KNOWLEDGE CREATION: SYSTEMS THINKING OR PROCESS PARADIGM?

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ABSTRACT

Although the field of Knowledge Management has notched up some significant theoretical successes over its short history, the key processes of novelty-emergence and new knowledge creation remain largely an enigma. These processes are important, however, because they inform crucial organisational activities such as change and innovation. It is our contention that theorising in this area has been constrained by the philosophical assumptions that underlie systems thinking. In this paper, we explore the nature of these constraints as a preface to introducing an alternative approach that is grounded in a process-based paradigm. By combining two existing streams of theory that are consistent with this paradigm, namely Complex Responsive Processes theory and Personal Construct theory, we elaborate nine theoretical propositions, which collectively provide a comprehensive description of the dynamic process of knowledge creation. In particular, the propositions examine the necessary conditions for novelty generation through human micro-interactions, the ontological and temporal nature of this interaction space, the construction processes that are engaged during micro-interactions, and the non-linear, self-organising dynamics that lead to the emergence of new knowledge in the form of organisational innovation.

INTRODUCTION

The field of Knowledge Management (KM) is poised for a transformational change in the way it is theorised. In its short history, KM has already undergone significant conceptual change, shifting from an essentially technology-lead perspective that emphasised the efficient structuring and flow of information, to the more people oriented social processes of knowledge conversion between tacit and explicit forms (Nonaka & Takeuchi, 1995). While significant theoretical advances have been made in this field, neither of these approaches has adequately addressed the dynamic nature of knowledge, nor the complex processes of knowledge creation.

This, of course, is not only a recent issue. For millennia, philosophers have debated the nature of knowledge and its creation, and these epistemological debates persist even today. For instance, the Logical Positivists of the Vienna Circle defined knowledge as meaningful only when it can be empirically verified, whereas the Critical Realists (eg Harre, 1985) identified three separate, but inter-related realms of knowledge: the empirical, the actual, and the real. Each of these realms has its own specific requirements for knowledge creation. Epistemological assertions such as these are necessarily framed within a broader philosophical context that provides an axiomatic foundation for theory construction. But just as these foundations provide a way of seeing, so also do they obstruct a wider view (Poggi, 1965).

It is our contention that the field of Knowledge Management is constrained by the foundational assumptions that have guided its development to date. Systems Theory has provided the essential underpinnings of theory development in this, and many other areas of organisation studies. This approach has undoubtedly generated valuable insights into organisations as knowledge systems, but we will argue that it is inadequate when it comes to exploring dynamic processes. In the next section, we briefly outline those foundational assumptions of systems thinking that we see as potentially problematic. We then proceed to outline an alternative approach, which we call process thinking, that we suggest may be more appropriate for the development of dynamic theory. Then, to illustrate the potential of this approach, we develop a series of theoretical propositions that describe the knowledge creation process in organisations.

SYSTEMS THINKING

Systems thinking is concerned with understanding complexity. It recognises systems as more than the mere aggregation of their parts; it is the interactions between these parts that generate systemic complexity. Consequently, complex systems such as organisations can never be understood solely in reductionist terms. This realisation has lead to the rise of organic metaphors that locate the organism within a wider ecological system. However, there are several aspects of this organismic approach that are problematic when it comes to dynamic change and novelty creation.

The biological notion of homeostasis, for instance, implies that systems tend towards a steady state condition. Feedback mechanisms serve to regulate deviations from the system norms, always returning the system to equilibrium. It is this process that produces enduring

organisational forms, but at the same time, it quickly stamps out any form of novelty that might arise far from equilibrium. Such novelty is, of course, a necessary ingredient in every process of new knowledge creation. The systems condition of homeostasis is, therefore, a major obstacle to understanding the dynamics of organisational processes.

It would be unfair to suggest, however, that the systems perspective is completely incapable of accommodating change. Drawing once again on the organic metaphor, every organism undergoes continuous change throughout its life cycle. These changes may be quite dramatic, as illustrated for instance by the transformation of a caterpillar into a butterfly. But the nature of such change is biologically circumscribed. The initial genetic blueprint of the organism controls every stage of its development, ultimately arriving at a predestined end point. Thus the underlying teleological assumption is that change is directed towards a known outcome (Stacey et al, 2000), and the source of any novelty is necessarily exogenous to the system. Once again therefore, we see a foundational assumption of systems thinking militating against any deeper understanding of the generation of novelty and new knowledge.

Our third concern about systems thinking in this context relates to the notion of emergence. This concept has been in scholarly usage for well over 100 years, but its ambiguous nature has stimulated much debate (Emmeche et al, 1997). Within the systems movement, emergence has been a hot topic at least as far back as Ashby (1956) and von Bertalanffy (1968). The debate revolves around whether emergence is a function of hierarchical levels within a system, or is rather the unpredictable consequence of complex interactions that play out over time. Systems thinkers have, in general, opted for the former position, wherein each level of a system is characterised by emergent properties that do not exist at lower levels of complexity (Checkland, 1981). So, for instance, the properties of water (H_2O) cannot be predicted from the properties of hydrogen (H) and oxygen (O). Nevertheless, there is an implication that these properties, although only apparent when viewed at a higher level of complexity, are already hard-wired into the system. This particular combination of hydrogen and oxygen always produces water; there is no element of unpredictability about it. Thus there is no potential for genuine novelty from this construction of emergence.

PROCESS THINKING

Given these limitations of systems thinking, we now turn our gaze towards an alternative conceptualisation that frames reality in terms of process instead of systems. Micro-interactions rather than micro-levels form the fundamental ontological units of this approach, which traces its origins to the process philosopher, Alfred North Whitehead (1920, 1929). Although Whitehead's ideas were largely dismissed at the time "as metaphysical and useless speculation" (Hodgson, 2000:66), they have recently found a resonance with new ideas from the complexity sciences (Emmeche et al, 1997), especially Complex Responsive Processes theory (Stacey et al, 2000; Stacey, 2001; Griffin, 2002). Stacey and his colleagues go to considerable lengths to detail the teleological assumptions that underpin their version of complexity. Their basic premise is that transformative potential exists in the micro-diversity of human interactions. There is always an unknown element in these interactions, and it is this that ultimately generates novelty. In contrast to the known future that is implied by systems thinking, process thinking is characterised by an unknown future that is under perpetual construction through micro-interactions.

From this perspective it is more relevant to think of emergence as the unpredictable consequence of a time dependent, relational process that results in the creation of new properties (Morgan, 1923). Of course, unpredictability is a very uncomfortable notion in the context of positivist science, which probably accounts for the suppression of this view of emergence through much of the 20th century. However, the undeniable unpredictability of the knowledge creation process invites a reconsideration of this approach to emergence. And this, in turn, suggests the need for a comprehensive review of how we theorise process.

TOWARDS A PROCESS THEORY OF KNOWLEDGE CREATION

In this section we tentatively suggest a way forward in the development of authentically process-based theory. In particular, we outline a series of nine theoretical propositions that collectively describe the knowledge creation process. Our theory-building has been deeply informed by the writings of Ralph Stacey and his colleagues (Stacey, Griffin & Shaw, 2000; Stacey, 2001, Griffin, 2002), as well as by George Kelly's Personal Construct Theory (1955). Although quite distinct in both time and discipline, each of these two theoretical streams is entirely consistent with the principles of process thinking outlined above.

The work of Stacey and his colleagues arises from Complex Adaptive Systems (CAS) theory, which has its origins in the biological sciences (eg Kauffman, 1995; Goodwin, 1994). One of the key characteristics of this theory is that order emerges from the interactions of large numbers of organisms, each of which is seeking to improve its own survival prospects. The Darwinian evolutionary processes of variation, selection and retention frame the emergence of order within a population. At the same time, this population constantly reshapes the environment within which these evolutionary processes occur. Continuous co-evolution results in a system that is in a state of perpetual change and emergence.

The particular contribution of Stacey's group has been to extend the basic concept of emergence into the realms of human behaviour, where of course, each agent is unique and brings individualised behaviours to each and every interaction. It is this uniqueness and individual agency that introduces genuinely novel variations into human interactions, which then become the source of unanticipated, emergent creativity. This theoretical extension is distinguished from the mainstream of CAS by using the title 'Complex Responsive Processes' (Stacey, 2001).

Complex Responses Processes (CRP) theory is grounded in the ideas of George Herbert Mead (1934) who described individuals and their contexts as mutually constitutive and co-constructed through the processes of micro-interactions. In particular, Mead saw gestures and the responses that they engender as the foundation of all social acts (Griffin, 2002:150). Each action, or gesture, stimulates some form of response, which in turn motivates an adjustment in the original action. This dynamic is well illustrated, for instance, by David Bohm in his discussion of the nature of dialogue:

> "… consider a dialogue. In such a dialogue, when one person says something, the other person does not in general respond with exactly the same meaning as that seen by the first person. Rather the meanings are only *similar* and not identical. Thus, when the second person replies, the first person sees a *difference* between what he meant to say and what the other person understood. On considering this difference, he may then be able to see something new, which is relevant both to

> his own views and to those of the other person. And so it can go back and forth, with the continual emergence of a new content that is common to both participants. Thus, in a dialogue, each person does not attempt to *make common* certain ideas or items of information that are already known to him. Rather, it may be said that the two people are making something *in common,* i.e., creating something new together" Bohm (1996:2).

This exchange captures the very essence of human micro-interactions in all their complexity. Although there is a familiarity about any interaction, there is equally an element of the unknown, wherein lies the source of novelty and creative potential.

Proposition 1: New knowledge emerges from novel variations that arise out of the gesture and response processes of human micro-interactions.

We see strong parallels between these arguments of Mead's and the theory of Personal Construct Psychology (PCP) that was developed by George Kelly (1955). PCP is situated within an epistemology of constructive alternativism that explicitly recognises the dynamic, co-constructive interactions between individuals and their social contexts. Kelly proposed that we each make sense of the events of our lives by means of interpretational templates that we have constructed through our own life experiences. These templates are comparable to notions such as interpretive schemes (Daft & Weick, 1984) or mental models (Senge, 1990), which are already familiar within the organisational literature. Essentially they provide us with a sensemaking framework that allows us to interpret events and to anticipate their outcomes. According to Kelly, this process of interpretation involves erecting abstract representational structures within which meaning takes form. He emphasised that these representations are not produced by the events themselves; rather, they are psychologically generated by the construing person.

If micro-interactions are conceptualised as interacting representational systems, then it is a relatively straightforward step to suggest that the generation of novelty need not be restricted to person-to-person interactions. Non-human and/or inanimate objects are equally capable of stimulating a mental representation in a person's mind. This explains why it is, for instance, that prototyping is often an important stage in the development of an innovation. The prototype itself may stimulate new representations that challenge the pre-existing template. This approach may equally be applied intra-personally, as demonstrated for instance by Einstein's famous thought experiments. In such a case, the individual generates multiple alternative representations, each of which may then be compared with the pre-existing template.

Proposition 2: Knowledge-creating micro-interactions may occur inter-personally, intra-personally, or between human and non-human actants.

PCP is often criticised for its focus on the psychology of the individual. However, in his elaboration of the theory, Kelly goes to considerable lengths to recognise the role of social interactions in the process of constructing any individual's interpretational template. In particular, for any sort of meaningful interaction to occur between two people, PCP requires that they either share a common psychological process (Commonality Corollary in Kelly, 1991:63), or they must be able to anticipate each other's construction processes (Sociality Corollary in Kelly, 1991:66). Here, we refer to these psychological dynamics as convergent,

as they are a necessary requirement for interpersonal communication. This ability to anticipate the responses that any particular gesture may engender (i.e. to stand in the shoes of another person), and the potential to modify gestures accordingly, was also well recognised by Mead (1934). In the absence of these convergent dynamics of Commonality and Sociality, people simply pass each other by, like ships in the night, unable to engage with or influence each other's interpretational templates.

Kelly's theory is essentially concerned with the processes of learning and change. He asserts "our lives are wholly oriented towards the anticipation of events … [with a view to] making more and more of the world predictable" (1991:110). We deal with uncertainty by anticipating outcomes based on our past experience. More often than not, our anticipations are indeed validated by subsequent experience. In this paper, we refer to micro-interactions that lead to such validation as 'Routine'. No change to interpretational templates occurs as a result of Routine micro-interactions. They simply serve to reinforce current anticipatory assumptions. Routine micro-interactions are most likely to occur in situations where Commonality and Sociality create a dynamic of convergence.

A second type of micro-interaction, which we identify here as 'Generative', occurs when our anticipations are not matched by our subsequent experience. Generative micro-interactions occur as a consequence of divergent construction processes that result in what Leonard-Barton calls 'creative abrasion' (Leonard-Barton, 1995). The non-validation of anticipations is an invitation to learn and change, which may involve a person modifying their interpretational template, or adjusting the manner in which the existing template is applied Without some variation or divergence in construction processes, there will be no potential for creative novelty, but paradoxically, without some convergence in construction processes, micro-interactions cannot even occur.

Proposition 3a: Routine micro-interactions are characterised by stability that arises from convergent knowledge construction processes.

Proposition 3b: Generative micro-interactions are characterised by the paradoxical presence of both convergent and divergent knowledge construction processes.

In fact, paradox is an essential feature of any theory of complexity. For instance, emergence is said to occur at the 'edge of chaos' (Brown & Eisenhardt, 1998), where conditions of stability and instability paradoxically co-exist as a perpetual dynamic. Stacey's group, and in particular Griffin (2002), draws on Mead to elaborate a paradox that influences the social interactions of human individuals. They express this as the tension between self and community; between the individual, who is a necessary constituent of a group, and the group or other social collective, which is necessary for the shaping of individuals. Neither precedes the other. As Elias (1989) describes it, the individual and the group are the singular and plural of the same phenomenon, namely human interaction. They are at the same ontological level of existence, part of the same process, and should not therefore, be treated as discrete levels of analysis in the theorising of human processes.

This is a significant departure from conventional systems thinking, which seeks to subsume lower levels of a system (the parts) within higher level explanations (the whole). The process view provides a quite different way of viewing reality, in which all of the factors influencing any process are equally important, so none may be privileged in an analytical sense.

Conversely, any factor involved in a process will contain all the information required by that process. This formulation has a clear resonance with holographic principles, in which every part contains the whole.

Proposition 4: The complex processes of knowledge creation that occur in human micro-interactions may equally be explored through any factor that influences the process.

Another paradox that surfaces in complexity theories is that of time and the temporal quality of human experience. The nature of time is a critical issue for theory development within a process paradigm. Stacey's group uses the notion of the 'Living Present' to capture the temporal aspects of micro-interactions. On one hand, this Living Present is a timeless moment of experience, within which lies the potential for variation, leading to new realisations and transformative change (Mainemelis, 2001). On the other hand, the Living Present has a temporal structure that enfolds both the remembered past and the anticipated future, shaping actions that are taken in the present (Kelly, 1955). What we call to mind from the past in any specific situation is shaped by what we expect will happen, and what we anticipate is very much determined by our past experience. The inherent circularity in this structure is quite different from the conventional linear view of time, which locates the present at the point of separation between the past and the future. The existence of this paradoxical quality of time invites us to treat the Living Present "as if" it is timeless in the here-and-now and at the same time "as if" it is part of a movement towards an unknown, yet knowable, future.

Proposition 5: Knowledge creation occurs in the Living Present, which paradoxically represents both timelessness and a temporal structure that links the past and the future.

Following on from this discussion of time, we now move to consider the purpose of micro-interactions. Stacey et al (2000) argue that people engage in micro-interactions in their quest for meaning and a sense of identity. Meaning is formed out of actions, and it is through these actions and their consequences that people come to realise their identities. Kelly similarly suggests that the psychological motivation for construing is to elaborate one's understanding of what will happen and to improve the anticipatory potential of one's interpretational template. In both of these cases the individual is engaged in an ongoing process of identity construction. There is a parallel to this in the biological sciences, where Kauffman (1995) proposes that organisms engage in complex processes in order to improve their fitness for survival in a constantly changing landscape.

Identity is already a very familiar concept to readers of the organisational literature (eg Albert, Ashforth & Dutton, 2000). In fact, Wrong (2000) has suggested that identity is the most widely used concept in the humanities and social sciences. At the same time however, it continues to be an intensely contested concept, with enormous problems of definition and interpretation. Other than to note their existence, it is not our intention to engage with these debates in the context of this paper. Rather, we simply note the path dependence and perpetually changing character of constructed identity.

Proposition 6: Knowledge-creating micro-interactions are motivated by the inherent human desire for meaning and identity.

So far we have argued that human micro-interactions are the source of genuine novelty. The emergence of novelty is clearly a necessary condition for knowledge creation, but on its own it is not sufficient. It is at this point that yet another feature of complexity theories, namely self-organisation, becomes important. Self-organisation is the natural consequence of multiple, non-linear micro-interactions. When micro-interactions occur across a large number of agents, there is the possibility of positive, or reinforcing, feedback loops that will amplify some emerging novelties, while minimising the impact of others. Self-reinforcing feedback cycles become locked in, leading to the self-organised emergence of new recurrent patterns of collective behaviour, despite the apparent chaos that lies within.

For self-organisation to occur, chains of micro-interactions are required where each builds upon the novelty generated by its predecessors. The notion of 'critical mass', which comes from nuclear physics, provides a useful analogy to understand these chain reactions. Nuclear fission is a process that releases neutrons from atomic nuclei (cf generation of novelty from micro-interactions). These released neutrons may interact with other nuclei, causing them in turn to release neutrons; or they may simply pass through the empty spaces of the surrounding atoms. The probability of establishing a chain of nuclear fission reactions is greatly increased once the total mass of atoms available to this process exceeds a certain critical level. In just the same way, complex processes require a 'critical mass' of micro-interactions in order to create the necessary conditions for self-organising knowledge creation.

Proposition 7: Knowledge creation emerges out of the non-linear, self-organising chain reactions of multiple human micro-interactions.

Taking this analogy one step further, critical mass not only implies the total mass of atoms (cf total number of potential micro-interactions) available to develop chain reactions, but also it implies that these atoms are contained within a finite space. This notion of containment resonates with Prigogine's (1997) idea of dissipative structures, which are capable of transformation to a new state when in-flowing energy is contained and amplified rather than being allowed to dissipate back into the environment. So, even when chaos and unpredictability appear to reign, complex processes are necessarily contained within boundaries that are well-ordered and predictable (Wheatley, 1992). Applying this analogy to the complex process of self-organised knowledge creation, it is unlikely that the necessary chain reactions will be established unless they occur within a bounded context of time and space.

Proposition 8: For self-organised knowledge creation to occur, the contributing human micro-interactions must be contained in time and space.

The final step in this discussion is to move from consideration of a single process of knowledge creation, to understanding the organisational conditions required to sustain ongoing knowledge creation. In fact, this is a relatively straightforward step given that all of our theory development so far has been premised on assumptions of perpetual, ongoing processes. Thus the conditions that foster a single process of knowledge creation are exactly the conditions required to sustain an ongoing process. Put simply, these conditions require firstly that the environment is supportive of both routine and generative micro-interactions, and secondly, that appropriate boundaries are established to contain the chain reactions underpinning self-organisation. Clearly these boundaries will need to be defined more

broadly for long-term sustainability, but otherwise, the theory that we have developed here is equally applicable to any level of knowledge creation process.

Proposition 9: Sustainable knowledge creation requires an organisational context that fosters both routine and generative micro-interactions, and provides the boundary conditions necessary to contain self-organisation.

DISCUSSION

These nine theoretical propositions are offered here as a step towards re-theorising organisational processes, especially those that involve knowledge creation. In developing the propositions, we have endeavoured to retain consistency with the theme of process thinking that we discussed earlier. Process thinking is, in fact, founded on a consistent and coherent set of philosophical assumptions that constitute a paradigmatically different view of organisation. So, for example, rather than framing reality in terms of material substance, as is the case in the deductive-nomological paradigm that has tended to dominate thinking in organisation studies, the process paradigm is ontologically grounded in process. This means that authentic process theories are dependent on very small *processes* (ie micro-processes) rather than very small *things* as their basic building blocks (Rescher, 2000).

The related epistemological assumption is that knowledge is constructed within the gesture – response cycles of subjective experience. It tends, therefore, to be relative, path dependent, and historically situated. This view of knowledge as a process of construction is fundamental to the novelty-generation that characterises human organisation. This then, leads quite naturally to the teleological view that the future is unknowable and emergent, as opposed to the mechanistic pre-destination that characterises the dominant paradigm. Without this basic assumption, there is no possibility for genuine novelty. Our theoretical propositions also include a different perspective on time. Whereas contemporary conceptualisations of time are generally framed with reference to the clock as precise, objective, and external to human experience, the process paradigm necessarily involves a more pluralistic and paradoxical view that acknowledges human experience as the defining quality of time. Recognising this, Clark (2000) calls for the greater use of 'event time' rather than 'clock time' in the sociological analysis of organisational processes such as innovation and change.

The various assumptions that we have outlined here are interdependent, and collectively represent a sound philosophical foundation for building process theory. The propositions that we have developed have been derived with close attention to these process paradigm assumptions. Consequently the theory departs from the mainstream orthodoxy of the dominant paradigm in several important ways. Firstly, from a process perspective, there is no ontological distinction between physical levels when they are involved in the same process. Thus our theory circumvents the classical debates as to the primacy of the individual versus the collective and the need to confine research activities to one or another defined level of analysis. Similarly the categorical distinction between tacit and explicit forms of knowledge that has recently been popularised through the SECI model of knowledge creation (Nonaka & Takeuchi, 1995) is also challenged by our theory. From a process perspective, these two forms of knowledge co-exist on the same ontological plane as was originally envisaged by Polanyi (1962), so there is no need to distinguish between them in the theory. Indeed Clark (2000) introduces the notion of 'explacit' knowledge as a means of reuniting them.

Secondly, the theory is not intended to provide a universal prescription that offers predictability in what is quite clearly an unpredictable and emergent process. Rather, it suggests a means of gaining deeper understandings of the dynamics of the lived process as it unfolds. Insights afforded by the theoretical propositions are most certainly useful in informing organisational practice, directing attention towards questions such as 'what would constitute critical mass in a given organisational context?' or 'what boundaries would provide the most appropriate form of containment in a particular setting?'

At its core, the theory reminds us that the root of creativity lies in the gesture – response cycles, or 'double interacts' (Weick, 1979), that occur in all human interactions. The key to understanding these micro-interactions lies in the way in which individuals construe, or represent, the gestures that they perceive and the responses that they give. Importantly in this context, our theory recognises that the actants in these gesture – response cycles need not always be human. The human mind is equally capable of forming mental representations, or construals, of both human and non-human others.

The theory also distinguishes between Routine and Generative micro-interactions, confirming that both are necessary constituents of any knowledge creation process. Whereas Routine micro-interactions are the focus of much classical management theory, Generative micro-interactions probably require a quite different environment to flourish. This environment is likely to be more facilitative than controlling, but the paradox is that both forms of micro-interaction are necessary for knowledge creation to occur.

Issues of power and emotion are frequently overlooked in theories of organisation, especially those that are founded on systems thinking. Although we haven't discussed these dynamics in this paper, they are well accommodated in the process paradigm. Because the gesture – response process is subjective by nature, it is necessarily shaped by human feelings and emotions, albeit frequently at an unconscious level. This explains why it is that an individual may respond to similar circumstances in quite different ways on different occasions. Their response is not amenable to rational prediction. Further, the processes of power relationships are ubiquitous in all patterns of communicative interaction. The power differences that shape actions are immediately established in any human micro-interaction. So, for novelty to emerge, it is necessary to disrupt the currently existing patterns of power relations.

In conclusion, we are suggesting that in order for the field of Knowledge Management to continue to grow in relevance and importance, it is imperative that the processes of novelty-emergence and new knowledge creation are explicitly incorporated into the development of new theory. This, we believe, will require a paradigm shift in the most fundamental assumptions that underpin theory building. The arguments that we have presented here are necessarily 'once-over-lightly' because of the conference constraints on the length of written papers. However, we do hope that our ideas may serve as a stimulus to the scholarly debates that necessarily precede paradigmatic change.

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