Towards a theory of community technology centers: A knowledge-based study

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Abstract
The study of knowledge flows in organizations has provided penetrating insights into innovation processes and other forms of knowledge creation. The study of knowledge flows within small rural communities is a less developed area of research that has the potential to better understand community-wide knowledge creation. This is of particular importance when community technology centers (CTCs) are used to address problems in disadvantaged communities. In developing this idea, the paper reports on research that focused on a program to establish community technology centers (CTCs) in 55 regional areas of the Australian state of New South Wales (NSW). The research used Nonaka and Takeuchi’s Knowledge Creating Theory to provide an analytical framework to investigate knowledge creation within three selected cases. In analyzing the contrasts between cases the knowledge-based constructs provide penetrating insights into the problems solving endeavors of communities using information and communication technologies (ICTs).

1. Introduction

It is perhaps a truism that much of knowledge management research and practice seeks to better understand the management of knowledge flows within the organization. The extent to which this considerable bank of knowledge can be used to better address the knowledge needs of small rural communities in their use of community technology centers (CTCs) is addressed in this paper. The question as to whether an understanding of knowledge flows will lead to a better appreciation of CTCs as a facilitator of community-wide knowledge creation is the problem that motivates this research [17].

The underlying justification for the use of knowledge flows to better understand the ability of communities to address problems is provided by Callon’s discussion of social networks [3]. The networked nature of peoples’ interactions led Callon to describe the practical function of networks in terms of ‘ontology’ that serves as a collective resource for people to draw on when dealing with uncertainty. The implications of assigning social networks with an ontology-related purpose are that networks enable people to develop, organize, share and use knowledge.

As many aspects of shared knowledge creation can be better achieved by ICTs a potential problem emerges in the absence of ICTs, a situation ostensibly described by the term digital divide. In following this theme the paper reports on research that used a knowledge-based analytical framework to theorize about the introduction of community technology centers (CTCs) in regional areas of New South Wales (NSW), Australia. Named the NSW CTC Program, these centers provided communities of generally 3000 people or less with public access to computers and associated equipment as well as the Internet. Multiple case study research was used to analyze 17 cases from which three contrasting cases were chosen for in-depth analysis. Theory building was conducted using “analytical generalization” where insights are gained through the consistent application of theoretical principles to enable comparisons and theorizing to occur [19]. In this research, the theoretical principles that were used were derived from Nonaka and Takeuchi’s Knowledge Creating Theory [11, 15].

The structure of the paper is designed to demonstrate the value of studying knowledge flows when analyzing the introduction of CTCs into communities. The paper begins by making a case for the application of a knowledge-based analysis in a study of communities. It then moves on to describe pertinent aspects of the research that was undertaken. This includes background information to the NSW CTC Program, description of the research design and an explanation of the analytical framework based on Nonaka and Takeuchi’s Knowledge Creating theory that was used. Results of the study are then described and this is followed by a discussion about the value of the knowledge-based analytical framework in better understanding of CTCs within communities.

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1 The term community technology center or CTC is by no means universal as a number of terms have been used to describe similar facilities These include (but are not limited to), telecenters, telecottages, teleservice centres, Internet cafes, online access centres and so on.

2 The author acknowledges the assistance provided by volunteers and staff of the CTCA in NSW and its members
2. Using knowledge flows to better understand community problem solving

The focus on knowledge flows and their importance in addressing the needs of small town communities, particularly those under socio-economic stress, is based on a fundamental contention that a community’s ability to address problems is related to a collective ability to absorb, generate and use knowledge. The sociological basis on which this contention is advanced is drawn from Callon’s discussion about the knowledge-related functions of social networks [3]. Callon argues that people contend with the uncertainty of their daily existence by participation in networks made up of people and objects. While the number of networked connections one has, or the position one may hold within a network, may increase the capacity of individuals to make inspired choices, Callon reasons that the agency of individuals – their “values, preferences and projects” - needs to be also included in the analysis of networks. Accordingly, network analysis that places sole emphasis on network structure and ignores agency will be limited in its comprehension of social networks. Fundamentally, he argues that social networks are difficult to distinguish from the ontology that people use to develop meaning about their world and how best to negotiate uncertainty within this world (p.10).

Conceptualizing the disadvantage of marginalized communities in terms of knowledge has implications for our understanding of exclusion, which is not only indicated through, for example, poor access to ICTs or other sources of knowledge, but, more accurately, through exclusion from collective knowledge-generating processes within a community. Accordingly, a knowledge-based rationale is one that seeks to improve access to, and participation, in collective knowledge creation.

The purpose of the research, therefore, is to discover whether knowledge creation is a major activity of CTCs that assist communities to address local problems.

In order to facilitate investigation, an analytical framework was required to guide the collection and analysis of research data. Perhaps surprisingly, the research did not pursue Callon’s Actor Network Theory (see Footnote 2) but chose to use Nonaka and Takeuchi’s Knowledge Creating Theory. As described by De Michielis [7], Nonaka and Takeuchi’s work reveals knowledge flows in collective problem solving processes.

They are interested … in the processes through which knowledge is continuously created, modified, updated: the emphasis therefore is on the practice through which the members of workgroup or a whole organization increase their ability to perform individually and collectively [7].

Furthermore, given the focus that community technology centers (CTCs) brought to these collective problem solving processes within communities, the choice of Nonaka and Takeuchi’s Knowledge Creating Theory to develop the analytical framework was further strengthened because it is purpose-built for the analysis organizational level interactions.

There is well-developed literature that seeks to understand the significance of knowledge flows to communities of practice (COP) in organizations [1, 2, 5]. Given the obvious focus on communities some have asked why this literature was not chosen as the primary analytical context in which to investigate small geographic communities. In response, the primary phenomenon under study from the outset was innovation. Certainly, innovation, if found, may have been the work of a well-defined community of practice but, equally, may have been the work of a collection of individuals who had recently joined together under the umbrella of the CTC. Given this uncertainty, Nonaka and Takeuchi’s work presented itself as the most able to deal with the unknown attributes associated with these communities. This decision was made with the awareness that Nonaka and Takeuchi’s framework was not universally accepted by management theorists. In following the lead of two eminent COP researchers, Brown and Duguid, it was decided to look at these issues from the “prism of practice – the way in which work gets done and… knowledge is created” [1, p. 200].

3. The study: The NSW CTC Program

3.1. Background

In order to demonstrate the potential of a knowledge-based analysis to better understand use of CTCs by communities the paper proceeds to report on a research project that investigated a government program that established 89 CTCs in the state of New South Wales (NSW), Australia between 2000 and 2005. The NSW CTC Program reflected a public policy aspiration of the Australian government to address disparities that existed for rural communities (of 3000 people or less) that had difficulties accessing telecommunications including the Internet [12]. The program was notable for the desire by government to limit the period of funding until 2005 after which these

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Footnote 2: Callon, as a pioneer of Actor Network Theory (ANT), holds that humans and objects should be given equal recognition as actors in the function of networks [4].
CTCs were expected to be self-supporting independent businesses. The research investigated these CTCs from the time when government funding for the program ceased in June 2005 to June 2008.

3.2. Research Design

Over a period of four months in 2007, 17 CTCs were visited where interviews were held and surveys distributed. These 17 cases were able to provide a global perspective of the progress CTCs had made since the cessation of government funding in July 2005. The research benefited from documentation that was made available by the coordinating body of the CTCs in the NSW program called the Community Technology Centre Association (CTCA).

From these 17 cases, three were selected for in-depth analysis. The method that was used to select these three cases was guided by the need to choose both diverse and well-documented cases. While the seventeen cases provided an ample range of contrasts from which to choose from not all were supported by sufficient research data by way of survey responses and associated primary and secondary sources. Hence, final selection of the in-depth cases was determined by both diversity and the reliability of research data.

The case study method used to analyze knowledge-based interactions is described by Yin as analytical generalization. Analytic generalization is defined by Yin as a process where “previously developed theory is used as a template with which to compare the empirical results of a case study” [19]. In this case “dissimilar results are predicted for predictable reasons” [19]. Accordingly, the cases chosen for this study exemplify such differences [6].

The analytical constructs derived from Nonaka and Takeuchi provided a rationale that was used to explain the diverse characteristics of each of the three chosen cases. In turn, the consistency by which diverse circumstances can be explained provides the basis for theory building [19].

The potential diversity of the communities was acknowledged as a reality that would influence the nature of knowledge creation within communities. The manner in which this complexity was addressed was to adopt the approach of Stiglitz where people are assumed to make rational decisions and on the basis of past experience and available sources of knowledge [14]. The underlining principle is one that asserts the commonality of human experience when faced with the uncertainty of learning or discovering new ideas.

3.2.1. Defining the knowledge-based analytical constructs. Four analytical constructs were distilled from Nonaka and Takeuchi’s Knowledge Creating Theory to analyze case study accounts: Epistemology, Ontology, Paradox and the Knowledge Spiral. The analytical construct of Epistemology highlighted the tacit and explicit attributes of knowledge. Tacit knowledge is defined by Nonaka and Takeuchi as being knowledge that is “personal, context specific, and therefore hard to formalize and communicate” [10]. Explicit knowledge on the other hand refers to knowledge that is “transmittable in formal systematic language.”

They describe four “knowledge transformations” that they claim are fundamental to the process of innovation described by the terms Socialization, Externalization, Combination and Internalization (sometimes referred to as SECI, see Table 1). The first transformation, Socialization, describes tacit knowledge to tacit knowledge conversion, which requires a socialization process to enable this transformation to take place. Examples of the Socialization process include conversations between work colleagues and supervisors, learning by copying, and “war” stories. The creation of explicit knowledge from tacit knowledge can be achieved by a transformation called Externalization. Externalization is where the skills and experience of individuals are expressed in various ways including the telling of analogies and metaphors leading to documentation of procedures, rules and theories. Explicit to explicit knowledge transformations is called Combination and refers to the reconfiguring of existing information or explicit knowledge by adding, sorting and categorizing to create new explicit knowledge. Lastly, the transformation of explicit to tacit knowledge is achieved through what Nonaka and Takeuchi call Internalization. This is where individuals develop individual skills by applying explicit knowledge from sources such as books, manuals and procedures through a process of experimentation.

It can be seen that the construct of Epistemology is therefore a complex one that relies on the SECI

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<td>Externalization</td>
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<td>Combination</td>
<td>Explicit knowledge explicit knowledge</td>
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<td>Internalization</td>
<td>Explicit knowledge to tacit knowledge</td>
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Table 1. The four-part SECI model
framework. Nonaka and Takeuchi highlight Externalization as essential to innovation within organizations because it describes a key process that facilitates the diffusion of knowledge creating efforts of the individual to groups and the organization at-large.

Nonaka and Takeuchi distinguish knowledge creation on the basis of involvement by individuals and groups within the organization and outside the organization use the second construct of Ontology. This scale of knowledge creating activity is characterized by the descriptors ‘individual’, ‘groups’, ‘organization’ and ‘inter-organization’ [10]. In Figure 1, the descriptor of organization was replaced by CTC. In order to better reflect the community based nature of CTCs the descriptor of inter-organization was changed to a more inclusive term of “Community” in order to recognize the full gamut of community based groups, both formal and informal, that were operating (see Figure 1).

The third construct that was used in the analytical framework was called Paradox. The need to address a paradox provides the impetus to create new knowledge. Nonaka and Takeuchi use the construct of Paradox to describe situations where “contradictions, inconsistencies, dualities, polarities, dichotomies and opposites” exist [16]. Based on Hegel’s concept of dialectical thinking, Nonaka and Takeuchi claim that new knowledge is created is through a process described as synthesis [16]. The process of synthesis requires the ability to sense and articulate emerging possibilities, which, in turn, leads to the creation of new ideas. The term “self transcending” is used to describe the ability of people to move beyond their current frame of understanding to a new one [9] Nonaka and Takeuchi identify direct experience, physical proximity, shared experience and discussion as being important when synthesizing new knowledge [9, 16].

The fourth construct of the Knowledge Spiral represents the interaction of the three other constructs [10]. With Paradox representing the focus of knowledge creating efforts the epistemological aspects of the Knowledge Spiral are described by the four SECI conversion modes while the Ontology aspects are described by the increasing scale of knowledge creating activities as these relate to individual and groups within and outside the organization. This is depicted in Figure 2 where the spiral can be seen to link the quadrants of the SECI model in a cyclic fashion but importantly not as a circle. In order to see the significance of the spiral one has to imagine a third dimension vertically from the page indicating increasing ontological scale. The ever-widening cyclic trajectory of the spiral indicates an increasing scale of Ontology or, put more plainly, increasing numbers of people (as it figuratively moves away from the plane of the page). This is to Nonaka and Takeuchi an idealized form of innovation that is networked throughout the organization and beyond.

The means by which these constructs were operationalized were in a series of guide questions that sought information about each of the constructs (see Table 2).

The analytical framework provided the research with the means to compare and analyze situations for their knowledge creating attributes. The extent to which the analytical framework was able to consistently deliver credible insights into the CTC case study data provided a basis on which to assess the value of this knowledge based framework for better understanding problem solving in each of the cases.

4. Results

The three cases chosen for analysis were based on CTCs in the towns of Parkdale, Rangemoore and Viewbank. Each of these locations exhibited contrasts in the nature of activities that were undertaken in each location.

Parkdale CTC was notable for its auspicing of a community engagement program that was designed to address problems that mainly affected local indigenous
families. Program managers were required to interact with individuals and groups within the community to encourage improvements in five key areas: law and order; health; education; job creation; and young people and families. The CTC was used to host group meetings such as the mothers’ group as well as the program managers who had an office in the premises.

In contrast, Rangemoore CTC managed a commercial newspaper operation that was able to support the employment of one of its managers. Located in a beef producing area, the statewide drought had significantly reduced their incomes.

The third CTC in Viewbank was a centre for training in the town and was able to derive sufficient income from this initiative to support the employment of a manager. In the recent past the town had suffered a significant and sudden increase in unemployment when the local timber products factory was destroyed by fire.

The diverse locations of the three cases were indicated by contrasts in key socioeconomic data. Each of the towns was small with a population less than 3000 people. The diverse locations led to differences in the industries that dominated local economies. Also notable was below national average levels of income and above average levels of unemployment.

4.1. Application of constructs – Epistemology

The application of the analytical constructs to each of these cases provided a number of points of contrasts that revealed the significance of their initiatives to the local communities in terms of knowledge creation. Notably, the three in-depth cases were distinguished by the ways in which application of the analytical construct of Epistemology emphasized one aspect of the SECI knowledge framework. This finding was noteworthy because the theory holds that, while all four knowledge transformations represented by the SECI framework should ideally be represented, the prospect that one should be more obvious is not considered. Hence, the first immediate contrast that could be discerned was the existence of a dominant form of knowledge creation in each of the three cases, which became the basis for theorizing about knowledge creation within each of the three CTCs.

In the case of the Community Engagement Program in Parkdale, the necessity for group level interaction in order to negotiate changes to the way people lived their lives to promote better socio-economic outcomes was most easily aligned to the SECI concept of Externalization. The guide question for Externalization asks whether any of the observed activities be viewed in terms of tacit knowledge being made explicit (such as through analogies, metaphors, models, dialogue, text or diagrams). The need to develop local responses to problems within the local indigenous community and to make these explicit enough for groups of people to understand and emulate resonated most strongly with the guide question for Externalization.

By way of contrast, the work associated with the production of the Community Newspaper in Rangemoore most strongly resonated with the SECI concept of Combination. The analytical construct for Combination asks whether any of the observed activities can be understood in terms of sorting, combining or editing explicit knowledge to create new explicit knowledge for networking in the organization or beyond (see Table 2). It was possible to associate this with the production of the newspaper, which involved combining various media items into an appealing layout, editing stories to satisfy size constraints, and ensuring information was checked for accuracy. The subsequent publication of the newspaper is the means by which information was “networked” to the community.

In the case of Viewbank, research accounts of the training initiatives resonated most strongly with the SECI concept of Internalization. The question for

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<td>1.2 Externalization</td>
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<td>1.3 Combination</td>
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<td>1.4 Internalization</td>
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<tr>
<td>2. Ontology</td>
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<td>3. Paradox</td>
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<td>4. Knowledge Spiral</td>
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Internalization asks whether people use explicit knowledge through the experience of learning-by-doing or formal learning. To the extent that textbooks and online resources are a common source of explicit knowledge for the Training Courses it can be seen that course participants were given opportunities to internalize this knowledge along with the knowledge that the course trainer was able to provide. It was also apparent in the more practically oriented computer refurbishing courses that took place. While this example did rely on using explicit knowledge there was also a strong learning-by-copying component where the instructor imparted knowledge through demonstrating the handling of circuit boards and ensuring individuals remained safe from electric shocks. Training courses and the computer-refurbishing course drew attention to processes by which people personalized the explicit knowledge presented in the course. By this process Nonaka and Takeuchi [11] claim that explicit knowledge is transformed into personal tacit knowledge.

4.2. Application of constructs – Ontology

The construct of Ontology proved to be an effective analytical concept in describing the relative scale of knowledge creating activities within the cases. For example, the Community Engagement Program was found to be centered within the CTC as most of the interaction occurred within groups who met within the CTC (see Figure 3.a). This was consistent with the earlier observations where tacit knowledge creation and subsequent creation of explicit knowledge was found to be evident when analyzing the construct of Epistemology. In contrast, the application of the analytical construct of Ontology to the Community Newspaper in Rangemoore revealed that knowledge creation was not centered within the CTC but was best described as a community-wide knowledge creation process (see Figure 3.b). The source for most of the newspaper items came from community members. The subsequent publication and distribution of the paper to the community meant that the community was able to inform themselves of relevant and current information. While the CTC staff contributed some items their primary role was in the editing and combining of media items for final publication. The application of the construct of Ontology to Viewbank CTC revealed another form of community-wide engagement but primarily with those who were seeking work (see Figure 3.c). The availability of training courses at the CTC provided an appropriate response to the high number of young people who were seeking work. It was interesting to see how training material developed outside the community was used in the planning and delivery of courses.

![Figure 3: Different scales of knowledge creation within communities were mapped](image)

4.3. Application of constructs - Paradox

It is when the third construct of Paradox is considered where the observations made in relation to Epistemology and Ontology begin to take on added meaning in relation to each of the case study locations. The analytical construct of Paradox identifies situations in which inconsistent and contradictory information exists which in turn provide the impetus for knowledge creation activity (see Table 2).
Understanding the construct of Paradox was assisted by identification of recognized community problems that were deemed important by the CTC management to address. In the case of Parkdale, the challenge of promoting better social-economic outcomes in the local indigenous community was considered important by the community given concerns about socially destructive patterns of behavior. Rangemoore, in contrast, was tasked with a less onerous problem of ensuring community members were kept informed about the local events, even though some of these events were of a complex social nature. Viewbank CTC’s response to the locally recognized problem of unemployment in the wake of a devastating fire to the local wood manufacturing plant was welcomed by the community at large given the high number of people who were made unemployed as a consequence.

It was apparent that each of these towns was dealing with different problems. The significance of these differing circumstances is that each led to different knowledge creating responses, which in turn had implications for each in terms of being able to generate income from these activities. Contingent circumstances proved to be an important factor in determining the activities of CTCs.

4.4. Application of constructs – Knowledge Spiral

The fourth construct of the Knowledge Spiral considers the three constructs of Epistemology, Ontology and Paradox simultaneously. Fundamentally, Nonaka and Takeuchi claim that the Knowledge Spiral describes the increasing propensity of knowledge to be networked as it is made explicit. This was found to be the case where the creation of explicit knowledge led to its diffusion among increasingly larger groups of people. The construct of Ontology enabled this diffusion process to be tracked from individuals to groups within the CTC to groups in the community and beyond the community.

One inconsistency in the application of the Knowledge Spiral was discovered here - it was not possible to observe the sequential transitions between tacit and explicit knowledge as defined by the SECI framework. Rather than the ordered transitions of the idealized spiral, tacit and explicit knowledge appeared to be used more in an ad hoc way in response to prevailing circumstances. This emerged as point for discussion in the research in relation to criticisms other scholars have made of Nonaka and Takeuchi’s framework, which will be discussed later in this paper.

5. ICT use in the three cases

The different ways that communities to create knowledge in response to local problems have used ICTs is interesting. In surveying the personal use of ICTs by customers it was clear that email, word processing and photography applications were most popular. Among younger people, nomination of Bebo, Facebook and other social media sites was also apparent. Indeed, it was interesting to see the variety of uses that people put the public access computers to including the writing of an autobiography, the recording of local and family history, the development of online businesses, eBay, footy tipping and the list goes on.

In relation to the dominant modes of knowledge creation that were observed it was interesting to note the varying modes of computer use. In the case of the Community Engagement Program at Parkdale, ICTs played an understated role. For example, the focus of the mothers group that used the CTC was (unsurprisingly) on mother-craft where convenient access to computers allowed production of newsletters and flyers, information to be accessed from the Internet or emails to be read and sent. In this example, the incentive to use ICTs related to the need to manage and coordinate activities within the group. In summary, the availability of computers at the CTC enhanced the management of the group. As people were exposed to ICTs one expected that people’s ICT skills would also develop even though ICTs were not the primary focus of the group.

In the case of Rangemoore, it was also possible to find support for the contention that ICT use can be linked to knowledge creation. In this case, the absence of organized group activity within the CTC meant that ICTs are not overtly associated with the management and function of groups in the CTC, in contrast to Parkdale CTC. Instead, ICT use was associated with newspaper production including printing of the paper using the risograph. Interestingly, ICTs have been used in Rangemoore to publish newspapers, which is a technology that has a long history in regional NSW. However, the means of newspaper production, once the provenance of trained typesetters and printers, has been made accessible to people who are competent in using ICTs.

Lastly, a clear connection between ICT use and training can be established in the case study accounts of Viewbank. Courses at the adult training organization focused on teaching people how to use ICTs and relevant business applications. On first appearance, people seemed to be learning about ICTs just for the sake of learning about ICTs. As common wisdom dictated the need for ICT skills for job seekers, the
incentives for ICT training can also be linked with improved prospects in obtaining a job. Whether this kind of training will be sufficient to deliver a positive outcome or not is open to conjecture given the complex nature of regional economies but ICT training appears to be a necessary component. To that end, a clear link between ICT use and knowledge creation is identified.

In summary, the research used knowledge-based concepts to provide detailed description of cases designed to overcome the digital divide. It did this by providing an account of ICT use within these local communities to address issues of concern to them. It was found that in addressing these issues of concern knowledge creation was fundamental to their responses to these problems.

6. Discussion

The knowledge-based conceptualizations that this research seeks to develop are one that focuses on the ways ICTs have been used by communities to create knowledge in response to local problems. In considering each analytical construct individually and collectively it was found that the use of ICTs varied in response to the unique circumstances of each location. For example, the use of ICTs in the production of the community newspaper in Rangemoore assumed a different function to its training focus in Viewbank and the Community Engagement Program in Parkdale.

A knowledge-based analytical framework also revealed the role of the CTC in the local knowledge economy of each location. Even though the three in-depth cases were different each CTC had assumed an important place within the town as a reliable source of information. This was relatively easy to observe in the example of Rangemoore where the publication of the newspaper could be tracked from the writing of media releases, their editing and inclusion into final copy and the printing of the paper for distribution to the public. In the other cases, this was apparent because the CTC had become a place where people congregated. This was obvious in Viewbank where groups of people attended training courses. In the case of Parkdale it was evident in the use people made of the CTC to run courses for teenagers and young mothers. Interviews and surveys revealed that the CTCs had also become a place where social interaction was valued. When asked what they would miss most should the CTC close, customers chose social interaction as their second most popular response after email.

The significance of social interaction was not lost on the analysis given the importance attached to Socialization as a key process in synthesizing new tacit knowledge. Even though the analysis focuses on the three other parts of the SECI model (Externalization, Combination and Internalization), to varying degrees, each relied on the one-to-one interaction of Socialization to develop new knowledge in response to unforeseen problems. Although the SECI implies the translation of tacit knowledge to explicit knowledge back to tacit knowledge, this does not uniformly occur. This feature of the research data represents an area for further research.

The nature of the paradox fundamental to local problems was reasoned to have significant implications in relation to the relative level of complexity involved in knowledge creation (see Table 4). The research found that greater levels of uncertainty required responses that were heavily dependant on Socialization-like activities to generate new tacit knowledge. For example, the complexities associated with Community Engagement Program were consistent with group-based interaction, where the need for tacit knowledge creation to address the complexities of social problems was evident. Less complex paradoxes were addressed with knowledge creation that was not so dependent on Socialization-like activities and more readily codified into knowledge that could be embodied in various information artifacts such as printed publications, DVDs and the like. This was consistent with the Community Newspaper initiative at Rangemoore where the timing of a cattle sale for an advertisement, as one example, required much less deliberation as the paradox was relatively straightforward. Even so, the newspaper provided a useful forum to discuss complex social problems local to the community. In the case of the training courses at Viewbank, it was possible codify a sufficient amount of information to enable people to make a decision whether they wished to pay for the course.

As a consequence, the degree of uncertainty under which communities operated emerged as influential in determining the nature of knowledge-creating activity. Complex problems appeared more reliant on the generation of tacit knowledge while more straightforward problem responses such as the newspaper and training course were less reliant on the deliberation of tacit knowledge creation. As communities were not able to choose the problems that dominated their existence, the range of knowledge-creating responses, and by extension, commercial opportunities, were influenced by the relative complexity of the paradox. Accordingly, contingent circumstances were reasoned to be influential in determining a CTC’s ability to commercialize their operation and develop into independent businesses.

In assessing initiatives in the other 14 cases it was found that CTCs were generally responsive to the
needs of their local communities. It was also found that the initiatives that were developed were amenable to a knowledge-based analysis using the analytical constructs. When assessing the potential value of the NSW CTC Program, Australian government planners based their judgment of success mainly on the criteria of commercial sustainability. This left many communities confused when they could see that they were making valuable contributions through the use of ICTs to the social well-being of their town even though such initiatives were not commercially viable. In other cases, it was possible to see a connection between the nature of knowledge creation and the propensity to generate revenue from such activities. Where it was possible to create knowledge in the explicit domain, the cases reveal that the commercial imperative set by the program planners was easier to achieve. The analysis reasoned that explicit knowledge was amenable to being disembodied into information artifacts such as a newspaper or even a training course and more commercially attractive. By way of contrast, the group-based interactions such as were evident in the Community Engagement Program, did not lend itself to the commoditization of such information.

Despite the generally positive assessment that the research was able to make about the analytical constructs derived from Nonaka and Takeuchi’s Knowledge Creating Theory, some aspects were found wanting. This was most pronounced when seeking to distinguish tacit knowledge creation from explicit knowledge. Assumed by Nonaka and Takeuchi as a continuum, the research was as a continuum, the researcher was challenged on occasions when attempting to objectively distinguish between tacit knowledge and explicit knowledge.

It was also apparent that the process of knowledge creation, as indicated by the Knowledge Spiral, did not always follow the cyclic transitions in the order of Socialization Externalization, Combination then Internalization. Rather, the use of tacit knowledge and explicit knowledge appeared to be ad hoc in nature in response to the problems at hand. This finding resonates with criticisms COP and other management theorists have made of Nonaka and Takeuchi’s Knowledge Spiral [8, 5, 13, 18]. This appears to once again boil down to the relationship between tacit knowledge and explicit knowledge - whether there is a natural connection leading to conversion from one form of knowledge into the other.

Hence, some of the issues identified in the paper are artifacts of the model not matching the complex interactions of the real world. On the basis of the findings here, future research into knowledge flows within local communities should seek to better account for the existing practices in communities, (or ontology, as described by Callon), to more accurately track knowledge creation.

Despite these areas of contention, it can be seen that the constructs derived from Nonaka and Takeuchi’s Knowledge Creating Theory enable some penetrating insights to be developed into role of CTCs in facilitating problem solving within communities. The contention of the paper is that this issue can be understood as a knowledge-related process where the means by which people are able to

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<td>Connecting CTC activities with income generation</td>
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<td>Mode of knowledge creation most readily associated with resource generation: <strong>Combination</strong></td>
<td>Mode of knowledge creation most readily associated with resource generation: <strong>Internalization</strong></td>
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effectively negotiate an uncertain future can be constrained by their capabilities as well as poor access to ICTs. Hence, initiatives to address the needs of such communities need to account for deficits in prior experience and knowledge as well as ICTs. The underlying premise here is that people will generally act in a rational manner and consistent manner – the difference in outcomes explained by differing perceptions about the world built upon the learning from life experiences as well as access to relevant sources of knowledge.

7. Conclusion

This paper has endeavored to provide a novel approach to understanding the use of CTCs by communities to address their problems. The use of Nonaka and Takeuchi’s Knowledge Creating Theory was found to provide analytical constructs that were able to reveal such processes in relation to specific problems that motivated action in the studied communities. By focusing on ICT-use within CTCs the analysis is able to better understand the use of ICTs to solve problems and create knowledge within these communities. To the extent that community technology initiatives are ultimately intended to assist communities to function at higher levels, a knowledge-based approach enables penetrating insights to be made into the ways ICTs are used by communities to address problems that are important to them.

8. References


