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# The Three K's

## A model for knowledge that supports ontology and epistemology

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### ABSTRACT

The predominant taxonomy of knowledge models depict a hierarchical prescriptive structure that emphasizes discrete categorisation of knowledge. Whilst benefiting cataloguing of knowledge, by favouring an ontological over epistemological approach these taxonomies do not comfortably facilitate codification under situations of ambiguity, intangibility or duality. By incorporating the circumstances of knowledge into the knowledge itself, the 3K model supports more accurate capture, storage and utilisation than purely ontological mechanisms. Apart from improving the ability to capture more elusive implicit knowledge, conditions of dualism where the same knowledge is known in different ways by different people or under different contexts by the same person may now be better accommodated.

**Keywords**: knowledge, ontology, epistemology, 3K model, homeostasis, known, knower, knowing

### 1. INTRODUCTION

Much effort is being expended, particularly within the disciplines of information and computer sciences, in identifying the optimal structure to support knowledge as a record of reality. This reality may be explicit and readily codified, such as a manufacturing process, or it may be implicit and difficult to articulate and separate from the mind of the knower, such as sculpting.

However, a simple example will show that approaching knowledge as an ontology (the study of the nature and relations of things which exist) is insufficient. Two people, standing together, perceive the temperature of a cup of coffee differently. One of those people perceives the temperature differently on different days. In all cases the absolute temperature of the coffee does not change.

Our perception of reality is imperfect. In some way we are always observing and internalizing an abstraction of reality as we sense it. By regarding knowledge merely as a mechanistic copy or summarisation of reality, we assume Ackoff's hierarchy of data and information through to knowledge [1] provides sufficient explanation.

Epistemology, the study of theories of knowledge or ways of knowing, should not be left to philosophers and the cognitive sciences. This paper intends to show how knowledge is inextricably linked to the knower.

Using our example, the one coffee drinker is used to hot coffee, and feels our serving is lukewarm, whereas the other feels that cup is hot. At second tasting, the ambient temperature may have been warmer, and the second drinker experiences what he perceived as a now slightly cooler beverage. From this evidence, how do we categorize our knowledge of coffee and coffee drinkers, or codify a consistent set of rules?

Building on previous research [2,7], this paper will present a model that supports externalization and codification of both the structure and function of knowledge. Rather than supplant previous work in this field, it will offer an enveloping framework that supports and supplies relevance to the disparate theories both within and across ontological and epistemological fields (examples of which are tabled in Appendix A)

### 2. THE KNOWLEDGE PROBLEM

We will suggest that there are two predominant problems afflicting the study and utilisation of knowledge today. The first problem, which we seek to address here, is consensus on an accurate and embracing definition for knowledge. The second is a suitable method for the manipulation of knowledge.

The prevailing taxonomy of knowledge models depicts a hierarchical prescriptive structure emphasizing categorization of knowledge according to discrete classifications. This facilitates comprehension and implementation and supports implementation of knowledge in situations where a catalogue is beneficial. These models recognize that knowledge may be implicit, imply that it may be codifiable, but rarely describe how to codify it. There is however no suitable provision for dualism, where tacit and explicit coexist and are inextricably linked.

This presents a problem because much of what we do practically relies on knowledge, not information or data, and historically recent pervasion of technology requires that we share our knowledge more openly using less intrinsic methods than our born senses. Writers of an email, for example, will use capitals or emoticons such as little smiley faces to communicate their intentions. Previously that meaning would be clarified with body language.

Without a satisfactory definition for knowledge, any application or technology runs the risk of only being a partial solution. Not only are there technical and conceptual complications, but also machines do not possess a sufficiently compatible interface with biological systems. During externalizing and transfer, not only is the storage medium for knowledge changing, but usually format and substance of knowledge changes too.

For example, an organization using an intranet as a knowledge transfer and productivity tool would need to consider the context of the knowledge, relevant to the organization, the creator or codifier, and the recipient. Otherwise, a prescriptive approach may result in instructions on cheque requisition taking on the enthusiasm of marketing, or a compassionate leave assistant being as dry and impersonal as an inventory checklist.

## 3. MODELS OF KNOWLEDGE

We shall first consider various contemporary models of knowledge.

### Ontological views

Polanyi [3] arranged knowledge on a continuum from explicit to tacit; from tangible and which could be expressed, to intangible and retained in the mind of the knower. Choo [4] added cultural knowledge, the basis for what we deem fair and trustworthy. Vasconcelos et al [5] classify knowledge by replacing Polanyi's continuum with a dichotomy, and adding another level to further categorize tacit and explicit knowledge.

Considering knowledge practically, Demarest [6] identifies scientific, commercial and philosophical knowledge. Orange et al [7] present knowledge on two levels, soft knowledge that is close to information and codifiable, and interpretive knowledge, which is practically understood and may be held individually, socially or by an organization. Sveiby [8], in his model of knowledge management practitioners, divides knowledge into objects and processes.

The transfer of knowledge has also been treated ontologically. Boisot [9] regarded knowledge as either codified or uncodified in his *C-D Theory*. Nonaka and Takeuchi [10] described the flow of knowledge as a transfer process that involves either tacit or explicit.

Many knowledge models contradict Polanyi in requiring discrete categorisation of a piece of knowledge into one or another type. Most cannot completely accommodate duality, where the nature of a piece of knowledge is twofold. Their value comes from their strictly describing the nature of a single atomic piece of knowledge, suited to situations where neat classification is useful, such as catalogues.

### Epistemological views

Philosopher Karl Popper [11, 12], after deliberating on scientific knowledge, developed his *theory of falsification* whereby knowledge cannot intrinsically be proven true, only false by means of a refutation, knowledge a belief until replaced with a concrete rebuttal. This implies if a belief is knowledge, then knowledge must be able to exist solely in the imagination of the knower and have no prior corporeal relationship.

Medical opinion has considered whether knowing knowledge and brain function are linked. Penfield [13] described the mind as a tape recorder, and linked mind to body. Bateson [15] deduced that to biological systems, information is based on perceived difference. Greenfield [14] separated memory into short term and long term, where long term memory has an explicit and implicit component, the latter not needing to actively and consciously remember something.

Perception however is not necessarily just a faithful replica of what we sense. In discussing data analysis in social systems, Dey [16] said, "*The trouble is, of course, that we tend to see what we want to see and hear what we want to hear… We tend to make more of the evidence that confirms our beliefs and pay less attention to any evidence that contradicts them.*" This suggests that knowledge may be strongly affected by context and past or other knowledge.

**Comprehensive views**

Some authorities have described knowledge more comprehensively. Samuel Johnson, succinctly defined it as:

"*Knowledge is of two kinds: we know a subject ourselves, or we know where we can find information upon it*."

A little more detailed is Wiig's [17] definition:

"*Knowledge consists of truths, beliefs, perspectives and concerns, judgements and expectations, methodologies and know-how. Knowledge is accumulated, organized and integrated and held over longer periods to be available to be applied to handle specific situations and problems.*"

Although not formal enough on which to design a digital repository, this definition introduces time and process. The Davenport and Prusak [18] definition includes the concepts of transience, context, frameworks, metaphors, processes and the mind of the knower:

"*…a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of the knowers…*"

They go on to support Ackoff and Bateson to some extent by discussing how the process of evolution of information into knowledge occurs through comparison, consequences, connections and conversation.

## 4. THE 3K MODEL

The above views of knowledge have been reached through extensive research, are well considered positions and all demonstrable through observation. To reconcile rather than replace the work of the authorities mentioned and others, it is necessary to view knowledge holistically. Young [29] says:

"*What is missing in modern sociology is the understanding that it is inevitable that epistemology and ontology will, whatever the linguistic system we use, collapse in on each other… …the respectable thing to do is to accept the interconnection between epistemology and ontology and, thus, accept our moral responsibility for the world we shape and misshape.*"

**The dimensions of knowledge**

From the above research we develop the argument that knowledge simultaneously exhibits properties from three dimensions:

- *Known* dimension – **what** is known
- *Knower* dimension – the viewpoint and context introduced by the mind of the holder of what is known, the **who, why** and the **where.**
- *Knowing* dimension – the processes associated with knowing what is known, specific to the knower, the **how** and some of the **why.**

These three dimensions are inextricably linked, yet are each constituted from, and may be regarded as, knowledge in their own right. Consequently, each dimension may be independently examined and even codified. The relationship between these dimensions is also circumstantial and differs for each piece of knowledge.

Each dimension may vary in its significance to each piece of knowledge. Implicit knowledge would typically have a higher knowing and knower content than tacit knowledge. Explicit knowledge would be richer in the known dimension.

Importantly, knowledge that forms the known dimension for one piece of knowledge may be the knower dimension for another. Given that knowledge occurs at the confluence of these three dimensions, and that a piece of knowledge in one dimension may have influence on several others, the body of knowledge should not be structurally prescribed. It should rather be amorphous. This is not to say that distinct hierarchies may not evolve as the body of knowledge grows. Structurally, knowledge and the device or system that retains it differs.

Dimensions of knowledge may be illustrated using our coffee drinker. The temperature of the beverage and the climate fall into the known dimension, taste and temperature preference come from the knower, and the validity of experience induced by scalding becomes part of the knowing dimension.

**Knowledge as a system**

Most knowledge comes about through interaction with and absorption from the environment, so probably no single piece of knowledge is self contained. As part of a larger system, and since we are following a pragmatic approach, knowledge is by implication an open system. The nature and structure of this system therefore can be expected to determine the nature of its knowledge.

The first question to ask is as to why the system is collecting knowledge. Perhaps it is to achieve objectives. Checkland [19] defines hard systems as those displaying well defined objectives or where the end state is clear, and soft systems as those where it is difficult to define the objectives or where the end state is unclear. Popper's theory of falsification would suggest then that knowledge as a belief indicates the system is soft. Klir [20] in his

definition of self-organizing systems provides insight into why the system is functioning:

"[self-organizing systems are] *a case of goal oriented systems that are capable, with no explicit outside help, of improving their performance whilst pursuing their goals*."

Next, we must consider how the knowledge comes into being. In addition to Bateson [15], we may also find evidence of knowledge generation mechanisms in Prigogine [21] and Kauffman [22], the latter saying:

"*Organisms and other entities which interact with their worlds are likely to couple to those worlds in such a way that smooth classification occurs, and the world is seen as relatively stable. Then the 'knower' should not be chaotic, nor should its classification, the 'known' be.*"

Are systems capable of becoming knowledgeable through complexity, an idea behind endeavours such as Lenat's *Cyc*? In considering living systems, Sober [27] distinguishes between *structuralism*, the material arrangement of many individual components, and *functionalism*, the high level operation of the system. Rosen [28] feels that emergent behavior cannot be achieved through a threshold systemic complexity of either of these.

We therefore establish that knowledge is an integral part of a system, and that a knowledge system requires an identity or understanding of itself (*distinction*), an environment (*space*), an understanding of the environment and a boundary between the two to serve as the benchmark for identifying difference (*observer*) and supporting mechanisms such as *structural coupling*. It must also accommodate the requirements of both structure (*structure*) and function (*organization*). (Words in brackets are Maturana and Varela's definitions [25]).

Using the organization intranet to illustrate, its distinction is a tool that serves knowledge requirements of the organization. Without that identity it may become a games and graphics repository for personal use. It recognizes its space as being people within the firm, and includes a limited number of external information sources. Unbounded, the system may bloat and become inefficient. Structurally the body of knowledge may be arranged along vertical departmental lines, but functionally it may serve requirements horizontally across departments, thereby separating for performance reasons the creation and utilisation of knowledge.

**Knowledge and learning**

Chilean biologists Maturana and Varela's autopoietic theory [25] was used extensively in the research leading up to this paper to understand the underlying reasons why a system would accumulate knowledge, and what knowledge it would seek. Autopoiesis is defined as those systems that maintain their organization in spite of environmental or structural change, and regenerate their components in the course of their operation. From autopoietic theory, the concept of homeostasis appears to play an important part in the collection of knowledge. Homeostasis is where an organism maintains a stable equilibrium within itself and will display an ability to recognize and react to the conditions present in that environment.

A system should understand the dynamics of its world in order to survive or react to conditions, and stable equilibrium may be a requirement at all levels of Maslow's [30] hierarchy of needs. A system observes a difference (Bateson [15]), identifies an impact on itself and stores that information. For that information to become knowledge, it stores the context too. Future interactions with similar circumstances build up the body of knowledge, and the system becomes more adept at identifying difference, particularly when it learns to compare external stimuli against internal memory.

So why does the system not run out of control, trying to remember everything and become "*an unwieldy and shapeless mass of human experience*" (Chia [23])?

Firstly, Checkland's [19] concept of *Weltanschauung*, the world-view of the system, is useful in addressing this issue. Unless the edge of the system has been delineated, its identity is unclear. Unless the system 'knows' what it is, it cannot know where its boundaries lie. Since a system should have goals or some end state, the breadth of knowledge collection cannot be restricted until it 'knows' what it is by introducing that boundary. Homeostasis would guide the system to recognize only important or relevant conditions that affect its equilibrium, and that stability is the boundary.

We have shown that knowledge is an open system, that its boundary with the environment is permeable. If knowledge is absorbed from, or created as a result of interaction with, the environment and then modifies the existing body of knowledge, we consider the system to have learnt something.

Interaction with the environment is bidirectional, and there is a difference between the push and pull of that flow. Rocha [24] says, "*we should move towards models that include both programmable and self organizing components*". A model for knowledge should allow both. We teach our children, if only to prevent them from learning painful lessons, and they gradually become more adept at learning themselves. Once again the principle of homeostasis is used to regulate the balance between teaching and learning. A body of knowledge would have stimuli pushed upon it until it approaches the desired

equilibrium, whereupon its probing of the environment for further stimuli will become predominant.

There is evidence that certain regularly performed memory functions change from being long chains of explicitly held instructions, to implicitly known shortcuts, where as Greenfield [14] describes "*we do not need to actively and consciously remember how to do something*." This is part of learning too, and the original unabbreviated chains could be retained in the knowing rather than the known dimension, available to the knower as context or background when analysis or explanation is necessary.

**Transient knowledge**

Ratey [26] describes research that has shown that the physical interconnection of synapses in the human brain are not hard wired during childhood, but constantly develop throughout life. Human systems also forget, and this is sometimes necessary or advantageous, as knowledge of pain would suggest.

As a homeostatic open system, knowledge must be able to accommodate changes in the environment, either by replacement, addition, modification or deletion. The various original dimensions that have combined to hold a piece of knowledge may still be intact and unaltered, but changes in the ratios and content of one or more dimension may affect the knowledge itself.

**3K model synopsis**

The 3K (*known-knowing-knower*) model of knowledge presents knowledge as:

- having a weltanschauung that consists of the body of knowledge, its environment, and the channels that connect the two.
- residing at the confluence of other pieces of knowledge from the dimensions of what is known, knowing it, and in the mind of the knower.
- having a understanding of its own identity as separate from the environment.
- achieving homeostasis within its environment.
- being intrinsically amorphous.

Functionally, knowledge has

- three dimensions which are structurally identical but may functionally differ.
- accommodates programming, evolving and learning; and does not structurally differentiate knowledge purely on the basis of these mechanisms.
- a piece of knowledge has a boundary that is a subset of the system boundary.
- pieces of knowledge that can be extracted intact from the body of knowledge, but not without all related knowledge from the three dimensions within its boundary.

## 5. EVOLUTION OF THE 3K MODEL

A viable generic model for knowledge should be theoretically sound as well as pragmatic. For practical purposes it would have to deliver the following benefits:

- Describe the nature of knowledge in a generally useful and pragmatic way.
- Support codification of knowledge under many circumstances.
- Support knowledge as either a singularity or as part of an interdependent collection.
- Support relevant and cohesive retrieval of knowledge consistent with the contexts of the original knower and the destination knower.
- Describe knowledge in a way that is compatible with the operations and manipulations knowledge undertakes and is subjected to.
- Provide a framework across disciplines that will not detract from proven work.

Definition: *Knowledge* is a transient state at the confluence of what is known, how it is known (knowing), and who knows it (knower).

Definition: The *Knower* possesses and understands its own identity, and maintains its body of knowledge in order to and in the course of sustaining a stable equilibrium with its environment.

The 3K model for knowledge appears to theoretically reconcile views of knowledge across several disciplines. Appendix A tables these similarities. The model further provides for situations where knowledge is complex, and even when it is dualist or multi faceted. With correct and comprehensive codification, both epistemological and ontological perspectives are supported.

**Future work**

Future research will involve a deeper investigation into the nature of knowledge as a state, lower level analysis of the dimensions of knowledge, and evaluation and design of repository technologies. It will further develop a model produced during funded research (Further details may be found at http://is.lse.ac.uk/b-hive) [7] in which a framework and method for the externalization, codification and capture (using database technology) of implicit knowledge was developed. This is a simplistic but effective model that provides a situation through workshops to simulate the social environment within which the knowledge was created. Future research will seek to place this model within the context of the 3K model, thereby providing a more sophisticated model facilitating the contextualization of knowledge.

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## APPENDIX A: SIMILARITIES ACROSS DISCIPLINES

| *Dimension* | *Authority* | *Ontological* | *Epistemological* |
|---|---|---|---|
| Known (ontology) | Aristotle and Johnson | Real and permanent | Known |
| | Popper | Nature | Validity and justification |
| | Polanyi, Choo | Explicit | Implicit |
| | Sveiby | Object | Process |
| | Boisot | Codified | Uncodified |
| | Nonaka and Takeuchi | Explicit | Tacit |
| Knowing (epistemology) | Greenfield | Facts and events | Instinctive, habitual memory |
| | Penfield | Body, biological | Mind, psychological |
| | Dey | Evidence | Beliefs |
| | Westley, Lackoff, Nonaka Yamanouchi | Facts | Metaphors |

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| | | | |
|---|---|---|---|
| | Bateson, Hoffmeyer and Emmeche | Information | Difference |
| Knower (system) | Checkland | Hard systems | Soft systems |
| | Langton | As we know it | As it could be |
| | Sober | Structuralism | Functionalism |
| | Kauffman | Known | Knower |
| | Conrad | Programmability | Evolvability |
| | Clark and Staunton | What | Who |
| Autopoiesis | Maturana and Varela | Structure | Organization |