Tacit Knowledge: Capture, Sharing, And Unwritten Assumptions

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ABSTRACT:

The transfer of tacit knowledge from those who have it to those who need it is often seen as the Holy Grail of knowledge management. Yet the literature on tacit knowledge gives mixed messages about the feasibility of, or techniques for, transferring tacit knowledge, and it is difficult to evaluate the strengths of the competing claims. Part of the problem is that there are several debates in the knowledge management community that affect authors' underlying assumptions about tacit knowledge, but authors of papers often fail to make clear their position on these various debates. This is ironic, given the topic being discussed.

This paper is intended to make clear the key underlying assumptions in the literature that are relevant to capture and sharing of tacit knowledge. Four such assumptions are discussed: whether tacit knowledge includes all knowledge that is not explicit; whether tacit knowledge is unrecordable or simply unrecorded; whether knowledge can be owned by groups as well as individuals; and whether the capture of partial knowledge is a necessary step in knowledge sharing, or a waste of effort because the subjectivity of the knowledge structures in an expert's head means that, if knowledge can be captured at all, it must be captured in its entirety or vital context is lost.

The paper makes some recommendations for classifying tacit knowledge, and for capture (where feasible) and sharing techniques for different categories of tacit knowledge.

Keywords: *Tacit knowledge, Knowledge capture, Knowledge sharing, Assumptions, Classification*

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1. Introduction

There are several debates in the knowledge management community about tacit knowledge, but authors of papers often fail to make clear their position on these various debates; instead, they simply state the consequences of their beliefs. These statements are then quoted as facts by other authors, until a position is reached where a respected knowledge management and social media practitioner baldly states that "tacit knowledge can only be shared through conversations" (Jarche, 2010), even though this statement is not only based on several assumptions, but is also inconsistent with one of these assumptions.

It is ironic that many authors writing about tacit knowledge fail to make clear the assumptions and worldviews on which their conclusions are based. This paper is intended to make clear the key underlying assumptions in the literature that are relevant to capture and sharing of tacit knowledge, and thus to clear up some of the confusion that clouds effective progress on these questions, as well as recommending certain techniques or approaches.

This paper sets out to answer three questions, which determine the structure of the paper:

- What is tacit knowledge?
- Can it be captured?
- Can it be shared?

2. Tacit Knowledge: Definitions

2.1. Tacit Knowledge: Unrecorded Or Unrecordable?

The word 'tacit' means 'hidden' and so tacit knowledge means hidden knowledge.

The concept of tacit knowledge was originally proposed by Polanyi (Polanyi 1967). Polanyi suggests that the starting point for understanding a person's knowledge is that "we know more than we can tell" (Polanyi 1967, p. 4). Polanyi proceeded to argue that this hidden knowledge inspires 'hunches' as well as other capabilities (Polanyi 1967, p. 29), and that scientists use these hunches as a spur for scientific research (Polanyi 1967, p.76). Furthermore, he argues that such research is typically motivated by strong personal feelings or commitments, and "It is only by a passionate commitment to a particular view that the imagination can discover the evidence that supports it" (Polanyi 1967, p.79). Polanyi does not argue that we are unaware of our tacit knowledge but the fact that we cannot articulate it implies that it is not in a form that can be stated in propositional or formal terms.

Polanyi (1967) has, in fact, identified two types of tacit knowledge: the knowledge that inspires 'hunches', which might be classed generally as 'intuitive knowledge'; and "strong personal feelings or commitments", which might be described as 'worldview'. Intuitive knowledge is directly related to a particular task; worldview influences whether intuitive knowledge is applied to any task.

However, in the years since Polanyi published his ideas, a shift has taken place in the accepted definition of tacit knowledge. The shift can be detected in academic publications such as Nonaka and Takeuchi (1995), but is perhaps best summed up by the following quote from a company's website:

> "Tacit knowledge is made up of best practices, experience, wisdom and unrecordable intellectual property that lives within individuals and teams. Since tacit knowledge exists within minds, it cannot be reduced to the digital domain

> as a material asset, or be manipulated directly. However, it expresses in the social realm as the response ability of individuals (productivity, innovation and initiative), and teamwork (communication, coordination and collaboration)." (CDS, 2003).

There are two key differences between CDS' definition and Polanyi's. First, Polanyi identified two types of tacit knowledge: intuitive knowledge and worldview. The CDS definition expands it to include knowledge learned from experience; tactical knowledge (best practices); and strategic meta-knowledge (wisdom). This view perhaps derives from the assumption that tacit knowledge includes anything that is not explicit knowledge (i.e. knowledge that is already recorded in written form). The second difference is that Polanyi considered that tacit knowledge could not currently be articulated by its owner; whereas the CDS definition considers tacit knowledge to be 'unrecordable' or 'not reducible to the digital domain'; i.e. it can *never* be articulated, for if it can be articulated then it can be recorded.

It is widely accepted that the most valuable knowledge that many organisations possess lies not in their written procedures but in the heads of their long-serving staff, and that this knowledge often includes best practice knowledge and 'wisdom'. If this experience-based knowledge is classified as tacit, and hence as being unrecordable, then this has major implications if the organisation wants to transfer some of that knowledge to other staff; in short, knowledge capture is impossible. Organisations must therefore use knowledge sharing approaches that do not require knowledge capture; instead, most of these approaches rely on dialogue between a knowledge owner and a knowledge user.

But there is an inconsistency here: if tacit knowledge is unrecordable then it cannot be discussed directly, because if it could be discussed in words, then it can be recorded. Furthermore, CDS' concept of 'unrecordable intellectual property' is an oxymoron, since intellectual property has to be recorded to be legally protected.

Polanyi recommended dialogue as a way to handle communication that relied on intuition and worldview, because he saw that many people hold strongly to their opinions and understandings -- i.e. their worldview -- and resist changing them. Polanyi's approach is consistent with his definitions, because dialogue about worldview (typically the task of a counselor, mediator or negotiator) usually does not discuss a participant's worldview directly; most of the conversation is about related issues that are designed to help the participant identify their worldview for themselves. But if the scope of tacit knowledge is expanded from intuitive knowledge and worldview to include knowledge learned from experience (as CDS suggest), that consistency is lost.

2.2. Categories Of Tacit Knowledge

So knowledge that is learned from experience is important in business, but it does not fit the classic definition of tacit knowledge. How then should it be classified? This paper presents a classification of knowledge that expands the commonly used 'tacit/explicit' dichotomy into four categories:

- Explicit knowledge: Knowledge that has been written down, described verbally, or captured in diagrams or documents.

- Symbolic experiential knowledge: Knowledge gained from experience that the knowledge owner knows that they possess. It is in the form of words or concepts; it can therefore be verbalised or recorded, but never has been.

- Non-symbolic experiential knowledge: This is knowledge gained from experience that is not in the form of symbols but in some other form: numeric; geometric; perceptual; or physiological. The owner of this knowledge knows that they have it, but may find it very difficult to verbalise.

- True tacit knowledge: This is knowledge (in any form) that a person possesses but does not know that they have.

2.3. Symbolic Experiential Knowledge

It is widely accepted that people learn from experience, and that those who know a great deal about a particular task are capable of performing that task far better than novices can. What has been a subject of debate over many years is the format or structure of that knowledge in an expert's head.

There is good evidence for each of the following three formats:

- *Heuristics***.** Experience-based knowledge often includes heuristics or 'rules of thumb' that provide good advice in most situations; taking gardening as an example, a heuristic might be, 'If the topsoil is dry enough to crumble in your fingers, water your plants'. Feigenbaum and McCorduck (1983, p. 64) argued that:

  > "[T]he matters that set experts apart from beginners, are symbolic, inferential, and rooted in experiential knowledge. ... Experts build up a repertory of working rules of thumb, or 'heuristics,' that, combined with book knowledge, make them expert practitioners."

- *Classification hierarchies*. Experts are believed to categorise domain items differently from novices, which assists them in problem solving. For example, (Chi et al., 1981) showed how experts (PhD students in physics) and novices (first year undergraduate students) categorise and represent physics problems. They found that novices sort problems into categories based upon superficial features (e.g. key words in the question) while experts categorise problems based upon the primary physics principle involved

- *Pattern recognition*. Experts sometimes recognise previously encountered problems from their domain from the pattern of inputs presented to them, and this helps them to perform at an expert level. An example can be found in research carried out by (Chase and Simon, 1973) on chess players: when novice and expert chess players were shown chess boards containing 16 pieces for 30

seconds and then asked to remember the location of the pieces, the experts typically got all 16 correct, in contrast to 10 or 11 for the novices. But when the test was repeated with the pieces in positions that were impossible according to the rules of chess, the experts performed just as poorly as the novices. The conclusion was that expert chess players learn domain-specific patterns (probably based on lines of attack and defence), and that when these patterns are disrupted, they no longer show expert performance.

It should be noted that both 'best practice' (tactical) knowledge and 'wisdom' (strategic meta-knowledge) can be explained in terms of the above three knowledge categories:

- If a practitioner has learned enough heuristics from experience, s/he may be able to combine these heuristics to form his/her own 'best practice' knowledge.

- If a practitioner is very experienced, s/he may have compiled several sets of 'best practice' knowledge, along with some heuristics about which set to use in which situation, and enough pattern recognition knowledge to classify the current situation correctly. This is 'wisdom'.

2.4. Non-Symbolic Experiential Knowledge

Non-symbolic experiential knowledge, sometimes referred to as 'skill', is (by definition) very hard to express in words. For example, (Gladwell, 2007) recounts instances where professional tennis players believed they were giving an accurate account of how they hit a topspin forehand when they said that they used their wrist to roll the racquet over the ball when hitting a forehand. Yet video recording of the professional players showed that they rolled the racquet *after* hitting the ball. Gladwell doesn't accuse the players of falsehood or error, even though following their instructions would have led to a sprained wrist. Instead, he suggests that their knowledge was instinctive (or, in the language of this paper, physiological) and that they were unable to reduce it to words.

Non-symbolic experiential knowledge is rare in the commercial world, with a few obvious exceptions such as the sports and entertainment sectors. However, an example of non-symbolic experiential knowledge being used in the industrial world can be found in the (now largely obsolete) task of 'wheel tapping' in the rail industry. This involved striking the wheel of a railway engine or carriage with a long-handled hammer and listening to the resulting sound to determine if the wheel was cracked or damaged. The primary skill used by wheel tappers was perceptual (identifying 'incorrect' sounds); there were also secondary skills in knowing where and how hard to tap the wheel (geometric and physiological knowledge).

3. True Tacit Knowledge

True tacit knowledge is taken to include factors that affect decision making where the person is not necessarily conscious that they have that knowledge or are using it.

Published examples of true tacit knowledge are rare. However, (Collins 1974) describes the situation in which an innovative laser could be constructed by anyone who had seen the original (working) set-up, but could not be constructed by people who had only seen its circuit diagram. Eventually, the inventors tested each piece of the set-up to find the problem, and discovered that the timings that operated the laser were so fine that one particular wire needed to be less than eight inches long.

Another example of true tacit knowledge can be found in a psychological experiment on the nature of intuition (Maier 1931). Maier asked subjects to tie together two strings hanging from the ceiling of a room, which were too far apart to be grasped simultaneously while hanging vertically. There were also several objects in the room, one of which was a pair of pliers. The solution was to tie the pliers to one string and then to set it swinging. Maier discovered that some subjects struggled to solve the problem until the investigator walked through the room and 'accidentally' set one of the strings swinging, after which they solved it rapidly. The interesting result was that many of these subjects reported having a flash of intuition that helped them to solve the problem, but apparently had no memory of the investigator setting the string in motion.

The Bessemer steel process is sometimes cited as an example of true tacit knowledge. Sir Henry Bessemer sold a patent for his advanced steel making process but the licensees could not get it to work. But the reason for their failure turned out to be the differing levels of impurities in the iron used, and Bessemer was unable to produce a workable solution to this problem despite much scientific experimentation. In short, this is not an example of Bessemer having knowledge but being unaware of it; it is an example of Bessemer *not* having knowledge and initially being unaware of it.

It seems from these examples that identifying true tacit knowledge (a necessary prerequisite to capturing it) is possible, but outside the confines of a psychological experiment, the process is arduous; it is often similar to looking for a needle in a haystack.

4. Capturing Tacit Knowledge

Before discussing techniques for capturing knowledge, it is necessary to consider another set of assumptions that underlie many published papers on knowledge management. These assumptions arise from the cognitivist/constructivist debate about the importance and value of capturing only part of an expert's knowledge. Cognitivists believe that "[captured] knowledge consists of models that attempt to represent the environment in such a way as to maximally simplify problem-solving […] no model can ever hope to capture all relevant information, and even if such a complete model would exist, it would be too complicated to use in any practical way" (Heylighen, 1993). Constructivists, however, believe that each knowledge owner actively builds up their own subjective knowledge structure, and that without completely understanding that structure, captured knowledge cannot be used in the way that the expert uses it. Constructivists stress that the structure (and the selection of 'facts' to populate the structure) are subjective rather than any reflection of an objective ontological reality (von Glasersfeld, 1988); a phrase that is often used is that knowledge is a 'justified

personal belief'. This implies that it is not feasible to substitute a theoretically-derived knowledge structure (or any other 'objective' knowledge structure) for an expert's own knowledge structure in order to make knowledge capture successful, as there is no guarantee that the expert's knowledge structure will match the external knowledge structure.

The practical implications of these views are that cognitivists see the capture of partial knowledge as an essential component of the knowledge transfer process, while constructivists believe that any 'partial' knowledge is not knowledge at all because it eliminates some of the context or structure within which that knowledge exists.

Some constructivists go as far as stating that any knowledge that is 'captured' into a repository is not truly knowledge, because a repository is inanimate and is therefore not capable of holding a justified personal belief (see e.g. Goodwin, 2009). This paper does not accept this argument; an inanimate repository may be incapable of adding to or refining an existing store of subjective knowledge, but there is no reason why it should not record the current contents of it.

However, there is a practical solution to this debate that works for many typical business problems. It is clear from experiments such as those conducted by Chi et al. (1981) and Chase and Simon (1973) that experts do indeed store their knowledge in a structured way. So if the expert's knowledge structure is (fully) captured, and then the knowledge that populates that structure is (partially or fully) captured too, this should satisfy both cognitivists and all but the most radical constructivists.

The discussion on capturing 'tacit' knowledge below therefore places special emphasis on the need to capture the expert's knowledge structure.

5. Capturing Symbolic Experiential Knowledge

There seems no reason why heuristics, classification hierarchies and patterns cannot be made explicit i.e. recorded in words (or, sometimes more conveniently, in 'mind map' diagrams or other knowledge models). Indeed, there is extensive literature on methods for capturing symbolic knowledge. Readers are referred to McGraw and Harbison-Biggs(1989), Burge (1998) and Shadbolt et al. (1999).

The capture methods proposed in the above literature can be divided into three main categories:

- Structured interviewing techniques. The structure used is usually domain- or problem-specific. Such techniques tend to be used at the early stages of knowledge capture, when little is known about the structure of an expert's knowledge, or when the knowledge that is being captured does not neatly fit a single structure e.g. the expert is providing an overview of several different areas of work.

- Techniques for capturing the attributes and values of domain objects. These include techniques for capturing classification hierarchies, as links within

hierarchies can be represented as attribute-value pairs (for example, the taxonomic link 'X is a Y' can be treated as an attribute and value of X). These techniques are intended for use when it is believed that the expert's knowledge structure includes at least one of the following classification hierarchies:

- Heuristics – the conditions of heuristics are often based on values of attributes of objects;

- One or more 'ideal standard' objects against which new inputs must be compared. This situation arises frequently when the expert is performing a task that involves selecting items or assessing risks. In some cases, 'ideal standard' objects may be used by the expert to represent patterns that they have encountered previously.

- Process analysis techniques, designed to identify the steps that the expert follows in performing a task or solving a problem. These techniques are intended for use when it is believed that the expert's knowledge structure includes 'best practice' procedures for solving a particular problem, or where the key elements of knowledge are tasks rather than concepts or physical items. This is often true when the expert is performing a diagnosis or a repair.

An example of one method from each category is given below:

Top 5 Top 5. This is a structured interviewing technique that follows a two-stage process. In the first stage, the knowledge engineer meets with the stakeholders – i.e. those who will need the captured knowledge – to find out what they need to know from the expert who will be interviewed. The title of the technique refers to the recommended structure for the discussion: stakeholders are asked to consider up to five items of enquiry under each of five headings (Activities, Internal Contacts, External Contacts, Files/Folders, and Lessons Learned). The second stage is that the knowledge engineer asks the expert these questions.

Repertory grid. This technique was originally designed as a method of identifying 'personal constructs' (subjective categorisations) that participants are reluctant to verbalise, or that may even be 'true tacit' knowledge – George Kelly, who proposed this method (Kelly 1955), was clearly a constructivist. However, it has been adapted to be a method of collecting attributes and values of domain elements. It works as follows: Participants are presented with a matrix in which domain objects form one axis and the other axis (and all the cells) are blank. Participants are then prompted to differentiate the objects by triadic elicitation (selecting three at random and asking how two of them differ from the third). The difference identified is treated as an attribute, and participants are asked to rate all objects on that attribute on a 1-5 scale. The process is then repeated until no more differences can be elicited; this typically occurs after 4-8 attributes have been identified. The repertory grid is the most structured of all the techniques for capturing attribute-value knowledge. This structure gives it some strengths and some weaknesses. Weaknesses include the fact that a 1-5 scale makes no sense for categorical attributes. Strengths include the fact that statistical analysis can be

performed on the scores for different objects to see if the knowledge provider uses an implicit taxonomy of objects (this was Kelly's method of discovering 'personal constructs'); completeness (because the expert must assign a value to every object for every attribute); and speed and ease of use.

Curtain technique. This is one of several techniques that require an expert to walk through a problem solving scenario, with the aim of identifying the steps that the expert takes to solve the problem. The 'curtain' is used to force the expert to verbalise everything that s/he needs to know to solve the problem. The technique involves placing an expert at one end of a long table; placing a novice from the same domain at the other end, with all the manuals and other information or items necessary to solve a problem; and placing a curtain or screen across the middle of the table. The expert is then asked to guide the novice verbally through the process of solving the problem, telling them exactly which pages in the manual to consult, what actions to take with other items, and so on.

5.1. Capturing Non-Symbolic Experiential Knowledge

Capturing non-symbolic knowledge is always a slow process, and is sometimes impossible, because non-symbolic knowledge is, by definition, very hard to put into words. To demonstrate this, the reader should try to describe (in sufficient detail for someone else to replicate it) how the income and expenditure columns of a spreadsheet combine to produce the profit column (numeric knowledge); the shape of an egg (geometric knowledge); the sound of a metal hammer hitting a metal wheel (perceptual knowledge); or the muscle movements required to perform a pirouette (physiological knowledge). without using the self-referential terms 'egg-shaped' or 'ovoid'. Most people would find it possible, if tedious, to describe the numeric knowledge in words, but would find the other three types of knowledge close to impossible to describe adequately.

If such knowledge can captured, the record of knowledge often includes non-symbolic supporting material – photographs, diagrams, videos, etc. – to support the communication of that knowledge. A good example of this can be seen in Gladwell's capture of knowledge of how a tennis forehand is actually performed, which was only discovered, and can currently only be communicated completely, using videos.

5.2. Capturing True Tacit Knowledge

Capturing true tacit knowledge is possible – see the TEA laser example, where the relevant knowledge was identified by changing every part of the electrical set-up, bit by bit – but it often requires significant effort to identify it. If true tacit knowledge can be identified, then the chances of capturing it depend on whether it resembles symbolic or non-symbolic experiential knowledge, and whether it is structural knowledge or a simple fact. In the TEA laser example, the true tacit knowledge is a single fact of numeric knowledge, while in Maier's strings experiment, it seems that intuitive knowledge actually consists of pattern recognition (i.e. a structure of symbolic knowledge), possibly with a small geometric component as well.

It is possible to obtain some hints about 'true tacit' knowledge by analysing statistical associations between evidence used to make decisions and decisions reached. This is the technique used to simulate 'knowledge' in neural network systems, so it seems to be possible to use such statistical analysis to reach decisions similar to those reached by human decision makers when presented with similar evidence. However, such statistical associations are usually not regarded as 'captured knowledge' but merely as the results produced by some unspecified underlying knowledge. Statistical analysis therefore reduces the problem of identifying 'true tacit' knowledge, but does not eliminate it.

5.3. Capturing Group Knowledge

Before concluding this discussion of techniques for capturing tacit knowledge, there is another area of debate in the knowledge management literature that needs to be discussed. This is the debate over whether knowledge resides only in the heads of individuals, or whether it can also reside in a group consensus.

The idea behind the latter view is that individuals contribute their knowledge and experience to a group, until the group arrives at a state of knowledge which is expressed in the language of the group, and may be greater than the sum of its parts. This view can be traced back to a much-cited paper by Brown and Duguid (1991) in which they give an example of diagnosing faults in a photocopier. In this example, the diagnosis was performed by two operators, the sales rep and a technical specialist sharing parts of their experience and knowledge with each other until they all achieved a correct understanding of the state of the machine. Brown and Duguid believe that a community is capable of maintaining a 'correct understanding' and worldview that is shared by its members, and therefore, in a sense, belongs to the group rather than the individuals.

The view that groups can be considered to hold knowledge has been supported by other theorists, most notably by the seminal work of Nonaka and Takeuchi (1995); their 'knowledge creating cycle' explicitly states that knowledge may be 'owned' either by a group or by an individual. If it is true that a group can own knowledge (and there seems little reason to doubt it), then this paper needs to consider methods of capturing knowledge from groups.

The following techniques have been successful at capturing group knowledge in at least some situations:

- Wikis. Wikis were designed to be built by groups of people, who each contribute parts of their own knowledge to a (written) whole. The structure of the wiki is supposed to be designed by the contributors, or at least by a few knowledgeable members of the group. Wikis that follow this model are perhaps the purest form of group knowledge capture.

- Folksonomies. These have some similarity to a wiki, but the artifact that the group produces is not a record of the group's knowledge, but an ontology/taxonomy (i.e. a structured index) to the group's knowledge.

Folksonomies are useful where the knowledge itself is non-symbolic e.g. where the 'knowledge' consists of a large collection of photographs. For more details on folksonomies, see (Van der Waal, 2005).

- Knowledge modeling. This method creates one or more diagrams that represent the knowledge, and then asks a group of users to brainstorm/debate whether the diagram represents the knowledge correctly. The diagrams are typically 'box and arrow' diagrams, similar to mind maps or flowcharts. For a review of possible knowledge modeling approaches, see (Kingston, 2005). This method can be used synchronously (i.e. with a group of experts in a meeting examining the model and commenting on it, and a facilitator making live updates to the model) or asynchronously.

- Use techniques for capturing knowledge from individuals with multiple experts, compare the results, and then question the experts about any differences observed. This may require experts to assess each other's captured knowledge (preferably using anonymised records of captured knowledge); for some technique (e.g. the repertory grid) it might be feasible for the knowledge engineer to compare the results. This approach was used to collect knowledge about tasks in the domain of air campaign planning (Kingston et al., 1997). A repertory grid with some attributes of tasks already defined was sent to each expert, and they filled in the attribute values. They were then questioned about any values where major differences were observed. An example of knowledge collected was that one expert assumed that a particular task included a necessary preparation step (which had not been previously made explicit) while another expert assumed that the task did not include that step.

6. Sharing Tacit Knowledge

Techniques for knowledge sharing can be divided into four categories. These categories were proposed by Milton (2010) for categorising 'lessons learned' techniques, and adapted by Kingston (2012) to categorise knowledge sharing techniques. Milton divides techniques into 'connect' (person-to-person knowledge sharing techniques) and 'collect' techniques (those techniques that distribute captured or otherwise recorded knowledge); he then further divides them into structured and unstructured techniques. Knowledge sharing techniques that fall into each of the four categories are suggested in Table 1 below.

	Unstructured	Structured
Connect	Communities of Practice Storytelling 'An audience with' Apprenticeship/ Mentoring [Footnote: Kingston 2012 acknowledges that apprenticeship has some formal aspects – capabilities to be achieved – as well as the informal aspects]	Knowledge Portals Training Seminars/Conferences Peer Assists

Collect	Blogs and other publications Wikis Folksonomies	Lessons Learned databases Knowledge based systems Mind maps/knowledge models The written (or audio/video recorded) results of any knowledge capture technique

Table 1: Knowledge Sharing Techniques, Divided According To Milton's Four Categories

A detailed description of four of the above techniques is given in Kingston (2012). In this paper, the focus will be on which of these categories of techniques can be used to share tacit knowledge from the four categories identified in the previous section.

It is noted, however, that the cognitivist/constructivist debate may well influence preferred knowledge sharing techniques as well as knowledge capture techniques: cognitivists are likely to prefer 'collect' techniques since they see knowledge capture as near-essential, whereas constructivists are likely to favour informal techniques because there is no guarantee that the formal structure provided by a knowledge sharing technique will match the subjective knowledge structure of a knowledge provider.

6.1. Sharing Symbolic Experiential Knowledge

Since symbolic experiential knowledge can be captured, almost any of the techniques listed in Table 1 can be used. The criteria for deciding which technique is most appropriate will depend on a number of factors, including the number of potential users of the knowledge; how much knowledge they have already; where they are based; how quickly and cheaply the technique needs to be introduced; and how important it is that the knowledge shared is correct and complete.

6.2. Sharing Non-Symbolic Experiential Knowledge

As non-symbolic knowledge often cannot be captured, connect techniques are strongly recommended. For tasks that require repeated practice before they are learned (typically those involving physiological knowledge), apprenticeship (or its modern equivalent, mentoring) is perhaps the best technique to use.

6.3. Sharing True Tacit Knowledge

If true tacit knowledge is captured, then it can be shared using any of the techniques in Table 1. It can also be shared by non-verbal means without being captured (see the TEA laser example, where anyone who had seen the original set-up of the TEA laser could successfully build their own). In practice, 'non-verbal' usually means 'visual', and so the recommended techniques are either apprenticeship or making video recordings of scenario walkthroughs.

6.4. Sharing Group Knowledge

There are two primary methods of obtaining knowledge from a group:

- Become part of the group;
- View the results of knowledge capture from that group.

The latter approach requires less effort, particularly for wikis and folksonomies, which are designed to be knowledge sharing techniques as well as knowledge capture techniques. Knowledge models can also be made available to support knowledge sharing (see Simpson et al., 1999). The former approach provides wider access to the knowledge of the group, and its context. Which approach is recommended will depend on the overall goals of knowledge sharing; if the learner needs to understand this topic in detail, then joining the group is recommended; if it is only of peripheral or passing interest, then using captured knowledge is recommended.

7. Conclusion

This paper set out to answer the following questions:

- What is tacit knowledge?
- Can it be captured?
- Can it be shared?

In answering these questions, the paper has described some knowledge capture techniques, and categorised and recommended some knowledge sharing techniques. It has also addressed issues that are implicit in much of the literature on knowledge management, but that cause confusion because they are not openly discussed. These issues are:

- Whether tacit knowledge includes all knowledge that is not explicitly recorded. This paper concludes that four categories of knowledge are needed, of which 'true tacit' knowledge forms just one category.
- Whether tacit knowledge is unrecordable, or simply not yet in a form that can be recorded. This paper concludes that symbolic experiential knowledge is recordable; non-symbolic experiential knowledge is sometimes recordable, with supporting multimedia; and true tacit knowledge is usually recordable, if the (often considerable) cost of identifying it can be supported.
- Whether knowledge belongs only to individuals, or whether knowledge can also be 'owned' by a group. The key literature is heavily weighted towards the latter view, and this paper accepts that view, and discusses possible techniques for capturing group knowledge.
- Whether knowledge should be captured in models that reflect part of an expert's knowledge, or whether true knowledge exists in an expert's head

within a subjective structure that can only be understood if captured/ transferred as a whole. This paper argues that, in many cases, it is possible (and highly desirable) to capture the whole of the subjective structure as well as some or all of the knowledge that populates it, thus satisfying both sides of this particular debate.

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