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EXAMINING RURAL ADOPTION OF BROADBAND – CRITICAL REALIST PERSPECTIVES

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Abstract

Broadband infrastructure is currently being implemented throughout Australia as part of a government funded National Broadband Network (NBN). Ultimately successful universal provision will require that metropolitan installations subsidize rural adoption. It is important for the success of the project that rural adoption is maximized. This will require an understanding of the complex social, political and technical aspects affecting the adoption process for rural regions. The paper argues that critical realism can provide a useful meta-theoretical position to examine the important social and physical aspects of the adoption process. Drawing on the work of Raduescu and Vessey (2008) on critical realist explanatory frameworks, it supports using 3 commonly used critical realist frameworks to guide the examination process – that of Pawson and Tilley (2007) and Danermark et al. (2002), together with Archer's (1995, 1998) morphogenetic model as the meta theory that underpins the examination. The frameworks and model are introduced briefly and examples provided as to how they can contribute to the examination of the rural broadband adoption process.

Keywords: Critical realism, broadband adoption, realistic evaluation, morphogenetic model.

1 INTRODUCTION

Broadband infrastructure is currently being implemented throughout Australia as part of a government backed National Broadband Network (NBN). The promotion of this mammoth project by the incumbent Labour government garnered backing from rural Independent politicians and allowed Labour to hold on to power following recent elections in late 2010. The NBN will be the largest single infrastructure project in Australia's history. The ownership and mode of finance are controversial, but there is general agreement that business and communities will benefit (Access Economics, 2010). It has the potential to increase productivity, enhance social cohesion and improve the delivery of government services such as healthcare and education.

But the uptake of broadband services in other countries, such as the UK and Taiwan, has been slower than anticipated, indicating that rapid adoption is not guaranteed (Crabtree & Roberts, 2003). In Australia, there are wide variations in attitudes to and knowledge about superfast broadband, in business and amongst private individuals. Even regular users of the Internet are often indifferent to its capabilities. Internet use in rural areas of South Australia has been found to be marginally lower than for metropolitan use (Feist et al. (2010)), with the elderly (over 65) usage less than half those under 65. As Feist et al. (2010) suggest, it is not clear however, whether this is due to "access to Internet connections, perceived high costs associated with ICT, lack of education and opportunity, a lack of interest in, or lack of comfort with, new technologies within this cohort". (p. 74). Gregg (2010) also suggests that the often disengaged rural identity largely rejects the online connectivity promised by the NBN as being uncompelling compared to their more traditional social modes of connectivity.

Ironically, regional and rural Australians seem particularly opposed to the NBN, although they stand to benefit the most in terms of health, education and other government service delivery. It seems apparent that in some cases, it is not a lack of technology knowledge that is the problem; it is an inability to conceptualize how one might structure one's life or business to take advantage of the new possibilities. The value of simply asking potential users whether they would subscribe is limited, because of their inability to conceptualize the radical effect that it may have on their lives. Furthermore, in the robust and confrontational context of Australian politics, critics relentlessly attack the implementation as a waste of taxpayers' money and proponents respond, without much hard evidence, that the project is "transformational". Research and analysis are required which will allow the emergence of a rigorous and satisfying view of the potential applications, benefits, inhibitors and facilitators to adoption and use.

To conduct research into this complex social, political and technical undertaking, a research perspective is required which helps us to understand and integrate the various causal factors into a consistent and coherent model of reality. The 'social nature' and 'ubiquity' of today's IS (especially under broadband) merits a holistic research approach – i.e. examining the interrelatedness between social use, business use, personal use, and organisational use. Critical realism is suggested as an appropriate approach to guide a deep analysis of the social and physical factors involved in technology adoption and use. This paper describes how the outcomes of an initial study into broadband adoption in rural and regional Australia can be well supported by a critical realist stance. In contrast to positivist and constructivist paradigms, it can integrate the ontological durability and causative power of existing and evolving social structures (such as ways of doing business, forms of communal living, and ideological belief systems of "user pays" or "social goods") as well as the properties of physical objects (fibre optic cable, wireless technology, and layers of software). The paper describes some commonly used critical realist frameworks and models and indicates how they may contribute to examination of rural broadband adoption.

2 BACKGROUND

Broadband is a technology that is not clearly defined. A useful technology neutral definition is provided by the Broadband Stakeholder's group in Choudrie and Papazafeiropoulou (2007, p. 297):

'always on access, at work, at home or on the move provided by range of fixed line, wireless and satellite technologies to progressively higher bandwidths capable of supporting genuinely new and innovative interactive content, applications and services and the delivery of enhanced public services'

The functionality provided by "broadband" depends to a large extent on the medium by which it is provided. Transmission over existing copper wire telephone network has performance limitations in terms of upload speed, bandwidth and latency. Fibre optic cable is seen as the best long term solution as a transmission medium, however the costs associated with installation and maintenance throughout Australia are huge and difficult to justify on a straight cost-benefit analysis. The sheer enormity of the cost of connecting all households has removed the project from private hands and necessitated public involvement as an infrastructure project. The provision of fibre optic cable throughout metropolitan and rural Australia is presented as a nation building exercise by public and private promoters. Ultimately successful universal provision to the premises (FTTP) will require that metropolitan installations subsidize rural adoption. It would be easy to justify metropolitan implementation, much less so for rural implementations. The nation-building commitment to provide access to almost all Australians means the project becomes heavily political as the enormous cost of rural provision can only be justified on altruistic grounds.

The take-up of national broadband facilities, particularly in regional and remote areas, is a complex, multi-factorial scenario in which personal and organizational decisions are shaped by physical, cultural, economic and political elements. The vast distances and extremes of climate in the Australian outback provide physical obstacles, the sparse population reduces the economic viability of these services and the community based culture of an aging population resists computer-mediated communication. To top it off, the political federal conservative opposition (the natural constituency of the rural and regional population) is trenchantly and vocally opposed to the scope of the project, seeing it as a white elephant and a waste of taxpayers' money. Yet inherent in the technology are capabilities which will help ameliorate the tyranny of distance, open up communications within community groups and between service providers and individuals, and integrate remote businesses into global supply chains.

The ultimate success of the network depends very much on how many users sign up for the new technology. International experience suggests that despite strong promotion, reasonable pricing and obvious social and economic benefits, adoption has been disappointing worldwide. For example, even in a highly compact, technologically aware location like Singapore, after many years of high-speed broadband provision and governmental promotion 40% of households still refuse free connection. Similarly Japan has 90% fibre to the home (FTTH) coverage but only 30% uptake (Patterson 2010). For Australia it is difficult to see rural adoption reaching anywhere near these levels in the near future. Yet this is difficult to understand given the potential benefits to isolated rural communities. It is important to understand the reasons why rural adoption of broadband has traditionally been low. The ultimate success of the project depends on developing a coherent picture of the barriers and possible facilitators to adoption of "super-fast" broadband by rural users, communities and government and private sector enterprises.

3 CRITICAL REALIST PRE-SUPPOSITIONS

Critical realism argues for a so-called depth realism which suggests that beneath the level of events and the level of empirical observations there is a deeper level of reality where the mechanisms that instigate events exist. The critical realist believes that there is more to the world than that which we experience. Bhaskar (1978) distinguishes between three overlapping ontological domains: the empirical, the actual and the real. The empirical domain consists of what we experience, directly or

indirectly. This domain is part of the actual domain where events happen whether we experience them or not - what happens in the world is not the same as that which is observed. The actual domain is in its turn different from the real domain, where we also find the forces, mechanisms, which can produce events in the world.

As Lawson (1997) argues transcendental (or critical) realism is developed around a scientific realist position which asserts that "the ultimate objects of scientific investigation exist for the most part quite independent of, or at least prior to, their investigation" (p. 15). This common external realist position is extended under critical realism in that it presents a philosophical argument for the nature, constitution and structure of the underlying objects of enquiry. Such a realism is heavily concerned with ontology or metaphysics, that is, the nature of being and existence. This philosophical questioning concludes a, so-called, depth realism that proposes that "the world is composed not only of events and our experience or impression of them, but also of (irreducible) structures and mechanisms, powers and tendencies, etc. that, although not directly observable, nevertheless underlie actual events that we experience and govern or produce them" (Lawson 1997, p. 8).

4 THE CRITICAL REALIST "METHOD"

According to Danermark et al. (2002, p. 150) critical realism in itself is not a method – it cannot be applied unambiguously in practical research. Yet it does guide the research process in that the objects defined by critical realism frame subsequent ontological, epistemological and methodological development. As Archer (1995) suggests "the nature of what exists cannot be unrelated to how it is studied…the social ontology endorsed does play a powerful regulatory role vis-à-vis the explanatory methodology for the basic reason that it conceptualises social reality in certain terms, thus identifying what there is to be explained and also ruling out explanations in terms of entities or properties which are deemed non-existent" (p. 16-17). Similarly, Craib (1992, p.656) suggests that "our methods of understanding the world and the forms of the theory we use are based on the nature of the realities we are trying to understand".

For the critical realist the "generative mechanism" is the stuff of research. "What happens in the world is not the same as that which is observed... Acquiring access to forces—generative mechanisms—which can produce events in the world, we must pursue our hunt in the domain of the real (by means of abstraction and analytical work). However, according to this ontology, the world is not only differentiated and structured, it is also stratified: the mechanisms in their turn belong to different layers or strata of reality, and furthermore, these strata are hierarchically organized." (Moren & Blom, 2003, p. 46).

Hedström and Swedberg (1998) propose three basic mechanisms linking the macro (structure) and the micro (agency) levels:

1. Situational Mechanisms (macro-micro level)

2. Action-Formation Mechanisms (micro-micro level)

3. Transformational Mechanisms (micro-macro level)

The typology implies that macro-level events or conditions affect the individual (step 1), the individual assimilates the impact of the macro-level events (step 2) and a number of individuals generate, through their actions and interactions, macro-level outcomes (step 3). Such a typology is in line with perhaps the most commonly used critical realist model – Archer's morphogenetic model.

Outhwaite (1987, p. 58) suggests the critical realist method involves "the postulation of a possible [structure or] mechanism, the attempt to collect evidence for or against its existence and the elimination of possible alternatives". The realist agrees that we have a good explanation when (i) the postulated mechanism is capable of explaining the phenomenon (ii) we have good reason to believe in its existence (iii) we cannot think of any equally good alternatives.

Such an explanatory target suggests that philosophical considerations must play an important role in the critical realist method since such an approach often requires transcending, or speculating, perhaps non-observable mechanisms and structures to explain perceived happenings. As Wad (2001, p. 2) suggests "If we take explanation to be the core purpose of science, critical realism seems to emphasise thinking instead of experiencing, and especially the process of abstraction from the domains of the actual and the empirical world to the transfactual mechanisms of the real world". In the movement from a surface phenomena to a deeper, perhaps non-observable causal thing the critical realist uses abductive reasoning to propose possibilities. Such a perspective is consistent with a depth realism where explanation is not about prediction but about the steady unearthing of deeper levels of structures and mechanisms.

In proposing a critical realist "method" Danermark et al. (2002, p. 109) describe 6 stages in explanatory research moving from the concrete initial description to "analytical resolution" whereby the components of interest are identified and separated (see Figure 1). Abduction is involved in the third stage where the components are re-interpreted using different theories and frameworks. Retroduction is then applied whereby the abstractions are then made "real" within a critical realist frame by hypothesizing the necessary structures and mechanisms consistent with the previous abstraction. The two stages of abduction and retroduction are in practice closely related as the theoretical re-framing is matched against consequent realist outcomes. The 5th stage examines the relative merit of each abstraction/theory in explaining the observed happenings. The final stage termed "concretization and contextualization" involves examining "how the different structures and mechanisms manifest themselves in concrete situations".

This basic model will be used to examine broadband adoption. Danermark et al. (2002) suggest that the stage one description should be made using "everyday concepts" and needs to include the interpretations of the persons involved and their own way of describing the current situation. Stage 2 involves separating or dissolving the composite and the complex by distinguishing the various components, aspects or dimensions. In our experience this stage depends heavily on critical realist representations to tease out appropriate elements. The initial phase of our research study involves this description and initial analysis (adopting Archer's morphogenetic framework to guide the analytical breakdown). The subsequent theory-focused phase of the research will address stages 3 to 5 where for particular cases and contexts the identified components are examined from various theoretical perspectives in order to derive particular plausible causal explanations. The final stage 6 will involve addressing these identified structures and mechanisms so as to encourage adoption. Danermark et al. warn against using the framework too prescriptively, suggesting that the framework should be used for guidance rather than a strict chronological roadmap.

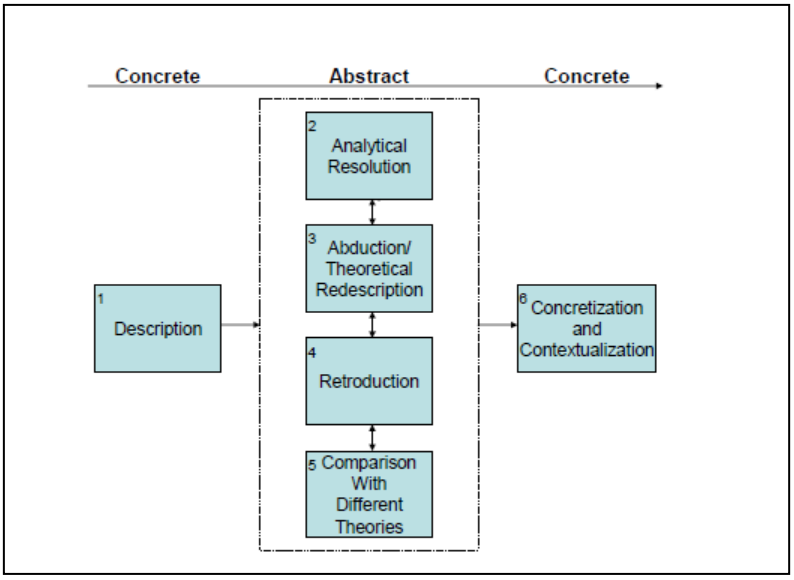

Figure 1: Danermark et al.'s (2002) Explanatory Framework (from Raduescu and Vessey, 2008, p. 20)

5 CRITICAL REALIST FRAMEWORKS

Whilst there are a number of articles promoting the use of critical realism in information systems research (for example, Mutch (1999), Mingers (2000), Dobson (2001), Carlsson (2003), Smith (2006)), to date there have been relatively few actual examples of its use in practice (particular exceptions being Morton (2006), Volkoff et al. (2007), Dobson et al. (2007), Fox (2009), Smith (2010), Mutch (2010), Strong et al. (2010), Bygstad (2010)). Despite the growing interest in and support of the critical realist approach to IS research, applying critical realism has proven to be difficult, partly because critical realism provides little practical guidance as to methodological development and even less guidance as to the role of technology within its complex arguments.

Raduescu and Vessey (2008) suggest that the most widely used explanatory frameworks within critical realism are Archer's (1995, 1998) morphogenetic framework, Danermark et al.'s (2002) staged model (see above) and Pawson and Tilley's (2007) realistic evaluation framework. The frameworks are described and their contribution to examining rural broadband adoption described.

5.1 Archer's Morphogenetic Framework

For the critical realist it is incorrect to suggest that agents create social systems – social systems are already made in that the ensemble of structures, practices and conventions precede agents' actions - ontology precedes epistemology – the morphogentic model detailed in Figure 2 below reflects this. The model also reflects Archer's (1995) contention that social examination requires an analytical separation of structure and agency. She equates a structural perspective with a macro or collectivist perspective and an agency perspective with a micro or individualist perspective. In social situations structure is assumed to precede agency action in that agents either reproduce or transform existing structures. Figure 2 describes the so-called morphogenetic model developed by Archer to represent social change.

Mutch (2010) describes how the morphogenetic model can provide a useful tool for examining organizational use of data warehouses. He suggests (p. 507) that "Three gains are seen to accrue from this approach: greater clarity about the material properties of technology, links to broader structural conditions arising from the conceptualization of the relationship between agency and structure, and the

potential to explore the importance of reflexivity in contemporary organizations, especially in conditions of the widespread use of information and communication technology".

This paper argues that similar benefits can accrue in adopting the framework to represent and examine broadband adoption, whether in an organizational, an individual or a community setting. The adoption decision that is made over the time period T^2 to T^3 is heavily influenced by pre-existing political outcomes and social structures – these imposing elements need to be identified and their influence on the mechanisms and processes by which individuals and groups make (or do not make) the decision to adopt broadband needs to be proposed and supported. The basic model provides a useful representation of the adoption decision as leading to a transformation or reproduction of pre-existing structural impositions.

It is intended in subsequent phases of the research to play an active role in the decision process by encouraging the transformational decision to adopt broadband. If the agent or individual can be directly introduced to the specific possibilities provided by superfast broadband and the potential for doing things in a 'new' way this could provide an encouragement towards morphogenesis.

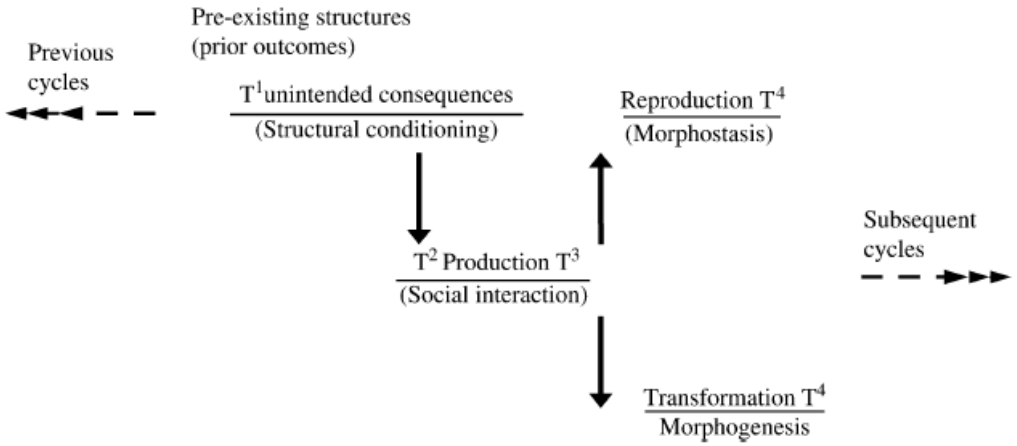

Figure 2: Transformation Model of Change (Archer, 1998, p. 376)

Archer's model is a powerful tool for directing critical realist interpretation in that it reflects the fundamental critical realist assumption that social systems require an analytical separation of macro (structural) and micro (agency) and that:

(i) structure necessarily pre-dates the action(s) leading to its reproduction or transformation.

(ii) structural elaboration necessarily post-dates the action sequences which gave rise to it (Archer, 1995, p.15).

As Pawson and Tilley (2007) suggest, the transformational model reflects an ongoing self-generated reshaping as structures proceed towards structural reproduction or structural transformation. They argue that the transformational model needs to be "peopled" in that "people are often aware of the patterns and regularities into which their lives are shaped, are aware of the choices which channel these activities, and are aware too of the broader social forces that limit their opportunities. This awareness will result, in some people at least, in a desire to change the pattern. This change may or may not happen because the people desiring change may or may not have the resources to bring it about, or their efforts may be countermanded by other groups with more resources. Further unpredictability is introduced because people have imperfect knowledge of the contextual conditions which limit their actions and the proposed change mechanism itself may have unanticipated consequences" (p. 72). Pawson and Tilley (2007) provide a useful adjunct to Archer's model in that their approach tends to be more focused on social interaction than the structural focus of Archer's model.

5.2 Pawson and Tilley's Realist Evaluation Framework

Pawson and Tilley (2007) use critical realism as a foundation for evaluating social programs. They see social programs as essentially theories for social change and argue for a strong realist focus. They suggest that evaluation needs to focus on context and determine what works for whom in which circumstance. Their approach can be similarly applied to examine broadband implementation as a social program to address rural disadvantage. As Moren and Blom (2003, p. 45) suggest in their examination of social work practice "genuine explanation of social and human change—how and why results emerge—demands knowledge about the dynamics that make change come about. To grasp these dynamics we must, aside from external casual factors, make sense of the potential for change that is inherent in the phenomena". Rural regions have particular social structures and properties that both enable and constrain the potential for change. These need to be made clear.

In concrete evaluation terms, social considerations must dominate: how and why do people in rural and regional Australia choose to change (or not change) their course of life as a response to the proposed broadband interventions? Pawson and Tilley (2007) criticize the evaluation of social programs for being too focused on "interventions and results", often defining goals or intentions in advance without reference to context. Evaluations often do not adequately reflect the process of change over time and how unexpected results can occur consequent from the "open systems" in which interventions occur. Certainly the NBN goal of providing fast broadband and wireless access to around 97% of Australians hides much of the social complexity involved. Context will play a vital role in explaining why some interventions work and others don't.

As Pawson and Tilley (2007, p. 216) argue "Interventions are always embedded in a range of attitudinal, individual, institutional and societal processes, and thus program outcomes are generated by a range of macro and micro social forces". Stakeholders' capacity for choice-making is constrained by their social position and their associated power and resources. Ontological depth is required to understand and explain the change decisions they make. As Moren and Bloom (2003, p. 40) argue "Social work practice, in our view, is carried out in a power-permeated field of tension between the level of individuals and the level of society. On the one side, there are individuals' inadequacy and aspirations to (trans)form their lives, and, on the other, there are expectations to adjust to societal demands. To weave a web of social work, you need both psychological and sociological threads. In other words, social work practice is characterized by a dialectics between human agency and social structure, by the dual praxis of human actions."

The mechanisms introduced by social programs need to be understood in terms of their ability to address existing social mechanisms already in place. "A key aspect of evaluation research design is thus to anticipate the diversity of potential program mechanisms involved and a key analytic task is to discover whether they have disabled or circumvented the mechanisms responsible for the original problem" (Pawson and Tilley, 2007, p. 216).

As for social programs, broadband provision does have the potential to change people's lives – but, of course, only if the program is adopted. Any broadband adoption study needs to understand "for whom and in what circumstances" a particular program might work. For example, Howick and Whalley (2008) in examining how to improve rural broadband adoption in Scotland suggest that the greatest impact is achievable by targeting those people who show no interest in broadband adoption, implying that those with Internet interest will inevitably move towards the more attractively featured broadband providers. This seemingly obvious statement has clear policy implications – their suggestion being that promotion of Internet adoption must continue well after the actual broadband provisioning process is completed.

International studies have clearly demonstrated that one of the most important drivers of broadband adoption is the cost of the ultimate package. A fundamental condition for lower costs is enabling competition – whether existing NBN monopoly arrangements will encourage competition has been widely questioned. In order to address low broadband adoption rates it is important to understand, for

example, the role that service cost plays in the adoption decision and how any issues identified be addressed.

The process by which individuals and groups make adoption decisions and the contexts within which they operate needs to be clearly identified. From a social community perspective why is it that some organizations and individuals grasp the opportunity provided by universally available broadband technologies where others continue along similar usage pathways? What part does geographical location play in adoption decisions? How significant are contextual (social and natural) conditions in the adoption process? Implicit in this brand of questioning is a desire to help individuals and groups achieve self-fulfillment. Yet, for the critical realist, it is not enough solely to identify the inequitable structures and mechanisms (although this is a vital component of emancipatory practice), there also needs to be a practical commitment as well: "..enlightening people (or facilitating their own self-enlightenment) as to the source of the illusions and other unwanted determinations responsible for their plight is not a sufficient condition for their emancipation from them, and may indeed increase dissonance and despair: for emancipation the mechanisms actually generating the problems must be removed or blocked" (Sayer 1997, p. 475).

Such an argument supports the second phase of the project – to **address** identified constraints and enablements.

6 DESCRIBING THE BROADBAND ADOPTION CONTEXT

Danermark et al.'s (2002) model suggests an initial stage in research where the problem situation is described in the participants own terms; they suggest this stage may involve an exploratory study to identify objects of interest. This first stage is underway in the MidWest supported by an internal faculty grant. Archer's morphogenetic model provides a useful basis for describing and resolving the important elements affecting the adoption decision. We present some of the initial descriptions as vignettes below:

6.1 Environmental Management

An environmental management group works on improving environmental, land management and water catchment outcomes for a rural area. It has three major focuses in terms of information management. Firstly, they collect and collate via GIS, multiple layers for maps of the area: this might include water courses, heritage conservation, vegetation, protected areas, and observations of rare species and so on. These will be made available to farmers who can use these maps to assist them to plan their land management. Secondly, through their social networking system they will make it possible for farmers and others to upload histories, diaries, photos and measurements of events on their own land. This will lead to increasingly detailed and rich observations about the land. Thirdly, they also make videos of events and stories for information and publicity. The heavy data load of the GIS application, the social networking components and podcasts and video streaming require broadband speeds and always-on capability. Referring to Figure 2 above, it is the ability of the group at time T^1 to conceptualize future transformed structures at T^4 that allows a transformational journey to begin. It is the capability of the group to envision such a structure and how it fits into social forms of life that have made a clear case for broadband. In terms of Archer's model, the mechanism of broadband fits with the transformative structures envisioned by the group: new modes of communicating information, social networking and user-generated content are examples of the morphogenesis envisioned by them. The new structures are only achievable if the technologies are upgraded to broadband. The applications will be rolled out between time T^2 and T^3 and hopefully, the transformation of the users' routine behaviour will happen by time T^4.

6.2 Educational

An educational institute aims to facilitate the delivery of higher education in a regional area, from undergraduate to postgraduate. This will reduce the need for potential students to leave the area to further their education. The institute has very attractive facilities and currently uses standard applications (WebCT, MS-Office and so on) to develop, deliver and manage courses. They do not have a clear vision of what broadband will be used for, but interestingly, they feel it will very important for their institute. This places them at point T^2 of Archer's model. Certain events, or mechanisms, have made them aware of the transformational potential of the technology. For example, through the mechanism of awareness of broadband facilities, they understand that because education is based upon information sharing, collaboration and communication, any technology which improves these is of interest. A second mechanism involved attempts by the institute to reach students to register for a certain activity. Where e-mail requests failed miserably, Facebook approaches were wildly successfully. This was one of the mechanisms which showed institute officials that they will have to change their routines and structures (a morphogenetic process) somehow, even if they don't know what those new structures will be!

6.3 Rural Community

A small, rural shire of 800 farmers and farming service workers is both declining and aging. Community activities, such as dances, concerts, fetes and sports which involve face to face interaction are very important and provide critical opportunities for social contact and community building. Participants in a focus group said there was no substitute for being together and that broadband would not be very useful to them. After some discussion, they came to appreciate that many of their interactions would usefully be supported by broadband. This lack of awareness of the routines of the pre-existing structure of their lives (the myriad telephone calls to support dance preparation for example) led them to judge broadband as not being relevant. They also came to realize that the people doing (and dominating) all the organizing were "old people". The focus group was itself partially a process of revealing structures which were not salient to the participants, the actual agents and owners of those structures. This focus group revealed to us that often, people are not aware of the structures which shape their lives: they are conditioned to act in regular ways, but these habituations are invisible to them. So at time T^2, even when the possibilities of broadband had been explained, they were unable to envision applications because of the invisibility of their own morphostatic structures.

7 SUGGESTED RESEARCH PROGRAM

The three frameworks detailed can provide an outline for research into rural broadband adoption. The first phase of the research is currently underway and aims to address stage 1 of Danermark's model. The aim of this initial phase of the research is to understand the complex social, political and technical aspects affecting adoption of broadband in regional Australia. This requires the examination of a number of exploratory cases requiring participants to describe in their own terms their experiences with the Internet to date, their current usage patterns and their views of the NBN. Interviews aim to explicate the existing structures and mechanisms in place that support or limit their current and future adoption. Archer's Morphogenetic model is used to frame the types of questions that are asked and helps with the initial analysis and breakdown of the various elements framing their involvement (see vignettes above). This work corresponds to Danermark et al.'s stage 1 and part of stage 2.

The second stage of the research (yet to be funded) involves following Danermark et al.'s stage 2 to 6 where the research will attempt to target some of the identified constraining elements in order to encourage broadband adoption. Clearly this aim will be selective in its focus by targeting particular case examples – initially focusing on those cases for which change is feasible, most needed and most immediate. Identifying the important structures and mechanisms constraining or enabling broadband

adoption will lean heavily on theoretical description and re-description as proposed mechanisms are evaluated against their ability to explain the observed adoption decisions.

In line with the morphogenetic model the researchers themselves act as agents of change as they propose new possibilities (and the disseminated research outcomes also become an element in the change mechanism as other readers are made aware of NBN possibilities). In the MidWest region underlying infrastructure for the NBN is available now in specific areas and decisions are being made as to adoption options. There is considerable scope to be involved with supporting the adoption process. Contextual examination will lean heavily on Pawson and Tilley's (2007) approach to encourage change - the focus being on introducing measures that answer "what it is about the measure which might produce change, which individuals, groups and locations might benefit from the program, and which social cultural resources are necessary to sustain change" (p. 85).

The ongoing research into the uptake of broadband in rural and regional Australia will thus continue to use Archer's model and the other critical realist frameworks discussed above. These frameworks, used in combination, should help us to arrive at a deeper understanding of how and why people in these areas choose to change (or not to change) their course of life as a response to the proposed broadband interventions.

8 CONCLUSION

The interplay between technology and the economy is not simply one in which a better mousetrap appears and replaces the previous version. A new technology, such as broadband, can provide both expected and unexpected outcomes that need to be examined in context. New possibilities are provided and previous ways of operating and living are overtaken. The new, previously unimagined arrangements eventually become part of the reified landscape of economic activity and influence the emergence and evaluation of subsequent generations of technologies. Archer's morphogenetic model provides a useful means for representing these changes in its analytical separation of structure and agency, in its representation of structure predating agency action and in its specific incorporation of time within the model. The seemingly simple representation has deep impacts and considerable analytical power.

Similarly, the framework suggested by Danermark et al. (2002) can be used to guide the critical realist research process in that the stages proposed help to define subsequent ontological, epistemological and methodological development. Pawson and Tilley's (2007) realistic evaluation framework is also particularly useful in examining social programs. The NBN can be seen as a social program on an enormous scale heavily impacting structures and mechanisms at a macro and micro social level. The use of the model allows a strong contextual focus and ensures that research addresses important questions as to "what works for whom; how and in what circumstances". The deep understanding of the particularities of mechanisms and structures in context can allow possible extension to other regional areas. Critical realism can help to provide explanatory models of the impacting structures and mechanisms which guide human interpretations and activity based upon the appearance of technology. This technology cannot be represented as solely a "social construction" – it has "real world" capabilities which a social realist perspective can account for. The explanatory frameworks introduced allow this dual representation and suggest that critical realism can act as a useful under-labourer for research into broadband adoption under the NBN program.

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