THE IMPLICATIONS OF TACIT KNOWLEDGE RESEARCH FOR ORGANIZATIONS

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ABSTRACT

With the growing realization that tacit knowledge is at least as important as codified knowledge, it is in the interest of organizations to manage their tacit knowledge resources and not to focus solely on the codified knowledge component in order to gain that competitive advantage. To that end we have been exploring the phenomena of tacit knowledge. Through a number of case studies we have found that the parameters conducive to tacit knowledge transfer include intimate meetings, lack of electronic communication and repeated contact. Such findings have ramifications for organization structure and management suggesting that when it comes to tacit knowledge large organizations may be at a disadvantage to small cottage style industries.

KEY WORDS

Tacit knowledge, technology, social networks, knowledge diffusion

1. Introduction

The use of knowledge in some form is a common ingredient in most, if not all, artificial intelligence applications. Most applications, particularly expert systems, have focused on the codification of knowledge so that expertise may be replicated for the purposes of decision making. However, it has been shown [8], that whilst codified knowledge has always permitted managerial decisions to be *planned*, it was the tacit knowledge component that was often called upon in emergency situations to provide decisions in a fast changing situation. In our work focusing on the phenomena of tacit knowledge, we have taken an alternative approach to mainstream knowledge capture by seeking to measure who has tacit knowledge and how it flows around an organisation. Our findings have important implications for the structure of an organisation, the technologies used and the cultural environment. Before discussing our research and findings, let's consider what is meant by tacit knowledge.

Tacit knowledge (TK) in itself is clearly the opposite of codified knowledge. Codified knowledge exists in print or electronic form and tends to be available to some degree either freely or for sale, or perhaps in the form of patent and classified documentation. What we often refer to as codified knowledge is however not necessarily knowledge, but information. In other words it does not become knowledge until the receiver understands what it is they are receiving. Technically speaking tacit knowledge on the other hand *is* knowledge, not data or information, insofar as the term tends to be used to describe knowledge that is far more heavily based on personal understanding or experience.

Strictly speaking tacit knowledge cannot be codified, rather what passes for tacit knowledge is actually the implicit knowledge that we as individuals all make use of to greater or lesser degrees of success. What is meant by implicit knowledge is that component that is not necessarily written anywhere, but we *tacitly* understand that using such knowledge is likely to lead to greater personal success. Stated another way, tacit knowledge is "knowledge that usually is not openly expressed or taught … by our use of tacit in the present context we do not wish to imply that this knowledge is inaccessible to conscious awareness, unspeakable, or unteachable, but merely that it is not taught directly to most of us" [47:436, 439]. Or as Baumard [4:2] differentiates, "on the one hand it is implicit knowledge, that is something we might know, but we do not wish to express. On the other hand, it is tacit knowledge, that is something that we know but cannot express".

Knowledge management in the context of western firms has meant the overemphasis on codified knowledge [34, 16]. Whilst such an approach is broadly acceptable, it nevertheless misses out on the role that tacit knowledge plays [8]. Until we realise that some 90% of any organisational knowledge is embedded and created in the minds of staff [41], the western organisation will never fully utilise the most valuable resource it possesses. Nevertheless in western society, it has been shown that the use made by management in arriving at decisions is often a combination of almost *equal* amounts of tacit and explicit knowledge [18]. Evidence would seem to suggest that the two types of knowledge are indeed complementary, rather than alternatives (Lawson and Lorenz 1999).

Apart from the loss of the true tacit component of the knowledge (i.e. the inarticulable component) that often occurs in the development of expert systems, the cost factor of making knowledge explicit often outweighs the

benefits [6]. Some current IT based knowledge diffusion approaches include the use of intranets, video-conferencing, company encyclopaedias, *LotusNotes*™ databases and the use of email sifting tools such as *Tacitmail*™ [5]. Knowledge management research, typically within the field of Information Systems, is increasingly concerned with tacit knowledge, but currently offers few technological solutions and is currently mostly in the process of discussing its definition, existence and importance. In short, current technology based approaches provide the infrastructure, but not the social networking processes necessary for sense making [46]. Knowledge acquisition approaches which use general problem solving methods [7] and ontologies (e.g. [19]) are based on knowledge-level modelling [31] and also tend to focus on codification and formalisation of knowledge. We see tacit knowledge as a much more primitive form of knowledge. Following Nonaka et al's [33] cycle of socialisation, externalisation, combination and internalisation and the five-tiered knowledge hierarchy [11] which moves from tacit, articulable-tacit, codified or articulate knowledge, categorised knowledge, finally to formalised knowledge, we see tacit knowledge as starting out as that knowledge that we don't know we know. In short, tacit knowledge is often overlooked or treated within the knowledge acquisition and knowledge management research communities as that knowledge which can't be captured.

We do not take such a pessimistic view. On the one hand we believe that knowledge, both tacit and explicit, should not be viewed as nuggets that can be mined or transferred from one head to another. This had been the view in the first-generation of expert systems based on the physical symbol systems hypothesis [32]. Instead, we believe tacit knowledge can be transferred but due to its sticky nature [35] it must be passed in person or via technology that captures the holders behaviour. Through demonstration or execution of the knowledge it can be passed on to another. This is similar to the traditional way of passing on tacit knowledge via the master-apprentice hands-on process of watching and doing. Our work using the Ripple-Down Rules knowledge acquisition and representation technique [14] attempts to capture knowledge in action by having domain experts interact with live cases. Through these interactions experts specify what conclusion they would give for that case and then by selecting features (A-V pairs) in the case they are building rules for the system. An exception structure is used for knowledge representation. Cases are used to both motivate and provide validation of the knowledge captured.

Similarly in the case studies described briefly in section 3, we have sought to measure tacit knowledge by eliciting responses to typical workplace scenarios based on the psychology-based work of Sternberg [43] at Yale. In these studies we were not interested so much with capturing tacit knowledge, in so far as there were no right or wrong answers, but on measuring (via the scenarios)

who had tacit knowledge and the flow of that knowledge around the organisation which we captured using social network analysis (SNA) [39] which models the relationships between individuals. Using SNA we determined whether there were communication bottlenecks, the communication patterns within the organisation and the likelihood of the free flow of tacit knowledge around the organisation. Our approach was based on the tacit knowledge literature, which revealed an overwhelming need for a better means of permitting tacit knowledge to flow amongst personnel and the limitations of current information technologies. Before introducing our studies we consider in more detail the role of human networks in the diffusion of knowledge.

2. Knowledge and human networks as a means of knowledge diffusion

Software may be appropriate for information transfer, but individuals are generally considered appropriate for 'knowledge' transfer [21].

Granted that tacit knowledge is difficult to diffuse technologically [20], some evidence [2] would suggest that for knowledge to be transferred, it needs to be codified. If we conclude that tacit knowledge is both socially embedded [22,25], and contextually based [12], tacit knowledge is not likely to be effectively transferred. In short, the marginal cost of transmitting tacit knowledge rises with distance [3], which explains at a macro level at least, the conglomeration of industry based on access to tacit knowledge [15, 22]. Silicon Valley provides a superlative example of this phenomenon [40]. Tacit knowledge is best transmitted through face-to-face interaction and repeated contact [3]. The non-rival[1] nature of tacit knowledge [3] means that the benefits of this knowledge type are able to spread to other knowledge domains. This would tend to suggest why tacit knowledge possesses attributes corresponding to low environmental support for its distribution [45]. As a result of all of these factors we tend to keep knowledge to ourselves. This last point however, is not what organisations necessarily desire, at least at an *intra*-organisational level even if diffusion is difficult at an *inter*-organisational level [37]. We must also realise that knowledge fully utilised is not a thing in itself, it exists as part of a holistic network system [17].

Communication networks thus form the vital infrastructure needed for knowledge and particularly tacit knowledge transfer. How does one define a network? The *Macquarie Dictionary* [29:1446] defines a network as "**1**. any netlike combination of filaments, lines, passages, or the like. …. [and more relevantly] **9**. to establish social contact with particular people because it is thought that they may prove to be useful". It is this latter point that

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[1] "Goods are called non-rival when they can be consumed by many agents simultaneously" URL: www.econlinks.com/ glossary/non_rival_goods.php (accessed 11/3/04).

emphasises the role that we as humans play in our transfer of knowledge. In other words we seek council with people who are likely to help us in our goals. The networks form social conduits [1] with a person's position in the network determining how effective knowledge transfer is likely to be. Traditionally one means of diffusing tacit knowledge in the workplace, reliant also upon one's role in the network, has been through 'war stories', where employees discussed ways they achieved technical success. Indeed management at *Xerox*™ had tried to prevent this, and then decided it was for the best [9]. An alternative to 'war stories' is 'storking' or popping one's head up from cubicle dividers [28].

3. A Case study involving three organisations

We conducted three cases studies with IT personnel in three different sized organisations, which we refer to as Organisations X (108 participants), Y (7 participants) and Z (16 participants). The studies were focused on measuring to what extent an individual could be said to possess tacit knowledge (via use of a tacit knowledge inventory along the lines of Sternberg's [44] psychological testing involving workplace scenarios and answer options, an example is shown in Figure 1), whether the biographical features of the individual (age, gender, education, years of experience, ethnicity, etc) correlate to the degree of tacit knowledge held (modelled using formal concept analysis [49]) and whether effective transfer of tacit knowledge from experts to novices was likely within an organisation (captured and modelled using Social Network Analysis [39]). As shown in Figure 2, the latter involved asking who met with whom, how often, and the nature and importance of the meeting. The responses to the tacit knowledge inventory, biographical data and social network data were captured via a questionnaire. See Figures 1 and 2 for Part B and C of the questionnaire. Part A covered the participants' biographical details.

4. Speculations on the Optimal Firm for Tacit Knowledge Diffusion

In our study we considered the participant's cultural background, their use of technology and various biographical features and found no correlation between these factors as indicators of who was deemed to possess tacit knowledge. We did, however, observe a relationship between the character of the organisation and the communication patterns between IS personnel and the form of communication being used, that is personal or via a technology driven communication channel. Our summarised observations regarding diffusion patterns within the organisations include:

- The size of the organisation appear to be the greatest determinant *indirectly* with regard to whether tacit knowledge is likely to be effectively transferred from tacit knowledge rich personnel to lesser knowledge

rich personnel. It would appear the smaller the firm the more likely its members will communicate on a face-to-face basis and therefore make use of and pass around tacit forms of knowledge.

- More direct factors relate to the extent to which companies make use of electronic forms of communication, which by their nature *do not* transmit tacit knowledge.

- Another factor affecting diffusion was the density of cliques; Organisation Y involved the most connected actors who formed one clique, while Organisation X had a number of cliques involving actors who had no direct access in their clique to a tacit knowledge rich actor. Organisation Z whilst quite centralised nevertheless had 13 cliques where tacit knowledge rich actors were present in each of these cliques.

- Tacit knowledge can be gained through personal experience. Nevertheless should it need to be transferred from one individual to the next then this must necessarily take place through verbal and visual interaction. Generally speaking it would appear the larger the organisation, the more the firm is inclined towards electronic forms of data administration and transfer. There would appear to be a strong positive correlation between organisational size and diminishing ease with which tacit knowledge *is* being transferred. Furthermore the research seems to indicate that there is not a strong positive correlation between technically qualified or formally qualified personnel and their tacit knowledge richness. Nor for that matter is there a strong positive correlation between increasing age and tacit knowledge richness.

Based on these observations, from a tacit knowledge transfer effectiveness point of view the optimal firm would be that of Y. That is to say a small firm along the lines of an operating adhocracy [26] or perhaps professional bureaucracy [30]. More specifically the factors that were helpful included: a single clique arrangement where all were directly connected and daily meetings (largely informal) involved all staff, a lack of widespread use of electronic forms of communication and a close physical proximity. In view of these factors, it is highly unlikely that tacit knowledge bottlenecking could be said to be taking place, certainly not on any noticeable scale. It is highly probable that similar sized firms with similar communication patterns would also be effective in transferring their tacit knowledge.

In terms therefore of tacit knowledge diffusion likelihood, the firm best placed for its transfer is clearly our smallest one (Y), but the next best would have to be our small-medium one (Z) followed by X. Based on our research it appears that the larger the firm the less likely tacit knowledge is to be successfully transferred from one individual to the next. To this end the model proposed by [10] maintains its validity with regard to tacit knowledge and organisational size. Somewhat similar research by [13] indicated the same pattern.

5. Summary

We know then that tacit knowledge is either gained through self-experience or through working with people who possess "know-how" [36]. Furthermore the dissemination of tacit knowledge can be a problem where organisations rely too heavily on information technology [23, 48]. For an organisation to benefit from its tacit knowledge resources it must undertake to examine the richness of the different forms of communication mediums it makes use of [38, 24]. Aside from studying the role of semiotics in interpreting meanings flowing between individuals, at a more practical level, research indicates the only way for soft knowledge to be effectively transferred is through the socialisation process [36].

Thus it has been established that current knowledge management practices have almost exclusively focused on explicit knowledge. What is understood is that although information technologies have empowered many organisations, they are precisely that, *information* technologies. *Knowledge* technologies tend to be embedded within the human context. Attention needs to be paid to understanding the tacit flows that take place within an intra-organisational context. Social networks of one form or the other provide the fundamental means by which this process is able to take place. The characteristics of social networks vary based on the attributes of the networks themselves. Information richness, which in turn will affect knowledge richness, is dependent upon the type of media utilised. In combination with the effect of the media used, the strength of networks between individuals is expected to heavily influence the degree to which tacit knowledge is transferred. In order to study flows one must begin with a source and destination for tacit knowledge. Organisational staff provide the source and destination of such knowledge.

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Part C: (articulable) Tacit Knowledge Inventory for Information Systems

We realise that any of the following questionnaire scenarios may be tackled from an IDEAL (ethical) and a REALISTIC (perhaps unethical) point of view. We would like you to select BOTH an IDEAL AND REALISTIC value for each answer option.

Read each scenario and select what you consider to be the most appropriate scale for each answer option. Remember we would like you to select BOTH an IDEAL AND REALISTIC value for each answer option.

Scenario 13

A large consultancy corporation has been called in to do an IT security audit of your company.

As you are a computing professional, you are more than usually interested in what they have to do and say.

You find that when you get to read the report it appears to be rote written with your company's name substituted on top (at least as far as you are concerned). In other words, although the report looks professionally written and bound, it does not really address the IT security peculiarities of your organisation.

Rate each of the following responses in relation to the given scenario. It is advisable to read all of the responses before replying.

1. Decide that this is simply another management exercise and as you are not management there is little point in questioning the whole activity

ETHICAL

Choose one:	○	○	○	○	○	○	○
	Extremely Bad			Neither Good nor Bad			Extremely Good

REALISTIC

Choose one:	○	○	○	○	○	○	○
	Extremely Bad			Neither Good nor Bad			Extremely Good

Figure 1: Part C: Scenario 13 and answer option 1 (of 6) from the IT Tacit Knowledge Inventory.

Part B: Social Network Analysis

1. Please select individuals of relevance to yourself, select the levels of importance and frequency and type of contact. In question 2 below, you may say if you have trouble getting hold of them.

    Please note that you may have more than one (1) type of intra-organisational relationship with someone, if so please select another set of relationship information for the same individual

1. Select the people you network with from the lists below:	2. Add the details with these tools	3. This is the list of people you have selected, should you wish to change preferences, please use the tools provided
A. Select firstly the section, then your Contacts: -- SECTION -- -- PERSON -- **B. Frequency of contact:** -- CONTACT FREQUENCY -- **C. Importance of the person:** -- PERSON IMPORTANCE -- **D. Importance of the occasion:** -- MEETING TYPE --	You may use this button to clear your results and begin again: Clear All Having selected the correct combination on the left, click this button to add the details to the right window: Add Details --> Should you change your mind regarding a relationship combination you have selected for any one individual, you may use this button to remove the record: Remove a Result	**Here are your results!**

2. Because tacit knowledge is often passed in inter-personal settings, do you find you have trouble getting to see people? Who are they ...? (Remember individuals are de-indentified)

Hard to find people? [   ]

3. Please provide feedback on whom you feel is SUCCESSFUL or PROFICIENT in what they do within the IT section of your organisation? Or in other words are there some GURUs you know of in the IT section ... ?

Successful persons? [   ]

Figure 2: Part B: Social Network Analysis Component of the Survey.