expected of them, what they contribute and they are now starting to become much more effective[105].

The requirement for a victory narrative, focusing only on a success story with no acknowledgement of setbacks and deviations to avoid pitfalls, limits the capacity for real change. It is not very useful to people struggling with practical problems of a similar nature, whereas a frank and full exposition of the story of HTCs from multiple perspectives could be invaluable.

[104] P 8: Category B Respondent: Key public sector regional innovation officer .
[105] P 6: Category A Respondent: Pivotal and strategic actor in regional innovation.

7.4 The Roles of Animateur and Auditor

Difficulties arose for all the English Regional Development Agencies[106] (RDAs) because of the *ad hoc* development of policies in response to very tight funding deadlines driven by UK Government's economic performance targets. In the West Midlands, a local 'critical incident', known as the Rover Crisis[107] applied additional pressure to the situation. In effect there was a *post hoc rationalisation* of a suite of technology transfer and innovation policies devised in haste. These now appear to be full of tensions and contradictions, which need to be understood, in order to change future practice.

Internal contradictions between two different cultures at the RDA contributed to miscommunication, wasted time and effort. The RDA acted as both a regional animateur and as the 'gatekeeper and auditor' of public money. There were inherent tensions in these two roles. In their dual role the RDA did not recognise this *dilemma* and their internal contradictions of organisational purpose created problems and confusion for the so-called 'partner' organisations.

For instance, the comments of a member of an HTC steering group can be related to a depiction in activity theory of internal conflicts and 'institutional schizophrenia' within the RDA[108].

> *Because it does not fit into a standard contract model some AWM staff are reluctant to move things forward. At the root of the problem is a dilemma as to whether AWM*

[106] Locally the RDA is referred to as Advantage West Midlands and that is why the acronym AWM appears in the data excerpts.
[107] Described in the Rover Task Force Report (SQW, 2001).
[108] P15: Category B Respondent: Head of Innovation in a rural local authority and actor in HTC1.

*is a **delivery organisation** or a '**strategic planning body**'. There are almost **two cultures** at work in AWM pulling in different directions. But there is not the capacity to deliver even though there may be the ambition to do so.* [109]

Two cultures existed side by side at the RDA. This may be summed up as '*driving with one foot on the brake and the other on the accelerator*'. Respondents at all levels and from several of the stakeholder partners inferred that the RDA gave mixed messages and exhibited contradictory behaviours.

*The issue is about the **funding bureaucracy** being at odds with the timescales for project delivery. It makes it difficult to plan 'forwards' in a consistent way*[110].

One team of people applied strict rules from an audit perspective and this contradicted the efforts of a different team of people whose role was to enthuse regional organisations to join the HTC policy partnership.

The partners are disparate and (getting agreement is slow). The RDA is one of the partners but their funding mechanisms slow things down[111].

Tensions within and between the activity systems drive change. It may bring people closer together, or drive them apart. An unintended and fortuitous result of the frustrations arising from the complexity of the rules of the various funding regimes was that the HTC partners drew closer together. The tension between the different sets of rules and 'competing objects of activity' in the HTC united the partners. A

[109] P15: Category B Respondent: Head of Innovation in a rural local authority and actor in HTC 1.
[110] P25: Category B Respondent: Manager of a Science Park and member of an HTC steering group.
[111] P27: Category B Respondent: Manager of a Science Park and member of the HTC1 steering group.

'wartime spirit' prevailed and they agreed unanimously to fight the inflexibility of the rules.

> *Because we had such a tough time sorting out the HTC funding vehicle (state aid rules were a big problem), I think we started concentrating on land and site acquisition. The revenue expenditure for spinouts has taken a back seat*[112].

In HTC1, the 'resistance' to bureaucratic funding approval processes, resulted in a decision by the steering group, to gain more control by changing the legal status and name of their HTC[113]. Consequently, the steering group members established as a company limited by guarantee and adopted a new name and set a 20-year strategy. They asserted their independence from the regional development agency and changed the dynamics of relationships. Their action prevented the RDA from dominating the partnership by virtue of their status and power as *gatekeepers* of funding. Nevertheless the RDA continued to give mixed messages to the so called 'partner organisations'.

> *They had to own the corridors-they are **not** owned by the agency* [114]*. The agency is the **funding route**. They have to develop their policies and get those individual projects up and running and establish their long-term vision and their long-term plan. So that really is the implementation and that really is the stage where we are at the moment.*[115]

Tensions continued to arise from 'conflicting rules' associated with the Rover Task Force funding package. There were persistent difficulties that took a great deal of patience and energy to resolve. The complexity of the HTC funding package

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[112]P28: Category B Respondent: Senior Manager in public sector business support organisation and member of the HTC1 steering group.
[113] P 4: Category B Respondent: Director of HTC 1.
[114] The word 'they' refers to the Steering Group or Board running the HTCs.
[115] P 8: Category B Respondent: Key public sector regional innovation officer.

encouraged the use of measures such as jobs created on all projects. In some instances this made no sense because in the Information Technology or Design Industry, freelance employment conditions do not make the number of jobs created a reasonable measure of success.

> *Unfortunately many of the old performance measures that apply are support measures, which are out of date and inappropriate to what is needed*[116].

For instance profitability would reflect more accurately, the improvement in business performance, but the EU or UK Government funding programmes will not accept it as a performance measure. The overall impact of utilising a mixture of European Social Fund, ERDF and DTI money was not appreciated until there was no turning back.

> *We were pretty much constrained by what went into the Secretary of State ... it didn't incorporate some of the things we now know needed to have been included (and we are going to find the funding from elsewhere to make them happen). It's more than a package of knowledge intensive activities and land and property propositions*[117].

Interviews with key actors illustrate tensions and contradictions between how the policy is portrayed and how it is experienced. In the same interview in 2003, the lead policy officer voiced some revealing self-contradictions.

> *The agency owns in effect the corridors and we have funded the people in the corridors who are administering the running of the corridors. In the case of the HTC1 there is a Management Board. In the case of HTC3 and HTC2 we're funding a*

[116] P20: Category C Respondent: Manager of an HTC2 project.
[117] P 6: Category A Respondent: Pivotal and strategic actor in regional innovation.

corridor Director, and although we're funding them, and they report to the group, effectively they report to us [118].

Another consequence of the rigorous auditing of individual projects was the sheer effort and staff time this absorbed. This tension was embodied in a contradiction between the espoused autonomy of the HTCs and the control mechanisms imposed by the RDA's project management practices.

So we're monitoring the longer-term policy development of the corridors so there is that level and then as far as the individual projects are doing, we are funding and monitoring these as well. So in effect there are two levels of monitoring.[119]

Within the same interview an AWM officer said exactly the opposite and stressed that each HTC was responsible for 'developing' policy. However, the senior manager (and line manager for this officer) never wavered in the opinion that 'the RDA owned the corridors'[120]. It was implied that paying the salaries of the Directors, equated to owning the corridor agenda. There were inherent contradictions between the espoused autonomy for the HTC steering groups, which included creation of a long-term vision, and the treatment of each project by the RDA as if it were independent from the HTC plan.

We've now funded corridor Directors, so from a corridor perspective they start bringing everything together and are able to give us a ***report*** *on the delivery in terms of quality. The fact is that the expenditure is being managed and the outputs are being*

[118] P 8: Category B Respondent: Key public sector regional innovation officer.
[119] P 8: Category B Respondent: Key public sector regional innovation officer.
[120] P 9: Category A Respondent: Senior public sector officer responsible for regional innovation contracts.

managed, so Directors are employed by the corridor ***but*** *report to us (AWM) in a* ***contractual*** *sense*[121].

There was no recognition of inconsistency or internal contradiction in the detailed monitoring requirements at project level within each corridor and RDA priorities were clearly to ensure that public money had been spent correctly and had a robust audit trail.

Until further delegation happens every single project in the corridor is on a contract basis in terms of spend and outputs on a monthly basis. The reports are on a quarterly basis and that's followed up by on-site visits so it would be standard agency monitoring really[122].

The HTC policy rhetoric constantly spoke of the need to support the business community and listen to what they wanted. In practice the business community was very confused by a vast array of projects with different eligibility criteria and funding rules. Their needs were not well served during this period.

The '*project management model*' seemed to have become a *discursive force* in the struggle to create hegemony in institutional practices. It enforced compliance by withholding funds. At the RDA a team of people carried out detailed management of contracts for every HTC project. AWM employed a 'project management model' that focused on detailed auditing of project outputs and did not reflect a comprehensive view of the issues.

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[121] P 9: Category A Respondent: Senior public sector officer responsible for regional innovation contracts.

[122] P 9: Category A Respondent: Senior public sector officer responsible for regional innovation contracts.

AWM can be less constructive on the soft aspects than the hard aspects. Land and buildings are not the solution[123].

At the micro level of HTC projects an unhelpful bureaucracy impeded progress because they attended the wrong metrics. They defined success in terms of *outputs* rather than *outcomes*[124]. By focusing on the things that could be measured, important factors that were difficult to quantify were ignored. For instance there was little emphasis on qualitative changes in behaviour that could sustain meaningful change. This also highlighted a contradiction between the espoused rhetoric in AWM's mission statement, and the 'actual practices' of AWM managers and officers.

7.5 Sustaining Coherent Development with Short Term Projects

The contradictions between the short-term regional 'objectives' of the corridors and their long-term survival in a global economy caused dilemmas for the HTC steering groups. Although the stakeholder partners were aware of the need to plan for the future, their freedom of action was constrained by the terms and conditions of the funding from the DTI and the EU. Many regional problems were deeply entrenched and required sustained and consistent treatment over decades. Two or three year projects simply disguised the problem.

[123] P27: Category B Respondent: Manager of a Science Park and member of the HTC1 steering group.
[124] The RDA values *outputs* such as 'jobs protected' because they can be achieved quickly and measured. While long -term *outcomes,* such as qualitative changes in practices, are ignored because they take a long time to achieve.

There was a tension between the need for a long-term strategy and the fact that public funding was available for only the first three years of operation[125]. The complexity of the investment and revenue funding streams for the HTCs caused huge practical difficulties, which gradually became apparent during the implementation process. The dilemma at the meso level facing the HTC Directors and their Steering Groups resulted from the tension between short-term targets and long-term sustainability.

> *We have funding for only three years but clustering takes 15 or 20 years to achieve. We need to prolong the project and expand it from the geographical region defined by the HTC3. I think clustering is best done internationally and we are discussing working with companies across the UK and then we want to expand worldwide. In particular we are keen to link with Indian companies. Local funding conditions make this forward vision difficult. AWM want us to focus on achieving local targets*[126].

Contradictory and inconsistent policy messages were confusing because on the one hand the HTC funding was time limited, but the problem the policy sought to address was long term. Sometimes the officers at the RDA conflated the two issues and used emotive language in describing the HTC as a long-term solution.

> *Unless the corridor has got a long-term aspiration then it will have* ***failed***[127].

The key actors in each HTC described the process of persuading AWM to see the contradictions between short-term funding and long-term aims as '*a long uphill struggle*'. Whilst the focus has been on delivering the Polymer Cluster and Advanced

[125] P11: Category B Respondent: Director of HTC 3.
[126] P18: Category C Respondent: Project Manager in HTC 3.
[127] P 8: Category B Respondent: Key public sector regional innovation officer.

Engineering Projects in the HTC3, sustaining these projects to meet a long-term need was also considered.

> *While I think the policies have been supported and the corridors are now seen by AWM as one of their long-term strategic regeneration vehicles and have begun to talk about a 20 –25 year lifetime. Getting that expressed consistently by funding strategies is always a little more difficult. I think that where the difficulties have arisen is where the rules around matched funding and spending profiles created confusion around* ***output targets****. So I think that the policy framework is supported but* ***the practical interpretation*** *of that through funding is more difficult*[128].

After a good deal of reiteration of the problems experienced at project level, changes were made to the 'targets and performance measures' which were applied to some of the partner organisations working in the HTCs. During 2003 Business Link and HTC actions were aligned to alleviate the impact of performance measures to reduce self-interest and help to align the partners towards the same goal. The efforts at the micro level to influence the macro level eventually resulted in a change in 2004, when AWM adopted new strategies to encourage closer working relations between local public bodies.

Individual officers within AWM were aware of the difficulties but were powerless to 'change the rules'. A complicated chain of approvals was required before anything practical could be done at the micro level and this proved very frustrating for the espoused beneficiaries of the HTC policy, the SMEs[129].

[128] P 7: Category A Respondent: Pivotal and strategic actor in regional innovation and HTC 3.
[129] P 6: Category A Respondent: Pivotal and strategic actor in regional innovation.

Given that we didn't have well founded partnerships in the early days at least it was important for external agencies to take a very strong view on whether or not things were approvable and in the case of the ones where we had RTF money - they had got a plan to work to and any things that were not in the plan were not going to get signed off by the Secretary of State[130].

As a result of persistent lobbying from the HTCs about their approach to managing this diverse array of public funding, their perspective shifted during 2003 to allow a more flexible approach to address issues of sustainability.

A more positive indicator is that AWM are now talking about continuing the concept to 2010 and plan to include references to corridors in the RES (Regional Economic Strategy). It may be that AWM now appreciate that a 10-15 year cycle is required to assure the desired payoff for the investment[131].

This realisation came too late to redress the balance between capital and revenue expenditure. In effect no additional resource could be made available to address the problem of sustainability. Unfortunately, as in other instances, the messages from the EU funding regimes and from AWM were contradictory and confusing. Ironically this contradiction was a driving force for expansive learning in the meso level and collaboration between the members of the HTC steering group became deeper. In a sense they were united against the common enemy of 'bureaucracy'. Their object of activity was *re-orientated* towards overcoming obstacles imposed at the macro level. The research findings suggest that it would have been valuable to realign existing partners, re-conceptualise the problem, and evaluate progress and problems together.

[130] P 6: Category A Respondent: Pivotal and strategic actor in regional innovation.
[131] P25: Category B Respondent: Manager of a Science Park and member of an HTC steering group.

I think that where the difficulties have arisen is where the rules around matched funding and spending profiles created confusion around output targets. So I think that the policy framework is supported but the practical interpretation of that through funding is more difficult. [132]

During policy enactment it gradually became evident that there were huge problems associated with accepting a funding package of extreme complexity with rigid spending profiles.

We've tried along the way, for 2 or 3 years I suppose, to keep industry and commerce in the corridor briefed about what was happening and about the opportunities. It was quite difficult. I mean the progress for the past 3 years has been about progress with bureaucratic procedures about money and that's seemed pretty difficult to comprehend I think unless you have been in the middle of the process. ***It's sometimes difficult to comprehend when you've been there*** [133].

This resulted in almost no flexibility to address surprises and adapt practices. The various terms and conditions from elements in the complex funding package were contradictory and confusing. Overall this contributed to a quick fix, 'project' culture in which numerous short-term projects proliferated to solve intractable economic problems.

[132] P 7: Category A Respondent: Pivotal and strategic actor in regional innovation and HTC3.
[133] P10: Category A Respondent: Mediator and key regional actor for innovation and HTC1.

To do economic development properly you need a much longer-term vision. So although we've got a vision you need longer-term resources to have a real impact.[134]

Different types of innovation have specific effects. A solution innovation typically applies only to the specific case for which it was invented and often this may not have a lasting or wider effect. Sustainable 'trajectory innovation' is difficult to achieve in a climate of short term 'project funding'. Sustaining a consistent service should have been compared with the opportunity cost of failing to broker or mediate communications between users and developer communities. On the other hand a trajectory innovation is aimed at becoming a more or less permanent repeatedly used procedure (Fichtner, 1999 , p.387). The English RDAs are relatively new organisations. Compared with economic development agencies in other European companies they seem unstable and transitory.

*Italian development agencies are **stable** over long periods and are not subject to rapid policy change determined by changes of Government. (In Italy the Governments change very frequently, and so stability for regional economic development is crucial.) SMEs need longevity and continuity in the UK. The phrase **'please stop helping me'** sums up the feelings of SMEs about the confusing array of short-term support available in the West Midlands*[135].

Although solution innovations can sometimes be transformed into trajectory innovations, the process is difficult to achieve in a climate of short term 'project funding'.

[134] P 5: Category B Respondent: Director of HTC 2.
[135] P32: Category C Respondents: Managers of projects in HTC2.

When an innovation is rejected but has conceptual coherence and is anchored in the needs of the collective activity system, it is not likely to disappear, but subsequently may reappear in modified forms (Engeström, 1999, p.397).

In many instances new regional initiatives were launched prematurely before a prior 'solution to the problem' had played out to its conclusion. *Initiativitus* arose as the short term funding of a 'solution innovation' reached an end (Brown, 2004b). Instead of being transformed into a sustained trajectory innovation, the same good idea re-surfaced time and again as a re-branded solution innovation. Not surprisingly this caused confusion amongst the very people it set out to help.

This risks repeating local policy failure, because sustained co-operation between complementary roles of regional agencies was disrupted in the hiatus between one short-term solution and the next. The cost of sustaining a consistent service was not compared with the 'opportunity cost' of failing to broker a sustained dialogue between users and developer communities, without which innovation would not succeed.

The HTC policy fuelled unreasonable expectation that economic and social problems can be solved quickly. An exclusive focus on hard data, assumes that 'what is measurable is most important'. The soft data pertaining to cultural change in SMEs was not valued because it did not correspond to concrete outputs such as the number of new companies created or jobs protected. Ironically the hard outputs may not be appropriate to measuring performance in the new global knowledge economy.

During 2004, the empirical data showed that the perspective of the RDA shifted to allow a more flexible approach, which addresses issues of sustainability.

I think there was a realisation that business support needs were specialised- a different mix was needed - The planning framework is not set up to acknowledge this particular type of problem[136].

In the financial year 2004/5 the RDA took responsibility for monitoring 1,800 projects[137]. RDA personnel were accountable for the delivery of outputs on all these projects to the UK Government and the EU. In anticipation of some difficulty, efforts had been made during the previous financial year to cut this down to manageable numbers and to focus on ten major regional projects. However, it proved to be impossible to jettison existing projects or to rationalise them by aggregation.

7.6 Overview

In this chapter I discussed relationships between apparently contradictory phenomena that cause tensions between activity systems and drive change. These contradictions often amount to differences between 'how the HTC was experienced' and 'how the process was intended to be'.

By alerting people to the tensions in the HTCs that would otherwise be ignored or tolerated, a process of dialogue, experimentation and collective learning can be triggered that may transform participants' understanding of their activities and the systems through which they are enacted (Blackler, 1995).

[136] P25: Category B - Director Warwick Science Park and acted as interim Director of HTC2.
[137] The source was a conversation on August 5th 2004 with an ex-financial consultant to AWM.

Public organisations responsible for public funding such as RDAs would benefit from a more reflective stance and systematic evaluation of the effectiveness of policy. This would help them to listen to how policy is 'experienced' in the implementation process, without having to be defensive about public money.

Policies for innovation and technology transfer are emotive and politicised, and when people work across boundaries they enter *hybrid* and potentially hostile territory. Despite the frustrations and problems, the data indicated that people at the micro and meso levels worked together to overcome the bureaucratic blockages to progress. Claims for ownership of the 'territory' of technology transfer are many and various. The activities in the HTCs drew people into 'contested terrain' because individuals and organisations were working in new domains, without the comfort of familiar routines and practices.

Overall, respondents were reluctant to be critical, and there was consensus that everyone was doing his or her best in uniquely challenging circumstances. Although this did not alleviate a sense of frustration, it did indicate a commitment to make HTC policy work despite the past and present problems.

Chapter Eight summarises the findings and addresses the research questions directed at understanding the policy context in which HTCs were created. It depicts the characteristic differences across the range of organisations involved. It also summarises the impact of the enactment of the policy at three hierarchical levels.

8. A Policy Overview: Multi-Agency Learning

8.1 Key Findings

The overarching aim was to explore the implementation of the HTC policy and its enactment in three tiers, the macro, meso and micro levels. Four questions were derived from this aim.

Research Question 1

> *What was the context for the introduction and implementation of the HTC policy? (Chapters one, two and four)*

The unique context of the implementation of HTC policy was due to a confluence of three circumstances. Firstly, the crisis for automotive manufacturing in the region focused attention on job losses resulting from the threatened closure of the Rover Plant. Secondly, the intervention of the DTI and the establishment of the Rover Task Force aligned the regional public and private sector stakeholders to address the ensuing problems. Thirdly, the opportunity arose to add value to DTI and RDA funds by matching it with ERDF and ESF, which created a funding package of Byzantine complexity with contradictory rules and foci.

Various incompatible fragments from diverse theories of change seem to have shaped policy (Weiss, 1995). The planned delivery of the HTC policy through a multi level implementation structure led to misapprehensions about the limits of strategic and operational decision-making.

Research Question 2

> *What technology transfer practices were evident prior to the enactment of HTC policy? (Chapter Four)*

When the regional HTC policy was devised in 1999, there was no prior experience to prepare people for implementing anything so complex and on such a large scale. Yet there was an urgent need to do something to take advantage of a unique funding opportunity for developing a regional knowledge economy. Inevitably this meant starting work before setting a clear and carefully considered strategy. Unsurprisingly there were instances of people working valiantly, but not necessarily in the same direction. In expansive learning theory this would be expressed as being orientated towards different *competing objects of activity*. In everyday language this might be expressed as misalignments of stakeholders, which left individuals confused as to how to work together.

The espoused policy portrayed in publicity materials such as the West Midlands Regional Innovation Strategy and Regional Economic Strategy documents, assumed that the key was to put groups of 'developers' and 'users' together. The HTC policy assumed that copying models, that had worked successfully elsewhere, could create a regional knowledge economy. This approach of 'policy borrowing' was discussed in Chapter Four and assumed that 'technology transfer' could be achieved by adopting the ideas and mechanisms that had been effective in Massachusetts, Stockholm and Cambridge. Implicitly this underestimated the human dynamics and communication gaps that influenced whether 'technology transfer' was successful or not. It was

therefore not dissimilar to EU or DTI policy assumptions, which were discussed in Chapter Two.

Initially the policy makers in the West Midlands did not prioritise the need to actively help people to work together. Creating the relationships between organisations to support a new regional knowledge economy required time, money, and a huge amount of effort. The difficulty of unfreezing entrenched positions and moving towards a shared vision were underestimated[138] (Trowler et al., 2002).

Research Question 3

> *What knowledge transfer practices were evident amongst key stakeholders? (Chapters Four and Five)*

Surprisingly the greatest polarisation was not between public and private sector organisations. The strongest differences in 'technology transfer' practices depended on how close the individual was to the practical application of a new idea or technology in a local company. Individuals who could draw on practical experience of technology transfer made the most insightful comments. They described the process as fraught with unpredictable complications, and occasional serendipity from which unexpected benefits might flow. They stressed that it was important to nurture long-term relationships and to invest time and effort as well as resource.

In general the West Midlands suffers from a traditionally low level of investment in research and development by the private sector. The predominance of SMEs, the vast

[138] The concept of 'unfreezing' was originally developed by Lewis Elton and cited in the referenced publication on Change.

majority of which employed less than fifty people, suggests that company investment in research is unlikely to improve. The evidence shows that only a small amount of research was conducted in the private sector, and most of it was done on an ad hoc basis. The need to change attitudes in private sector companies towards sustained investment in research and development became more evident as implementation progressed. In particular the process of cultural change in SMEs required time and effort, and the value of networking and collaborative cluster based research became clear.

The policy enacters at the micro level focused their attention on developing practical micro clustering projects that would make a difference to attitudes by creating good experiences of collaborative research and development that brought swift results in terms of new products and profits. There were numerous small companies employing less than five people and 'research' was virtually impossible. The HTC projects helped them to carry out research and new product development collaboratively by providing an infrastructure of equipment and mentoring.

Research Question 4

> *How influential were policy enacters at each level of the implementation of HTC policy? (Chapters Six and Seven)*

Characteristically different degrees of influence and agency were associated with three levels of HTC policy implementation. The individuals who enacted the policy at this strategic level had the most 'agency' but were distanced from practical experience. At the meso and micro level the enactors of policy had less agency but had a wealth of

practical experience of working with companies. Collectively they understood technology transfer to be a long and difficult process, in which both developers and users would be challenged and would need to change their routine behaviour.

At the operational or micro level, there was least agency but the closest working relationships with SMEs. At this level, projects were created on the basis of pragmatic and detailed knowledge of what would work for small clusters of companies in a particular context. At this level the enactors of policy were well aware of the need to spend time and effort in applying a new technology or business process in a new context.

It became evident that the enactors at the micro and meso level expressed a lack of faith in the willingness of the macro level and certain organisations to listen to their views. In terms of expansive learning theory, this suggested that learning is inhibited between activity systems in which there are marked differences in power. This was a cause for concern because nowhere in the public domain was this tension recognised and addressed. This same point might be expressed in common-sense terms by suggesting that powerful groups may disregard the contribution of relatively less powerful groups and this inhibits learning and occludes their view.

In the absence of mediation this can result in 'overt compliance' arising from an enforced consensus and the suppression of alternative views, and tends to distort potentially collaborative relationships (Fullan, 1993 p82). There is a risk that in the absence of negotiation between the perspectives adopted at the three levels, the macro level simply issues instructions to the meso and micro levels.

8.2 Overview

My starting point was a critical incident that sparked concerted action. Prior to the Rover Crisis the West Midlands had no recent history of multi-agency learning and it is important to consider the distance travelled in the short space of time between the policy idea and its enactment at local levels.

Each HTC developed new practices customised to the needs of a specific group of 'user companies' to 'transfer technology' of a particular type. A diversity of collaborative practices evolved over time and some became established routines where they were successful.

Chapter Nine moves the focus from the overarching aim to the theoretical research questions. This chapter reports the findings that were informed by the capacity of expansive learning theory to illuminate the complex multi-dimensional interactions within and between activity systems.

9. A Theoretical Overview

9.1 Key Findings

In the terminology of expansive learning theory the term 'object' encapsulates issues concerning individual and shared interests, the divisions of labour and rules are associated with organisational positioning and 'perspective'. Five research questions address the theoretical aim:

Research Question 5

> *What were the different 'objects' at different implementation levels at regional (macro), sub regional (meso) and local (micro) levels? (Chapters Four, Six and Seven)*

The notion of individual interests and organisational positioning speaks of both the motivation and the goal to which the activity is orientated. The espoused object of the HTC policy was regional knowledge transfer. At the strategic macro level the 'object of activity' was more abstract than at other levels of policy enactment. In other words, the policy assumed that inter-organisational collaboration or multi-agency learning would take place by bringing together the worlds of Universities and Commerce, with resource acting as an incentive.

It was significant that those responsible for macro level policy enactment were reluctant to be influenced by operational practice at the meso and micro levels. Since agency and money was concentrated at the top level, this constrained what could be

achieved at the meso and micro levels of activity. The *espoused* macro object of activity as described in policy documents competed with rival *tacit* objects of activity created at the meso and micro levels. The meso object of activity was orientated towards solving urgent sub-regional problems such as saving jobs in local communities. For example in one HTC this shaped a suite of projects to enhance the existing capacity of a sub-regional cluster of companies specialising in Information and Communications Technologies (ICT).

At the micro level, the object of activity for an HTC project tended to be even more concrete than the object for the HTC steering group as a whole. For instance projects addressed the practical needs of small sub sets of companies that were clustered in a locality and provided a solution linked to the use of a specific new technology. The digital games cluster and the polymer cluster were defined by both technology and geographic location.

At this micro level 'clustering behaviour' as described in a DTI sponsored report was evidently successful (Ecotec & DTI, 2004). The micro clustering HTC projects were small-scale and highly effective. They developed new collaborative practices, which resulted in demonstrable benefits as discussed in Chapters Five and Six. Nevertheless, communication from the micro levels to the macro level was problematic and people working at the operational level had difficulty making their voice heard and felt disempowered.

There was a contradiction between the policy rhetoric, which espoused autonomy for the HTC steering groups and 'what really happened in practice'. In practice the meso-

level experienced very limited autonomy. Although there were understandable reasons for this, communication was slow and there was a lack of transparency in decision-making. The data indicated that people at the micro and meso levels worked together to overcome the bureaucratic blockages to progress.

If the strategic policy level had understood the implications of accepting a complex funding package, they may well have explained things better at the start. Individual projects at the micro level were monitored in great detail and there was little flexibility to adjust them once they had started. If the implication of the funding rules had been communicated to the micro level at the outset, expectations could have been modified. With hindsight it may have been a mistake to create a three tier implementation structure and to raise expectations of 'autonomous decision-making' beyond the level at which it was practically feasible for this to happen.

Research Question 6

How do boundary objects connect activity systems? (Chapters Two, Three and Five and Six)

The empirical data confirmed that it was relatively easy to expand the object of activity horizontally. Expansive learning was convincing in its explanation of horizontal collaboration between experts. They use a boundary object to help them to share information by moving beyond their familiar routines and culture towards expanding the object of activity as discussed in detail in Chapter Five.

In the process of innovation *user* and *developer* communities meet to work together in new contexts. Boundary objects are mechanisms to link two or more activity systems by translating the vocabulary and conceptual language of experts with complementary skills and perspectives. Although lateral boundaries between activity systems restricted movement across cultures these are comparatively weak. Sideways moves *across* boundaries were evident in many instances. In Chapter Five my data reconstructs several examples of boundary objects that act at the *micro level* as tools to link the perspectives of communities who had not previously worked together.

Data suggests that it not possible for users to specify their demand if they are unacquainted with what is available. At the most practical level it was very difficult to get clear and coherent messages about 'technology needs' from local companies. In Chapters Five and Six I described some boundary objects that catalysed closer working relationships between users and developers of specific technologies. For example collaborative visualisation software and rapid prototyping equipment acted as boundary objects. Several respondents described boundary objects as tools that seemed to have 'crystallised collaboration' in the sense of structuring routine ways of working together[139]. The phrase, '*we now have a tool to do x*' appeared several times in the data. This supports the view that policy enactment is smoother where there the process is supported by 'quality materials' and 'a highly interactive infrastructure of pressure and support' (Fullan, 2001).

At the micro level boundary objects were versatile and could be transformed by being used in different ways by particular activity systems. As described in Chapter Six,

[139] No one used the term 'crystallised knowledge' to refer to boundary objects.

collaborative visualisation software was used as a boundary object to connect communities of experts in a large engineering company. It was then adopted by the Advanced Engineering HTC project. It then acted as a device to enrol small engineering companies to join the AE micro cluster. When the small companies used the software it acted as a *tool* to help them carry out new product development activities. Finally the software was an *outcome* of the expansive activities when it was launched as a commercial product.

At the *meso level* there was evidence in my data that the creation of a *boundary object*, helped to 'crystallise an emergent practice'. The creation of a boundary object helps individuals from different organisational cultures to share a common vision and a sense of identity as a new community of practice with a sense of shared identity and allegiance. Two HTC steering groups developed electronic tools and the process of creation of these *boundary objects* captured 'transitory insights' about how the partners could work more closely together. At the same time the *use* of the boundary buttressed the emerging collaborative partnership between the members of the HTC steering group.

This suggests that a boundary object can have different degrees of *agency* depending on the user and the context of use. Actors who had shared in the creation of the boundary object experienced it as a powerful tool. On the other hand although other actors could use the boundary object it was not so powerful for them because they had not developed it and it did not belong to them. The data showed that the creation and use of web sites and electronic data bases helped to build upon shared knowledge and

experience and new divisions of labour and this concurs with findings in a recent study of innovation in Scandinavia (Hasu, 2001 , p.49).

Research Question 7

> *Are boundary objects equally effective across cultures and between levels distinguished by agency? (Chapters Five and Six)*

It seemed that motivation to create a boundary object between levels was too weak. Power differences between activity systems are dysfunctional to a commitment to harmonious collaboration. The character of relationships between levels was hierarchical and instructions tended to emanate from the macro level with little opportunity for negotiation. Those at the macro level did not need to invest time and effort communicating with those below enacting the policy at a practical level. Consequently I found no evidence of a boundary object being created simply to link two or more levels.

There was no data to suggest that boundary objects were created between vertically arrayed levels though boundary mediators effectively acted as bridges between levels. I had not considered the potential interactions of boundary mediators with boundary objects. On further scrutiny the data seemed to suggest that certain HTC projects incorporate elements of human interaction. In such instances a boundary mediator might use a boundary objects to communicate 'technology transfer' opportunities to SMEs.

However I found that special people at the macro level of policy enactment level can act as *boundary mediators* and in this role they can use a *boundary object*. At first I thought this was a curious and contradictory finding, because my first analysis of the data suggested that boundary objects linked activity systems horizontally. Whereas connecting levels was more difficult .It seemed that to link activity systems vertically required a boundary mediator.

On more detailed analysis of the data I found that boundary mediators were important in HTC projects and could help to mediate with the meso level, but seemed to have no agency to link with the perspective of the macro level. Projects employed key people who worked as 'technology translators'. They operated in a *hybrid* environment between the developers of a new technology and a small company who may be able to apply the innovation in a commercial process. In other words they were not empowered as strategic actors and therefore they could not carry messages from the operational level, in the way that the most powerful actors could (as described in Chapter Six). This suggested that mediation by boundary objects and boundary mediators was not a black and white issue but more a question of *degree*.

The boundaries between the levels were strong and more resistant to vertical movement from the operational levels to the strategic level. The kudos of a *boundary mediator* determined their capacity to move between levels. This supported my initial finding that mediation with the macro level was only effective if the mediator had the status and influence associated with their membership of the strategic macro levels. Mediators could be advocates for HTC projects in circumstances where other lines of

communication had failed. Someone important has to intervene as an advocate on behalf of those at meso and micro levels whose voice was ignored.

Research Question 8

> *What are the benefits and limitations of using expansive learning theory to analyse the development of multi agency learning? (Chapter Nine)*

The collisions between activity systems operating at different levels did not result in multi-agency expansive learning because of inherent differences in political power and agency. Expansive learning between activity systems occurs when they learn from one another through mutual collaboration. The theory does not yet deal adequately with the issue of power differentials between activity systems.

My findings suggest that the dynamics of power can impair collaboration. The collisions between activity systems were not productive and clashes between the macro, meso and micro object were not open to change because of the hierarchical implementation structure through which policy HTC was enacted.

Expansive learning theory helped to identify dynamic conflicts in the relationships between people and agencies and the concurrent impact of social structures including institutions, rules and norms. In order to be innovative in a larger social system, the innovating group or person has to be 'incubated' in another social system. So the role expectations, and norm driven actions, would be innovative in comparison with the outside social system. This is relevant to the contradictory conception of the

innovating entrepreneur as being both a generalised cultural type and yet a pure expression of individual intentions (Hellström, 2004, p. 640).

This implies taking *intention* seriously in the study of innovation, including mediation of identity, technological factors, emotional commitment and re-conceptualisation of the object of activity. In the visualisation of an idea the use of *tools* such as computers may help to create a material manifestation of an innovation. Chapter Five describes how Rapid Prototyping Software is used to reify an idea, firstly in a computer-aided drawing and then in a prototype. The *tool* changes the design process of transforming an idea into a commercial product.

Recently criticisms of organisational applications of activity theory such as expansive learning addressed concerns about the autonomy of individuals acting in social contexts. In expansive learning theory, collaboration and multi-agency learning depends upon individuals sharing their ideas and working towards shared goals, but this has led to criticism of a perceived tendency to reify organisations (Thompson, 2004, p.583). In other words critics argue that the tension between individual and collective consciousness is not completely resolved in theoretical terms. It is therefore suggested that the theory has been stretched too far and extrapolating activity theory from its origins in individual consciousness and learning may weaken its conceptual coherence.

At the root of the dilemma of clarifying the 'subject' in activity, is the drift of organisational activity theory, away from 'its moorings in Vygotsky's original focus on human consciousness' (Thompson, 2004, p. 580). When organisations become

reified at group level, this contradicts the original premise of activity theory that organisations emerge through interpretative human activity. By reifying organisations and groups they acquire an ontological existence. It is therefore suggested that this converts a dynamic process of organisational development into a representation, which reverts to the Cartesian dualism, between subject and object, that activity theory originally sought to overcome. Expansive learning theory accepts that the self changes constantly. Historical selves are entities who 'create futures yet are themselves created by the past' (Hellström, 2004, 643). In the attention to boundary crossing, the theory encompasses the melding of multiple identities and transient social worlds in the process of innovation.

In my research it became very important to clarify the meaning of the term *subject* in specific contexts when considering the emergence of a collective object of activity. Some personal elements seemed attributable to the 'object of activity' because individuals and groups were dynamically related. Locating the various facets of individual and collective subject perspectives is difficult in HTCs because they are complex multi-layer, organisational partnerships.

Each interview transcript articulates a subject perspective. Although an individual expresses this perspective, it is at the same time influenced by their membership of communities with various organisational cultures, positioning and agency. Notwithstanding an acceptance of the inherent contradictions in self-identity, arising from simultaneous membership of multiple communities of practice, it was difficult to distinguish between personal expectations and non-organisational concerns related to 'shared motivation'.

The findings suggest that *self-identity* is created by continuous interactions between an individual and social worlds. The fluidity of self-identity and group membership was an interesting phenomenon, yet it did not necessarily reify any group or organisation. (Reification was discussed earlier in Chapter Two). Membership of horizontal and vertical activity systems was obscured because it changed over time. Individuals acted in one or more activity systems across organisational cultures, but they were also members of a tier in the policy enactment hierarchy.

As the complexity of activity increases, communications become more difficult and the object in a complex activity network is inherently problematic because the consistent direction and coherent motivation for change is very difficult to identify. There is also some slippage in the consistency with which terms are used by key authors. The ad hoc introduction of new terms clutters the theoretical vocabulary and tends to obscure, rather than clarify, the meaning of activity in particular contexts. Whilst I could agree that in structured and facilitated conditions it may be possible to depict and influence change, in practice in naturalistic settings it is very difficult to represent the complex multi-layered interactions in an activity network (Toiviainen, 2003; Tuomi-Grohn, 2003). In this study of HTCs, the data is grounded in an uncontrolled naturalistic situation with no structures to facilitate reflective practice and to therefore drive the cycle of expansion.

One disadvantage of using expansive learning theory is that it is inaccessible and obscure to people engaged in facilitating change, because of its complex and abstract terminology. Specific meanings of key terms in activity theory are too close to

everyday vocabulary in English and this can be confusing. Much of the subtlety of theoretical concepts devised by the original Russian and Finnish authors is lost when translated into English. For instance the term object has a specific meaning in activity theory. It seems closer to the meaning of the everyday meaning of objective than to the everyday meaning of the word object.

Despite the dilemma of using graphic depictions of an essentially dynamic process, I used diagrams to illustrate links between the data and the theoretical analysis in Chapters Two, Three, Four, Five, and Six. Also because expansive learning theory is evolving there are few precedents for studying organisational complexity. I have therefore had to create my own diagrams and to explain what the data seemed to be suggesting.

Expansive learning theory frames the contexts and circumstances of inter-agency learning and draws attention to the circumstances in which new collaborative practices are created. Although expansive learning theory may not be able to predict the best course of action, it can draw attention to factors that are likely to affect the successful implementation of similar policies elsewhere.

One final research question links the overarching and theoretical aims together:

Research Question 9

What insights from expansive learning theory and from the analysis of collaboration in the HTCs can be applied to similar policy initiatives[140]*? (Chapters Eight, Nine and Ten)*

As depicted in expansive learning theory the creation of sustainable collaborative practices seems to be exceptionally difficult (Tuomi-Grohn, 2003, p.207)[141]. Small expansive cycles seemed to be most effective in changing practices throughout the HTCs. The data showed that although a project was a 'small step' or a miniature expansive cycle it can act as a catalyst for more ambitious and extensive work.

In expansive learning theory, boundary objects and boundary mediators can help to orientate activity systems towards collaboration. HTC projects were most effective when they combined the work of boundary mediators with one or more boundary objects. In the Medilink project for instance an ambitious idea at meso level instigated numerous Medilink Projects at micro level. Two boundary mediators who had strategic influence at the macro level of HTC policy were successful in lobbying for project resources. However the Medilink Collaboration was built on the success of a previous collaboration between Universities and the Medici project acted as an embedded boundary object within a larger project. The Medici project provides training in entrepreneurship for medical and bio-science researchers to help them to turn research ideas into commercial opportunities. Medici commissioned research into the potential for a medical technologies cluster in the West Midlands. This research

[140] When 'expansive learning theory' is applied to the study of organisations the 'multi agency learning outcomes' are described as collaboration. Empirical data describes both the process, as experienced by key individuals, and specific examples of collaborative practices.

[141] Yet another term is introduced by activity theorists and 'advanced collaborative practices' are simply practices that can be sustained and become established.

also acted as a boundary object to connect the steering group and unite them in allocating resources to Medilink projects (Burfitt, Gibney, MacNeill, & Schierenbeck, 2003).

Projects were capable of building collaborative potential by developing trust and mutual confidence to enable more ambitious work to take place. This finding relates to Engestrom's emphasis on the *Collective Zone of Proximal Development* and it suggests that wholesale ambitious change, under pressure of time and money is unlikely to be sustained.

Although there are currently insufficient words to describe the variation in the quality of collaboration and the commitment, the research findings suggests it would be useful to distinguish between different ways in which organisations work together[142]. The HTC was described by a number of respondents as 'a partnership'. However the term meant various things to different individuals. The variation in meaning attributed to 'so-called partnership' is discussed in Chapters Four and Seven[143]. The word 'partnership' appears frequently in the policy discourse, but the quality of engagement of the partners is likely to be seen in terms of 'action' and 'practices' rather than rhetoric. It is important to understand the dynamics of 'partnerships' and to differentiate the quality of commitment to the 'object'.

[142] Given the importance of this central concept, it may be useful to adopt the approach of the Eskimos who have a great number of words to describe snow because the quality of snow makes a difference to their survival.

[143] There were tensions between the hierarchical decision making layers in the implementation of HTC policy as discussed in Chapter Six. However the tensions were not so pronounced across the activity systems of the stakeholder organisations.

Activity theorists often use the term 'advanced collaborative practices' to describe sustained and progressive interaction. However, collaboration has two alternative meanings. In some contexts it implies a treacherous alliance with an enemy, but in other contexts it is used interchangeably with the term co-operation.

In everyday usage, the term collaboration suggests strategic alliances toward goals of mutual interest. Co-operation captures the essence of expansive learning and '*partnership*', associated with a commitment to shared values and a vision that motivates and sustains shared work (as discussed in Chapter 7). Co-operation happens when projects are anchored in wider practice. Distinctions can be made in the quality of relationships and suggest that: -

> **Co-operation** - describes the sub-regional focus on local problems adopted by the members of an HTC steering group operating at the meso level and interactions in HTC projects where co-configuration occurred at the micro level.
>
> **Instrumental Collaboration** - describes the macro-level 'strategic alignment' of regional agencies to solve the 'Rover Crisis'.
>
> **Pragmatic Acquiescence** - describes the reluctant agreement to something that seems to be inevitable. This was manifested in the acceptance of delays in funding and complicated auditing procedures that resulted in tension between the RDA (as the 'gatekeeper and auditor' of funds) and the other partners.

Less rhetoric espousing partnership and more practical demonstrations of collaborative decision-making may have worked more effectively. In one of the rare

references to the dynamics of power in expansive learning theory Engeström explains that the espoused object of activity is creatively reconstructed. This issue is at the heart of the clashes between the macro, meso and micro levels of HTC policy enactment.

> *No matter how clear the intention and assignment may be for management,* ***the object*** *will be creatively reconstructed by those who are supposed to solve the problem. This creative reconstruction often involves questioning, confrontation and debate. If this is overlooked, the important dimension of* ***power*** *will be artificially separated from object-oriented collaborative work and innovative learning in work organisations and teams (Engeström, 1999, p.392).*

Expectations about collaboration outstripped what was actually possible, and it was unrealistic to represent the notion of partnership as an easy process. The HTC Directors were tasked to write strategic plans. It was expected that these local plans would predict the future development of the HTCs. In this sense strategic plans are close to 'theories about what needs to happen next' (Colville et al., 1999). However the environment for HTCs was so unstable that strategic planning was fraught with unpredictable complications.

> *The demand for outline budgets at short notice did not recognise the time it takes for a partnership to go through the iterations of a development plan*[144].

Partnerships are not harmonious and naturally perspectives collide. Disagreements can be creative and are the drivers for expansion and collaboration. Suppression of dissent

[144] P25: Category B Respondent: Manager of a Science Park and member of an HTC steering group.

is damaging and can create Shibboleths of partnership. Acquiescence is a poor substitute for passionate commitment.

> *Innovative learning processes may not be harmonious brainstorming sessions or situations where 'members think alike'(Engeström, 1999, p.400).*

Processes of innovation and knowledge creation exhibit expansive and non-expansive phases, both steps forward and digressions (Engeström, 1999, p.391). Discussion and disagreements can result in collective refocusing, even though the object is captured in *fuzzy* and *ambiguous* form (Engeström, 1999, p.392).

9.2 Overview

The dominant policy discourse portrays the notion of 'partnership' as a panacea for the solution of entrenched social and economic problems. Expansive learning theory suggests that policy makers tended to use the terms collaboration and partnership as a general catchall. The overuse of the word partnership has clouded its meaning.

The positive motivation that drove me to complete the research was a conviction that the findings would be helpful and informative to people working in similar contexts and in two ways. Firstly, the implementation of a complex policy by organisations as loosely structured as multi-agency partnerships is challenging and formal evaluations omit a detailed chronology of struggles and difficulties to be overcome. Secondly, setting up practical innovation projects with SMEs is fraught with difficulties and the data showed that boundary objects and boundary mediators could work in particular ways to achieve successful outcomes.

Specific questions need to be asked about the purpose of a partnership, *who* is involved, *why* their contribution is vital, and *how* the individuals and organisations will work together. Partnership involves co-operation based upon a shared vision and mutual trust. Partnership does not just happen because people meet occasionally it requires each organisation to commit a great deal of time, effort and resource towards doing something new together. It involves abandoning old routines and devising with partners new practices, which are orientated towards achieving a shared and clearly articulated goal, embodied in the emerging object.

10. Reflections on the Research Process

10.1 Risks and Limitations of the Research

There is a risk that this research could be interpreted as a criticism of key actors and institutions responsible for enacting the HTC policy. Consequently it is important to stress that the region coped admirably with an almost impossible challenge. No doubt individual interests and organisational positioning may have a bearing on the interpretation of the findings and on perceptions of the 'legitimacy of claims'. Nevertheless, comments made by the respondents in the research illuminate what happened. By collecting data from multiple sources I was able to suggest possible reasons for why some things did not work well, as well as making suggestions about what might have worked more smoothly.

As mentioned briefly in Chapters Two and Nine, there are risks in using expansive learning theory because it is *unstable* and *evolving*. Nevertheless it offers an action-orientated framework in which to study the effect of social practices and structures on relationships between individuals in organisational contexts. There was no existing methodology that I could replicate or precedents for studies of complex multi-agency partnerships.

Although expansive learning theory was used in studies of organisational change and innovation there was very little reference to the dynamics of political power and agency (Hasu, 2001; Ludvigsen et al., 2003; Toiviainen, 2003; Tuomi-Grohn, 2003). I suspect that my research may be at the outer edge of what is achievable because of the multifaceted interactions in HTCs. Although there were surprises and outliers in the empirical data, the analysis revealed patterns and shaped insights that are relevant to similar programmes and policy initiatives elsewhere.

As mentioned in Chapter Two some attempts have been made by researchers in Finland to shape new practices in laboratory environments. In the Change Lab very detailed analyses of interactions were made based upon video evidence. In the laboratory environment researchers could intervene and deliberately push change in a particular direction.

Clearly this was impossible in my study of HTCs, given the naturalistic environment in which my research was conducted. Consequently it is likely that critics of my research may focus attention on how my methodology differs from that adopted in Scandinavian studies. There is also a risk that critics may focus on 'what my analysis

cannot do' and suggestions that my use of expansive learning theory 'generates more heat than light'.

However expansive learning theory may need to be radically developed if it is to inform practices, rather than simply point to complexity. The challenge is to move from an understanding of 'how things are', towards *imagining* better ways of doing things. The challenge presented by the complexity of networks of organisations, loosely connected in so-called 'partnerships' increases the need to develop comprehensive models and tools to help people deal with new work environments.

I began my research in 2003, almost four years after the Rover Task Force had first met to consider the embryonic idea for HTCs. In retrospect the discussions that shaped the policy at this stage were influenced by unique circumstances surrounding the looming closure of the Rover Plant in 1999. If it had been possible for me to go back in time and gather data from those debates as they happened, these would make fascinating reading in comparison with the recollections of events as described to me in interviews. Ideally I would like to have taken five years to track the changes in practices and carried out more interviews over a larger sample size, including a fuller investigation of anomalies and outliers such as people in organisations who shunned involvement in HTCs despite, being in a position to make a contribution[145].

My reconstruction of the *developmental history* of HTCs relies upon interviews capturing how decisions were reached and inevitably recollections are coloured by tendencies to simplify what happened in order to tell a story that 'makes sense'. This

[145] I refer to an anomaly in an interview with an individual at a Defence Research Agency, who was unenthusiastic about the HTC policy.

does not suggest that people deliberately falsified their memories and interpretation of events. Yet, the freshness and immediacy of how partners worked together to reach decisions fades over time, and all that remains is a story of their cumulative impact. There is a risk that a *post hoc rationalisation* of policy leaves out much that is of interest and a valuable resource for learning is lost.

10.2 Future Development of Expansive Learning Theory

My research revealed that boundary objects play a pivotal role in linking the perspectives of different activity systems. However they are complex and transitory tools and so a focused and longitudinal study of the changing nature and form of boundary objects may yield fascinating insights. A study of the evolution of *boundary objects* over several years could illuminate their capacity to change relationships between activity systems (Ludvigsen et al., 2003 , p.308). It could also trace the transformation of boundary objects into elements of activity such as tools and outcomes, as suggested in my research and described in Chapter Five.

In the future it would be useful to study how to create '*conscription devices*' to deliberately enhance 'emotional commitment' to a new partnership. If this was better understood it could speed up the development of project teams from instrumental alliances towards more robust collaborations and sustained co-operation. Conscription devices may reduce anxiety about change and help people to feel positive about new ways of doing things.

The creation of the so-called 'knowledge economy' and the rise of global corporations, suggests that activity systems, which were previously segregated, will be

interlinked and grow larger. Yet, little is known about the consequences of working in increasingly complex work environments mediated by electronic communications.

As new organisational contexts arising from global networking, it would be valuable to orientate the scope of expansive learning theory towards these new work contexts. There is potential to explore the relationship between individual and collective consciousness. The so-called freedom of 'knowledge workers' is questionable because they are dependent on new socially embedded *knowledge technologies* that lie beyond their control (Hellström, 2004, p.641).

Little is understood about the role of *boundary mediators* in electronically mediated work environments. It is uncertain how conscription devices and boundary objects might act to create allegiance to new communities of practice mediated by the Internet. The development of the knowledge economy produces considerable changes in human activity. Expansive learning theory needs to be extended to explain how activity systems interact in new virtual work contexts. There are new contexts for product development by experts 'collaborating across' different companies in different time zones so that effectively the team works around the clock (on a 24/7 basis).

It is unclear how initiatives such as the HTC policy that encourages regional clustering of companies and regional knowledge economies will interact with trends for globalisation. Ironically, an appreciation of global changes in product development processes where 'knowledge workers' collaborate across time zones, and national borders had a positive impact on local clustering behaviour. In at least one HTC an

awareness of global networks caused local companies to see one another not as competitors but as allies in competing for work.

> *They might start in Australia, then its passed to someone in India then it comes to the UK - then it goes to United States, and in that circle you're getting people working on that design 24 hours a day - so that what used to take three years to design a new car can now be done in 6 months*[146].

This poses an interesting challenge to the development of organisational applications of expansive learning theory. A sustained study of the development of *boundary objects* as tools to bridge the perspectives of remote knowledge workers could be valuable. The economic transformations that flow from a *Knowledge Society* may depend upon how well humans manage to control and utilise technology, compared to the moulding of human practices by the dominant work tools. Expansive learning theory stresses the importance of intention and commitment. My research infers that people are capable of innovating for other purposes than those intended by the powers that be[147].

10.3 Relevance of Insights from my Research

The Economic and Social Research Council (ESRC), and other funding bodies devote serious consideration to the meaning of 'relevance in practice' (Rappert, 1999). It is important to appreciate that the perspectives of policy makers and beneficiaries such

[146] P 5: Category B Respondent: Director of HTC 2- Director Coventry Solihull Warwickshire HTC.

[147] The success of the Napster web site offering free downloads of music is an example of this.

as SMEs tend to be incompatible. These two groups may be interested in different insights from my findings and may interpret them differently.

It may be possible for implementers of similar policies enacted by evolving multi agency structures to consider some of the difficulties highlighted by this research. A relevant question may be '*How can this research help policy makers to understand the perspectives of people implementing policy in practice*?' The implementation gap in HTC policy and the 'mixed messages about local autonomy and responsibility' caused committed actors to be frustrated by the bureaucracy. The emergence of competing objects during the implementation process suggests that the espoused object of activity may not necessarily be consistent during the enactment of policy.

Innovation and collaboration are likely to be most successful in contexts where the partners share an emotional commitment to working together. This happens when people appreciate they can achieve more together than independently. Co-operation in the HTCs is built on the foundations of small successful projects that act as miniature expansive cycles to motivate deeper engagement of the partners. In a *Collective Zone of Proximal Development* activity systems can expand their horizons towards a shared object of activity. As discussed in Chapters Two and Three ambitious change can be too challenging. If the gap between old and new practices is too wide the change will falter. The collective ZPD need to be 'just right' to support expansive learning. Change is more sustainable and ultimately effective if not taken in radical leaps. It also suggests that organisations can be thought to mature, just as individuals mature, so that readiness for change is important.

An analysis of the tensions in complex activity networks such as an HTC offers a *stronger theoretical perspective* than mere descriptions of controversies or divergent views. Recognising the existence of competing objects of activity can stimulate healthy debate and a consequent realignment and expansion of perspectives.
The research suggests that it is helpful if there are realistic expectations about contradictions and tensions.

Instability arising from contradictions between different perspectives can be seen as a 'creative' stage in the process of change. Responses to these tensions can drive change in a particular direction. By raising awareness of the process of 'object construction' and the trajectory of activity, it is possible to see conflict differently.

> *Conflict engenders new and better ideas and pushes towards a more comprehensive understanding (Hellström, 2004, p.639-40).*

Expansive learning is impaired in the HTCs by strong pressure to achieve 'success' very quickly. Collaboration is difficult when success as defined by 'target driven' performance measures linked to funding *outputs*. There is a danger that when linear progress is not evident, a promising experiment is curtailed and a new raft of policy is imposed before the original policy has been given time to bear fruit. This tends to be counter productive and arises as a 'quick fix reaction' to fear of failure.

My research shows that when organisational cultures create an atmosphere of anxiety, individuals tend to protect themselves by avoiding blame. Partnerships risk spreading responsibility so thinly that nobody is accountable for anything specific. Conversely,

it also seems to be dysfunctional to collaboration to project manage and audit every minute detail of HTC activity.

Many recent changes in work practices have been driven by economic pressures to do 'more with less' and so many people resist change on the assumption that new ways of doing things will inevitably be worse for them. Pressures from increased performance and target driven work cultures can make it difficult for new communities of practice to form. Similarly, increasing the number of people involved in creating a new practice is complicated and communication difficulties arise. Where people feel empowered to create solutions to problems, their ownership of the change reduces the risk of new practices being rejected (Trowler et al., 2002).

Rapid organisational change took place in the development of the HTCs and it fractured comfortable routines. People were continually facing conflicting pressures and demands on their time. It was evident that in the evolution of the HTCs there were few mechanisms to understand and alleviate those pressures (Blackler, 1995; Bonamy et al., 2001). Understanding the dynamics of their environment can empower individuals to make choices, even if it does not necessarily enable them to change the situation and to make improvements. Debate and *reflection* was found to be essential to sustained collaboration and expansive learning. Reflection on change offers an opportunity to reconsider and adjust the trajectory of the change.

Metaphors were found to be helpful in remodelling ideas by juxtaposing 'pairs of opposites' to capture contradictions. Metaphors construct visual images that create relationships between different and contradictory phenomena and processes, to reform

them into a coherent system (Fichtner, 1999, p 315). The image of *technology pull and push* visualises the dilemma for 'technology transfer' policy makers, whose aim is to rebalance 'demand and supply' in a 'knowledge economy'. The attitude of the RDA towards the HTC policy generated a metaphor of a driver with *one foot on the brake and the other on the accelerator*. It expresses how a confused organisational identity led to consequent frustrations for 'partner organisations'.

The metaphor of *translation* captured the need to connect understanding between two different cultures and to link the knowledge of users and developers of new technology. There were many references in the interview data to *boundary objects* as tools to facilitate '*technology translation*' which could change the direction of change. Tracking the object of activity in an HTC is vital, because it changes constantly. Although activity is transient and inherently unstable, there are potentially valuable *breathing spaces* where it is possible to pause for reflection in order to make wise decisions and move forward. The notions of provisional stability and the 'expanded object of activity' represent moments when it is possible to reconsider the direction and momentum of change (Bonamy et al., 2001; Engeström, 2001).

My research suggests that people were often surprised by the frequent reinterpretations and re-orientation of the HTC policy. They seemed disconcerted to find that the object, on which they thought they had agreed, turns out to have transformed itself into something different. Future studies could focus on tracking an object over time, from the perspectives of several different subjects.

My research highlights the need to work hard to create partnerships. The quality of the human dynamics is crucial to the success of the implementation process. This insight is not unique to HTCs, despite the special circumstances in which HTCs were created. This research illustrates the importance of *figure and ground* in that individual human relationships are *mediated* by tools, communities, rules and divisions of labour orientated towards an object of activity. In turn relationships within and between activity systems are also *mediated* by proximity to networks or *meta-activity systems*.

It is possible to say with hindsight that opportunities for supporting the development of collaborative practices in the HTCs were missed at the outset. It was assumed that 'partnership' would be a natural and inevitable consequence of bringing together people from the private and public sector with resources to achieve a complex policy goal. From the policy makers there was too much emphasis on the financial responsibilities of steering groups and insufficient focus on creating time and space for high quality networking. Time and effort invested in communication and the shared development of new practices is evidently well spent.

The data shows that without structures to support the robust exchange of views, *collisions between perspectives* fail to expand the object towards collaborative activity. Ironically, the perspective of people closest to 'technology transfer' practice is not considered. This omits important feedback from the overall picture. Clearly the power dynamics between the HTC implementation levels makes it difficult for the voices of the 'disempowered' to be heard.

Partnership has been shown to be a much-abused concept in policy. At the root of the difficulties of implementing the HTC policy was a mismatch between espoused autonomy and real agency. My research showed that a disassociation of power and accountability was unhelpful. At the meso and micro levels there was a lethal combination of having responsibility for outcomes of policy, whilst at the same time having no power to change the way things were done. Expectations inspired by the rhetoric were far from what actually happened in practice. Contradictory behaviours and mixed messages caused confusion and created a culture of anxiety and blame. In general there was inadequate debate and in some instances *consensus* was forced. Acquiesce is not the same as emotional commitment and does not lead to sustained co-operation. Chapter Seven described how partners drew closer together to fight 'coercion'. The data showed that an HTC steering group worked around the problem of 'powerlessness' by setting up a company limited by guarantee, which gave them more autonomy.

Working across boundaries and developing *boundary objects* as 'communication tools' to facilitate collaboration requires concerted effort and resource. The findings suggest that similar 'technology transfer' initiatives would benefit from attending to mechanisms such as boundary objects that can smooth communication between separate 'worlds'.

My findings suggest that sharing the creation of boundary objects was important because it involved sharing common issues and problems. Boundary objects have agency and are important tools for innovators because they can move people towards

new ways of doing something. The innovative applications of a new technology can more easily be understood by reference to an artefact.

A boundary object seems to have variable agency when used in different contexts When used by those who shared in its creation it seemed to be more powerful, than when it was used by other activity systems where it had limited and general value as a communication tool. The emotional investment and sense of ownership that happens in the creation of a boundary object optimises its functionality as a tool.

I found no instances of boundary objects being created between levels of HTC policy enactment. It seems that different degrees of 'agency' make collaboration between levels difficult. The unequal distribution of power causes a one-way information flow. Instructions are issued by the macro level, which are received and acted upon by the meso and micro levels. This inhibits negotiation between partners, since 'co-operation' it is not in the interests of the more powerful actors.

My research showed that the process of creating a boundary object supported expansive learning across activity systems. However acting alone they were not able to connect activity systems between levels where there were marked differences in power. Learning seemed to be most expansive when boundary mediators were able to use boundary objects to connect activity systems vertically and horizontally. My data suggests that when *boundary mediators use boundary objects* they become more powerful tools for bridging between activity systems.

In the case of Medilink '*compound boundary objects*' were in evidence. Although Medilink itself can be regarded as a boundary object, it has other boundary objects embedded within it, such as the Medici Project, which involves collaboration between eight of the Universities in the region in the training of 'entrepreneurial researchers' in the medical and biosciences (Burfitt et al., 2003). Consequently Medilink is revealed as a multi-faceted ambitious project that enjoys continued support from two powerful mediators and incorporates existing collaboration in the form of *embedded boundary objects*.

Expansive learning theory can increase awareness of the developmental trajectory of activity and the potential to mould change to achieve specific outcomes. Although such awareness may not make change predictable, it explains why change does not happen smoothly and may even reduce the anxiety of change.

Expansive learning theory suggests that *conscription devices* can help to bind a new partnership. Money proved to be moderately successful in aligning the interests of partners, but for sustained co-operation, emotional commitment is a crucial factor. There seems to be no substitute for a strong emotional commitment to the object of activity.

Researching complex HTCs pushed the envelope of expansive learning theory to its outer limits. The confluence of the efforts of boundary mediators in the use of a boundary object achieved significantly more than could be done separately. In the hands of boundary mediators boundary objects become powerful multi-directional tools. Healthcare issues seem uniquely motivating and this suggests that the strength

of emotional commitment embodied in a conscription device can lead to sustained and concerted co-operation even between disparate organisations. There was a harmonious alignment of boundary mediators, with the highly specific Medilink boundary object. At the same time an emotional commitment to improving healthcare, through innovative medical technologies, acted as a conscription device.

11. Appendices

11.1 Research Instruments

Semi Structured Interview Schedules

Phase 1

1) How was the policy idea for Technology Corridors developed?

PROBES

Who was involved?

Individuals/agencies

How was the decision to develop 3 corridors made?

2) How did Technology Corridor policy relate to other regional policies?

3)Was the Technology Corridor dependent upon other regional policies?

PROBES

Did it relate to other projects initiatives described in the AfA, RIS & RES?

If so which policies & how strongly dependent?

4) How much support was there from key regional stakeholders?

PROBES

Was it supported by the RDA, by HEIs, industry, business networks, LSCs, BLs, West Midlands Local Government Association?

How radical was the Technology Corridor policy perceived to be?

How important do you think Technology Corridors were to the local companies?

7) What were the components of the original implementation plan?

PROBES

How were universities engaged in the implementation plan?

How were other stakeholders/agencies and key individuals involved?

Were they satisfied with the plan?

8) How precise and elaborate was the plan?

PROBES

Did the plan deal with all the problems anticipated?

Were the requisite conditions for implementation ensured before it began?

What were the explicit commitments by key individuals/agencies?

Were any important conditions missing?

Were perceived omissions addressed?

9) What monitoring procedures were in place?

10) How well do the partners on the Steering Group work?

PROBE

Was any one agency perceived to drive the policy?

Phase 2

1) What was your initial impression of the concept?

PROBE

When did you get involved?

2) How important do you think was the Technology Corridors to the local companies?

3) What aspects of the policy concept seemed most attractive?

PROBE

What did your sub-region/company/organization hope for?

4) Did you have a view of the timescale specified?

5) What was your involvement in the original implementation plan?

PROBES

Were you satisfied with the plan?

How were other stakeholders/agencies and key individuals involved?

6) Do you have a role on the Steering Group or have influence on it?

PROBE

Would you like more influence?

Phase 3

1) How did you prioritise projects?

Can you give an example of a discussion/interaction between partners that changed someone's viewpoint? PROBE Can you describe a critical incident?

2) Can you give an example of a corridor project where the partnership struggled to reach agreement?

3) Can you give an example of a project where the outcome resulted in a new approach to subsequent projects?

4) Has the 'point of' the partnership evolved or changed over time?

PROBE Can you describe it?

Is there shared motivation?

5) Where should (you) collectively be aiming? PROBE Do you see any barriers ahead?

6) How do developers and users (of new technology and knowledge) work together on projects?

7) Do SMEs or public sector groups work with Researchers?

PROBE Have you found any ways of making this easy?

Phase 4

1) Can you describe the project you developed with the (NOVUS/Polymer/AE) Cluster?

2) Where did the idea come from?

3) What was it like to reach agreement?

PROBES

Was it a long process, or challenging in any way?

How did you agree the project outputs?

4) What did you want to get out of the project?

5) On the basis of this experience would you go about things differently?

6) Do you have the same priorities?

7) In the future do you think you will take your partners' views into account in taking things forward?

8) What role do you play and what role do they play?

11.2 Data Analysis Tools

The table below summarises the process of searching for the patterns in the data, and identifies characteristic differences between the emerging objects of activity and the prevailing tensions at the three levels of HTC policy implementation. The closer the individual respondent was to the practical adoption of new practices in SMEs, the more difficult it was for them to influence the powerful policy makers whose decisions had far reaching consequences. The figure below depicts the emerging patterns in the data analysis. It shows how the descriptions of the object of activity are strongly influenced by the positioning of the subject in the HTC implementation process. The table shows how different respondents described characteristically different tensions.

Figure 20: Emerging Patterns in the Data

Analysis of HTCs	Subject Positioning	Contingent Communities or Activity Systems	Tensions Between Elements within Activity System	Contradictions Between Activity Systems	Emerging Object
Category A Respondents	Subject positioned at the macro, policy enactment level	Subjects vary in their association with contingent communities at meso and micro levels	Tensions between the rules and division of labour at this level	Explicit rules are imposed at this level on the meso and micro level	A regional knowledge economy as espoused in the policy rhetoric
Category B Respondents	Subject positioned at the, meso policy enactment level	Most willingness to work across diverse cultures	Very strong tensions between divisions of labour, the community and rules	At the confluence of tensions between rules at the macro level and pressure for flexibility from the micro, operational level	Sub-regional interests focus on solving problems
Category C Respondents	Subject positioned at the micro policy enactment level	Tends to be a smaller number of organisations involved. Mainly SMEs and Universities and one other	Funding rules are imposed by the macro community above who did not interact at this level	Frustrated by lack of communicating with macro level	Practical clustering activities with SMEs

11.3 Codes of Practice

Ethical guidelines from the UK Evaluation Society were followed (Website: http://www.evaluation.org.uk)

The research also adhered to the ethical guidelines published by the British Educational Research Association BERA (Website: http://www.bera.ac.uk/guidelines.html

I shared my data interview data with each respondent to ensure that I had accurately captured their comments.

Letters to Respondents

Dear x

I am carrying out some research about Technology Corridors as part of a research degree at Lancaster University. I would be most grateful if you could spare half an hour at most to talk to me. I plan to tape record your answers to a number of questions about the Technology Corridors. These interview tapes will be treated in confidence and are for academic use only.

The purpose of the research is to understand some of the interactions between different individuals and agencies in regional technology transfer projects. I would be happy to share the outcome of any final report with you.

I will telephone your office to try to arrange a time and place where it would be convenient for us to meet.

Many thanks for your help with this project

Dear x

Many thanks for the time you spent in contributing vital information to research about Technology Corridors. I have now transcribed the tapes and it would be much appreciated if you could check these for accuracy.

In some cases, the background noise made it difficult for me to hear one or two of your comments. In some cases, I have marked in blue areas where I believe I have missed something important. Incidentally, I have used a series of dots to indicate where you paused for thought. These transcripts will be treated in confidence and are for academic use only.

I enclose a stamped addressed envelope for you return the transcript marked with any corrections or additional comments.

Many thanks for your help with this project

Dear x

Many thanks for taking part in the telephone interview this morning. As promised I enclose my notes of our conversation. Please mark or amend the text if at any point I have mis understood or incorrectly interpreted your meaning. It would be helpful if you could either confirm you are happy with this draft, or return by - email any

corrections. I very much appreciate your insights and look forward to talking with you again.

Many thanks for your help with this project

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