The Knowledge Conundrum
Unravelling the Knowledge Component in Knowledge Management Models

By
Graham Durant-Law
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Executive Summary

Introduction

In the past decade or so there has been an explosive interest in academic and business circles in knowledge management. The central theme is that we are now in the ‘knowledge age’ (Drucker 1993) and that the new economy is based on knowledge exploitation (Kermally 1997, p. 220). Knowledge exploitation, so the argument goes, is concerned with capturing existing knowledge and/or creating new knowledge for commercial advantage (Probert 2003, p. 63). But the striking aspect in this interest in knowledge management is the diversity and inter-disciplinary nature of the field itself, and the consequent lack of a universal lexicon (Hasan & Handzic 2003, p. 3). It becomes even more confusing when knowledge typologies are introduced.

How then does an enterprise engage in ‘knowledge exploitation,’ and evaluate the utility of the various knowledge management models, given that there seems to be no agreed definition of knowledge? This paper attempts to answer that question by examining the epistemological foundations of contemporary knowledge management, with a particular emphasis on ‘what is knowledge?’ Five knowledge management models are examined to see if they have a sound epistemological basis, before culminating with an assessment of the practical utility and limitations of each. The models are:

- Ackoff’s ‘Pyramid to Wisdom’,
- Lundvall and Johnson’s 'Six Knows',
- Nonaka and Takeuchi’s ‘SECI Knowledge Spiral’,
- Popper’s ‘Three Knowledge Worlds’, and
- Firestone and McElroy’s ‘Knowledge Life Cycle.’

Truth and True Beliefs

Knowledge is one of those content-free management words that has many meanings. Indeed the Macquarie Dictionary provides eight definitions of knowledge. The linking concept in all definitions is truth, but what is truth?

The Prussia philosopher Immanuel Kant held that there were two types of truth – analytic truths and synthetic truths. According to Kant analytic truths are both necessarily true, universally true, and have a law-like generality with no exceptions (Horner & Westacott 2000, p. 23). Analytic truths represent knowledge because they are undeniable facts. On the other hand synthetic truths are statements that are true but can be denied without creating a contradiction (Horner & Westacott 2000, p. 21).

The problem arises when we introduce an absolute statement that we understand to be generally true, and which many would believe to be true – that is we have a synthetic truth that some believe is an analytic truth. We have to determine in what circumstances the belief is a truth, and when a truth constitutes knowledge. This is where the notion of ‘true belief’, and particularly ‘justified true belief’ and ‘appropriately caused true belief’, enters the debate.

Beliefs are something that we hold to be true. To the individual beliefs are facts that are derived from either analytic or synthetic truths, or some other source such as an authoritative
reference or person, but of course it is possible to hold a mistaken belief. Should this belief be considered to be knowledge? The solution to this dilemma has eluded philosophers for aeons. We should also note that it is not possible for a belief to exist per se independently of a sentinel being, meaning that knowledge cannot exist outside of a human!

So where does this leave us? We don’t have a clear-cut definition of true belief, which makes our definition of truth incomplete, resulting in an inability to precisely define knowledge. We can safely say that truth is a universally agreed component of knowledge, but our inability to define what a true belief is leaves us with a conundrum – knowledge can be whatever we believe it to be! The inability to precisely define what knowledge is, and to develop an empirical test, means that we must have a very clear understanding of our belief basis if we are to successfully manage, or even enable, what we call knowledge.

Towards a Working Definition of Knowledge

Most epistemologists typically make a major distinction between empirical knowledge, and a priori knowledge. A priori knowledge is said to be gained by reason alone. On the other hand, empirical knowledge, or a posteriori knowledge, is usually thought of as being knowledge that is derivable from experience or the senses alone (Everitt & Fisher 1995, p. 2). Some epistemologists also make a distinction between capacity knowledge, acquaintance knowledge, and propositional knowledge. Capacity knowledge is knowledge on how to do something (Everitt & Fisher 1995, p. 12). Acquaintance knowledge is knowing something by personal acquaintance in space and time (Everitt & Fisher 1995, p. 13). Propositional knowledge deals with true or false situations.

Based on the definitions outlined immediately above, epistemologists broadly fit into three schools. The first school is the autopoietic school. This school’s position is that knowledge belongs to individuals since information, which is mere data in context, needs to be interpreted according to the individual’s internal mental model. This means that knowledge is extremely difficult if not impossible to transfer. The second school might be called the cognitivists. This school focuses on the collection and central dissemination of knowledge as the main knowledge development activity. In this school knowledge might be considered to be facts and is based on the philosopher’s argument of ‘justified true beliefs.’ The last school is the connectivists who believe that knowledge can and does reside in the team, and in the interactions within the team, therefore communication and flow of information is the focus of knowledge management. Clearly knowledge management practitioners generally reside in either the cognitive or connectivist school. Regardless of their school knowledge practitioners characteristically make a distinction between data, information and knowledge.

Data is usually thought as being ‘a set of discrete, objective facts existing in symbolic form that have not been interpreted’ (Davenport & Prusak 1998, pp. 2-3), but which can be ‘shaped and formed to create information’ (Laudon & Laudon 1998, p. 16). When data is enriched by adding context it may become information. Information is ‘data that have been shaped by humans into a meaningful and useful form’ (Laudon & Laudon 1998, p. 16). It is data with a message, and therefore has a receiver and sender.

Knowledge management practitioners, with a few exceptions, typically delineate between tacit and explicit knowledge. Tacit knowledge is the understanding held by an individual that is derived from the integration of values, perceptions, opinions and personal beliefs with experience and information, which allows it to be employed effectively (Nonaka, I. & Konno
Explicit knowledge is codified, clearly articulated, making it available to all and sundry, and in this sense it is public knowledge. It is found in the form of books, documents, reports, white papers, spreadsheets, memos, training course and the like (Awad & Ghaziri 2004, p. 47).

From these definitions we can safely conclude that explicit knowledge therefore exists as an artefact, and tacit knowledge is some sort of understanding that is difficult to articulate, but is based on beliefs. But at this point we are still left with a conundrum. To an epistemologist a fact represents a truth, and a truth in some cases is knowledge. It follows therefore that data as we have defined it can actually be knowledge, and the same can be said for information. On the other hand the knowledge management practitioner’s definition of explicit knowledge is less than useful because explicit knowledge is an artefact which actually means it is data, or at best information!

The problem lies in the artificial split into tacit and explicit knowledge by knowledge practitioners. Knowledge is in fact both explicit and tacit at the same time (Takeuchi & Nonaka 2004, p. 4). All public explicit knowledge has a tacit dimension based in individual experience (Polanyi 1966) and is therefore personal. As soon as we accept that knowledge is at once both tacit and explicit, and public and private, we are able to reconcile the epistemologist’s position with the knowledge management practitioner’s. The epistemologist’s various positions (that knowledge belongs to individuals since information needs to be interpreted according to the individual’s internal mental model, or that knowledge is justified true beliefs’ which can manifest as social values and reside in a team) all sit comfortably with the knowledge practitioner’s data, information, knowledge divide providing we accept that knowledge can only be generated in a human mind and is not instantly transferable (Kluge, Stein & Licht 2001, p. 107).

Davenport and Prusak’s definition that knowledge is a fluid mix of data, experience, practice, values, beliefs, standards, context, and expert insight that provides a conceptual arrangement for evaluating and incorporating new data, information and experiences (Davenport & Prusak 1998, p. 5) now seems reasonable, but the challenge is to actually manage all of these things.

**Five Knowledge Management Models**

Management as a discipline was born in the 20th century, and for most of its short life has sort the ‘silver bullet’ or ‘golden nugget’ solution (Kennedy 2001, p. ix). Knowledge management is the current silver bullet. It promises much, but unless practitioners make explicit the underlying foundations of their model, and managers take the time to understand these foundations there is a danger that the promise will not be delivered.

**Ackoff’s ‘Pyramid to Wisdom’**

The ‘Pyramid to Wisdom’ Model is perhaps the most well known of all the models. It was first espoused by Russel Ackoff as a model that described the learning process (Ackoff 1989, 1996), but has since appeared in various guises in the knowledge management literature (See for example Håkanson 2001; Kannegieter 2001; Stewart 1999). Ackoff believes that data, information, knowledge, understanding and wisdom are all components of individual and organisational learning (Ackoff 1996, pp. 27-8).

The problem with the Pyramid to Wisdom is that it as a model it is far too simple, and it is fundamentally flawed because Ackoff’s definition of data being a product of information
(Ackoff 1996, pp. 28-9) makes the model somewhat nonsensical, given that information is depicted as a higher order. Furthermore it poses a real conundrum if in fact data is the product of information, and data presupposes information! The model also suffers from other definitional problems. For example Ackoff has defined data through to understanding as phenomena that can be codified as artefacts of one type or another – for example a symbol, description, instruction, or explanation. Wisdom however is defined solely as a phenomenon, which means the typology is inconsistent. Accordingly, the model has no place in the knowledge management discipline unless it is substantially amended and refined, and has little or no practical application.

**Lundvall and Johnson’s ‘Six Knows’**

The knowledge components of Lundvall and Johnson’s ‘Six Knows’ model are: know what, know how, know why, know who, know where, and know when. Know what knowledge is the knowledge about how to find the relevant data to produce information. Know how knowledge is skills based and generally, but not exclusively, is personal in nature. Know why knowledge is both explicit and tacit, and involves the ability to understand and explain natural and social phenomena, and deals with principles. Know who knowledge is a form of individual and social knowledge that is largely tacit. It involves information about the gatekeepers to ‘know what’, the owners of ‘know how’ knowledge, and the possessors of ‘know why’ knowledge (Gregersen & Johnson 2001). Know where and know when knowledge is economically useful knowledge about markets (Standing & Benson 2000).

Because the Six Knows model is first and foremost an economic model it begins with the premise that individuals make rational choices (Mooney 1986), and to make these choices they must have knowledge. Rational choice is firmly rooted in the justified true belief school, and this model therefore belongs to this school. Whilst it has sound epistemological foundation it makes little distinction between information and knowledge, and barely mentions data. This is the model’s primary weakness from a knowledge management perspective.

The model provides managers with a useful way to look at the types of data and information they need for their business and gives some clues as to where it may reside, but whether they actually end up with knowledge is open to conjecture. It does not, however, provide a means for evaluating a knowledge claim, nor is it clear what processes are required to link people and technology. Its primary utility is therefore to provide a framework within which to park and test other initiatives.

**Nonaka and Takeuchi’s ‘SECI Knowledge Spiral’**

Nonaka and Takeuchi’s ‘SECI Knowledge’ is perhaps the most cited knowledge process in the literature. It is important to note from the outset that Nonaka and Takeuchi use a justified true belief stance. In particular they say that ‘...knowledge unlike information is about beliefs and commitment. Knowledge is a function of a particular stance, perspective, or intention’ (Nonaka, I. & Takeuchi 2004, p. 49). Furthermore whilst they make the distinction between tacit and explicit knowledge, they actually distinguish between two types of tacit knowledge – the technical and cognitive – and make the point that knowledge is neither explicit or tacit, rather it is both explicit and tacit (Takeuchi & Nonaka 2004, p. 4).
The SECI process deals with four modes of knowledge acquisition that together form a spiral - these are:

- tacit to tacit, which is known as socialisation;
- tacit to explicit, which is called externalisation;
- explicit to explicit, which is labelled combination; and
- explicit to tacit, which is described as internalisation (Nonaka, I. 2004).

There is no doubt that the SECI Knowledge Spiral has very robust epistemological foundations and that these are declared from the outset. The model is also very powerful in that it shows how knowledge is generated, acquired and assimilated in the individual as well the organisation. It has considerable utility as a knowledge management model because it provides a clear hypothesis of how knowledge is generated in the individual and organisation, but its real strength is the people focus and the emphasis on providing people with tools and processes to enable their productivity and creativity.

Popper’s ‘Three Knowledge Worlds’

Sir Karl Popper had a major influence on philosophical thinking in the middle 20th Century, and therefore is most often thought of as a philosopher. His model is actually a theory of reality rather than a knowledge management model, but none the less is useful. Popper conceived reality as occupying three worlds – these are:

- the physical world, which he called World One;
- the psychological or cognitive world, which he called World Two; and
- the world of products of the human mind, which is sometimes called the information world in the knowledge management literature (see for example McDonald 2003, p. 1), but which Popper called World Three.

The power of Popper’s model lies in the clear distinction it allows between data and knowledge. Data is a symbolic statement, and therefore belongs in World Three (McDonald 2003, p. 2). Data when activated by a thought process may become knowledge, but this knowledge resides in World Two until such time as it is codified and becomes subject to criticism, whereupon it moves into World Two and becomes at best represented knowledge, or decomposes back to data or information.

Popper's 'Three Knowledge Worlds' is useful in so far as it provides a framework for a knowledge management initiative and the potential to pull together several other models into a common overarching construct.

Firestone and McElroy’s ‘Knowledge Life Cycle’

Pulling together several other models into a common construct is arguably exactly what Firestone and McElroy have done. They see knowledge as a subset of information rather than a higher order, and that the knowledge cycle begins with a problem that produces information, which may result in data, just information, or knowledge. Of note, they distinguish between demand-side knowledge management and supply-side knowledge management. McElroy, in particular, believes that most knowledge management initiatives focus on the supply side, and that the reason for this is an underlying assumption that knowledge already exists. This results in an unholy emphasis on codification, storage and
retrieval, and distribution and sharing, at the expense of knowledge production (McElroy, M. 2003).

Firestone and McElroy’s ‘Knowledge Life Cycle’ has very sound epistemological foundations, which are made apparent from the outset. Indeed Firestone and McElroy go to great pains to cover all aspects of knowledge from political views to links with organisational learning and complex systems theory: in this sense the model is holistic as opposed to mechanistic, and seems to account for many of the anomalies that other models fail to cover. But the problem is operationalising the model. Whilst Firestone and McElroy show how it might be operationalised in their various publications (see for example Firestone, J. & McElroy 2003; Firestone, J. M. 1999, 2003; McElroy, M. 2003; McElroy, M. W. 2000), it is my view that their examples lack some credibility because a case study from cradle to grave is not presented. This view is supported by others like Nowe, who say that some aspects of the process are too unrealistic to be of value (Nowe 2003).

**Conclusion**

Epistemology is regulative – that is it seeks to prove or disprove that something is knowledge. Knowledge management theory tends to be generative – that is it tends to try to understand how knowledge is grown and fostered. Unfortunately the knowledge management discipline has focussed on the generative aspects of knowledge with little regard to the regulative aspects defined by questions like ‘What is knowledge?’ and ‘What kinds of knowledge are there?’ This is an obvious weakness in the state of the art.

Humans are an essential agent for knowledge and knowledge probably cannot exist outside of a human, particularly if we adopt a justified true belief position. Indeed it is wise to remember that whilst computers can extract dumb data from machines, and can even find patterns that humans may take forever to find, this is simply taking data and making it into information by giving it context – it is not creating knowledge. Whether the patterns are real and useful ultimately requires understanding of relations and causalities, and when to apply or discard a rule, something that so far can only be done by a human (Martin 2000). Lewis Hassell, a philosopher at Drexel University Philadelphia, summarises this position nicely by saying that there is no knowledge outside of experience, therefore knowledge is always ‘embodied, and that experience is always the experience of some rational individual in society, therefore there is no such thing as disembodied knowledge.’ (Hassell 2004, p. 1)

All this means that explicit knowledge, as the knowledge practitioners define it, is quite simply datum and information artefacts. In turn it leads to the conclusion that knowledge cannot be managed per se, but it can be enabled – this is Nonaka and Takeuchi’s proposition from the outset.

**Which Model?**

On the models considered both Firestone and McElroy’s ‘Knowledge Life Cycle’ and Nonaka and Takeuchi’s ‘SECI Knowledge Spiral’ provide a solid basis for a knowledge management initiative. Both models are mature and have clear epistemological origins. But, both models suffer from a general weakness in the literature, in that no example is provided that firstly illustrates the ‘knowledge process’ from end to end, and then explains, rather than describes, how it actually works. This makes it extremely difficult to evaluate the models, let alone determine their utility in the business world.
Recommendations

Perhaps the strongest recommendation that could be made is the need for research that develops a common approach and an agreed lexicon for knowledge management as a discipline. Until the methodology and lexicon is developed and achieves wide acceptance knowledge management will remain as a black art, and will continue to be discredited as having a shaky theoretical basis akin to alchemy. Furthermore there is a need to put a boundary around the discipline if it is to survive as a discipline in its own right.

The second most important recommendation is the requirement for a recognised method to evaluate a knowledge claim, both at the personal and organisational level. The test need not be as stringent and rigid as the philosophers method outlined in Chapter Two, but it should be repeatable in similar circumstances.

Thirdly case study research that illustrates a knowledge management intervention and explains, rather than describes, the ‘knowledge process’ from end to end, is sorely needed. In a similar vein critical analysis of the existing models is also required.

Finally it is worth noting that this report has a once over lightly flavour. The theme of the report, if coupled with a case study, would provide an outstanding topic for a Doctor of Philosophy candidate. I strongly recommend that Canberra University consider sponsoring research into this area – I would like to be that candidate.
Chapter One: Introduction

‘I ask you to look both ways. For the road to a knowledge of the stars leads through the atom; and important knowledge of the atom has been reached through the stars.’

Sir Arthur Eddington 1882 – 1944 British Astrophysicist (Partington 1996, p. 266)

Introduction

Legend has it that General George Patton once said, “I don’t know what this logistic stuff is all about, but I sure as hell want some!” Knowledge management is the same – everybody wants some, but it means different things to different people. Indeed, in the past decade or so there has been an explosive interest in academic and business circles in knowledge management. The central theme is that we are now in the ‘knowledge age’ (Drucker 1993) and that the new economy is based on knowledge exploitation (Kermally 1997, p. 220). Knowledge exploitation, so the argument goes, is concerned with capturing existing knowledge and/or creating new knowledge for commercial advantage (Probert 2003, p. 63).

The other striking aspect in this interest in knowledge management is the diversity and interdisciplinary nature of the field itself, and the consequent lack of a universal lexicon (Handzic & Hasan 2003, p. 3). Indeed, the knowledge management literature provides many definitions of knowledge, most of which build the concept from data, to information, to knowledge. Some of the literature even takes this one step further and expands knowledge to understanding and wisdom (Ackoff 1989; Kannegieter 2001; Stewart 1999); however there is little agreement for a precise definition of knowledge (Biggam 2001, p. 2; Håkanson 2001, p. 3). Data and information are often used interchangeably, and information and knowledge are used as synonyms.

It becomes even more confusing when knowledge typologies are introduced. These typologies include the differentiation between tacit, implicit, and explicit knowledge (Nickols 2000); a divide into human, social, and structured knowledge (De Long & Fahey 2000); and partitioning knowledge into declarative, procedural, and strategic knowledge (Nickols 2000). Two other typologies separate knowledge into the ‘know what’, the ‘know how’, the ‘know why’, the ‘know who’, the ‘know where’, and the ‘know when’ (Lundvall & Johnson 1994), and ‘embrained’, ‘embodied’, ‘encultured’, ‘embedded’ and ‘encoded’ (Blacker 2002).

How then does an enterprise engage in ‘knowledge exploitation,’ and evaluate the utility of the various knowledge management models, given that there seems to be no agreed definition of knowledge? Clearly there is a need to return to first principles and work out what knowledge actually is for an organisation, and what it actually means to manage knowledge. David Snowden, the director of IBM’s Global Services Knowledge and Differentiation Business Unit, suggests that to do this one should first turn to the philosophical discipline of epistemology (Snowden 1999, p. 63).

The Philosophical Discipline of Epistemology

Epistemology is concerned with the ‘theory of knowledge’, and has a history in the Western world dating to the works of Plato and Aristotle. The word epistemology is derived from the Greek words episteme, meaning knowledge, and logos, meaning rational explanation (Horner & Westacott 2000, p. 28). Epistemology seeks to define a standard of evidence for the
justification of our beliefs and an understanding of how we know what we know (Audi 2000, p. i). In this sense epistemology is a regulative discipline (Probert 2003, p. 63).

Traditional epistemology seeks to answer eight questions (Everitt & Fisher 1995, pp. 1-11). These are:

- What is knowledge?
- What kinds of knowledge are there?
- What are the sources of knowledge?
- What is the structure of our body of knowledge?
- What are the limits of what can be known?
- What are the mechanisms by which we gain knowledge?
- How is knowledge related to belief and justification? and
- How ought we to proceed in order to acquire knowledge?

Epistemology therefore offers the promise to solve part of the manager’s conundrum to determine what the knowledge component in the various knowledge management models actually is. If nothing else an epistemological examination of the firm should allow the manager to determine its belief basis, and therefore to develop a shared understanding of what knowledge means to the organisation.

**Aim and Scope**

Accordingly, the aim of the report is to examine the epistemological foundations of contemporary knowledge management, with a particular emphasis on ‘what is knowledge?’ Of the eight traditional epistemological questions only three will be considered in any detail. These are:

- ‘what is knowledge?’
- ‘what kinds of knowledge are there?’ and
- ‘how is knowledge related to belief and justification?’

Five knowledge management models will then be examined to see if these foundations have been used, partially used, or ignored, culminating with an assessment of the practical utility and limitations of each. The models are:

- Ackoff’s ‘Pyramid to Wisdom’,
- Lundvall and Johnson’s ‘Six Knows’
- Nonaka and Takeuchi’s ‘SECI Knowledge Spiral’,
- Popper’s ‘Three Knowledge Worlds’, and
- Firestone and McElroy’s ‘Knowledge Life Cycle.’

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1 Lundvall and Johnson do not give their model a name. I have called it the ‘Six Knows’ Model for ease of reference. The MIT Sloan School of Management appear to use this model in some of their work - see for example Yoshioka, T, Herman, G, Yates, J & Orlikowski, W 2003, 'Genere taxonomy: a knowledge repository of communicative actions', in T Malone, K Crowstone & G Herman (eds), *Organising business knowledge: the MIT handbook*, MIT Press, Cambridge Massachsetts, pp. 465-93. They call it the ‘5W1H’ model - why, what, who, when, where and how - but do reference Lundvall and Johnson.
The Report’s Purpose

On might ask what is the purpose of this report? It is my contention that we have the puzzling situation where we talk about knowledge without really understanding what it is we are talking about. Indeed, Thomas Davenport and Laurence Prusak, two acknowledged gurus of knowledge management, make the point that:

‘Confusion about what data, information, and knowledge are – how they differ, what the words mean – has resulted in enormous expenditures on technology initiatives that rarely deliver what the firms spending the money needed or thought they were getting’ (Davenport & Prusak 1998, p. 1).

I believe we truly have a conundrum, and it is my purpose to demonstrate that in most cases what we really are talking about in knowledge management models is actually data and information.

The Report’s Road-map

The report begins with an examination in Chapter Two of the philosophical notion of truth and true beliefs to provide an insight into what constitutes knowledge.

Chapter Three builds upon Chapter Two and moves towards a working definition of knowledge. The literature is examined to identify and describe the various types of knowledge, including:

- empirical and a priori knowledge;
- capacity and acquaintance knowledge; and
- tacit and explicit knowledge.

Chapter Four is the crux of the report. Each of the five knowledge management models identified earlier are first described, and then analysed for purity of thought based on the epistemological foundations developed in Chapters Two and Three. An assessment of the practical utility and limitations of each knowledge management model is then made.

Finally, Chapter Five draws together the report; proposes which model is most suitable for knowledge management system development, and then makes some recommendations for further research.
Chapter Two: Truth and True Beliefs

‘It is the customary fate of new truths to begin as heresies and to end as superstitions... Irrationally held truths may be more harmful than reasoned errors.’


Introduction

Knowledge is one of those content-free management words that has many meanings. Indeed the Macquarie Dictionary provides eight definitions of knowledge. The first says knowledge is ‘acquaintance with facts, truths, or principles, from study or investigation.’ Another says knowledge is the ‘perception of fact and truth and being cognisant or aware of fact or circumstance.’ The last definition says knowledge is the ‘body of truths or facts accumulated by human beings in the course of time’ (Eurofield Information Systems 2002). From these definitions we might deduce that in order to have knowledge one must first have some facts.

The same dictionary provides three definitions of a fact. The first says a fact is something that ‘has really happened or is the case.’ The second says a fact is a ‘truth known by actual experience or observation’, and the last muddies the waters by saying a fact is ‘something said to be true or supposed to have happened’ (Eurofield Information Systems 2002).

The linking concept in both cases is truth, but what is truth?

Truth Types

The Prussia philosopher Immanuel Kant held that there were two types of truth – analytic truths and synthetic truths. Analytic truths are statements whose denial leads to a contradiction (Horner & Westacott 2000, p. 21). For example, the assertion that ‘all mothers are female’ is an analytic truth because all mothers can be defined as a female parent. To deny the statement that ‘all mothers are female’ results in the absurd assertion that not all female parents are female. We arrive at this truth simply by analysing the subject term in the statement. According to Kant analytic truths are both necessarily true and universally true. By this he means that the truth cannot be conceived in any other way, and that the truth has a law-like generality with no exceptions (Horner & Westacott 2000, p. 23). Analytic truths represent knowledge because they are undeniable facts.

On the other hand synthetic truths are statements that are true but can be denied without creating a contradiction (Horner & Westacott 2000, p. 21). For example the statement ‘most human mothers are over twelve years old’ is a synthetic truth because it contains two unrelated concepts – the concept of being over twelve years old, and the notion of being a human mother. We know the statement is true on the basis of experience, and not simply by understanding the meanings of the words. It is not inconceivable for there to be a nine year old human mother, but from experience we know that this is most unusual. Indeed, if we changed the statement to ‘most human mothers are over nine years old’ it would remain a synthetic truth.

If on the other hand we change the statement to ‘all human mothers are over nine years old’ we introduce a degree of fuzziness to the argument. We have an absolute statement that we understand to be generally true, and which many would believe to be true. Now we have to
determine in what circumstances the belief is a truth, and when a truth constitutes knowledge. This is where the notion of ‘true belief’, and particularly ‘justified true belief’ and ‘appropriately caused true belief’, enters the debate.

True Beliefs

Beliefs are something that we hold to be true. To the individual beliefs are facts that are derived from either analytic or synthetic truths, or some other source such as an authoritative reference or person. Our dictionary definition of knowledge says it consists of facts and truths. We have just determined that a belief is something that we hold to be true, in other words a belief is a truth; yet it is possible to hold a mistaken belief – that is we believe something to be true when in fact it is false. Clearly then a mistaken belief should not be considered to be knowledge. But how do we determine whether a belief is true or otherwise?

Philosophers test their arguments using a conditional equation where $S$ is a person and $p$ is a proposition. According to this philosophical approach belief becomes knowledge if, and only if, the following conditions are met:

- $p$ is true, and
- $S$ believes that $p$ is true.

The first condition requires something to be true, and that someone cannot know that it is true if in fact it is false. In this sense the condition is absolute. The second condition requires that the person actually is aware of the proposition and believes it to be true. We have already established that it is possible to have a mistaken belief; therefore the equation requires an additional statement. Philosophers who subscribe to the notion of justified true belief change the equation to:

- $p$ is true, and
- $S$ believes that $p$ is true, and
- $S$ has adequate justification for believing that $p$ is true.

The final condition requires justification for the belief (Everitt & Fisher 1995, pp. 12-9). But we are still left with a problem because the justification for the belief could be wrong resulting in the justified true belief being false and hence the failure to end up with knowledge. Such a situation might arise because the source of much of what we know is the written or spoken word, and these written or spoken words may be factually incorrect despite us believing that the source is authoritative.

Some philosophers have tried to resolve the justified true belief problem by linking knowledge to causality. This changes the equation to:

- $p$ is true, and
- $S$ believes that $p$ is true, and
- What $p$ is about is causally connected in an appropriate way to $S$’s belief that $p$ is true. (Everitt & Fisher 1995, p. 37).
It means that to distinguish knowledge from beliefs and opinions the key is not justification, but rather the causal connections. At first blush this appears to solve the problem, but it does not account for situations where we know something but the ‘knowing’ is not caused by the thing. For example we can know that 13 is a prime number, perhaps because we are told this by an authoritative mathematician, or perhaps by using the fermata formula to work it out for ourselves. In both cases, however, it is not the number 13 itself that causes us to know it is a prime number (Everitt & Fisher 1995, pp. 37-48).

Conclusion

Clearly it is extraordinarily difficult to define what a true belief is, and provide a test that accounts for all possibilities. So where does this leave us? We don’t have a clear-cut definition of true belief, which makes our definition of truth incomplete, resulting in an inability to precisely define knowledge. It is perhaps better, therefore, to look at what we have established. Our dictionary definition says that knowledge is ‘body of truths or facts accumulated by human beings in the course of time’, and that a fact is ‘something said to be true or supposed to have happened’ (Eurofield Information Systems 2002). We can safely say that truth is a universally agreed component of knowledge. We also understand that truth can be broken into analytic and synthetic truths with the former being an absolute fact, and the later being based on a true belief. What we are unable to define is what a true belief is, and this leaves us with a conundrum – knowledge can be whatever we believe it to be! We should also note that it is not possible for a belief to exist per se independently of a sentinel being, meaning that knowledge cannot exist outside of a human. We really do have a conundrum!
Chapter Three: Towards a Working Definition of Knowledge

‘What is all knowledge too but recorded experience, and a product of history; of which, therefore, reasoning and belief, no less than action and passion, are essential materials?’

Thomas Carlyle 1795-1881 Scottish Philosopher (Partington 1996, p. 179)

Introduction

The inability to precisely define what knowledge is, and to develop an empirical test, means that we must have a very clear understanding of our belief basis if we are to successfully manage, or even enable, what we call knowledge. In this chapter we attempt to arrive at a working definition of knowledge that is acceptable to both epistemologists and knowledge practitioners. From the outset we should note that epistemologists seek conclusive proof that something is in fact knowledge: in this sense the discipline is regulative (Probert 2003, p. 63). On the other hand knowledge management practitioners are happy with a much looser definition and tend to focus on the generative rather than regulative aspects.

An Epistemological View of Knowledge

Epistemologists typically make a major distinction between empirical knowledge, and a priori knowledge. A priori knowledge is said to be gained by reason alone (Everitt & Fisher 1995, p. 2). A priori knowledge consists of statements that we know to be true without consulting our experience and therefore comprises analytic truths (Horner & Westacott 2000, p. 23). On the other hand, empirical knowledge, or a posteriori knowledge, is usually thought of as being knowledge that is derivable from experience or the senses alone (Everitt & Fisher 1995, p. 2). Empirical knowledge therefore does not contain analytic truths, but rather truths that have been derived from observation, experimentation, collecting evidence, and so on (Horner & Westacott 2000, p. 23).

Some epistemologists also make a distinction between capacity knowledge, acquaintance knowledge, and propositional knowledge. Capacity knowledge is knowledge on how to do something (Everitt & Fisher 1995, p. 12). It is both cognitive and actionable. An example of capacity knowledge is knowing how to swim or to use Microsoft® Word 2002. Acquaintance knowledge is knowing something by personal acquaintance in space and time (Everitt & Fisher 1995, p. 13). For example, we can say that we know Tony Eccleston, and that we know he is a lecturer at Canberra University. Propositional knowledge deals with true or false situations. To be propositional knowledge something is either true or false. For example, the statement ‘one plus one equals two’ is true, and the statement ‘one plus one equals three’ is false. We know the first statement to be true and the second to be false hence we have knowledge - in this example based on an analytic truth.

Based on the definitions outlined immediately above, epistemologists broadly fit into three schools. The first school is the autopoietic school. This school’s position is that knowledge belongs to individuals since information, which is mere data in context, needs to be interpreted according to the individual’s internal mental model. This means that knowledge is extremely difficult if not impossible to transfer. The second school might be called the cognitivists. This school focuses on the collection and central dissemination of knowledge as the main knowledge development activity. In this school knowledge might be considered to be facts and is based on the philosopher’s argument of ‘justified true beliefs.’ The last school
is the connectivists who believe that knowledge can and does reside in the team, and in the interactions within the team, therefore communication and flow of information is the focus of knowledge management.

Knowledge Practitioners’ Views on Knowledge

Clearly knowledge management practitioners generally reside in either the cognitive or connectivist school. Regardless of their school knowledge practitioners characteristically make a distinction between data, information and knowledge.

Data and Information

Data is typically thought of as being ‘a set of discrete, objective facts existing in symbolic form that have not been interpreted’ (Davenport & Prusak 1998, pp. 2-3), but which can be ‘shaped and formed to create information’ (Laudon & Laudon 1998, p. 16). The symbolic form may be text, images, or pre-processed code. Data is usually organised into structured records, however it lacks context. The declaration ‘Iron melts at 1,538 degrees Celsius.’ is a data statement because it has no context.

When data is enriched by adding context it may become information. Information is ‘data that have been shaped by humans into a meaningful and useful form’ (Laudon & Laudon 1998, p. 16). It is data with a message, and therefore has a receiver and sender. It is data with relevance and purpose that is useful for a particular task (Liebowitz & Beckman 1998), and is meant to enlighten the receiver and shape their outlooks or insights (Davenport & Prusak 1998). Information results in an action that allows the data to be applied to a specific set of circumstances and to be employed effectively, therefore, data only becomes information after the receiver has interpreted it. Furthermore information is descriptive. The statement ‘Newcastle steel-mill’s smelter temperature has been set at 2,300 degrees Celsius.’ conveys information because it has been enriched by context. The enrichment from data to information is a ‘know what and how’ procedure that results in an understanding of relationships and patterns. However, information by itself remains descriptive and without additional data or information it cannot be used to predict an event or outcome.

Knowledge

Information only becomes knowledge after it has been examined and compared to other information or data, and is then applied to describe, predict or adapt to a situation (Kock, McQueen & Corner 1997, p. 70). A ‘know how and why’ enrichment occurs with the addition of further context, experience and understanding, to result in an understanding of principles. The statement ‘If the steel-mill’s smelter temperature is set at 2,000 degrees Celsius, then all the iron in the smelter will melt in 30 minutes.’ represents knowledge, because it is both predictive and descriptive, has context, and demonstrates understanding.

Knowledge management practitioners typically delineate between tacit and explicit knowledge. Definitions in the knowledge management literature of tacit knowledge include:

- that which is used by all people but not necessarily able to be easily articulated (Polanyi 1966, p. 4);
- understanding gained by people through selective categorisation of their world view, which, once established changes slowly over time to form the foundation for new knowledge (Ehin 2000, p. 108);
• the understanding held by an individual that is derived from the integration of values, perceptions, opinions and personal beliefs with experience and information, which allows it to be employed effectively (Nonaka, I. & Konno 2000); and
• personal context-specific knowledge that is difficult to formalise, record, or articulate (Tiwana 2002, p. 44).

The Macquarie Dictionary defines explicit as being something that it is definitive, clearly developed or formulated, and leaving nothing to be implied (Eurofield Information Systems 2002). Explicit knowledge is codified, clearly articulated, making it available to all and sundry, and in this sense it is public knowledge. Tiwana defines explicit knowledge as ‘that component of knowledge that can be codified and transmitted in a systematic and formal language: documents, databases, webs, e-mails, charts, etc.’ (Tiwana 2002, p. 45). Awad and Ghaziri say that ‘explicit knowledge is knowledge codified and digitised in books, documents, reports, white papers, spreadsheets, memos, training course and the like’ (Awad & Ghaziri 2004, p. 47).

Towards A Working Definition of Knowledge

From these definitions we can safely conclude that explicit knowledge therefore exists as an artefact, and tacit knowledge is some sort of understanding that is difficult to articulate, but is based on beliefs. But at this point we are again left with a conundrum. To an epistemologist a fact represents a truth, and a truth in some cases is knowledge. It follows therefore that data, as we have defined it, can actually be knowledge, and the same can be said for information. On the other hand the knowledge management practitioner’s definition of explicit knowledge is less than useful because explicit knowledge is an artefact which actually means it is data, or at best information!

The problem lies in the artificial split into tacit and explicit knowledge by knowledge practitioners. It is instructive to return to source writings. Michael Polanyi is usually credited with developing the theory of tacit and explicit knowledge. He believed that knowledge was both individually and collectively formed in a constant cycle between personal tacit knowledge and public explicit knowledge, but that all public explicit knowledge has a tacit dimension – that is public explicit knowledge is at once both tacit and explicit and based in individual experience (Polanyi 1966). Similarly Nonaka and Tacheui are widely quoted in the literature however much of their work has been misquoted, or incompletely quoted. In particular they actually distinguish between two types of tacit knowledge – the technical and cognitive. Furthermore they actually say that ‘Knowledge is not either explicit or tacit. Knowledge is both explicit and tacit’ (Takeuchi & Nonaka 2004, p. 4).

As soon as we accept that knowledge is at once both tacit and explicit, and public and private, we are able to reconcile the epistemologist’s position with the knowledge management practitioner’s. The epistemologist’s various positions (that knowledge belongs to individuals since information needs to be interpreted according to the individual’s internal mental model, or that knowledge is justified true beliefs’ which can manifest as social values and reside in a team) all sit comfortably with the knowledge practitioner’s data, information, knowledge divide, providing we accept that knowledge can only be generated in a human mind and is not instantly transferable (Kluge, Stein & Licht 2001, p. 107).

Davenport and Prusak’s definition that knowledge is a fluid mix of data, experience, practice, values, beliefs, standards, context, and expert insight that provides a conceptual arrangement
for evaluating and incorporating new data, information and experiences (Davenport & Prusak 1998, p. 5) now seems reasonable, but the challenge is to actually manage all of these things.

**Conclusion**

So where are we now? We have established that knowledge is derived from ‘justified true beliefs’, and is at once private and personal, and public and private. We have also established that ‘explicit knowledge’ by itself does not exist and actually is data, or at best information. We have determined that knowledge is a human phenomena that is dynamic, personal and degrades over time, and we have accepted Davenport and Prusak’s definition of knowledge whilst noting that the real challenge is actually manage a set of processes and interactions that may be inherently uncontrollable (Krogh, Ichijo & Nonaka 2000, p. vii).

In the next chapter five knowledge management models will be examined to see how these epistemological foundations have been used or not used.
Chapter Four: An Epistemological Evaluation of Five Knowledge Management Models

'I shall certainly admit a system as empirical or scientific only if it is capable of being tested by experience. These considerations suggest that not the verifiability but the falsifiability of a system is to be taken as a criterion of demarcation ... It must be possible for an empirical scientific system to be refuted by experience.'


Introduction

Management as a discipline was born in the 20th century, and for most of its short life has sort the ‘silver bullet’ or ‘golden nugget’ solution (Kennedy 2001, p. ix). This approach has not worked because managers have failed to implement fully the ‘big idea’, or worse still they have failed to fully comprehend the idea. Knowledge management is the current silver bullet. It promises much, but unless practitioners make explicit the underlying foundations of their model, and managers take the time to understand these foundations there is a danger that the promise will not be delivered.

In this chapter five knowledge management models are examined and their epistemological foundations are exposed. The models are:

- Ackoff’s ‘Pyramid to Wisdom’,
- Lundvall and Johnson’s 'Six Knows',
- Nonaka and Takeuchi’s ‘SECI Knowledge Spiral’,
- Popper’s ‘Three Knowledge Worlds’, and
- Firestone and McElroy’s ‘Knowledge Life Cycle’.

The analysis then examines how knowledge as both a phenomenon and as an artefact is used in each model. Finally an assessment of the practical utility and limitations of each knowledge management model is made.

The ‘Pyramid to Wisdom’

The Model

The ‘Pyramid to Wisdom’ Model is perhaps the most well known of all the models. It was first espoused by Russel Ackoff as a model that described the learning process (Ackoff 1989, 1996), but has since appeared in various guises in the knowledge management literature (See for example Håkanson 2001; Kannegieter 2001; Stewart 1999). Russel Ackoff’s pyramid is illustrated at Figure 1.

Ackoff believes that data, information, knowledge, understanding and wisdom are all components of individual and organisational learning (Ackoff 1996, pp. 27-8). He provides the following definitions:

‘Data consists of symbols that represent objects, events, and/or their properties. They are the products of information..."
Information is contained in descriptions, in answers to questions that begin with such words as who, what, where, when, and how many ...

Knowledge is contained in instructions. Knowledge consists of know-how... It makes maintenance and control of objects, systems and events possible...

Understanding is contained in explanations, answers to why questions...

Wisdom is the ability to perceive and evaluate the long-run consequence of behaviour.’ (Ackoff 1996, pp. 28-9).

To Ackoff these components of learning form a ‘hierarchy of increasing value’ (Ackoff 1996, p. 28) hence the reason for structuring the model as a pyramid. He makes the point that data transitions into information when it has been processed into a symbolic format, and that the distinction is one of usefulness not function. Information is useable in deciding what to do, not how to do it, and transmogrifies to knowledge when a how to question can be answered.

Ackoff believes that knowledge can be obtained from direct or indirect experience, and that both humans and computers can be taught how to do something, the later by having the knowledge of an expert programmed into it (Ackoff 1996, p. 28), presumably by encoding in how to instructions. He does make the point, however, that intelligence is the ability of an individual to acquire knowledge, and that computer systems that do not have the ability to learn can possess knowledge but not acquire it.

Understanding is the component that facilitates knowledge acquisition and determines the relevance and causal relationships of data and information. Ackoff says that:
Data, information, knowledge and understanding presuppose each other. They are acquired and develop interdependently. They form a hierarchy with respect to value, but none is more fundamental than others (Ackoff 1996, p. 29).

He goes to say that these components are the elements that contribute to doing things right but wisdom is the component that allows us to do the right thing.

An Evaluation of the Model

Newtonian logic posits that a machine is constructed from well-defined, precisely assembled, and interchangeable components that interact with each other in a pre-determined and specified way (Ehin 2000, p. 100). The problem with the ‘Pyramid to Wisdom’ is that it views knowledge in the same way, resulting in a model that is far too simple. Indeed, Ackoff’s definition of data being a product of information (Ackoff 1996, pp. 28-9) also makes the model as drawn somewhat nonsensical, given that information is depicted as a higher order. Furthermore it poses a real conundrum if in fact data is the product of information, and data presupposes information!

At this point we are left wondering exactly what information is and how, if it degrades to data, it becomes knowledge. Other author’s have also identified this same problem. For example, Thomas Stewart, in his book entitled ‘Intellectual Capital, the New Wealth of Organisations’, says that knowledge cannot be slotted into a data-to-wisdom hierarchy for the simple reason that one man’s knowledge is another man’s data (Stewart 1999, p. 70).

Ackoff’s definition of information as descriptions, if taken in isolation, appears to equate to illustrative facts, and therefore equates to the epistemologists true belief proposition, which in turn makes it knowledge. Perhaps this is how the transmogrification occurs!

Ackoff’s definitions of knowledge, understanding and wisdom appear to loosely correlate with the epistemological typology of capacity knowledge, acquaintance knowledge, and propositional knowledge. A closer examination reveals that Ackoff has defined data through to understanding as phenomena that can be codified as artefacts of one type or another – for example a symbol, description, instruction, or explanation. Wisdom however is problematic. It is defined solely as a phenomenon in which case it is more akin to an action or process rather than a thing. This typology is inconsistent. So where does this leave us, and is Ackoff’s model useful?

The Model’s Utility

Ackoff’s model and definitions, as depicted and described above from the source literature, are fundamentally flawed and have weak epistemological foundations. That said, providing the flaws are recognised, the model is useful in so far as it makes it clear that there is some sort of relationship between data, information, knowledge and understanding. It is an easy model to introduce to senior management when first introducing a knowledge management initiative to an organisation, as it depicts a possible strategy for where emphasis might be placed. For example, it can be used to highlight that technology solutions focus on the data and information components, whilst people initiatives are required for the knowledge, understanding and wisdom triumvirate. Beyond this the model has no place in the knowledge management discipline unless it is substantially amended and refined.
Lundvall and Johnson’s ‘Six Knows’

The Model

Lundvall and Johnson’s ‘Six Knows’ model\(^2\)\(^3\) is illustrated at Figure 2. The knowledge components of this model are: know what, know how, know why, know who, know where, and know when, each of which is introduced below.

![Figure 2: Lundvall and Johnson's (1994) 'Six Knows' Model](image)

‘Know what’ knowledge is the knowledge about how to find the relevant data to produce information. It is not about the data or information itself (Gregersen & Johnson 2001). This type of knowledge is increasing in importance simply because of the sheer volume of data that is now available to a corporation.

‘Know how’ knowledge is skills based and generally, but not exclusively, is personal in nature. ‘Know how’ knowledge is expert insight that allows an individual to interpret and give meaning to emerging complexity, and is often used to predict outcomes (Lundvall 2000). It is what distinguishes successful entrepreneurs from pedestrian businessmen, and plays a key role in all enterprise activities. ‘Know how’ knowledge is also found in teams, and is

\(^2\) Lundvall and Johnson do not give their model a name. I have called it the ‘Six Knows’ Model for ease of reference.

\(^3\) The MIT Sloan School of Management appear to use this model in some of their work. See for example Yoshioka, T, Herman, G, Yates, J & Orlikowski, W 2003, 'Genere taxonomy: a knowledge repository of communicative actions', in T Malone, K Crowstone & G Herman (eds), Organising business knowledge: the MIT handbook, MIT Press, Cambridge Masssachusetts, pp. 465-93. They call it the ‘5W1H’ model - why, what, who, when, where and how - but do reference Lundvall and Johnson, or Ackof.
The Knowledge Conundrum: Unravelling the Knowledge Component in Knowledge Management Models

represented in the shared routines, social relationships, and lexicons (Lundvall 2000). Without 'know how' knowledge teams cannot operate effectively. In this context 'know how' knowledge could be considered to be relationship capital.

‘Know why’ knowledge is both explicit and tacit, and involves the ability to understand and explain natural and social phenomena. It is explanatory and deals with principles (Gregersen & Johnson 2001). Explicit ‘know why’ knowledge resides in procedural publications and other books, which may be hard copy or held electronically. Tacit ‘know why’ knowledge is present in the various formal and informal groups within an organisation.

‘Know who’ knowledge is a form of individual and social knowledge that is largely tacit. It involves information about the gatekeepers to ‘know what’, the owners of ‘know how’ knowledge, and the possessors of ‘know why’ knowledge (Gregersen & Johnson 2001). ‘Know who’ knowledge also deals with the ability to cooperate effectively with different types of people and experts, and is a fundamental prerequisite for the learning organisation (Lundvall 2000). ‘Know who' knowledge therefore deals with human capital, and is learnt in both formal and informal social practice, in specialised education environments, and with day-to-day dealings with colleagues, customers, and competitors (Gregersen & Johnson 2001).

‘Know where’ and ‘know when’ knowledge is economically useful knowledge about markets (Standing & Benson 2000). It is knowledge that provides an economic advantage. For example Wal-Mart discovered a relationship between the sale of beer and nappies. They also found on further examination that the correlation was greater on a Friday evening. Wal-Mart increased sales by collocating the items near checkout counters on Fridays (Martin 2000). This represents both ‘know where’ and ‘know when’ knowledge. The ‘know where’ component is the collocation of the items. The ‘know when’ component is Friday evenings.

An Evaluation of the Model

Lundvall and Johnson’s 'Six Knows' model is actually a macro-economic model (Hasan & Handzic 2004, p. 7) that has found its way into the knowledge management literature. The model posits that different kinds of knowledge are useful for understanding the interactions between organisational learning, knowledge, and national economic development. It therefore makes little distinction between information and knowledge, and barely mentions data – this is the model’s primary weakness from a knowledge management perspective.

Because the Six Knows model is first and foremost an economic model it begins with the premise that individuals make rational choices (Mooney 1986), and to make these choices they must have knowledge. Rational choice is firmly rooted in the justified true belief school, and this model therefore belongs to this school.

The model has sound epistemological foundations. For example know what knowledge could be considered to be facts, know why as principles, and know how as skills. Clearly this encompasses the tacit explicit divide, as well as the epistemologist’s capacity knowledge, acquaintance knowledge, and propositional knowledge split.

The Model’s Utility

Lundvall and Johnson’s model has many similarities to John Zachman’s enterprise architecture model (see www.zifa.com), and uses the same six primary interrogatives. The Six Knows model has also been used to develop a genre taxonomy at the MIT Sloan School of
Management (Yoshioka et al. 2003, p. 466). It therefore has demonstrated utility as a framework for other initiatives that may contribute towards a knowledge management architecture. It provides managers with a useful way to look at the types of data and information they need for their business and gives some clues as to where it may reside, but whether they actually end up with knowledge is open to conjecture.

The model does provide cues that suggest any knowledge management issue must have a people dimension as well as a technology dimension such as data mining. It does not, however, provide a means for evaluating a knowledge claim, nor is it clear what processes are required to link people and technology. Its primary utility is therefore to provide a framework within which to park other initiatives.

**Nonaka and Takeuchi’s ‘SECI Knowledge Spiral’**

**The Model**

Nonaka and Takeuchi’s ‘SECI Knowledge Spiral’ is perhaps the most cited in the literature. It was first developed by Ikujiro Nonaka in 1991 and then collaboratively expanded by Hirotaka Takeuchi in 1995. Nonaka and Takeuchi’s students and colleagues at the Hitosubashi University Graduate School of International Strategy have further refined the model in later years.

It is important to note from the outset that Nonaka and Takeuchi use a justified true belief stance. In particular they say that ‘...knowledge unlike information is about beliefs and commitment. Knowledge is a function of a particular stance, perspective, or intention’ (Nonaka, I. & Takeuchi 2004, p. 49). Furthermore whilst they make the distinction between tacit and explicit knowledge, they actually distinguish between two types of tacit knowledge – the technical and cognitive – and make the point that knowledge is neither explicit or tacit, rather it is both explicit and tacit (Takeuchi & Nonaka 2004, p. 4).

The model consists of two parts. The first part is illustrated at Figure 3, and shows four modes of knowledge acquisition. These are:

- tacit to tacit, which is known as socialisation;
- tacit to explicit, which is called externalisation;
- explicit to explicit, which is labelled combination; and
- explicit to tacit, which is described as internalisation (Nonaka, I. 2004).

Nonaka makes the point that new knowledge always begins with the individual (Nonaka, I. 2004, p. 32), and then goes through the SECI process in what he calls the knowledge spiral, and which is depicted in Figure 3 as the green arrows. Tacit to tacit knowledge is acquired through social interactions and shared experience. Tacit to explicit knowledge represents the codification of an individuals or organisations experience, hence making it public. It is ‘triggered by dialogue and collective reflection’ (Nonaka, I. & Takeuchi 2004, p. 57). Explicit to explicit knowledge expands on externalisation by merging knowledge, distilling common threads, and combining the outcomes. Explicit to tacit knowledge is the creation of new knowledge by learning and internalising that knowledge. Nonaka says that:

*Articulation, converting tacit knowledge into explicit knowledge, and internalisation using that explicit knowledge to extend one’s own tacit knowledge base, are the*
critical steps in this spiral of knowledge. The reason is that both require the active involvement of the self – that is personal commitment (Nonaka, I. 2004, p. 35).

In 1995 Nonaka and Takeuchi developed a second model, which built on the first, to create a theory of organisational knowledge creation. This model is illustrated at Figure 4. It depicts the SECI spiral as knowledge moving from the individual to multiple organisations. They say the SECI process ‘constitutes the engine of the entire knowledge creation process’ (Nonaka, I. & Takeuchi 2004, p. 48).
If the SECI process is the engine of organisational knowledge creation, then the fuel is intention. Intention is most usually expressed as a business strategy. Because knowledge can mean many things to many people, and because the model relies on a justified true belief premise, Nonaka and Takeuchi say that:

‘The most critical element of corporate strategy is to conceptualise a vision about what kind of knowledge should be developed and to operationalise it into a management system for implementation’ (Nonaka, I. & Takeuchi 2004, p. 68).

Nonaka also make the point that:

‘...because tacit knowledge includes mental models and beliefs in addition to know-how, moving from the tacit to the explicit is really a process of articulating one’s vision of the world – what it is and what it ought to be. When employees invent new knowledge, they are reinventing themselves, the company, and even the world. When managers grasp this they realise that the appropriate tools for managing the knowledge-creating company look very different from those found at most Western companies (Nonaka, I. 2004, pp. 35-6).

Nonaka’s SECI Knowledge Spiral puts a large emphasis on the human factor, and goes so far as to say that knowledge is created through ‘interactions between humans and their environment’ (Nonaka, I. & Toyama 2004, p. 97). Because of this Nonaka believes that knowledge can only be enabled, not managed.

An Evaluation of the Model

There is no doubt that the SECI Knowledge Spiral has very robust epistemological foundations and that these are declared from the outset. The model is also very powerful in that it shows how knowledge is generated, acquired and assimilated in the individual as well the organisation. However, like the ‘Six Knows’ model little attempt is made to distinguish between data and information, and information and knowledge – perhaps this is not a bad thing? That said it is easy to argue that ‘explicit knowledge’ in the combination square is actually data, or perhaps information if it has some context. This square fails to account for the premise that Nonaka began with - that knowledge is neither explicit or tacit, rather it is both explicit and tacit (Takeuchi & Nonaka 2004, p. 4).

Subsequent versions of the SECI process developed at the Hitosubashi University Graduate School of International Strategy have refined the model somewhat by indicating what actions are necessary in which sector to enable knowledge (See the diagram in Nonaka, I & Toyama 2004, p. 98). For example, in the combination square they say that explicit knowledge and information is systemised through the actions of:

- gathering and integrating;
- transferring and diffusing; and
- editing (Nonaka, I & Toyama 2004, p. 98).

This resolves some of the difficulties because there is an acknowledgment of the existence of information, and clearly editing involves some invisible thought and tacit knowledge acquired through internalisation.
Another weakness is the spiral itself. The idea appears to be that knowledge is ever growing phenomena that do not degrade over time. Accordingly we have a single direction upwards moving model, yet intuitively we know that this is not true.

**The Model’s Utility**

Despite the criticisms espoused above the SECI Knowledge Spiral has considerable utility as knowledge management model in that it provides a clear hypothesis of how knowledge is generated in the individual and organisation. It also makes plain its justified true belief premise, which should allow managers to evaluate what is knowledge to them, and for their organisation. Finally, it is particularly useful in highlighting that knowledge management at the end of the day is about managing people and providing them with tools and processes that enable their productivity – it is not about technology initiatives.

**Popper’s ‘Three Knowledge Worlds’**

**The Model**

Sir Karl Popper had a major influence on philosophical thinking in the middle 20th Century, and therefore is most often thought of as a philosopher. It is debateable, therefore, whether his writings and his ‘Three Knowledge Worlds’ model should be considered here or in Chapter Three. I have placed it here because I believe that his model has some virtue as a knowledge management model, even though it was originally developed as a knowledge model.

Popper conceived reality as occupying three worlds – these are:

- the physical world, which he called World One;
- the psychological or cognitive world, which he called World Two; and
- the world of products of the human mind, which is sometimes called the information world in the knowledge management literature (see for example McDonald 2003, p. 1), but which Popper called World Three.

For Popper World One consists of non-living physical objects and living things. World Two is the place of pain and pleasure, thought and decisions, perceptions and observation, and in this sense is personal. World Three is the product of the human mind such as music, stories, and engineering feats like the Sydney Harbour Bridge (Popper 1978, pp. 143-4). Popper’s ‘Three Knowledge Worlds’ is illustrated at Figure 5.

What is immediately evident from the brief description is that it is possible for something to simultaneously belong to both physical World One and the product World Three. If a book is taken as the example, such as the Bible, it is possible for the product to be the same – that is the words are the same - but the various physical entities to be vastly different (Popper 1978, pp. 144-5). In this sense World Three objects are embodied or physically realised in World One artefacts, and might even be considered to be data, although most usually it is considered to be represented knowledge. World Three objects are abstract and their physical embodiment is concrete objects (Popper 1978, p. 145).

Popper distinguishes between what he calls 'knowledge in the subjective sense' and 'knowledge in the objective sense'. 'Knowledge in the subjective sense' consists of subjective expectations and thought processes, which largely exist in World Two, whilst
'knowledge in the objective sense' is thought content expressed as linguistically formulated theories (Popper 1978, p. 145). The transition from a thought process to a thought content may result in a World Three object (Popper 1978, p. 145) because it is codified into a form that others can use. To Popper a belief is a World Two object until such time as it is codified and subject to criticism, whereupon it become a World Three artefact and may become a truth. These truths are expressed as linguistic statements (McDonald 2003, p. 2), which are data and information.

![Figure 5: Popper’s Three Knowledge Worlds’ Model](adapted from McDonald 2003, p. 2)

**An Evaluation of the Model**

Whilst Popper probably would not agree, his model has the elements of justified true belief. He held that scientists could not prove anything with certainty – all they could do was prove that theories are not correct by falsifying them (Popper 1963, pp. 36-7). That is, a theory or belief, once codified and criticised becomes a truth; or in other words it has been justified and we end up with a justified true belief (Skerry), until such time as it is falsified.

Popper’s dichotomy between subjective knowledge and objective knowledge can be likened to the analogous dichotomy between tacit and explicit knowledge. However, Popper clearly belongs in the autopoietic epistemological school. Recall that this school’s position is that knowledge belongs to individuals since information, which is mere data in context, needs to be interpreted according to the individual’s internal mental model.

The real strength of Popper’s model lies, however, in the clear distinction it allows between data and knowledge. Data is a symbolic statement, and therefore belongs in World Three (McDonald 2003, p. 2). Data when activated by a thought process may become knowledge, but this knowledge resides in World Two until such time as it is codified and becomes subject to criticism, whereupon it moves into World One and Three to become at best represented knowledge in World Three, or decomposes back to data or information. This distinction is important because it implies that for something to be represented knowledge it must first be evaluated.
The Model's Utility

Popper's 'Three Knowledge Worlds' is useful in so far as it provides a framework for a knowledge management initiative and the potential to pull together several other models into a common overarching construct.

Firestone and McElroy's 'Knowledge Life Cycle'

The Model

Pulling together several other models into a common construct is arguably exactly what Firestone and McElroy have done. Using Karl Popper's works as a framework, they define knowledge as follows:

- World One knowledge is encoded structures in physical systems that allow those objects to adapt to an environment.
- World Two knowledge consist of beliefs and belief dispositions about the world that have survived personal tests and evaluations.
- World Three knowledge is shareable linguistic claims about the world (Firestone, J. & McElroy 2003, pp. 5-6).

They also say that:

*Our definitions of Worlds 2 and 3 knowledge do not require that knowledge be true. In fact, our position is that knowledge claims are fallible and that while a particular knowledge claim may be true, and that its function is to state what is true, even those that we call knowledge may prove to be false in the future if they fail to survive our tests* (Firestone, J. & McElroy 2003, p. 7).

Clearly they view knowledge in different way to most other knowledge practitioners, and question many of the assumptions behind current thinking in knowledge management (See Firestone, J. & McElroy 2003; Firestone, J. M. 2003; McElroy, M. 2003). In particular they see knowledge as a subset of information rather than a higher order, and say that knowledge is actually a special form of information (Firestone, J. & McElroy 2003, pp. 18-9).

Firestone and McElroy’s ‘Knowledge Life Cycle’ Model is illustrated at Figure 6. You should note that the knowledge cycle begins with a problem that produces information, which may result in data, just information, or knowledge.
The ‘Knowledge Life Cycle’ itself is illustrated at Figure 7. Of note is that the model distinguishes between demand-side knowledge management and supply-side knowledge management. Demand-side knowledge management is concerned with knowledge production, and supply-side knowledge management with knowledge integration. McElroy, in particular, believes that most knowledge management initiatives focus on the supply side, and that the reason for this is an underlying assumption that knowledge already exists. This results in an emphasis on codification, storage and retrieval, and distribution and sharing, at the expense of knowledge production (McElroy, M. 2003).

An Evaluation of the Model

It is very difficult to give due justice to Firestone and McElroy’s model in this short space, particularly given they have written three books on it and numerous articles. Like Nonaka and Takeuchi’s ‘SECI Knowledge Spiral’, Firestone and McElroy’s ‘Knowledge Life Cycle’ has very sound epistemological foundations, which are made apparent from the outset. Indeed Firestone and McElroy go to great pains to cover all aspects of knowledge from political views to links with organisational learning and complex systems theory: in this sense the model is holistic as opposed to mechanistic, and seems to account for many of the anomalies that other models fail to cover. Furthermore by adopting a Popperian framework the model makes a clear distinction between data, information and knowledge.

A particular strength of the model is the distinction between the business processing environment and the knowledge processing environment, as depicted in Figure 7. This distinction is important as it delineates procedural know how knowledge from declarative
knowledge, and information articulated as artefacts. Such an approach recognises that people can and do solve problems without following declared business processes, and that this social process cannot be managed but it might be enabled in the right conditions.

**The Model’s Utility**

Firestone and McElroy’s ‘Knowledge Life Cycle’ has considerable utility in the workplace if it can be operationalised. For example, it neatly ties together many other management theories, as well as systems and complexity theory, in a holistic way to focus on both knowledge production and knowledge integration. Firestone and McElroy go to great pains to show how it might be operationalised in their various publications (see for example Firestone, J. & McElroy 2003; Firestone, J. M. 1999, 2003; McElroy, M. 2003; McElroy, M. W. 2000), however it is my view that their examples lack some credibility because a case study from cradle to grave is not presented. This view is supported by others like Nowe who says that some aspects of the process are too unrealistic to be of value (Nowe 2003).

**Conclusion**

Of the models the weakest is Ackoff’s ‘Pyramid to Wisdom’, which has little epistemological foundation and actually does not make sense when the definitions are considered in detail! Popper’s ‘Three Knowledge Worlds’ and Lundvall and Johnson’s ‘Six Knows’ provide useful frameworks for knowledge management initiatives, but by themselves are unsatisfactory.

On the other hand, Firestone and McElroy’s ‘Knowledge Life Cycle’ and Nonaka and Takeuchi’s ‘SECI Knowledge Spiral’ are both well developed models with explicit epistemological foundations. Both models suffer from a general weakness in the literature, in that no example is provided that firstly illustrates the ‘knowledge process’ from end to end, and then explains, rather than describes, how it actually works. This makes it extremely difficult to evaluate the models, let alone determine their utility in the business world.

A critical evaluation suggests that the ‘Knowledge Life Cycle’ and the ‘SECI Knowledge Spiral’ could be usefully combined. Denis Skerry sums it up nicely:

> People exist in World Two. Through socialisation they seek to construct a common understanding of the physical realities that are World One. The sender externalises (speaks – World Three) and the target internalises (listens – World Two) to share experience and construct a common frame of reference. The target then combines (World Two) what they heard with their own experience (tacit knowledge – World Two) to develop a new or better understanding (increase or improve tacit knowledge – World Two) (Skerry 2004).

This is an area that is worthy, in my opinion, of further research. This research would be of considerable value if the two models could be combined and refined, and then illustrated with an end to end case study. The case study should be both descriptive and explanatory.
Chapter Five: Conclusion

If you dissemble sometimes your knowledge of that you are thought to know, you shall be thought, another time, to know that you know not.

Francis Bacon – English Philosopher (Partington 1996, p. 43)

Introduction

This chapter draws together the report; proposes which model is most suitable for knowledge management system development; and then makes some recommendations for further research. It begins with question ‘What have we discovered?’

What have we Discovered?

We have discovered that epistemology is first and foremost a regulative discipline – that is it seeks to prove or disprove that something is knowledge. On the other hand knowledge management theory tends to be generative – that is it tends to try to understand how knowledge is grown and fostered. Unfortunately it has focussed on the generative aspects of knowledge with little regard to the regulative aspects defined by questions like ‘What is knowledge?’ and ‘What kinds of knowledge are there?’ This is an obvious weakness in the state of the art.

Secondly we have established that humans are an essential agent for knowledge and that knowledge probably cannot exist outside of a human, particularly if we adopt a justified true belief position. Indeed it is wise to remember that whilst computers can extract dumb data from machines, and can even find patterns that humans may take forever to find, this is simply taking data and making it into information by giving it context – it is not creating knowledge. Whether the patterns are real and useful ultimately requires understanding of relations and causalities, and when to apply or discard a rule, something that so far can only be done by a human (Martin 2000). Lewis Hassell, a philosopher at Drexel University Philadelphia, summarises this position nicely by saying that there is no knowledge outside of experience, therefore knowledge is always ‘embodied, and that experience is always the experience of some rational individual in society, therefore there is no such thing as disembodied knowledge.’ (Hassell 2004, p. 1) All this means that explicit knowledge, as the knowledge practitioners define it, is quite simply datum and information artefacts. In turn it leads to the conclusion that knowledge cannot be managed per se, but it can be enabled – this is Nonaka and Takeuchi’s proposition from the outset.

Which Model?

Of the models considered both Firestone and McElroy’s ‘Knowledge Life Cycle’ and Nonaka and Takeuchi’s ‘SECI Knowledge Spiral’ provide a solid basis for a knowledge management initiative. Both models are mature and have clear epistemological origins. But, both models suffer from a general weakness in the literature, in that no example is provided that firstly illustrates the ‘knowledge process’ from end to end, and then explains, rather than describes, how it actually works. This makes it extremely difficult to evaluate the models, let alone determine their utility in the business world.
Recommendations

Perhaps the strongest recommendation that could be made is the need for research that develops a common approach and an agreed lexicon for knowledge management as a discipline. Until the methodology and lexicon is developed and achieves wide acceptance knowledge management will remain as a black art, and will continue to be discredited as having a shaky theoretical basis akin to alchemy. Furthermore there is a need to put a boundary around the discipline if it is to survive as a discipline in its own right.

The second most important recommendation is the requirement for a recognised method to evaluate a knowledge claim, both at the personal and organisational level. The test need not be as stringent and rigid as the philosophers method outlined in Chapter Two, but it should be repeatable in similar circumstances.

Thirdly case study research that illustrates a knowledge management intervention and explains, rather than describes, the ‘knowledge process’ from end to end, is sorely needed. In a similar vein critical analysis of the existing models is also required.

Finally it is worth noting that this report has a once over lightly flavour. The theme of the report, if coupled with a case study, would provide an outstanding topic for a Doctor of Philosophy candidate. I strongly recommend that Canberra University consider sponsoring research into this area – I would like to be that candidate.
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