Anticipatory Viable Systems

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Abstract
Viable systems may be seen as third order cybernetic systems of coherent social organisations that are able to dynamically survive. Part of their survival process involves anticipation that is embedded in their logical models. The development of viable systems often occurs despite their inability to develop common patterns of knowledge for their world view holders. This has means that new anticipatory processes must be activated, when their viability may be endangered.
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1 Introduction

According to Robert Rosen (1985), an anticipatory system "contains a predictive model of itself and/or of its environment that allows it to change state at an instant in accord with the model's predictions pertaining to a latter instant". He also claimed that anticipation distinguishes living systems from non-living ones.

Dubois (2000) argued that using anticipation to distinguish between living and non-living systems is not adequate, and as an illustration of this showed that anticipatory effects exist in physics, for example in the electromagnetic field. He developed the notion of anticipation by distinguishing between two forms: weak and strong. Weak anticipation is a prediction that occurs through a model of a system, while strong anticipation is self-produced by the system itself.

Having distinguished between weak and strong anticipation, Dubois showed that any model is implicitly anticipatory. To do this it is first necessary to distinguish between *purpose* and *causation*, both of which can be argued to be properties of anticipation. Purpose is an endogenous product of the system, while causation is exogenous resulting from influences from its environment that affect it. Now, anticipatory systems must obey the least action principle of Maupertuis. This states that any system of equations that represents physical motion (whether classical, quantum or relativistic) has an optimum trajectory if it can be described by an integral that is defined by initial and final states. In such systems purpose is explicit while causation is complementary.

This paper is concerned with viable systems, and whether the notion of anticipation as explored by Rosen or Dubois is satisfactory when applied to these is something that we must take care over. By definition, viable systems theory is a cybernetic theory of coherent purposeful human organisations. They are not "living systems" in the biological sense, but can be argued to have generic characteristics that are related to living systems. For instance, they self-organise, self-produce, and even from time to time reproduce. Viable systems theory adopts a critical rationality that is different from traditional physics. In the latter, the notion of a model is that it is a representation of a given system, and that if we know everything that we need to about the system then the model and the system are one. Consider an alternative to this. Rather than referring to a system, let us refer instead to an "object of attention" that exists and that that is described by a metaphor. If we wish to describe the generic qualities of the object of attention, then we will use the metaphor to do this, which still remains distinct from the object of attention. So the notion of model from a critical perspective is quite different from the concept of model in the positivist/postpostivist perspective.

In physical sciences, one is able to differentiate between a model and a single objective reality, and this has an impact on the way that one considers and validates the model. For instance, it is possible to differentiate between a logical representation of an object of attention and the object itself. In a sense, the logical representation may be seen as a metaphor that needs to be validated against some criteria. However, from a critical perspective it may not be possible to know what constitutes that "reality". This is because any individual or group of individuals "sees" a representation of "reality" in a way that is unique to that individual or group due to their distinct worldviews. The worldviews are generators of knowledge, and provide criteria for validation. Adopting a critical worldview perspective therefore severely complexifies the traditional ontological considerations of models.

In social organisations weak anticipation occurs through the process of planning. This is because it is based on a model of the object of attention that is to be planned. Thus, in viable systems planning would seem to be a pre-requisite for self-production that occurs when the production of those elements of the systems occurs that are necessary to its development. However, in complex situations long-term planning and thus long-term deterministic anticipation normally fails, so that this weak (model based) anticipation is incremental (step by step) and is necessarily associated with adaptation. If a viable system is adaptive then it is both evolutionary and will change cognitively. This will enable new structures to arise enabling new forms of behaviour to occur that can relate to changes in the environment.

Anticipation is thus a dynamical process in constant renewal. It can be argued that this occurs through the development of patterns of knowledge that are being continually created and discarded, meaning that anticipatory systems in a complex world are continually finding new and shifting sites of bounded stability.

2 Ontology, Epistemology, and Systems

Guba and Lincoln (1994) identify four types of paradigm, positivism, postpositivism, critical theory, and constructivism. Each has its axiomatic ontology and epistemology that form the basis of its other propositions. Ontology concerns beliefs about the form and nature of reality, and epistemology the nature of knowledge and the relationship between those who know (the knowers) and knowing. How we inquire into, and see organisations and the environments in which they exist depends upon our knowledge, understanding, and epistemological frame of reference, and how we deal with what we know is determined by both epistemology and ontology.

Positivism has an ontology that is naïvely realistic (there is a reality that may be apprehended), an epistemology that adheres to the notion of objectivity, and the possibility of finding universal truths. Those who hold positivistic views see reality to exist autonomously from any observer, and inquirers can be objective and non-participant observers to the events that they see. The events can be represented by observer independent measurables called data that represent the "facts" of a single objective "reality". Thus for instance, a given investigation should always produce the same result for any observer if the theory about it is true, and if it is undertaken "scientifically" (according to a set of propositions that represents a positivist epistemology). The truths set up as a pattern of propositions represents the knowledge. Through deductive reasoning, the approach usually embeds an attempt to test theory in order to improve both the understanding of a situation and the ability to make anticipation about it. Postivism has a long tradition. During the last few hundred years within the period of the industrial revolution, there was a belief in the West that science had conquered the unknown. Simple mechanistic thinking ruled, and extended into what has been called behaviourism in psychology that is decried by systemic thinkers (Koestler, 1967).

The age of complexity has led many away from the positivist perspective. Postpositivism is linked to positivism. It supports the notion of an objective reality, but this may only be apprehended imperfectly and probabilistically, and only an approximate image of reality may be possible. It may be that an example of postpositivist perspective is that of the *engineering* view (see Fivaz, 2000). In this, observers can have their own perspective that can influence the way that they see things. They are endowed with consciousness, which in extension to simple behaviourism is seen to be a set of engineering processes that converts information acquired as observation from "outside" into information implemented "outside". A corollary of this is that different people can be better or worse at these engineering processes, and in all such perspectives, the possibility of at least fuzzy optimisation becomes a relevant concept. Thus, mind is a biased machine, reality is actually out there and may possibly be found, and knowledge is objective.

Critical theory is a blanket term that may be defined to include both postmodernism and poststructuralism since their epistemology supports the notion that inquiry is value determined (Guba and Lincoln, 1994). The ontology of critical theory holds that reality is virtual, and shaped by social, political, economic, ethnic and other factors that crystallise over time. Epistemologically it is subjectivist, so that findings are value laden with respect to the worldview of an inquirer. Finally, constructivism departs from critical theory in that it abandons ontological realism for ontological relativism, that is reality seen as a relative phenomenon. Epistemologically, knowledge is created in interaction between inquirers in a situation and its participants. It takes its name from the notion that there exist both local and specifically constructed realities. Both critical theory and constructivism are related in that both support subjectivist epistemology, but the latter relates to created findings.

The perspective adopted in this paper lies more within the critical tradition. Within it, there are no observers, there are only viewers, and their views like their behaviours are worldview derived. Worldviews also interact with each other. Following the work of Luhmann (1995), this interaction occurs through a semantic communication process. From Habermas (1987), interaction occurs in a framework of meaning called the lifeworld.

In critical theory there is no absolute real world that can be separated out, because viewers create it within their frame of reference, and interact with their creation. There is therefore no separation between the viewer and the behavioural world around him. Since what constitutes reality is determined through worldviews, it changes as worldviews change. In each worldview we build our view of what we perceive to be the world through our mental models. We may believe that we share them with others, but they will be incommensurable to some degree (Yolles, 1999). This is because the models may involve different conceptual extensions, or the same conceptual extension may take on meanings that are qualitatively different. We are never aware whether these shared models are related, except by attempting to draw meaning from others' explanations provided through language, or comparing what we expect from the behaviour of people in a situation, with what we perceive that they are doing.

One often thinks of physics being positivist or postpositivist. However, the interest of Frieden (1999) in physics is probably more related to critical theory than postpositivism. In his exploration of positive physics he acknowledges that people attempt to predict deterministically the future as a result of the past. Since reality is objective and unique, full knowledge is possible and prediction is certain. Along with this, it is usually held that "all statements other than those describing or predicting observations are meaningless" (Ibid., p108). His view, however, is that the idea of observation must be replaced by "creative observation", where observations are themselves meaningless except in so far as they create local physics. More generally, futures may be seen to be the result of changing patterns of perception that result from new knowledge, experiences and beliefs of viewers. Frieden holds that prediction is local, but it requires that people are prepared to constantly modify their view of the world arround them, and consistently need to realise or release the information potential inherent to the complex situations that they see around them. This does not seem too far from our view in which there is no observer, but rather an *other* who is a potential or actual viewer.

The concept of "oberver" is central in cybernetics and has evolved from the first cybernetics to the second cybernetics. A third order cybernetics should be the framework of a viable systems theory.

3 The Three Cybernetics

Dubois (1995) summarised the state-of-the-art in the modern cybernetics (Van de Vijver, 1992), beginning by a brief historical review that considered first and second order cybernetics, and ended with a proposition for a third order cybernetics.

3.1 The First Cybernetics

First order cybernetics is the interdisciplinary science of the control and communication in the animal and the machine, and was based on the Newtonian mechanical objectivity of "observed systems". It is thus positivist in its inception, but does not have to be.

Norbert Wiener (1894-1964) was the founder of cybernetics as it deals with the control by feedback mechanisms in natural and artificial systems. In a fundamental paper, Rosenblueth, Wiener and Bigelow (1943) considered that the meaning of the feedback and indicated that it has teological properties. It is related to recursive processes where the present state of a system is a function of its preceding states, so that the future is always a result of the past. Thus, the possible future states of a system are implicit in the system's initial representation. Finality is thus transformed into causality. McCulloch and Pitts (1943) were also concerned with first order cybernetics when they introduced the formal notion of the neuron.

3.2 The Second Cybernetics

The notion of second order cybernetics grew up through the works of H. Von Foerster (1960) and W. R. Ashby (1962) in self-organising systems. "Second cybernetics" deals with "observing systems" and with their subjectivity. Other theories deal with self-referential and autopoietic systems as considered by Maturana and Varela (1979).

Second cybernetics can be related to quantum mechanics. Indeed, contrary to Newtonian mechanics, quantum mechanics shows that experimental data cannot be obtained in an objective way, that is to say independently of the experimentation. Behind the experimental devices, there is the individual who interprets the data.

Information is related to the meaning of data. It is important to note that what is usually called Information Theory is only a communication theory dealing with the communication of coded data in channels between a sender and a receptor without any reference to the semantic aspect of the messages. The meaning of the message can only be understood by the receiver if he has the same cultural reference as the sender of the message and even in this case, nobody can be sure that the receiver understands the message exactly as the sender understood it when he built it. Because the message is only a sequential explanation of a non-communicable meaning of an idea in the mind of the sender which can be communicated to the receiver so that a certain meaning emerges in his mind. The meaning is relative or subjective in the sense that it depends on the experiential life or imagination of each of us. It is well-known that the semantic information of signs (like the coding of the signals for traffic) are the same for everybody (like having to stop at the red light at a cross roads) due to a collective agreement of their meanings in relation to actions. But the semantic information of an idea given by a sentence, for example, looks more like a symbol for which the meaning is more difficult to codify by a collective agreement. This is perhaps the origin of creativity: creativity is the result of a process for which a meaning of something new emerges from a trial to find a meaning for something which has no a priori meaning or a void meaning.

3.3 A Third Cybernetics

Second order cybernetics should be seen to be a complement to first order cybernetics that with new concepts enriches the whole field, for example through complexity theory and deterministic chaos.

A parallel can be established for the relationship between first and second order cybernetics through both physics and computation. In physics, Newtonian mechanics was enlarged by quantum mechanics. In computing, an extension of the Turing Machine is the Universal Quantum Computer as proposed by Deutsch (1985) after the Church-Turing principle. In the same way as we can think of Newtonian mechanics having been enlarged by relativity theory, so we can think of a relativistic computer. This very enlargement process can lead us to contemplate a third order cybernetics. The reason is as follows.

The computation paradigm is based on recursion, as in the Turing Machine. In this framework there is a *separation* between data and the operators, represented by a transformation function. The function is a truth table that is separated from the data, and the data has no impact on it. Classical algorithmic programmes deal with only syntactic information, that is to say without semantic and pragmatic information. In looking in a computer programme, all implementable orders (instructions and commands) are data for the computer. As pointed out by Hasslacher (1988) in his paper "Beyond the Turing Machine", there are theoretical limits to the Universal Turing Machine. He wrote: *"In Turing machine theory, and in the complexity analysis of algorithms processed by Turing machines, one concentrates on the properties of output tapes as a function of input tapes - the structure of the Turing machine's finite control is ignored. This is what physicists would call an S matrix theory of computation; the computer is a black box, and we are allowed to look only at the in-out state relations. We wish to enter the Turing machine and examine the possible structures one can embed in the finite control."*

The Dubois (2000) proposition goes beyond the paradigm of recursion with his concepts of incursion, inclusive or implicit recursion, and hyperincursion. An incursion occurs when several values can be generated at each time step. In incursive and hyperincursive systems, the current state depends not only on past and present states, but also on potential future states. External incursive inputs cannot be transformed into recursion, which is really a practical example of the Final Cause of Aristotle. But internal incursive inputs defined at a future time, and in a "closed system", can be transformed to recursive inputs by self-reference defining an autopoietic system. For example, a particular case of self-reference with a Fractal Machine shows a nondeterministic hyperincursive field.

We have implied the notion of a third order cybernetics, but if it exists what novelty might there be that cannot be part of first and second order cybernetics? To respond to this let us distinguish between an observed systems and an observing system, and say that together they form a third system. Is this system an observed or an observing system? Some scientists think that the reductionist view of systems must be enlarged by a total view of systems in a holistic way. Is the whole more than the sum of parts and the relation between these parts of a system? One view that supports this notion comes from Yolles (1999, p.214). His interest lay in the metasystem, the complement to the system maintained by worldviews, and that enable meaning to become manifested. He identified three types of worldview held: (a) within a situation, (b) by an inquirer, (c) at the foundation of a methodology. The interaction between them may itself be seen as an emergent whole metasystem.

Apparently the whole can live by itself. For example, in the brain, there is the emergence of mind and consciousness, the emergence of meaning and identity. The feeling of identity of each of us as an autonomous and unique system is still a mystery. The big issue for cybernetics as Dubois (1990) has written in his book "The labyrinth of intelligence: from natural intelligence to fractal intelligence", is the possibility of building an intelligent machine with an artificial mind and an artificial conscious. Third cybernetics could deal with such a machine with a mind and a conscious, and offer a science of consciousness.

Viable systems theory can be classified as a third order cybernetics because in social environments, individuals and groups of individuals are self-observing viewers and have relative self-observed worldviews.

4 Viable Systems

A viable system is an active, purposeful, and adaptive organisation that can operate in complex situations and survive. Since complex situations entail variety differentiation, in surviving a viable system responds to changing situations by generating sufficient variety through self-organisation to deal with the situational variety it encounters (called requisite variety). It is often said in the cybernetic literature that variety is a measure of complexity.

A viable organisation is able to support adaptability and change while maintaining stability in its behaviour. In particular an organisation is viable if it can maintain stable states of behaviour as it adapts to perturbations from its environment. Now, the environment can be differentiated into a suprasystem of interacting organisations that exists in *its* environment. Such organisations are normally considered to be autonomous, in that they are taken to be analytically and empirically independent from one another. What constitutes independence is a matter of practical requirement that enables, for instance, measurements to be taken from a given organisation without conceptually complicating them with data from other organisations. The question of whether an organisation in a suprasystem of them is indeed autonomous, is one of estimating its degree of interactivity with the other organisations. It is perspective driven, and is ultimately axiomatic.

Viable organisations seek ways of improving their ability to survive in complex situations. This is often coupled with the idea that they have fluid knowledge banks, and organisational survival hinges upon an ability to create and manage knowledge. Knowledge creation/recognition is therefore of prime importance to organisations.

The idea of knowledge creation is closely related to that of learning. A learner (who may be seen as an individual or organisation), will undertake viable learning if there is an ability to maintain stable learning behaviour. The caveat is that the learner is able to adapt to changes in a given learning environment that alters the learning situation. Whether a learner can adapt to the changes in the learning environment is a function of that learner's plastic limit. In the systems literature, when perturbations push it beyond this limit, the system either changes its form (incrementally through morphogenesis, or dramatically through metamorphosis) or dies. As an example of this, a learner studying on a university course who is struggling "dies" in this context when s/he leaves the course prematurely (fails?) because new learning behaviours cannot be established. If a viable organisation survives, then it is able to change its form and thus its behavioural potential, to adapt.

Knowledge creation is associated with different worldviews. They are relative to the institutions that one is attached to in a given society, and they change as the institutional realities change (Berger and Luckman, 1966). Thus, worldview has a view or perspective of the perceived behavioural world that is determined by cultural and other attributes of the viewers. Through a process of socialisation, a view is formed within the institutions one is attached to in a given society, and they change as the institutional realities change. Worldviews may be shared by a group of people, though when this occurs the individuals each retain their own realities while using common models to share meaning. Further, worldviews have boundaries that are generated within the belief system and cognitive space of their viewholders, and as a result we can explore worldviews in terms of their knowledge attributes.

In developing on from and relating the work of Checkland and Scholes (1990) and Kuhn (1970), two types of worldviews may be defined, informal (weltanschauung), and formal (paradigm). By formal we are referring to the expression of ideas through language. A formalisation enables a set of explicit statements (propositions and their corollaries) to be made about the beliefs and other attributes that enable (more or less) everything that must be expressed, to be expressed in a self-consistent way. Informal worldviews are more or less composed of a set of undeclared assumptions and propositions, while formal ones are more or less declared. Both are by their very nature bounded, and thus constrain the way in which perceived situations can be described. Now paradigms can change (Yolles, 1999; Kuhn, 1970), so that the nature of the constraint is subject to a degree of change - however bounded it might be. Consequently, the generation of knowledge is also constrained by the capacities and belief systems of the worldviews.

The idea of a worldview (Yolles, 1999) is that it:

(a) is culture centred,
(b) has cognitive organisation (beliefs, values, and attitudes) are its attributes,

(c) has normative and cognitive control of behaviour or action that can be differentiated from each other,
(d) has a cognitive space of concepts, knowledge and meaning that is strongly linked to culture.

Worldviews interact, and following the cybernetic tradition, this interaction can be placed in a cognitive domain that drives the purposeful adaptive activity system. The system has form, thus has structure, process and associated behaviour. It is assigned to an energetic behavioural domain. The knowledge related cognitive domain is the "cognitive consciousness" of the system that it drives. According to Yolles (1999), the two domains are connected across a gap that we refer to as the transformational or organising domain, and that may be subject to surprises. It is strategic in nature, and operates through information (figure 1). The three cognitive, organising, and behavioural domains are analytically and empirically independent. This model can be applied to any purposeful adaptive activity system by distinguishing between cognitive, strategic, and behavioural aspects of a situation.

This defines the basis of viable systems (as defined by Yolles) that, through transformational self-organising processes, are able to support adaptability and change while maintaining stability in their behaviour. In a plastic organisation the nature of that behaviour may change, and in so doing a viable system will maintain behavioural stability.

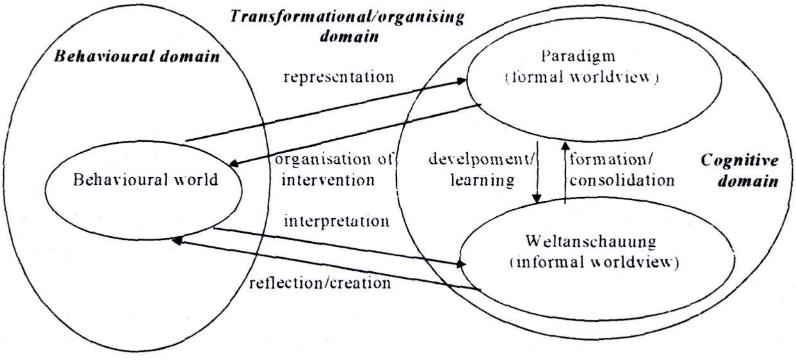

Figure 1: The Relationship between the Behavioural and Cognitive Domains in a Viable System

There are properties associated with each of these domains. This derives from Yolles (1999), and the notion that is associated with each of the three domains is a cognitive property that guides our organisations in the way that they function and survive. Yolles (1999a), in his exploration of the nature of cognitive influence, associates it with the process of knowledge migration, that is the movement of knowledge between worldviews that is subject to redefinition every time it migrates. It is not only knowledge that can be associated with the cognitive domain. Data are associated with the behavioural domain, and information with the organising domain. All three may also be identified as analytically independent commodities that enable the properties to become manifested.

Cognitive influences affect what we shall refer to as cognitive culture that includes the nature of meaning and relates to wisdom. In terms of knowledge, cognitive culture involves metaknowledge or knowledge about knowledge. It relates to the ability of viewholders to undertake knowledge housekeeping, enables knowledge maintenance, the examination of self-reasoning operations, and an explanation of self-behavioural processes. We may also associate this with what Marshall (1995) refers to as *identification knowledge* – the facts and concepts making up the knowledge domain. It is metaknowledge that also facilitates our rationality, and to establish practical interactive relationships that forms the core of our social structures. An illustration of the nature of cognitive influence is provided through an example that derives from Yolles (2000) that explores the development of joint ventures.

It is interesting from the above constructions that viable systems undertake organising processes as a transformation from the cognitive to the behavioural domains. This both implicitly and explicitly require anticipatory processes that will enable cognitive activities to be translated into behaviour. Thus, we are considering a different form of anticipatory system to that usual within the field of anticipatory systems that usually relates to a monotonic time based future. Rather, it relates to the self-capability of fulfilling a behavioural potential which might well not be time related in the traditional sense.

4 Autopoeisis and Anticipation

Viable systems are autopoietic, which provides "a condition of radical autonomy...(which) defines its own boundaries relative to its environment, develops its own unifying operational code, implements its own programmes, reproduces its own elements in a closed circuit, obeys its own laws of motion. When a system reaches what we might call 'autopoietic take-off', its operations can no longer be controlled from outside" (Jessop, 1990, p320).

Jessop continues by saying that autopoietic systems are not trivial input-output machines. Neither are they integrated into some broader control structure which determines their responses to environmental changes. Nor are they pre-destined to perform a particular function for other systems. Rather they may be seen in terms of environmental pressures that affect the system. The environment serves as a source for perturbing and/or potentially destructive changes to which the system reacts, if at all, according to its own determined processes. Any internal operations or restructuring triggered within the system is always governed by efforts to maintain the system's own basic organisational forms. Consistent with Jessop's argument, we can argue that this must involve anticipatory evaluations by the system. If an environmental change is so perturbing that they overwhelm the system's capacities for self-preservation and it disintegrates, then there is no external control on their internal reorganisation and only internal constraint is the goal of self-reproduction and self-production, which define strong anticipatory features. In this case weak external anticipatory features of the system must fail at this focus of examination.

According to Maturana (1980, p29,15-16), if we have a dynamic system composed of a network of processes that generate outputs, then it will be autopoietic if it:

1. generates outputs to that network of processes that are in part themselves the network of processes; this is a recursive definition.
2. defines for the recursive network a set of boundaries that satisfy the manifestation of its cognitive purposes.

In the development of the idea of autopoiesis, Maturana and Varela (1979) use the two concepts structure and organisation. Mingers (1995, p15) indicates that their use of "organisation" may be viewed as unobserved deeper forms of relationship that we may see as occurring within our domain of transmogrification (or behaviour organising), while "structure" may be viewed as an empirical surface phenomenon. For us then, autopoietic systems can be said to be closed at the organising level. Such *organisationally* closed systems are:

- systems not characterised as having external inputs and outputs;
- systems, once working, will continue to work though their own internal processes until an external force intervenes.

Schwarz (personal communication, 1996) sees autopoietic systems as being logically closed. This means that they are closed with respect to the logical organising processes suggesting that they have no logical relationships with their environment. The exchanges with the environment will normally occur at the behavioural level, and be experienced as perturbations that affect the organising processes. Expectations of behaviour are evident during the organising process of an organisation that manifest cognitive aspects of an organisation as behaviour, and behavioural perturbations will effect these. These expectations may be seen as nothing but elements of an anticipatory system. Homeostatic attempts will be made to adjust for the perturbations that will result in system regulatory changes. In the case that these fail, deeper cognitive learning occurs. This in turn results in self-organisation at the physical level. In this way, autopoietic systems are able to respond to the environment and self-organise, and implicitly involve anticipatory processes.

Schwarz (1994) also adopts the notion that social systems are autopoietic. A social system must be able to regenerate its logical or organising networks that ultimately derive from its paradigms, through actor and institutional behaviour.

5 The Viable Knowledge Creation Cycle

In any coherent social group situation, there is normally a dynamic between explicit and tacit knowledge. Tacit knowledge is seen as informal and determined through contextual experience, and will be unique to the viewer having the experience. It is therefore not transferable except through recreating the experiences that engendered the knowledge for others, and then the knowledge gained will be different. Tacit knowledge is therefore the result of self-learning. Explicit knowledge may be identified as formal, deriving in part from context related information established into definable patterns. Context formally exists as part of these patterns. Formal knowledge is transferable if the medium of transfer enables the transferral of meaning. Explicit knowledge can be a consequence of self-learning tacit knowledge, or received as a transfer. Examples of such transferable knowledge occur when it is provided in a book, or set out in a knowledge base system as a pattern of meanings through a set of propositional rules or through some other patterning process.

We consider that in social group situations, knowledge creation occurs through a process of knowledge migration from one worldview to another. It is an identification knowledge process. The basic knowledge management model is as given in figure 2 and depicts the three fundamental phases of the knowledge process: migration, appreciation, and action. Migration is associated with the cognitive domain, appreciation with the organising domain, and action with the behavioural domain. The way that migration occurs is conditioned by cognitive influence, appreciation through cognitive purpose, and action through cognitive intention, a strong anticipation. Each phase process has an input and an output. A feedback control process is able to condition each phase process directly, or through its input. The way that each phase process is conditioned by the feedback control is represented symbolically in figure 2 by a loop around the process bubble, the explicit meaning of each return loop being shown in figure 3.

Control processes not only condition phase processes. They can also be responsible for re-scheduling them in the overall knowledge cycle. Within perspectives of traditional positivism, it is normal to consider controls in simple terms; but they may also be susceptible to complexity and chaos (Yolles, 1999). This has implication for the development of a chaotic activation.

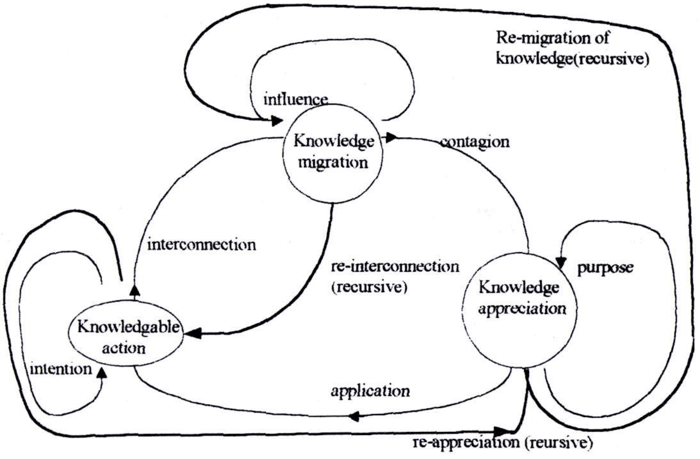

Figure 2: The Knowledge Cycle

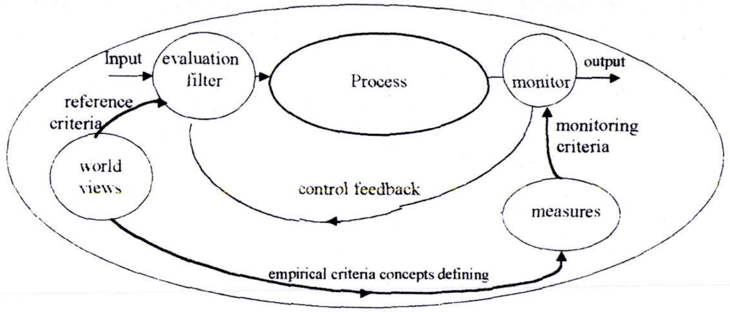

Figure 3: Basic form of the Control Model

Control processes, while often considered in terms of positivist or postpositivist paradigms, may also be seen from a critical theory perspective. To do this we invoke the propositions that:

(a) knowledge that enables the nature of a control process to be understood is local and worldview dependent;

(b) empirical and reference control criteria are worldview dependent, value laden, and will be susceptible to ideology and ethics;

(c) conditioning control processes are implemented in a local inquirer-relative way.

These propositions have implications for the way in which the coherent social group, subject to the phase process conditioning: (i) responds to the control situations, and (ii) appreciates the need of semantic communications that make it broadly meaningful. When the control processes are complex and control action fails, knowledge process metamorphosis can occur (Yolles, 1999).

We are aware that the graphs in figures 1 and 2, presenting the knowledge creation cycle, are relevant to the first cybernetics, with feedback loops and recursive processes. Feedforward controls, anticipatory processes and incursive and hyperincursive functions are not explicitly shown.

6 Knowledge, Logical Process, and Anticipation

The anticipatory capability by holders of worldviews derives from their self-referencing anticipatory logical structures in relation to their predictive models of environments. The models are integrally tied to the patterns of knowledge that they have, and these are generated by their worldviews. The anticipatory systems are logical structures that form within the organising domain through the use of the commodity of information. The weak anticipatory capability allows viewholders of a worldview to change their behaviour in accord with the predictability of the model of the environment pertaining to a later instant. The strong anticipation within the logical structure determines the evolution of the system among the set possibilities in front of the environment. A couple of considerations are raised here, one relating to behaviour and another to cognition. In respect of behavioural aspects, the ability of a worldview holder to change is bounded by their structural capacity. That is, there may be a need for change that cannot be managed due to the limitations of the structure.

Consider now the cognitive aspects. Let us suppose that it is recognised that there is a need for change. Sometimes in complex fluxes of events that the holder of a given worldview may not recognise the need for change because their patterns of knowledge do not enable that understanding. This is connected with an ability to appreciate the nature of ones behaviour and the behaviour that is required, and it occurs through a process of exception as a worldviewholder discerns that particular behaviours are endangering stability. It is also intimately tied up with logical anticipatory processes. Culture changes as cognitive organisation (beliefs, attitudes and values) change. With this patterns of knowledge also change, and this affects the logical models that are used in organising processes in the viable system, necessarily changing the logical models that provide an anticipatory capability.

Thus, the fundamental problem with anticipation and the capacity for behavioural change is not fundamentally behavioural, but cognitive and intimately tied up with patterns of knowledge. Since these are fundamentally worldview local, it suggests that anticipatory capability is also local. Knowledge cannot be transferred from one locality to another, but is rather spontaneously triggered through a process of migration. While this enables residues of common knowledge to occur across a set of localities - that is across a set of worldviewholders, we can never be sure how much knowledge is common. The logical models that result from our patterns of knowledge are therefore very much locally driven, and this affects the way that we organise, and our anticipatory capabilities.

According to the theory of knowledge migration, common patterns of knowledge may not develop for the viewholders of a given worldview. However, they manage to operate as a coherent group because of their cognitive interests or purposes, a notion consistent with the arguments of Habermas (1970), Jackson (1993) and Yolles (1999). If significant common patterns of knowledge have not arisen, then this has implication for the development of group anticipation. That is, there may not be a capability of developing coherent anticipatory models. This may well be a causative factor in the inability of organisations to develop and adapt. This has sever implications for the ability of a viable system to maintain its viability.

7 Conclusion

Anticipation in viable systems occurs as part of the self-organising processes through their logical structures and environmental models. However, these models are local to given worldviews. When these worldviews are coherent group affairs, then there will be some commonality in the patterns of knowledge that exist there, through the membership of the individuals.

Viable organisations work through cognitive interests and purposes implemented in their logical structures, which can drive the system even if all viewholders of a given worldview cannot apprehend any common patterns of knowledge that might exist. This means that the anticipatory activity of a viable system may not be a commonality for all the viewholders, which may have implications for the viability of some parts of viable systems. New anticipatory processes must be thus activated or created, giving rise to powerful means for the struggle for life.

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