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Keywords

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COMMUNITY TECHNOLOGY CENTRES: A PROPOSED FRAMEWORK FOR SUSTAINABILITY

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Digital Divide, Information Technology, Development Telecommunications

Abstract

The effectiveness of Community Technology Centres (CTCs) in meeting many of the challenges presented by the digital divide invites a closer scrutiny of factors that contribute to their sustainability. The success of CTCs appears to be related to the way in which these initiatives are able to respond to the multifaceted nature of the digital divide problem. However, more systematic approaches are required to enable the identification of common factors that contribute to sustainability in different contexts. The paper responds to this challenge by initially reviewing recent contributions on the digital divide debate. From a more refined understanding of what constitutes the digital divide the paper extends Kling's [6] two-part portrayal of the digital divide into a framework that captures both technical and social factors that contribute to sustainability of CTCs. The purpose of this proposed framework is to enable further research into the sustainability of CTCs for indigenous people of Australia.

Introduction

Community Technology Centres (CTCs) have been effective in meeting some of the challenges presented by the problem of the digital divide [11]. However, the digital divide problem remains a frustratingly persistent problem suggesting that further work is required in better understanding the role of CTCs in overcoming the digital divide. Initial investigations suggest that the term "digital divide" is problematic in fully defining the multifaceted nature of the problem concerning information poverty [2] [4] [11] [16]. The time now appears ripe to better formalise our understanding of the digital divide and more particularly the role CTCs play in overcoming the digital divide.

This paper responds to this challenge by proposing a socio-technical framework that seeks to better define the factors that contribute to the sustainability of CTCs. As reflected in the problematic nature of the digital divide, this task is complicated by the multiplicity of situations in which CTCs reside. The paper argues that there is no single answer to this problem. Sustainability should be considered as a multifaceted concept that needs to account

for both technical and social factors. The emphasis on a socio-technical foundation is drawn from Kling's characterisation of the digital divide problems as being composed of both physical infrastructure and social infrastructure [6]. The three part framework described in the paper attempts to better formalise the concept of sustainability while recognising the diversity of contexts in which CTCs operate. The specific attributes of the three part framework are developed from observations and analysis in the author's Master's research [15]. This study of a radio station situated in the South Pacific region provides a number of relevant insights that enable the development of such a framework.

The paper is organised in the following fashion. The paper begins by highlighting the problem of linking telecommunications with development and then moves on to a more general discussion on the digital divide. Out of this discussion CTCs are identified as a practical response to making more credible links between telecommunications and development. The paper then moves on to a brief discussion about the philosophical underpinnings supporting a socio-technical research. The analysis from the author's Master's research that gives rise to the 3 part framework is then explained. The paper concludes with a discussion about the proposed framework with a view of developing a means by which such a model can be validated.

Telecommunications for Development and the Digital Divide

To many marginalised groups in the world, Community Technology Centres (CTCs) represent the public face of the global information revolution. The effectiveness of Community Technology Centres seem to be derived from the way they are able to meet a broad range of information-related needs of disadvantaged groups. These include access to the online sources of information, education and training in the use of IT as well as developing social contact with others in the local community [11] [13]. Despite these benefits the long-term future of many CTCs are not assured. One example is the case of CTCs in rural Queensland, Australia, where Simpson et al. describe the difficulties that arise when government funding is discontinued. In this situation, the primary metric of "success" is economic viability. This measure of sustainability from the writers' perspectives is too narrow.

Prior to delving further into the issue of sustainability and CTCs it is useful to understand why there is such a strong connection between economics and telecommunications. This is best investigated in relation to the connections that are made between economic development and telecommunications.

The connection between economic development and telecommunications has long been a bone of contention. On the one hand there is an underlying belief that there is a direct relationship between telecommunications and economic growth. In a recent paper by Maddern et al. they claim that growth within mobile telecommunication markets can be predicted on the basis of income, cost and network externalities [8]. On the other hand Lee describes more complex and non-linear relationships [7]. Firstly, there are both positive and negative impacts from telecommunications. For example, while telecommunications opens up new markets for local business, the local domain of the small businessperson also becomes accessible to larger companies who operate further a field. Secondly, there is little known about the ways telecommunications promote better economic outcomes at the institutional or individual level. Thirdly, the relative importance of telecommunications in relation to other infrastructure investments such as water and electricity is not really known. Lastly, given a causal link between telecommunications and economic growth what are the optimal

conditions under which investments in telecommunications should be made? In summary Lee reflects on the need for a better understanding of the way telecommunications intercede on the daily life of communities.

Such sentiments would find favour with Newstead [9]. He makes the criticism that much of the telecommunications reform process to date worldwide has favoured “supply side” issues and has tended to steer away from “demand side” issues. While considerable attention has been given to the deregulation of telecommunications markets a similar degree of interest has not been shown in how these technologies can be used more productively. While the focus of Newstead’s comments was on the productivity of corporate telecommunications, the point is equally valid when looking at telecommunications use in society as a whole.

Modern trends in telecommunications technologies have resulted in greater intelligence being delivered to the peripheries of the telecommunications network. Intelligent networks (IN) have placed in the hands of end-users greater capabilities. As Shearman quips the potential exists for people to become ‘...information shapers...’ rather than information ‘...trailers...’ [12]. This in turn has engendered a new telecommunications constituency. This is reflected in the voluminous contributions to mailing lists dealing with the digital divide debate.

The most visible manifestation of this debate is the WSIS (World Symposium on the Information Society) process being undertaken under the auspices of the ITU. From Gurstein’s perspective the WSIS debate is characterised by two dominant modes of thinking [2]. On the one hand, there is a dominant e-commerce discourse that aims to open up new global e-commerce markets. The deployment of new ICTs is seen to be nothing more than the promotion consumerism where the end-user is perceived as a passive receiver of information and goods. On the other hand, there is a strong political focus in contributions from civil society groups. They argue a ‘...communication rights...’ agenda that is designed to rebalance access to communications to enable a range of inequalities to be addressed. These inequalities include human rights, gender equity, open access to scientific and technological information, Internet governance, and cultural and linguistic diversity.

Gurstein contrasts the communications rights approach to his ‘...effective use...’ approach. He takes issues with the communications right approach because it is difficult to translate into practical and effective action. The history of the communications rights approach takes one back to broadcasting and telecommunication technologies Gurstein claims where individuals are passive information consumers. This appears to ignore the potential of new ICTs as ‘...the production and management tools of the information economy...’ where individuals can become active contributors. The kinds of possibilities that could occur through an effective use of ICTs are ‘...support [for] local economic development, social justice and political empowerment; ensuring access to education and health services; enabling local control of information production and distribution; and ensuring the survival and continuing vitality of indigenous cultures...’ [2].

In terms of developing a practical plan of action Gurstein suggests that a dialogue be established between those who are responding to the digital divide problem and the end-users. This two-way relationship recognises the fact that both planners and end-users are working within the limitations of their own knowledge. On the one hand, researchers do not fully comprehend the local circumstances in which end-users reside. On the other hand, end-users do not necessarily have the knowledge and experience to guide the deployment of ICTs. To

this extent there needs to be a judicious mix of technology “push” and technology “pull”. This process is situated firmly within the cultural context in which the new ICTs will be deployed.

Other attempts at reconceptualising the digital divide similarly suggest that the use of new ICTs needs to be considered within a broader social process of learning. Warschauer suggests that the digital divide should be viewed in terms of acquiring literacy [16]. According to Warschauer, literacy acquisition has many similarities to the digital divide debate as both are related to communication technology development and knowledge production. Literacy development through the industrial revolution required the complementary development of new communication technologies (books, newspapers), organisation of content and requisite human skills (reading, writing). Similar processes can be seen at work today in relation to telecommunications and computers, web pages and the informational skills required by people to navigate information resources such as the World Wide Web. The specific ideas that this approach delivers is that:

‘...there is not one type of ICT access, but many; the meaning and value of access varies in particular social context; access exists in gradations, rather than in a bipolar opposition; computer and Internet use bring no automatic benefit outside of particular functions; ICT use is a social practice involving access to physical artifacts, content, skills, and social support; and, acquisition of ICT access is a matter not only of education, but also of power...’ [16].

From the perspective of those wishing to see more attention to the “demand” side of telecommunications, the insights of both Gurstein and Warschauer on the digital divide are very useful from three perspectives: firstly, the focus on end-users is welcome; secondly, the emphasis given to learning; and thirdly, the emphasis given to culture enables the broader community to be effectively incorporated in the analysis. All of these factors contribute to a more refined understanding of the ways telecommunications can be used to promote greater participation in the information economy. Importantly people are conceived of as being more than passive consumers of information but also contributors to knowledge creation within a country.

Such attributes describe an approach to development outlined by the economist Boulding close to thirty years ago [1]. In making an association between economic development and learning Boulding asserted that poorer countries were most disadvantaged by economic strategies that failed to account for learning. In a similar vein, the 2001 Nobel laureate in Economics, Joseph Stiglitz has devoted a good part of his career to investigating the information-related causes of development and under development [14]. He argues that development experts have generally underestimated the impact that information asymmetries have on the actions of people.

In terms of the restricted criteria cited in relation to the Australian CTCs described at the beginning of this section, justification is given to include a broader range of criteria when considering the viability of CTCs. It is clear that restricting the analysis to economic criteria does not fully recognise the important ways telecommunications intercede in the life of people within disadvantaged groups. The next section therefore, describes in greater detail the factors that contribute to the CTCs’ value as a community based resource.

Community Technology Centres (CTCs)

Community Technology Centres refer to a broad range of public and private organisations that offer an array of technology based services and programmes to a variety of populations [3] [11] [12] [13]. CTCs exist in a physical location, which distinguishes them from Community Computing Networks or more recently, Community Portals. The effectiveness of Community Technology Centres seem to be derived from the way they are able to meet a broad range of information-related needs of disadvantaged groups. As Servon states:

‘...[t]hey [CTCs] diffuse technology and IT training to people who have not benefited from the shift to an information society. They function as new forms of community institutions, generating both bonding and bridging social capital. They have triggered the release of a new stream of funding – from public and private, both corporate and philanthropic actors – into low income communities...’ [11]

From a communications perspective CTCs provide enhanced options for people to communicate. CTCs represent a physical space in which information distribution, information use and information creation come together.

The evidence suggests that CTCs have played an important role in narrowing the digital divide for many disadvantaged groups in urban USA. As the US economy has moved from an industry based economy to a service based there is an increasing reliance on information [11]. CTCs provide opportunities for those who have been made unemployed in this change to gain access to up-to-date information sources. As Government services are increasingly delivered via the Internet CTCs provide a means by which people can gain access to these services. CTCs have also enabled people to gain training in the use of IT and the Internet. In summary, the CTC can be seen as enabling mobilisation of community resources at a number of levels.

Similarities to Servon’s observations can be seen in the case of CTCs in rural Queensland, Australia [13]. Simpson’s et al. research appears to support the multifaceted purposes to which CTCs are used for which include: awareness and training; support for tourism; and equitable access to information and government services. Some times these goals come into conflict. Often there are difficulties in maintaining the CTCs in a technical sense because of the need to rely on volunteer labour.

Despite the multiplicity of needs that CTCs meet Servon and Simpson et. al observe that there is no systemic solution to the problem of unequal access to new ICTs. According to Servon, the digital divide problem is a frustratingly persistent problem that seems to change in reflection of the many ‘...cleavages...’ that characterise the digital divide. From her perspective the answer is to make further calls on Government programmes to ensure ongoing operation of CTCs through programmes such as the E-rate programme in the United States.

A similar response is evoked from Simpson et al. who also makes the case for ongoing funding from the Australian government. The examples of economically sustaining CTCs are few while common wisdom suggests that the achievement of financial viability is not immediately attainable. However, this is not an appropriate reflection of the value of such centres. Simpson et al. compare CTCs to schools and libraries and argue that even though such institutions do not turn a profit they are still valued for the social dividend they deliver. From Servon’s and Simpson et al. perspective CTCs perform a valuable social role and represent a new social institution on the landscape that contributes to a community’s social capital.

To the extent that CTCs have the potential to contribute to promoting social inclusion there appears the need to better define the processes that lead to their sustainable development. To that end the paper suggests that a comparative analysis of radio stations may yield useful results.

CTCs and Radio Stations

The justification for turning to the case of radio stations to inform the exploration of sustainability in CTCs is that there are some similarities between these two institutions. Both institutions are factored on communication technologies and facilitate communication between people. Both CTCs and radio stations are situated in communities and generally have links to this community. On this basis it is argued that the factors that contribute to sustainability for radio stations may have relevance to CTCs.

There are also differences between CTCs and radio stations in that CTCs provide enhanced forms of communication potential. Broadcasting is essentially a unidirectional form of communication and one-to-many. The generation of content within a radio station is framed within organisational procedures sometimes necessary to meet statutory obligations such as the broadcast of news, sports or local content. While on the other hand, CTCs enable bi-directional one-to-one communication as well as being the recipients of broadcasts via the Internet. In addition, individuals can become broadcasters themselves through the creation of their own content and publication via the Internet. While the freedoms often associated with the Internet are increasingly challenged by Government controls and restrictions, individuals are generally not restricted to the same degree of broadcasting institutions.

The similarities between CTCs and radio station will initially be used for the development of a proposed framework for sustainability.

Background to the Framework

The manner in which this paper responds to these issues is initially draw inspiration from Rob Kling's "Social Informatics" perspective [6].¹ Kling sets out a research agenda that studies the design, uses and consequences of information technologies that take into account their interaction with institutional and cultural contexts. In making specific reference to the digital divide Kling speaks about the need for both "technological infrastructure" and "social infrastructure" to overcome the digital divide. Technological infrastructure refers to the provision of telephone lines, networking and computer equipment to people. Social infrastructure refers to the purposeful provision of training, teachers, instructors and help-desk personnel who can attend to the difficulties end-users have in using new networked services.

The paper extends the two-part portrayal of the digital divide by Kling by drawing on observations and analysis taken from the author's Masters thesis [15]. The thesis details the information-related difficulties a group of technicians face in the Pacific Island country of

¹ The authority that Kling brings to the debate of deployment of ICTs in institutional settings as well as society in general is considerable. As the editor of a seminal text on computerisation [5] Kling is respected for his pioneering role in ICT social research by eminent researchers such as Oxford Internet Institute Director, William Dutton [personal communication, 15 October 2003]. Up until his death in 2003, Kling was the editor-in-chief of the journal *The Information Society* and served on the editorial and advisory boards of several other scholarly and professional journals including, *European Journal of CSCW*, *Information Technology and People*, *Social Science Computer Review*, and *Accounting, Management and Information Technology*. Further information on Rob Kling can be found at <http://www.slis.indiana.edu/faculty/kling/bio.html>.

Samoa in solving difficult technical problems. The methodology employed was an action research methodology. As the author is an experienced practitioner in broadcast engineering he was able to work with the case study participants to document and analyse their day-to-day experience. The focus of this account is the technicians and how they deal with vagaries of Western technologies in a non-Western cultural setting. In understanding the context in which these technicians must work the thesis provides an insight into ways the broader community has over time negotiated the adoption of a modern communications technology. In order to achieve sustainability a process has occurred where alignment needs to occur at both a technical and cultural level.

The Framework

The proposed framework recognises the need for sustainability of communication technologies in both a technical sense and a social sense. The following describes important insights from the case study of a radio station based in the South Pacific region

The first insight that the case study delivers is that the sustainability of radio broadcast technology is partly dependent on the artefacts that make the technology function in a technical sense. Machines, computer hardware, software, buildings, electricity supplies are examples of the physical infrastructure many people readily identify with modern technology. When technologies designed in more temperate climates are transferred into equatorial and tropical regions of the world technological systems readily break down. This was clearly evident in the radio station described in the case study. The high humidity of the climate necessitated the use of air conditioning so that equipment and storage media such as recording tape and paper could be stored in a dry and cool environment. There was also need for the radio station to own a back power supply because power fluctuations and interruptions were common. The proximity of the radio station to the sea meant that metallic objects corroded readily. For example, the radio stations transmitting mast needed annual painting. Equipment that was not housed in an air-conditioned room similarly aged prematurely. Similarly, computer discs that were not stored in an air-conditioned environment developed mould.

While many more examples could be given, the general principle is that technological artefacts need to be provided with an appropriate environment. The alternative is to design machines and equipment that can cope with local conditions. This has been the goal of the appropriate technology movement even though significant barriers exist to developing economically viable technologies. One example of such a technology is the Simputer, which is designed to overcome the barrier of literacy to using handheld PCs.² On the other hand, multinational corporations are increasingly encouraged to play their part by providing equipment. This is particularly relevant to CTCs who rely on a number of interconnected technologies such as computers, printers and telephone services. Companies such as Microsoft and Cisco are encouraged by UN organisations to play their part in overcoming the digital divide and have responded. However, it would be good if these companies took this commitment one step further and developed more robust versions of their models for use in the non-temperate countries of the world.

The second insight that the case study of radio station provides to this discussion is the extent to which complementary socially based resources enable technologies to function in a technical sense. For example human resources such as technicians who have the knowledge to operate, administer appropriate maintenance and repair regimes on a regular and ad hoc basis

² More information about the Simputer can be found at <http://www.simputer.org/>

are critically important. Some of these skills are found in people who must use the equipment to perform a particular function (such as an announcer). The services that support the work of front line technical people and those who just use technology to achieve a particular end are also important. This includes the resources the institution provides such as instruction manuals, tools, and training opportunities. It also includes spare parts suppliers and help desk services from equipment vendors. Less visible but also important are sources of technical information and training such as other locally experienced technical personnel, local or overseas professional societies and aid donors.

Hence, the second aspect of maintaining sustainability in a technical sense is the institutional settings that support the people who perform maintenance and operation of this equipment. This focuses on any local technical personnel and the support services that they draw on in order to do their work spare parts providers, tradespeople and so on. This may also include remote services such as help desk expertise available from equipment or service providers, professional bodies who ideally support the work of local technical people who are members of such organisations. Also important are educational institutions such as TAFE colleges or Universities whose primary role is educate people that will operate or maintain modern technology.

In summary, the need to ensure the ongoing technical operation of modern communication technologies most closely resembles Kling's advice about the two-part infrastructure to overcome the digital divide. Both physical and social infrastructure come together to ensure that the artefacts of technology function in a way that enables people to achieve their requirements without unnecessary impediments from machines. These represent two important aspects to achieving sustainability in CTCs where failure in one of these areas will result in the failure of the total system.

The third aspect to sustainability suggested by the author's Masters research project relates to the local community and the ways new technological systems are incorporated into it. At this point, the complexities of technical issues are collapsed or "black boxed" into a single entity and the radio station is treated as a single technological unit that mediates communication within the community. Sustainability of the radio station is largely dependent on support from the community through advertising revenues. The radio station's sustainability can also be related to the function it plays in providing a means by which personal messages (telegraphs) can be broadcast to families in outlying villages. Another example is the manner in which it local events such as sporting events and church services are broadcast by the radio station. Hence, many socially relevant activities of the community are mediated through the radio station. This to a large degree has contributed to its cultural sustainability in that it is viewed very much as a locally constituted organisation. For example, at the conclusion of significant cultural events, the radio station is usually offered gifts of food, as are other important and respected guests to the occasion. Many people grew up in their villages listening to this radio station and remember particularly the role the radio station plays in times of crisis such as cyclones.

These observations have relevance to CTCs. CTCs are uniformly focussed on servicing the needs of a local community or part of that community. The extent and degrees of engagements that the CTC is able to generate with the local community will arguably have bearing on its sustainability. Conversely, the absence of any meaningful engagement with the local community may provide an indicator why sustainability may be difficult to achieve even if all the necessary conditions exist for its proper technical function.

Discussion

The purpose of this framework is to enable a better understanding of sustainability in relation to CTCs. How reliably such a framework is able to achieve this purpose is an open question at this point. In order to answer this question a process of validation must begin. In order to be rigorous the validation process must necessarily include empirical work that will be the subject of further investigation. Tentative steps towards validation however, can be taken here through discussion of the framework in relation to the radio station case study and CTC case studies from the literature.

The three aspects of the framework described above are summarised in Table 1: Tier 1 describes the factors that relate to physical infrastructure; Tier 2 describes the socially-based resources that are required to enable the physical infrastructure to function in a technical sense; and Tier 3 indicates factors that relate to maintaining sustainability in a cultural sense. The basic principle of the framework is that failure in any of these three tiers will lead to poor outcomes in relation to sustainability. For example, a broken computer will undermine the viability of a CTC as will a lack of community support.

Table 1: Proposed Framework for Sustainability

Tier 3. Cultural Sustainability		
<i>Framework Attributes</i>	<i>Examples from Radio Station Case Study</i>	<i>Examples from CTC Studies</i>
Connections with immediate community	broadcast of news, sports, church services, events of cultural significance	access to online information sources, access to online government services, education and training in IT [11], community building [12]
Financial Sustainability	government funding plus advertising revenues	Government funding [13], Philanthropic [11]
Symbolic Importance	issue of Government transparency	Government measure to overcome rural access to new ICTs [13]
Tier 2. Technical Sustainability - Social Infrastructure		
<i>Framework Attributes</i>	<i>Examples from Radio Station Case Study</i>	<i>Examples from CTC Studies</i>
Skilled individuals	qualified & unqualified technical staff	unpaid volunteer help [13]
Institutional Setting	tools, training, budget allocations for maintenance and capital improvement	
Service Provider/Vendor Support	onsite and Help-desk support, spare parts, formal training.	local support from local technical college [3]
Other Support	educational and training institutions, financial support from government and non government funding organisations	
Tier 1. Technical Sustainability – Physical Infrastructure		
<i>Framework Attributes</i>	<i>Examples from Radio Station Case Study</i>	<i>Examples from CTC Studies</i>
Network Access	bandwidth, reliability	bandwidth, reliability
Equipment and Software	Broadcasting equipment, office computers	Computers, printers, software
Environmental control	buildings, air-conditioning, security	buildings, air-conditioning, security, virus protection
Electrical Supply	continuity, stability	continuity, stability

The second column of table 1 summarises key issues from radio station case study to support the claim for each tier of the framework. The third column lists issues that are drawn from the CTC case studies described earlier [3] [11] [12] [13]. For example, looking at Tier 1, it is relatively easy to make associations between the physical infrastructure of a radio station and a CTC. The artefacts of modern technologies are usually recognisable in that they are made of metal, have indicator lights and buttons, display monitors and are identified with corporate logos of familiar multinational companies. This appears as a manifestation of the convergence phenomenon where computers have become the primary means by which multimedia content is created and stored. The distribution of such content is enabled by networking technologies that rely on the use of networks supplied by telecommunication companies.

The second tier of the framework refers to the need for complementary social resources to enable the equipment to function in a reliable way. As the focus of the radio station case study was on the technicians it is perhaps not surprising that this aspect contains considerable detail. Both Servon and Simpson et al. identify lack of technical expertise as a significant factor in maintaining CTCs. Missing from these observations however, is an appreciation of the socially constituted nature of technical expertise. Ethnographic studies of technicians generally indicate that they rely on a social network of other technicians when troubled by difficult faults [10]. These networks are also used for gaining up-to-date information about machine performance that has not been detailed in technical manuals or imparted through their education and training. The probable lesson for CTCs is the need to pay attention to ensuring a local technician or engineer is available who has contacts with other sources of expertise. This appears as a particular problem for CTCs in isolated locations.

The third tier of the framework attempts to describe the need for the CTC to be sustainable in a cultural sense. The radio station case study provides some indications of what constitutes sustainability in relation to it. The radio station represents an important aspect to communication in the many developing countries and this is reflected in the radio station case study where it performs multiple roles of broadcasting news, sport, church services, telegrams, Government announcements and the like. Many of these functions could be delivered by a CTC. The commentary by James et al., Servon, Shearman and Simpson et al. further indicate that CTCs enable additional activities: information creation, information searching, communication with Government bodies and other institutions, training in IT and the Internet, community building and so on [3] [11] [12] [13]. This suggests the superior potential of CTCs as a communication technology over traditional media such as radio broadcasting.

Despite the increased potential of CTCs their sustainability is undermined by insufficient funds. The CTC studies by Servo and Simpson et al. identify financial sustainability as a major factor undermining CTC viability. The radio station case study reveals that some of its funding is gained from advertising revenues providing it with a source of finance. It also receives funding from Government to fulfil its public service role. Both Servon and Simpson et al. argue the need for continued public funding of CTCs. However, the radio station case study suggests that alternative forms of funding may also be considered. While advertising may not be wholly appropriate for CTCs, the need for new funding formulas nonetheless are.

Another third tier issue that can be observed in both the radio station case study and Simpson et al. CTC study is the symbolic importance that can be attached to new technologies. In the case of the radio station, the symbolic issue that was paramount was the role the radio station played in improving Government transparency. The limitations imposed on the radio station

to broadcast adverse comment of the ruling political party represented a point of contention. Some argued that such censorship was appropriate within the context of local culture while others argued that such censorship impeded the democratic process. In this case the radio station became an item of symbolic importance representing the potential for transition to more democratic forms of governance.

In the case of the rural CTCs in Australia, the symbolic issue is diminishing access to telecommunications service by rural Australians. Set within the context of a Government programme to privatise the publicly owned carrier, Telstra, the initial funding for CTCs was drawn from the proceeds of an earlier share offering. This was seen as a countervailing factor to the perception that rural telecommunications services would be threatened as the publicly owned carrier became increasingly privatised. Now that this funding source has finished there seems little interest by Australian Government authorities to further support these CTCs. Perhaps coincidentally, at the time of writing the further privatisation of Telstra had also been temporarily shelved.

The framework has the potential to develop a more penetrating understanding of how social factors can undermine the sustainability of CTCs. In the case of the radio station it was found that the technicians were influenced by two important factors: the first was unpredictable equipment behaviour while the second was the demands of the listening public. When the two come together - community demand for a particular service and the breakdown of that service - the stress under which the technicians work is considerable. If the community does not demand a particular service the technical sustainability of associated equipment may languish through inadequate maintenance. This example indicates that the tiers of the framework are not isolated but interrelated: Tier 3 factors can effect Tier 2 and in turn Tier 1. Hence, the breakdown of technological systems can be quite complex. It is anticipated that the framework may be able to promote understanding of this complexity of these situations

In summary, this brief analysis demonstrates that similarities exist in establishing sustainability in a radio station and CTCs. The extent to which such framework can be robustly applied to CTCs in general remains the purpose of future investigation. Ultimately, the purpose of the framework is to better understand the use of CTCs by Aboriginal Australians. On the basis that the end-user, learning and cultural considerations are fundamental to this approach it is anticipated that more effective measures can be developed to improve the access of Aboriginal Australians to the global information economy.

Conclusion

A study of CTCs is valuable in that three important aspects to using ICTs can be observed and analysed: firstly, there is a focus on the end-user and their particular needs; secondly, CTCs are a place in which learning occurs; and thirdly, the situated nature of CTCs within local communities enables the issue of culture to be meaningfully addressed. This paper proposes a framework that seeks to better define the concept of sustainability in relation to CTCs. It does this by drawing on the work of the author's Master's thesis that analyses a case study of a Pacific Island radio station. Three aspects of sustainability are defined: technical sustainability in terms of physical infrastructure; technical sustainability in terms of social infrastructure; and cultural sustainability. A cursory review of a number of commentaries on CTCs reveal that the framework does have application in this arena and deserves further investigation to further validate the proposed framework.

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