# Exploring the Foundations of

# Organisational Knowledge

An emergent synthesis grounded in thinking related to evolutionary biology.

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**Abstract**

Prevailing views about what constitutes organisational knowledge need to be systematically evaluated at deep epistemological levels. We argue there is a need is to establish a new paradigm comprised of both a theoretical and an ontological foundation for thinking about knowledge epistemologies. We think, along with Bill McKelvey, ([1997](#), [2002](#)) that the "science of management" as it relates to organisations seems to be greatly wanting.

Our approach is based on an evolutionary theory of knowledge contained within Karl Popper's later epistemological works beginning with his 1972 "Objective Knowledge – an evolutionary approach" and a framework of organisational theory based on Maturana and Varela's concept of self-producing complex systems ("autopoiesis"). We have drawn upon this combined approach in order to understand how best to integrate understandings of personal and objective knowledge and the notion of "living organisations" into a new paradigm of organisational knowledge.

A model that is congruent with this new paradigmatic approach is detailed and discussed. This model is designed to provide a general overview of the different types of knowledge that give rise to organisational knowledge.

Importantly, we highlight that all explicit knowledge held in organisations encoded in analogue or digital form (content) is in fact inert. Equally, we claim that calling such content knowledge objects is dependent upon the type and role of the social systems within which such content is created, reviewed and evaluated. In general terms, knowledge objects cannot be regarded as "living knowledge" unless the filter of human interpretative intelligence is applied to generate meaning from these objects or, increasingly, unless such intelligence is built into dynamic processes and systems within the organisation. Therefore, we claim that the human aspects of managing knowledge are of significant importance. We suggest that the metaphor of "organisational boundary as membrane" is an important element of organisational knowledge. This is because different types of flows and exchanges that cross the boundaries of organisations over periods of time are fundamental to how an organisation sustains its ability for self production and self-control. We claim, in conclusion, that these features of organisational knowledge have crucial implications for how different types of knowledge are best managed.

This paper relates to a power point presentation made at the actKM National Conference in September 2007 (see [http://tinyurl.com/2sjum4](http://tinyurl.com/2sjum4)). The ideas presented have been developed within a group of collaborators interested in developing a synthesis of approaches that embraces knowledge management and its links with organization theory, autopoiesis and Karl Popper's evolutionary epistemology.

# Introduction

This paper explores the relationships and differences between knowledge at the personal level and knowledge pertaining to whole organisations. Over the past decade, a number of different ways of thinking about such matters have evolved, primarily from within the domain of knowledge management (KM). For example, Snowden (2002) traces what he suggests are three distinctly different generations of KM. Firestone and McElroy (2002) critiqued Snowden and other's views (for example Koenig (2002) and suggested there has only really been two generations of KM. Quite independently, Vines and Naismith (2002a) embarked on a similar comparison of different generations of KM and proposed an adaptation of the concept of the Knowledge Life Cycle proposed by Firestone (1999b) and McElroy (1999, 2002)[1] and discussed extensively by Firestone and McElroy (2002). Vines and Naismith (ibid) concluded that KM should be conceived as an integrated support system. Quite unknown to them at the time, their conclusions, in part, reflected ideas about the Enterprise Knowledge Portal (EKP) proposed by Firestone (2000 and 2003).

What follows here is an attempt to adapt these original ideas and to explore some elements of how knowledge is formed and what might be the implications for understanding the nature of organisational knowledge.

In framing our paper, we are cognisant of very recent efforts taken around the world to explore the technical aspects of KM. For example, Prat (2006) has recently published a hierarchical model for knowledge management. Dieng-Kuntz (2006) explores the notion of Corporate Semantic Webs. Schwartz (2006) discusses an Aristotelian view of KM. Christani and Cuel (2006) write about domain ontologies. Aarons (2006) discusses "epistemology and knowledge management". These examples are all important contributions.

However, we think there is a need to establish a new paradigm (Kuhn 1962) comprised of both a theoretical and an ontological foundation for thinking about theories of knowledge. The notion of organisational knowledge needs to be systematically evaluated. Our view is that a "science of management" as it relates to organisations is greatly wanting. We contend that much of the paradigmatic thinking within the "management world" emerges from the social science areas and that this diminishes the potency of the management discourse and its application (McKelvey 1997, 2002). McKelvey (ibid) argues that organisation science has a very low status because of the multitude of paradigms it accepts:

> ...[O]rganisation science is destined to proliferate even more paradigms and sink to even lower status—surely an unattractive outcome. Campbellian realism [closely related to Popperian critical scientific realism (Niiniluoto 1999)] provides a way out of this downward spiral. A dynamic objectivist organisation science that does not deny social constructionist sociology of knowledge is possible.

As an evolutionary biologist and knowledge management practitioner, Hall (2003, 2003a, 2005, 2006a; Hall et al. 2002, 2005) has begun to provide a theoretical foundation for understanding personal and organisational knowledge through a combination of Popper's evolutionary epistemology (1972) with Nelson & Winter's (1982) concept of organisational evolution and Humberto Maturana and Francisco Varela's concept of autopoiesis. Autopoiesis literally means "auto (self)-creation" ('self' + 'production'). As neurobiologists Humberto Maturana and Francisco Maturana and Varela (1980; Varela et al, 1974) were interested to provide a necessary and sufficient definition for what it means to be living.

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[1]    We understand that the Knowledge Life Cycle was developed jointly between Joe Firestone and Mark McElroy in collaboration with Edward Swanstrom, Steve Cavaleri, and Douglas Weidner. It was initially proposed in the first version of Firestone's paper "The Metaprise, The AKMS, and the Enterprise Knowledge Portal", dated May 5, 1999.

The purpose of combining the thinking of Popper and Maturana and Varela is to create a theoretical framework for moving towards a "science of knowledge" for application in organisations. This paper will draw together this theory before defining different perspectives of knowledge in organisations and positioning these perspectives in Popper's three worlds. Using a series of models, we then discuss how knowledge can be leveraged in organisations.

# 1    Organisational Epistemology

## 1.1    Karl Popper's three worlds and theory of knowledge

In the domain of knowledge management there are almost as many definitions of knowledge as there are practitioners (e.g., Stenmark 2002). We will not attempt to review the many definitions, but will only state our own fairly general starting point based on our reading of Karl Popper's concept that knowledge is solutions to problems – or at least claims towards solutions (e.g., Popper 1999[2]).

Hall (2005, 2006a; Hall et al. 2005), draws on Popper (1972) and suggests "*World 1*" includes everything without interpretation. Popper (ibid) includes "*subjective*" or "*dispositional*" knowledge in "*World 2*", which approximates Polanyi's (1958, 1966) personal or 'tacit' knowledge[3]. "*World 3*" includes all kinds of persistently encoded knowledge (e.g., genetically encoded heredity, written documents, electronically encoded information etc. — Popper 1972: pp. 73-74) that Popper calls "objective" knowledge because its logical content can exist independently of the "knowing subject" and can be interpreted with similar subjective meanings by different subjects. Such objective knowledge often exists "virtually", logically encoded in the physical structure of a World 1 container (e.g., marks on paper, sequences of binary bits in a computer memory, etc.). Many knowledge management practitioners denigrate and devalue this persistent material as mere "information", but we argue that such objective knowledge is very significant to organisations.

What is important here is that Popper proposes that knowledge arises from the interaction of Worlds 1, 2 and 3. Popper argued that no objective truth could be proved - only that certain claims could be shown to be in error through trials or criticism of the claims as these claims have an impact in the world. However, a theory referring to World 1 can be constructed in World 2 and expressed in the form of World 3 content, and what it asserts in World 3 can approach correspondence with reality consisting of Worlds 1, 2 and 3 and their interactions.

In this sense, Popper suggested that knowledge should be conceived as evolved solutions to problems (Popper 1972) and that all life is problem solving (Popper 1999). Through iterated attempts to solve a problem of life and the selective elimination of tentative solutions that demonstrably fail when applied in World 1, the knowledge about the problem and the world (i.e., what is left after the errors are eliminated) will evolve and become more accurate through time. Thus, the value of the knowledge is determined by the extent to which solutions to pressing problems are identified and exploited. Importantly, the implementation of solutions actually has a material impact on the original problem. Through the iterated processes of problem solving the

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[2]    One of Karl Poppers' major contributions to the theory of knowledge is his discussion of various ontological domains or "worlds" in Objective Knowledge (Popper 1972, completed when he was aged 70).

[3]    We are grateful for useful comments from Joe Firestone highlighting some distinctions between Popper's and Polanyi's attitudes towards personal knowledge. Firestone suggests there is a difference between Popper and Polanyi in that Popper was more explicit about the importance of predispositions, as opposed to situational orientations (beliefs). Firestone thinks that Popper's view of mind and its interaction with body and culture is more comprehensive than Polanyi's.

entity learns more about the world it is living in. In fact, each application of a solution also changes the problem space.

These interconnected ideas formed the basis of Popper's (1972) "general theory of evolution" and "the growth of knowledge."

## 1.2 The notion of living organisations

The concept of evolutionary epistemology (EE) is an important theory that underpins the notion of "living organisations". Donald T. Campbell (1974) coined this term in 1974 for the epistemology he (Campbell 1960) and Popper developed. As it happened quite independently, Karl Popper's epistemology of evolution covered the same ground with more philosophical depth and Campbell credits Popper with originating EE and with expressing this fundamental perspective as early as Logik der Forschung (1934)[4]. Both Campbell and Popper argued that knowledge is an emergent property of life as it adapts to the world.

In the 1970's Maturana and Varela (Maturana 1970, 2002; Maturana and Varela 1980) developed the concept of autopoiesis as a minimal definition for what it meant for something to be considered living. Varela et al (1974) listed six criteria that we abbreviate and paraphrase here:

1. *Self-identifiably bounded* (demarcated from the environment by membranes, or the entity's components are tagged for self-identification)
2. *Individually identifiable components within the boundary* (complex)
3. *Mechanistic* (i.e., a system driven by cybernetically regulated energy fluxes or metabolic processes)
4. *System boundaries internally determined* (self referential)
5. *System intrinsically produces its own components* (self producing)
6. *Self-produced components are necessary and sufficient to produce the system* (autonomy).

Von Krogh and Roos (1995), Magalhaes (1996, 1998) and Hall (2003) took this concept further by suggesting that organisations might be autopoietic entities in their own right. Although others have argued against this stance (e.g., Mingers 2002, 2004; Hall 2005, 2006a; and Hall et al. 2005) presented detailed arguments in favour of this organisational paradigm and discusses in the framework of Popperian evolutionary epistemology, how knowledge in the sense of solutions to problems necessarily emerges in all kinds of autopoietic entities.

## *1.3 Individual knowledge vs organisational knowledge*

Hall (2005, 2006a) argued that autopoietically produced and maintained knowledge evolves at several different levels of biological organisation: e.g., at the cellular, multicellular and organisational (social) level. Although an individual person may possess some items of knowledge that are important to the organisation, much of what a person knows is irrelevant to the organisation. Also, knowledge at the organisational level is not identical to the sum of the knowledge of the people who may involve themselves in the organisation from time to time, but includes knowledge that emerges as a global property of the organisation. Organisational knowledge is a fundamentally different concept than that of individual knowledge as it includes embedded routines, processes and network, as well as many forms of knowledge held objectively in various areas of the organisation.

As discussed further below, Nelson and Winter's (1982, 2002) Evolutionary Theory of Economic Change presented an economic theory based on the assumption that organisations were entities

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[4]        We are grateful to Joe Firestone (personal communication) for highlighting this important point.

capable in their own right of evolution, and that aspects of organisational knowledge were inheritable resources like genes - where they equated organisational knowledge with organisational heredity.

## 2    Perspectives of knowledge in Living Organisations

### 2.1    *Personal knowledge* held by individuals participating in organisations

Following Polanyi (1958, 1966) we use the term "personal knowledge" to encompass several types of knowledge referred to in the literature. Here we specifically include what Popper described as dispositional or subjective knowledge.

*Personal knowledge* is located in people's minds (i.e., in World 2). The un-interpreted physical-chemical and dynamic structure of a person's brain exists in Popper's World 1, but the control information and memory of history that constitutes the mind's knowledge about World 1 exists in World 2 (Popper, 1977; Hall 2005, 2006a; Hall et al., 2005). When this knowledge is expressed linguistically in persistently objective form this results in that knowledge being encoded in World 3.

Personal knowledge is premised on a simple proposition that "we can know more than we can tell" (Polanyi 1966: p. 4) and "we will always tell more than we can write down" (Snowden 2002). It forms an integral part of the way we undertake "sense making". Sense-making encompasses the activities that create knowledge from uncovering new ways of seeing the world. Part of the process of sense-making involves the searching for documents, data and information, extracting and reformulating these materials in order to develop knowledge that supports action in a new and different context. In the process, new World 3 objects can be created in order to support the iterative process of making sense of the application of new thinking and to store the information.
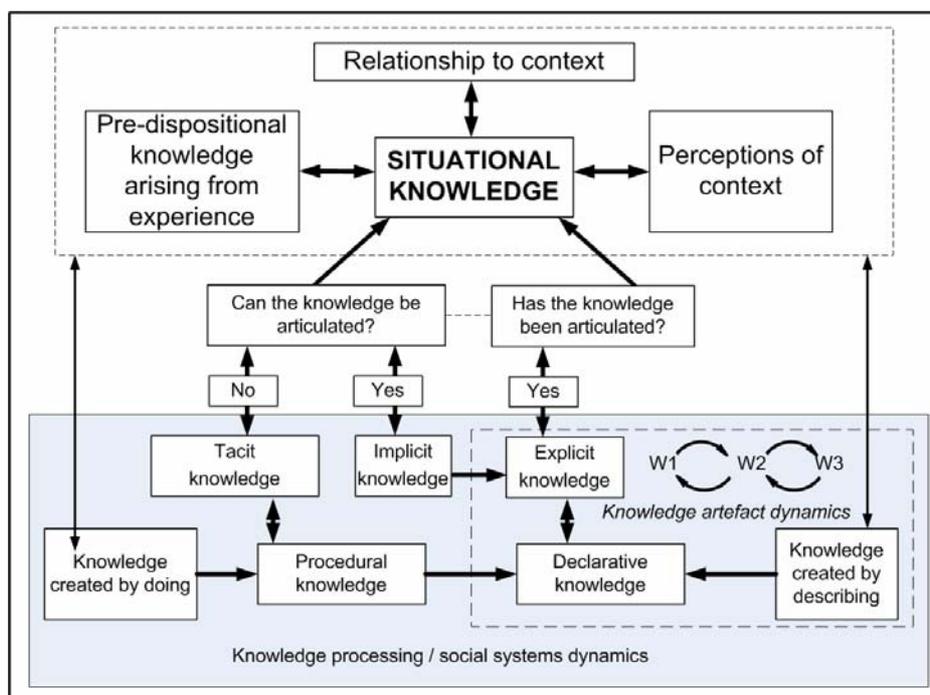


Figure 1. The contextual nature of personal knowledge (adapted from Nickols 2000)

We have adapted Nickols (2000 - Figure 1) to highlight that expressions of personal knowledge are highly contextualised – something we have called situational knowledge. That is, different

ways of "knowing" arise in different contexts and such ways of knowing are highly symbiotic with the relationship to context itself. Arising from this, different terminologies have developed to describe different types of situational knowledge. These have encompassed terms such as tacit, implicit, explicit, procedural and declarative knowledge, as explained in Figure 1. *Tacit knowledge* is knowledge that cannot be articulated by the person (i.e., it is unconscious or inherent in the person). *Implicit knowledge* resides in World 2 but it is possible to articulate this and therefore such knowledge is consciously available to the person. Once the knowledge has been articulated in some persistent form of expression, it becomes *explicit knowledge* (i.e., it is placed in World 3, where it is persistently available to other people). *Declarative knowledge* is knowledge created by describing things and *procedural knowledge* is created by "doing".

## 2.2    Tacit organisational knowledge

Nelson and Winter's (1982) Evolutionary Theory of Economic Change was founded on the idea that competitive differences between organisations were at least in part a consequence of comparatively stable capabilities (or organisational knowledge) built into the structure of the organisation as this propagates through time. They argued that these capabilities included things such as the unconscious "*routinisation*" of organisational activities, development of organisational jargons, the layout of plant and equipment, and the network relationships of people in the organisation. They defined this as "*tacit organisational knowledge*", citing Polanyi's (1958) concept of tacit knowledge referred to previously[5].

Just as explicit organisational knowledge can become shared explicit knowledge, so can tacit become shared common knowledge. The undocumented stories of "that's the way we do things around here", where they are shared widely and become folklore, are forms of common knowledge. Likewise, the grapevine and the rumour mill are excellent expressions of common tacit knowledge in organisations, with beneficial or damaging effects on an organisation. Formal tacit organisational knowledge may exist in smaller organisations which have strong induction or mentoring programs but this is considered to be a rare occurrence.

## 2.3    Explicit organisational knowledge

We use the term explicit knowledge in this paper as corresponding to Popper's objective knowledge that has been codified onto or within a persistent material structure (e.g., as marks on paper, charged bits in a silicon chip) in World 3 by World 2 processes. The logical and semantic content of the knowledge exists in World 3. The encoding of that content is embodied in World 1. Examples of explicit knowledge include all documents, graphics, spreadsheet files, databases, emails, video clips, wikis and blogging sites.

However, even in the situation where the organisation holds important knowledge in documents or other explicit forms, knowledge about the fact that such documents exist and where they can be found may remain the personal knowledge of only one or two people. There is an important distinction to be made here about explicit knowledge. An organisation might retain the explicit knowledge generated by its staff during any employment period and even after – in the form of digital files and the like. But in many cases personal knowledge is still required to access and apply it (Cowan et al. 2000; Tsoukas 2005; Nousala et al. 2005). When the personal knowledge about its existence and location leaves the organisation, such orphaned explicit knowledge is essentially worthless to the organisation.

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[5]    We suggest that Popper's (1972) "dispositional" or "subjective" knowledge provides an alternative perspective of understanding the nature of this tacit knowledge (as outlined in Figure 1).

## 2.4    Shared explicit-knowledge

We regard "*common- explicit knowledge*" as that subset of organisational explicit knowledge that is available or readily discoverable for sharing within a defined organisational and social context. Explicit knowledge only becomes common when it is easily discovered and shared using search tools or other methods of retrieval readily available to those in the organisation that need it. For example properly filed documents are forms of explicit knowledge. Once they become discoverable and available to a wide range of stakeholders, we regard this as shared explicit-knowledge. Internal security protocols that limit access to particular files and documents reduce the accessibility of this explicit knowledge and hence, the ability for it to become common.

## 2.5    Formal knowledge

We use the term "*formal knowledge*" as 'authorised' Shared explicit-knowledge. Formal knowledge is that subset of shared explicit-knowledge that has been critiqued in a social (i.e., organisational) context. Through the process of critiquing and reaching negotiated agreements, authorisation is given to use knowledge in an appropriate organisational context.

Examples of formal knowledge include:

- All types of manuals including instruction manuals, policies and procedures, lessons learned documentation and research publications – which have been reviewed and critiqued within an authorised social environment (such as a certification or approval workflow, organisational committee or a industry working party).

- Work produced as part of the achievement of a university accredited program

- Content of an industry training package

- Formal business processes and workflow pathways within enterprises

- Different types of products and services that have application to solve problems beyond the boundaries of particular enterprises.

- Documented routines and processes, including the layout of plant and equipment and the like. This type of knowledge is regarded as formal knowledge because people have authorised the implementation of chosen routines and processes.

# 3    Popper's three worlds ontology and organisational knowledge

## 3.1    Organisations as complex adaptive entities

We contend that organisational knowledge exists on the basis that organisations emerge as complex adaptive (i.e., "living") entities in their own right. Contextual influences, such as the loss of a large customer or the large drop in currency value can have a major impact on the nature of organisational knowledge. Organisations are adaptive, because such events can result in an organisation responding by radically re-shaping underlying assumptions to overcome the impact of such contextual influences.

We contend that all the kinds of knowledge that make up "organisational knowledge" are involved in maintaining the organisation and its activities in the world. That is, many organisations exhibit the characteristic of autopoietic entities in their own right (Hall 2005, 2006a).

## 3.2    "*Living knowledge*" as a foundation for organisational knowledge

Figure 2 outlines a view of organisational knowledge using the Popperian frame of three worlds. This highlights that organisational knowledge includes the interaction of personal knowledge,

organisational tacit knowledge with objectified knowledge (referred to in Figure 2 as explicit knowledge (EK), shared explicit-knowledge (SEK), and formal knowledge (FK). We also refer to transfer formal knowledge – presented as TFK).

To consider the subtleties of organisational knowledge outlined in Figure 2, it is essential to first understand the implications of the dynamics of World 2 processes. We contend that, in a time oriented sense (Dalmaris et al. 2006), the origins of all organisational knowledge occur via filtering through the implicitly and tacitly held paradigmatic world views (Kuhn 1962, 1983) of individual staff and the networks of people that make up the organisation. That is, all objectified knowledge embodied within analogue and digital objects exists inertly as World 3 objects and can only be regarded as "*living knowledge*" via the dynamics of World 2 activities.
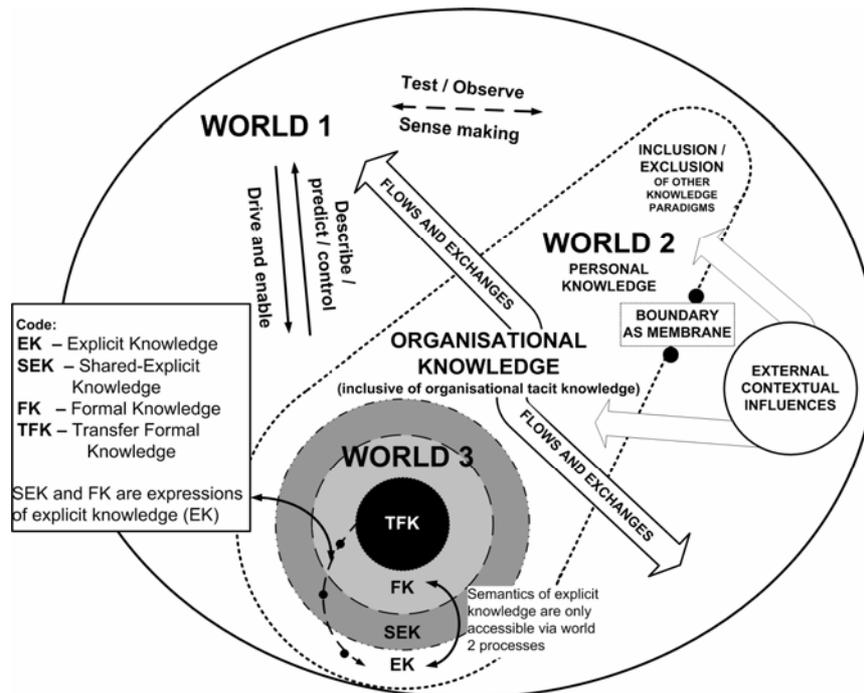


Figure 2. Karl Popper's three worlds ontology and organisational knowledge (adapted from Hall 2003, 2003a)

The importance of this cannot be overstated. With the increasing use of computer hardware and software to automate many business processes, it is important to be cognisant of the distinctions between World 2 knowledge processes and World 3 knowledge artefacts. As but one example, Vines and Firestone (2008) highlight the complexities associated with the exchange of humanly usable digital content when content is described in one XML standard and then transformed and re-represented in a different destination standard (an activity they call the transformation system). They conclude that where automated processes and systems are embedded within the transformation architecture, this does not allow for appropriate resolution of semantic distinctions. It is concluded that in any transformation system, the system needs to be designed to enable the application of what is called "human interpretative intelligence". This involves structured queries requiring user responses to mediate instances of semantic ambiguity. They suggest that user responses become part of the accumulated "recordings" of semantic translations and these build up to become a 'bank' of previous translations. The results stored in this bank might then be used to refine the operation of the filters, so that, as the transformation process is repeated, fewer and fewer structured queries are thrown up for the user to respond to. Thus, the more a transformation system that builds within it the potential to apply human interpretative intelligence, the more automated the system might become.

… we suggest that it will not be possible to dispense with human intervention in the transformation of humanly usable content. A technology that fails to acknowledge this, and to make suitable provision for it, will be dysfunctional in comparison with one that does. The reason for this is that HU [humanly usable] data has meaning to those people who use it; the categories used to organise data reflect these meanings. Different networks of activity create different meanings and thus different categories. Translation of the elements of content from one set of categories to another cannot, we claim, be accomplished without the application of what we will call "human interpretative intelligence".

We think these challenges associated with the data and information management world are very similar to Kuhn's notion of different paradigms (Kuhn, 1962, 1983) – as referred to above.

It is important to note that the notion of organisational tacit knowledge is not in conflict with these views. As we have highlighted previously, World 3 knowledge can in fact become built into dynamic processes and systems within the organisation. But the development of such dynamic processes and systems take time and therefore, it is very important to recognise the influence of time on the nature of organisational knowledge (Dalmaris et al. 2006; Martin et al. submitted; Philp and Martin in press; Hall et al. in prep).

## 3.3 The metaphor of organisational boundary as a permeable membrane

The concept that organisational knowledge is only knowledge belonging to the organisation is inadequate. We contend that organisational knowledge consists partly of both the knowledge encoded within an organisation and the expressions of organisational tacit knowledge described previously. In addition, it also includes the dynamics of knowledge exchanges and flows across the organisational boundary, where the boundary is understood as a permeable membrane. The notion of an "*organisational membrane*" is in keeping with Maturana and Varela's concept of autopoiesis (Maturana 1970; Maturana and Varela 1980, Maturana 2002) and Varela et al's (1974) six criteria for what it meant for something to be considered living (discussed in section 2.2). It is the mechanisms of acquiring and communicating knowledge via the exchange of artefacts and flow of knowledge across the membrane that contributes to organisational knowledge.

Three examples illuminate how the management of knowledge needs to be understood as encompassing both exchanges and flows.

**The published article.** An organisational staff member may perceive benefit in publishing an article to articulate an iteration of a formal knowledge claim relevant to his/her work in the organisation. This type of knowledge artefact exists in World 3 and can be exchanged across the boundary of the originating organisation and become available for application to staff in other organisations via World 2 processes.

**Learning circles.** Groups of staff from different organisations can come together to share their own experiences and reflections of personal knowledge in a learning circle. Well structured learning circles facilitate the flows of knowledge based on World 2 ideas. Further, new knowledge claims can be generated from this sharing. These can be published as World 3 artefacts in the form of published articles, web sites, or even databases of stories.

**Fellow positions within Universities**. The secondment of experienced staff into Universities for periods of time provides an interesting example of the exchange of personal knowledge across organisational boundaries. Such mechanisms allow staff members to reflect upon and articulate their World 2 knowledge and generate new formal knowledge claims based on their experiences – with outputs residing in World 3. These new knowledge claims have the potential to be relevant to the interests of both the University and originating organisation – especially if opportunities are created for industry clustering based on new expressions of formal knowledge.

The above examples highlight that knowledge flows and the exchange of artefacts can be complex in nature. Knowledge may belong to organisations, but importantly knowledge flows and the exchange of knowledge artefacts are essential for maintenance and growth of

organisational knowledge.  The work on developing clusters of associated industries and the tightening of supply chains are two examples in this area.

In considering the metaphor of organisational boundary as membrane, it is important to take into account the "living nature of organisations". If the membrane of the autopoietic organisation begins to break down, or be broken down intentionally, then the life of the organisation itself as a discrete entity can be threatened. Some examples are as follows.

**Thoughtless industrial redundancies and retirements.** The maintenance of knowledge within an organisation can depend on the orderly movement of organisational staff. A significant loss of personal knowledge via the uncoordinated departure of large numbers of staff can catastrophically impact organisational knowledge.

**Industrial espionage**. The leakage of highly sensitive data and information can allow competing organisations to determine points of competitive weakness in an organisation. From this, organisations can become vulnerable to the loss of market share and sustainable revenue returns.

## 4      Leveraging the value of knowledge work: A model

It can be concluded from the above discussion that there is some ambiguity as to how we define organisational knowledge. This is because organisational knowledge includes personal, tacit, explicit, shared explicit-knowledge and formal knowledge at any one period of time. But it also includes the dynamics of knowledge exchanges encompassing flows within and across the boundaries of the organisation.

This way of thinking raises the larger question of how organisational knowledge can be conceived as an integrated support system within a management paradigm. Firestone (1999a, 1999b, 1999c, 2000a, 2000b and 2003), McElroy (1999 and 2002) and (Vines and Naismith, 2002a) have all endeavoured to contribute to foundational understandings of this type of approach to knowledge management.

In this paper, we propose a model for leveraging the value of knowledge work built on this previous thinking (Figure 3). It is beyond our present scope to discuss all elements of this model in detail. We will focus only on the knowledge layer here. However, before examining the knowledge layer, we need to make some brief comments about the model's other layers.

*Context layer.* Knowledge work is undertaken within the framework of complex and often rapidly changing internal and external environments. The inclusion of the context layer is an important recognition of this fact. The notion of context has been partially discussed in Vines and Naismith (2002a, p. 47-52) and also in English (1995, 1997 and 2001). Especially important in this notion of context, is the idea of focusing systematically on the emergent patterns. This way of thinking is a natural consequence of thinking about organisations as complex adaptive systems.

*Intentionality layer.* What an organisation looks for in the context layer is primarily determined by its strategic intent.  The intentionality layer sits between the environment and the inner workings of the organisation.  Intent is the primary driver to leverage the value of knowledge. Intentionality represents the idea of organisational integrity including the establishment of strategy setting and accountability mechanisms to ensure that an organisation does what it declares it will do. Intent can easily be undermined by traditional hierarchies within organisations and as such, we think it is important to equip staff with the skills to engage effectively in intra and inter organisational networks. We claim that for the future, an important means of giving expression to this will be through a governance and fiduciary based approach to the application of knowledge management in organisations along the lines outlined by McElroy (2001, 2003) and Firestone (2004). This highlights that the management of organisational knowledge is focused on developing solutions to problems and not on supporting management's perceptions of

"idealised strategies". This means that a part of the knowledge function should be autonomous to operational management and its strategy. As Firestone (2004) states:

> …the KM function should derive its authority from and be directly responsible to such Boards and legislatures. This in turn implies that KM as currently practiced in organisations rests on an insecure foundation, one that is likely to lead to its failure due to conflicts of interest introduced by corporate management.

*Support systems layer*. In the previous model (Vines and Naismith, 2002a), a detailed explanation of the proposed three support systems, including a list of proposed "inputs" and "skills requirements", is outlined. It is this layer that gave rise to the title of our previous paper: namely conceiving knowledge management as an integrated support system. We attempt describe elements of the support systems layer and how the skills associated with this relate to traditional skills sets such as project management, research and development, IT management, human resources and the like.

*Knowledge work*. At the very centre of our model is the notion of knowledge as solutions to problems. This idea gives rise to the focus on the interface between the autopoietic entity (in our case, the organisation) and the world in which the entity is immersed. As argued by Firestone & McElroy (2003, 2003a) and that we have highlighted above, this means that management should focus on the processes associated with iterated attempts to solve the problems of the organisation's life in World 1, 2 and 3 and the selective elimination of tentative solutions that demonstrably fail when applied. The knowledge about the problem (i.e., what is left after the errors are eliminated) will evolve and become more accurate through time. Thus, the value of knowledge is determined by the extent to which solutions to pressing problems are identified and exploited. Put in another sense, this is a strengths-based approach to problem solving in that the focus of attention is always on what works and on severely testing what works against competitors to make sure it can be counted upon.
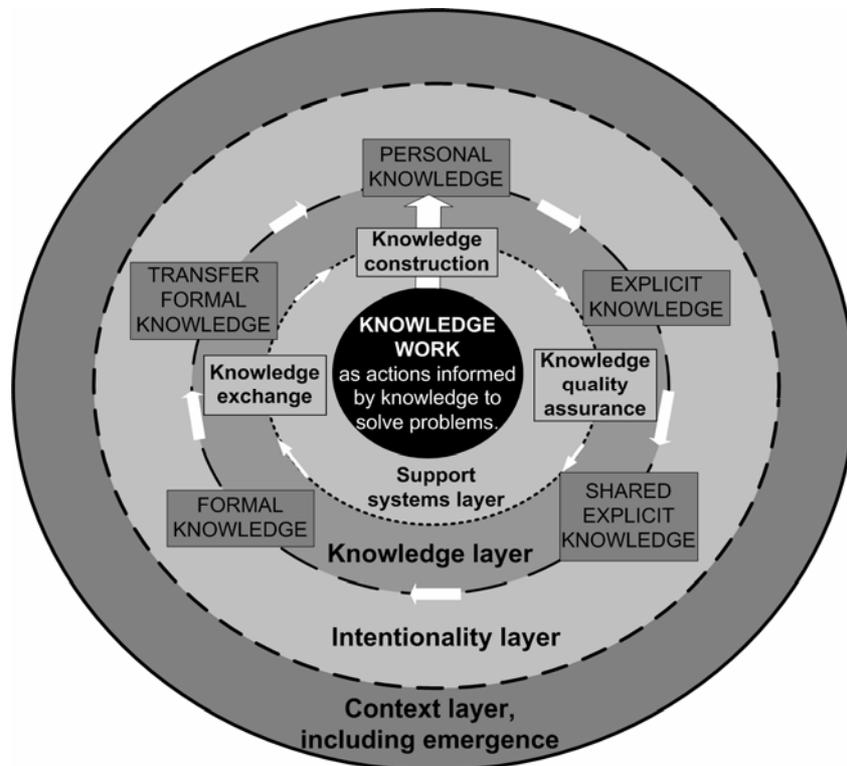


Figure 3. A model for leveraging the value of knowledge work.

We now turn to one particular layer of the model outlined in Figure 3 – namely the knowledge layer.

# 5 The dynamics of organisational knowledge processing

In this section, we now discuss the process of turning personal knowledge into different manifestations of explicit knowledge (and explicit knowledge back into personal knowledge) as well as exchanging knowledge between people. These dynamics carry the meaning and message of knowledge and are conveyed through different channels of representation. Personal knowledge can be conveyed by doing (for example, via demonstration or declaring through relevant anecdotes), whereas the types of explicit knowledge discussed in this paper are mediated through different communication channels such as print, hand-delivery, email, video and the like. These dynamics of organisational knowledge have the potential to lead to a transformation of knowledge embodied within an individual or encoded by organisation - as new knowledge is presented, considered, evaluated and incorporated.

We argue that knowledge dynamics are much more complicated than first meets the eye. To set a foundation for understanding such dynamics, we draw upon Hall (2003, 2005) and the adoption and extension of Boyd's (1996) Observe, Orient, Decide and Act (OODA) model. This is outlined in Figure 4 and discussed in detail in Hall (2006a).

Hall suggests that observation and orientation involve cybernetic processes (World 2) used by staff members to understand the context. Then a process of deciding how to act is undertaken (which can involve criticising hypotheses). And finally, staff act and test their learnings in the physical world. Through the action a new cycle commences, where staff then observe the impact of their actions and the cycle repeats itself.
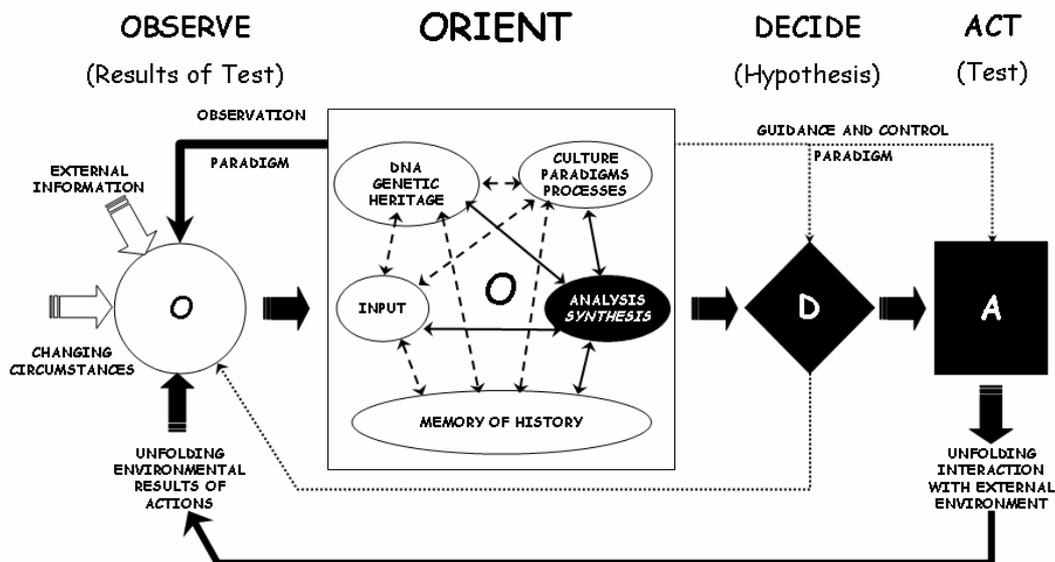


Figure 4. John Boyd's OODA Loop concept (from Hall 2003, after Boyd 1976. See http://www.d-n-i.net/boyd/boyds_ooda_loop.ppt).

To explain the subtleties of the OODA cycle and associated knowledge exchanges within an organisational context, we now discuss each dynamic in some detail.

## 5.1 Exchanging personal knowledge into new expressions of personal knowledge

We regard the exchange of personal knowledge from one organisational staff member to another as a potential knowledge transformation process. This is because each staff member sees the world always from his or her own frame of reference. As such, there is a need for each staff members to access an understanding of the knowledge in question and then express the learnings in actions to achieve a performance output that is common to a number of different staff. This

understanding of the knowledge in question requires receptiveness on behalf of the receiver. In most cases of ineffective knowledge exchange, new knowledge is discounted as it does not fit existing internal structures. These entrenched patterns need to be broken down for a transformation process to occur.

Personal knowledge exchanges such as on-the-job training, apprenticeships and mentoring can be important in cases where such knowledge expressions have been tested in practice as valid, but have not been made explicit.

## 5.2    Expressing personal knowledge as explicit knowledge

An example of an emergent pathway for expressing personal knowledge as explicit knowledge is summarised in Figure 5. The pathway outlined can begin at both individual and social levels, to involve an iterative interplay between the workings of the mind (World 2), use of social languages, narrative exchanges (such as story telling and listening), sense-making and observing. All of this can go on in parallel with other knowledge processes outlined in Figure 5. Different versions of knowledge artefacts are continuously produced throughout this process. In the continued modification of the knowledge artefact, an iterative exchange occurs where objective knowledge encoded in World 3, but which is accessed via World 2 cybernetic processes and critiqued against the subjective understanding of World 1. The critiquing process which may be self- or informal social-critiquing is a separate function from codification.
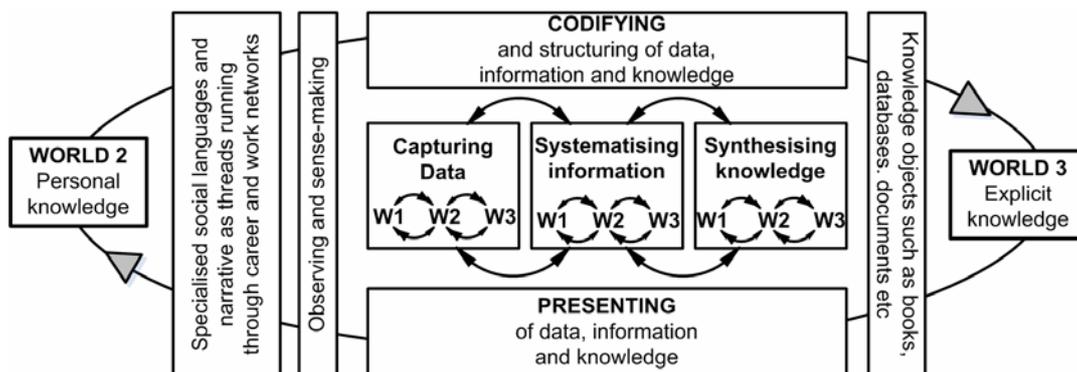


Figure 5. The pathways for turning personal into explicit knowledge (Vines 2006)

This process is complex and only contributes to organisational knowledge if staff are both willing and able to begin the process of making this personal knowledge explicit within an organisational context.

The difficulty is that much personal knowledge is needed when staff collaborate across diffuse intra and inter-organisational networks. In such contexts, staff often don't know how to make explicit what they know when they solve problems. There is a strong focus on emergence in applying solutions, and personal knowledge can provide an internal 'compass' to guide action. Trying to use personal knowledge to create explicit knowledge so it can be applied in other contexts by other people is problematic as emergent knowledge is not easily made explicit. In addition, if staff members are valued because of this personal knowledge, they may not necessarily want to make their expertise explicit in the first place.

On top of this, even where people are willing to share, there are still limitations to this sharing because of the principle of bounded rationality (Simon 1962; Snowden 2002; Else 2004; Nousala 2006; Nousala et al. 2005). This principle highlights that it is simply not feasible for workers to share all that they know; and that even if they were able to do this, there would be an inability to process all the alternatives. In addition, the means of expressing such knowledge invariably

results in some loss, But conversely, by making such knowledge explicit, the opportunity to increase the rate of spread of exchange is greatly increased.

It is for all these interrelated reasons why we claim that the system required to support the management of organisational knowledge, including personal and explicit knowledge, needs to be conceived as an integrated support system for the organisation. Organisational managers need to create conditions where staff will volunteer sharing their personal knowledge and provide a means for efficiently finding explicit knowledge. The support system should be designed so this knowledge can be accessed by others in different contexts, where assessments can be made about its applicability in these different contexts.

As a result of these considerations, we are very cautious about what can be done to support the expression of personal knowledge as explicit knowledge to make this available to others. Kurtz and Snowden (2006) highlighted the complexities of the challenge by hypothesising that it is through narrative that the network effects of identity, and trust are built. We and Nousala (2006; Nousala et al. 2005) contend that this network effect of trust is held by staff and that this is contained within the narratives of their own career journeys. The anecdotes contained within career journeys highlight important principles of identity and experiences of trust (or lack of it). The essence of such journeys is embedded within the networks of connections made by staff (which can be considered to be part of the organisation's tacit knowledge). Kurtz and Snowden (ibid, p2) highlight this by suggesting that narrative:

> can be best supported to maximise the intangible and yet strong elements of value afforded by inter-organisational networks.

We contend that it is the career journeys of staff themselves that generate the potential for organisational knowledge networks. These networks that exist both on an intra and inter-organisational basis have a powerful effect on the preparedness and effectiveness of staff members to bring their knowledge to bear in particular contexts.

Overall, we conclude that different types of support systems are required to assist with managing different types of knowledge. For example, personal knowledge may often be best applied within a loose network structure – primarily because emergent knowledge can easily be stifled by strongly hierarchical management systems. When the need for more objective types of knowledge come into play, adherence to strict policies and procedures may be required to maximise efficiency and effectiveness or to comply with quality assurance or safety obligations.

For the future, organisational managers will need to become more sensitive to the types of support systems best suited to the different solutions to problems being developed in different contexts. Emergent knowledge should not be in opposition to objective knowledge.

Despite our caution here, we think there are emerging approaches that involve the use of digital technologies that will facilitate the conversion of personal knowledge into an explicit knowledge framework. Our view is that such approaches are most likely to emerge where there is a focus on capturing the contextual information associated with the knowledge work itself, rather than the explicit focus on trying to describe what staff members know. This is also an expressed conclusion of Nousala et al (2005). and the justification for the approach used. There has been evidence of this emergent principle arising, interestingly from the cultural heritage industries in Australia (McCarthy, 1999).

> Most activity in the documentation and management of cultural heritage resources has been traditionally based around describing the things themselves. ……. However, broadening the scope of the descriptive practice within each industry sector to include the systematic documentation of context, that is people, family and corporate bodies (in the first instance), as distinct entities that are linked by defined relationships to the objects, records and other traces of their activity, will enable these bridges to be built. The World Wide Web provides the means by which these new bridges can be constructed.

This sort of systematic approach to the capturing of the context of information resources and not just the descriptive features of information if adopted into the mainstream management world

could begin to create possibilities for the effective identification of personal knowledge in large complex organisations.

A foundational approach similar to this has been piloted by mapping the context of personal knowledge with career histories of staff members (Nousala 2006, Nousala et al. 2005). The collection and analysis of personal narratives and war stories provide explicit traces of each staff member's personal career history. It was found that although much of the history remains tacit or implicit within the interviewee, other people with similar backgrounds can infer much more even without being able to elicit the kind of detail that can be transferred face-to-face when queried by someone with similar problems.

We conclude therefore, that new approaches involving the development of contextual information maps have the potential to speed up the ability to find what we need to know, when we need to know it. As the internet is increasingly used to manage all aspects of business information management, web based mapping systems that establish relationships between people, information and events will become part of the ways in which organisational knowledge is identified and monitored over periods of time.

## 5.3    Turning explicit knowledge into shared explicit-knowledge

The use of digital technologies provides an efficient mechanism for turning explicit knowledge into shared explicit-knowledge. Online databases, web site portals, document management systems (and associated metadata management) with electronic workflows and enterprise search mechanisms all help make explicit knowledge common. The challenge is to provide appropriate enterprise architecture and process workflows to make this easy and limit the use of internal security controls that reduce the discoverability and accessibility of explicit knowledge. This is a significant topic in its own right that we do not address here.

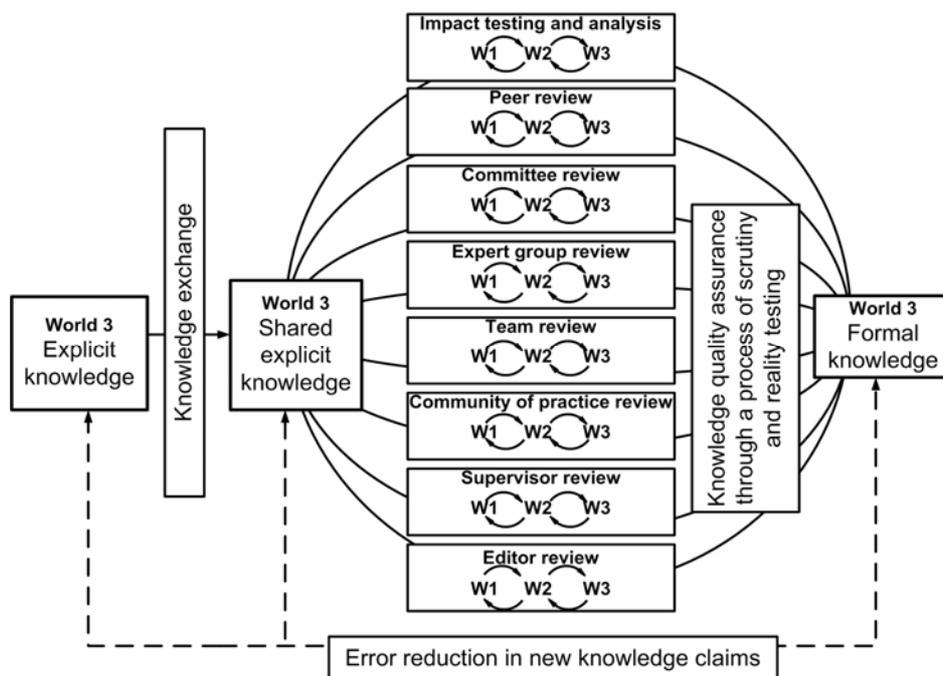## 5.4    The critiquing of shared explicit-knowledge to create formal knowledge



Figure 6. The conversion of shared explicit-knowledge into formal knowledge.

We contend that the conversion of shared explicit-knowledge into formal knowledge occurs through an iterative social process of critiquing claims in the real world as outlined simplistically

in Figure 6. Arising from this critique, agreements are struck about the veracity of knowledge claims and the potential application to solve specific problems[6]. We contend that this continuing review of shared explicit-knowledge is a type of knowledge quality-assurance process as proposed in Vines and Naismith (2002).

All critiquing occurs through the media of the social languages used by the organisational staff members themselves. It is through the use of these social languages, both written and oral, that negotiated agreements are established with a number of different stakeholder groups as suggested in Figure 6. Part of the process of reaching negotiated agreements involves dealing with the paradigmatic differences held by different domains of knowledge work.

This model has important implications for how review committees (and personnel) should understand their critiquing roles and the assumptions they bring to these roles. Such committees should not consider that their deliberations reflect a process of reaching "shared truths" about an organisation's knowledge. Nor should such committees come to decisions based on traditional hierarchical expression of power. Rather, their role is to test knowledge claims in the world and ensure the decisions reflect shared views about what will work to solve problems, until something else emerges as more pragmatically beneficial (Firestone and McElroy 2003). They should also learn to make their observations taking into account multiple perspectives and to have their underlying assumptions continuously tested (Firestone & McElroy 2003a) and share this learning throughout the organisation.

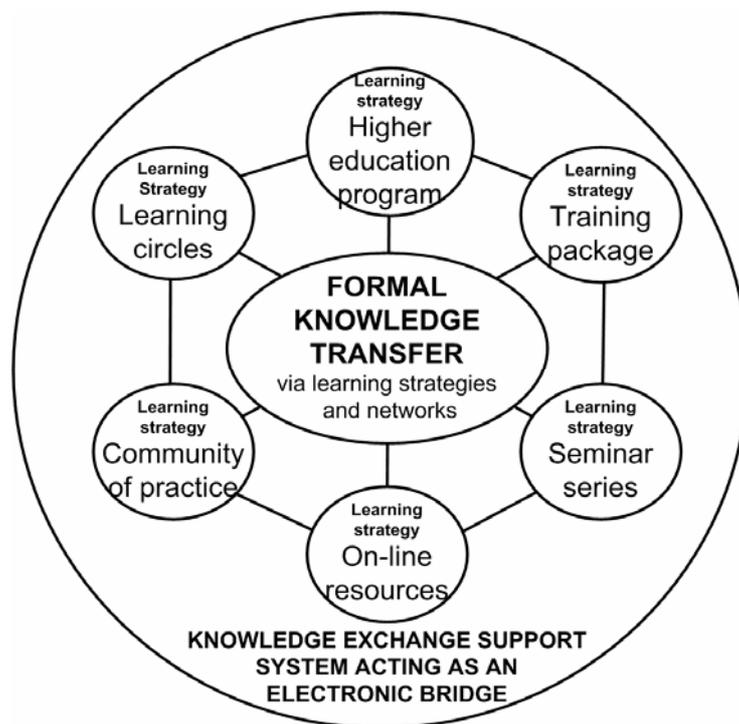## 5.5 Formal knowledge transfer through teaching and learning



Figure 7. The transfer of formal knowledge.

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[6] We find the views of Firestone and McElroy (2003a Ch. 5) a conceptually helpful way of thinking systematically about this issue of evaluating the veracity of knowledge claims. These views are based on the Theory of Fair Critical Comparison, originally developed by Firestone in 1973 [in an unpublished book-length ms. called The Adaptive Crisis and the Foundations of Social Science: A Critique and Some Suggestions for Its Reconstruction, State University of new York at Binghamton, Binghamton, NY, 1973. Originally the Theory was called the Theory of Fair Comparison. The word critical was added in 2005 to emphasize the connection to Evolutionary Epistemology and its selections context, which was less explicit in its original formulation than it is in recent work on the New Knowledge Management].

Often, as a result of converting personal knowledge into formal knowledge, there is a need to transfer learnings as particular types of formal knowledge. It is in the process of transferring formal knowledge that learning strategies can be established. These can take any form, including the establishment of higher education programs, implementation of a seminar series and the like, and it can be established at structural levels from in-house to industry and community (Figure 7).

This transfer of formal knowledge back into people within the organisation through learning completes a knowledge loop – because the outcomes of the learning and development activities results in the development of new types of personal knowledge.

## 6    Conclusions

We claim there is a need to establish a new paradigm (Kuhn 1962) for thinking about knowledge and the relationships and differences between knowledge at the personal level and knowledge pertaining to whole organisations. In thinking about this challenge, we have drawn upon Karl Popper's later epistemological works beginning with his (1972) "Objective Knowledge – An Evolutionary Approach" and a framework of organisational theory based on Maturana and Varela's concept of self-producing complex systems ("autopoiesis"). We have combined these two different approaches in order to understand how best to integrate understandings of personal and objective knowledge – to form the notion of living organisations.

The contention is that organisational knowledge exists on the basis that organisations become complex adaptive entities in their own right. Knowledge is an emergent property of an organisations adaptation in response to changes in its external environment. Different types of knowledge, including personal, explicit, common, formal knowledge and organisational tacit knowledge arise in organisations in order to maximise "self" production and "self" control.

It is highlighted that all explicit knowledge held in organisations encoded in analogue or digital objects is in fact inert. Such knowledge cannot be regarded as "living knowledge" unless the filter of human interpretative intelligence is applied to generate meaning from these knowledge objects or, increasingly, unless such intelligence is built into dynamic processes and systems within the organisation.

We have highlighted that the "organisational boundary as membrane" is helpful in understanding the nature of organisational knowledge. Different types of knowledge exchanges and flow can occur across the boundaries of organisations over periods of time and these are fundamental to how an organisation retains its ability for self production and self-control.

With these issues in mind we have presented a model for leveraging the value of knowledge work. This model is designed to assist managers deepen their understanding of what a knowledge culture might mean. The overall objective is to enable a more effective allocation of resources to generate solutions to pressing problems.

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