Systems, Structure and Agency: A contribution to the theory of social emergence and methods for its study.

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Abstract

In this paper we reflect on the conference theme 'Systemic Development: Local Solutions in a Global Environment' noting that this echoes sentiments captured in the slogans 'Think global, act local' and the complement 'Think local, act global'. We argue that these slogans embrace inherently systemic insights, but insights which current social and organisational theory, including that inspired by systems thinking, cannot adequately underpin. It is argued that a failure to establish an adequate understanding of the interplay between agency and structure is at the heart of the problem. In this paper we outline our theoretical and empirical collaboration exploring this issue. We draw on the theory of autopoetic systems to argue that social systems are complex systems of a particular class and that what distinguishes them as a class is the reflexive capacity of the constituent agents. Reflexivity happens in and through language and provides a capacity to distinguish macro structure and relate it to 'self 'and thus to change micro behaviour, and in so doing contribute to the generation of new emergent pattern. We explore this through two case examples. The first addresses issues affecting innovation within a senior management team in Westpac Bank. The second addresses self-organising normative processes within the global network institution Wikipedia. Links are drawn between the cases and the theoretical framework advanced in the first section. The cases serve to illustrate how methods which are normally associated with either micro or macro behaviour can be combined to help with research into the interplay between the two.

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Introduction

The theme of this conference *'Systemic Development: Local Solutions in a Global Environment'* appears to echo two reciprocal insights into the effect of systematicity. The first is captured by the slogan 'Think global, act local' which grew from environmental and social activism (Fisher, n.d). It reinforces that small local changes can propagate and have system wide effects and conveys messages about how individuals may try to effect change with a reminder of the ethical implications (responsibilities) of so doing. The second slogan 'Think local, act global' also rooted in activist practice, reflects how, through new technology, local solutions can be produced by harnessing wide spread active contribution from disparate global resources. These two slogans capture, in a very parsimonious way, what we take to be the implications of highly connected global ecological and social systems. Systems theory has been good at informing this type of insight. It has been significantly less good at supporting a clear explication of how and why such phenomena are possible and the conditions under which they may be realised: it suffers from excessive generality and a concern with macro order at the expense of the generative processes which produce that order.

Returning to the slogans and indeed the theme, at first glance both appear to point to issues of scope (local vs global), but look more closely and there is an implied issue of level: Both suggest that individual agency (changes in thinking and acting) can have large scale social consequences by which we might read a change at the level of collectives – or of institutions. But here we confront what Keith Sawyer has recently described as *'a fundamental intellectual problem'* (2001; 2003). When we posit the possibility of individuals using their agency (to act out of free will) to effect change on institutions we imply an understanding of the reciprocal relationship between the micro level (agent) and the macro level (social structure). The problem is that we lack such an understanding.

This lack, referred to in the social and philosophy of science literature as the problem of structure and agency or the micro-macro problem, is perhaps more familiar to this audience as the problem of *emergence*. It is of long standing. We argue that without an adequate account of the interpenetration of micro and macro process, we cannot explain the intrinsic nature of sociality and we cannot say much about how and when individuals acting locally may have wider effects nor how disparate individual contributions may be effectively harnessed so as to generate coherent solutions to local problems. Yet, as the appeal of such slogans reveals, to have some understanding of such phenomena would seem important.

The fact that such a fundamental problem remains unsolved should not be taken to imply that it has received no attention: It has received a great deal. That it remains unresolved is more a reflection of how intellectually formidable the problem is.

Wrestling with the micro-macro problem has provided a core to our collaboration over the past eight years. Our concern with it arose from our experience as practitioners it was and remains grounded in our attempt to effect change within organisational and social systems. It is not, therefore, an exercise in theoretical navel-gazing. That said it does not appear to lend itself to a purely empirical treatment.

In this paper we briefly identify the main strands of the theoretical debate around this problem. We then present a theoretical framework which we advance as an attempt to

resolve it. Following this we discuss how we are continuing to research the issue using two case studies. These cases serve to ground the discussion and to illustrate ways for furthering our understanding. We also use the cases to illustrate some of the methods we are finding useful.

What is the problem?

The problem is that contemporary approaches to social and organisational science, including those derived from systems thinking, fail adequately to address, either theoretically or methodologically, the reciprocal interplay between macro and micro phenomena. There have been two recent attempts to provide a meta-view of the problem as it applies to understanding social systems: That of Elke Weik (2006) and that of Christian Fuchs & Wolkgang Hofkirchner (2005: 33). Both conclude that existing social theory falls short of providing an adequate account of this relationship. Fuchs et al place systems theory in with other macro focused theories under the heading of *sociologism*. This is consistent with Burrell and Morgan's (1994) argument that it belongs to the functionalist paradigm and as such is poorly placed to understand processes of change – focusing instead on processes of order. This criticism is probably fair if by systems theory, they are referring to the body of work which came out of the attempt at a General Systems Theory or the cybernetics tradition. The associated 'black box' approach clearly masks the relationship between micro and macro. As a body of work, however, systems thinking does support an exploration of the difference made to system level behaviour as a consequence of how elements are bounded and connected. Application of the concept to social science, in particular through social cybernetics (Keeney, 1987), and soft systems approaches (Checkland, 1999) also confronted macro theorists with the need to deal with the role of the observer and the role of observation when studying social dynamics. More recently the development of complex systems has provided a better foundation for understanding the macro-micro interplay and for understanding the mechanisms and pre-conditions for emergence.

The concept of emergence has long been central to systems theory: It is implicit to the concept of holism. Unfortunately the concept remains problematic and has arguably brought as much confusion as it has clarity (for recent overviews of the state of play see Achim, 2004; Clayton & Davies, 2006; Sawyer, 2001, 2005).

One of the issues which has bedevilled the debate about emergence is what ontological status to attribute to 'emergent' structures – are they simply 'epiphenomenal' or do they have causal effect? Within social science this problem is manifest by two fundamental questions:
1. Ontologically, what is the origin or nature of (macro) social phenomena and how do they emerge from the (micro) actions of individuals in particular contexts of action?
2. Epistemologically, how is it that we can come to know about social phenomena?

Some useful advances have been made. The critical Realists argue convincingly that previous attempts to answer such questions have suffered from an inappropriate 'bundling' of ontological and epistemic assumptions (Archer, 1998; Bhaskar, 1998). Typically, realism is bundled with objectivism and idealism is bundled with relativism. We agree with Bhaskar that if an emergent structure can be seen to have causal effect then it should be awarded some ontological status.

From Complexity theory we take the understanding that what makes emergent properties irreducible in principle (and hence subject to emergence) is the presence of non-linearity at some level within the systems operation (Bak, 1996; Holland, 1998; Kauffman, 2000; Stewart, 1990). This results in one or both of the following conditions being present:

- Deterministic Chaos (Lorenz, 2001; Williams, 1997);

- Equifinality (Richardson, 2002b) or 'wild disjunction' (Fodor, 1974).

Equifinality as it is known within systems theory or the principle of 'wild disjunction' as it is known in philosophy, refers to a system where a single high level property may be realised by more than one set of micro-states which have no lawful relationship between them (Richardson, 2002a, 2002b; Sawyer, 2001). As there is no *a priori* basis by which the likely micro-state can be determined, such systems are irreducible and unpredictable in principle. From this we can conclude that there are systems which:

- are inherently analytically reducible (to which the concept of emergence does not apply);

- are analytically reducible in principle but difficult to reduce in practice and/or where an advance in science/knowledge is needed for reduction to be possible because the results were 'unexpected' (Chalmers, 2006) (to which the concept of 'weak' emergence can be applied);

- are not reducible in principle (to which the principle of 'strong' emergence is relevant).

To which of these three classes do social systems belong? We argue it is *always* the latter and this has a number of significant implications. The possible presence of non-linearity prepares us not to expect that social phenomena can necessarily be reduced to explanations at the level of physics, biology or individual psychology or behaviour even if it is dependent on them. We anticipate and expect that properties particular to the social level may be exhibited, that they may be novel, and that they could well be unpredictable in principle. What is missing, however, is a logically internally consistent theory which explicates the mechanism by which qualitatively distinct social phenomena emerge from the biological micro-processes which underpin it – from human agents. What might such a theory look like?

A possible theoretical treatment

In our view, any theory of sociality needs to be grounded in a biological theory which gives an account of the origins and fundamental characteristics of human social agents: In the case of human social systems this includes cognition and language. We argue that a suitable foundation is present to a large degree in Maturana and Varela's (1980) theory of autopoiesis. This theory embraces what we know about human cognition in a manner that is epistemologically and ontologically consistent with a complex systems view. Bringing these two views together furnishes significant advantages in that each serves to extend the other. In short, we argue that autopoiesis provides a logical and internally consistent account of what we consider to be:

- The fundamental mechanism of sociality – structural coupling;

- The consequence of language, and;

- A means of dealing with the (reflexive) observer within the generative process of sociality.

When combined with Complexity theory, these concepts potentially allow us to fully describe the interpenetration between structure and agency in human social systems. We have set out the basis of this approach in more detail elsewhere (Goldspink & Kay, 2003; Goldspink & Kay, 2004). Specifically we state:

> Humans exist in and through domains, which are the product of their structural coupling with an environment. This environment is the world around them including other humans …. The domain is a complex product of the context and time-specific interactions into which the individual enters. Included in this are the linguistic interactions that arise as individuals generate linguistic distinctions about that environment. As humans enter into reciprocal interaction over time, there emerges, as a consequence of structural coupling, a certain alignment of their behaviours, including their linguistic behaviours. Hence we can refer to the resulting domain as a consensual domain. This domain now forms the basic unit of social analysis, and exists in a causal sense but not a physical one (Goldspink & Kay, 2004: 605).

It is the mechanisms described above that provide for the emergent phenomena we describe as social. The resulting structurally coupled networks of heterogeneous agents can be expected to be intrinsically (indeed relentlessly) non-linear and hence subject to Chaos and equifinality. It is here that Complexity theory provides a suite of concepts and tools with which to explain and study the dynamic properties. However, autopoiesis also extends Complexity theory. Contemporary approaches to Complexity have failed to come to terms with the implications of the reflexive nature of human agents. To date the concern has been to understand the processes by which order emerges bottom up. Natural complex systems involve agents affecting one another only through local interaction – natural agents cannot observe macro consequences and change their behaviour accordingly – human agents, however, can and do. Social systems are complex systems of a particular class and with distinct characteristics. We need to come to terms with the consequence reflexivity has for social emergence.

Reflexive Emergence

What are the emergent mechanisms that generate *human* social phenomena? We have recently described these in some detail at the Fall Symposium of the Association for the Advancement of Artificial Intelligence in Washington (Goldspink & Kay, 2007), the key points are summarised here.

To distinguish natural complex systems from human complex systems we have suggested the need to consider two sets of generative mechanisms – pre-reflexive and reflexive. Linking this back to the theory of autopoietic systems, the pre-reflexive mode operates through structural coupling of behaviours. Specifically we state:

> *Structural coupling will arise between biological (autopoietic) agents which have sufficient cognitive range (behavioural repertoire) and if they are located in a common environment. Assuming that their phylogeny and ontogeny is such that they can co-exist, through the process of recurrent mutual perturbation, each will adjust its structure so as to accommodate the other - their structures will become mutually aligned or structurally coupled.*

This is the mode with which complexity theorists and social simulators are familiar. What is missing from it is what Gilbert (2002) has referred to as second-order

emergence. This is emergence which arises from the fact that agents are capable of language.

Language radically increases the behavioural plasticity of agents and has significant implications for the dimensionality of the phase space and of the resulting higher order structures it can generate and support. This is because language makes possible the emergence of domains of interaction which can themselves become the target for further linguistic distinction and hence new domains. An appreciation of this was clearly evident in the social constructionism of Berger and Luckmann (1972) but has since been largely ignored. Linking this back to the theory of autopoiesis, Maturana and Varela's (1980) notion of consensual domains giving rise to linguistic domains and linguistic domains supporting the development of further linguistic domains, reflects this bootstrapping of levels possible in human social systems. It makes possible a range of behavioural unparalleled in non-linguistic systems.

More than this, the advent of language means that another completely new source of pattern arises. Language allows the agent to make distinctions on prior distinctions. This capacity greatly expand the structural flexibility of the agent – the agent can now invent worlds or epistemic domains to use Luhmann's (1990; 1995) terminology. One of the abilities which appear to co-occur with language is the capacity to distinguish 'self' from 'other' (Gardenfors, 2006). Agents can then create epistemic worlds and locate 'self' within them. Self narrative also appears to play a role in this and may be fundamental to it (Ezzy, 1998). Narrative appears to arise as a cognitive capability before language albeit in more limited form (Dautenhahn, 2002).

The effect of the emergence of these capabilities is that the phase space of any system comprising such agents is now based partly on ontogenetic variables rather than only phylogenetic (as with non-linguistic/reflexive animals) and is hence subject to influence by the agents in and through their collective action. Furthermore as the agent can now differentiate itself from the environment, it can entertain itself as a causal agent and change its behaviour based on what it perceives as emergent social patterns. This suggests, for example, that an agent can form hypotheses about the relationship between a macro structural aspect of the social system in which it is a participant and then act on that hypothesis, potentially changing the structure which it participates in generating. This gives rise to a feedback path between macro and micro phenomena that is not present in any other natural phenomena. It is this that allows us to assert that human social systems are will, of necessity, be non-linear.

How are we working with this in practice?

We mentioned that our interest in this issue was born of practice. Advancement has, however, involved praxis. The theoretical work remains important and necessary as it helps us to successively distinguish more rather than less helpful areas in our practice. Conversely, we have been able to make advances in the theory only as and when we stretch our understanding of the implications through practice. In this section we discuss two practical projects and link them to the ideas presented so far. The first approach addresses the systemic origins of particular social patterns within Westpac Banking Corporation. The second is an empirical and computer simulation case study being conducted as a part of the EU funded project Emergence in the Loop (EMIL) to support the development and understanding of self-organisation within global network organisations including, as with this case, Wikipedia. In both cases we had to address a fundamental gap in the literature relating to autopoiesis and Complexity when it

comes to social systems – the basic lack of associated method. The cases serve, therefore, to illustrate methods relevant to the study of the interplay between micro and macro process.

Case Study One: Westpac Trust and Innovation

This case study is concerned with the need to plan and give effect to local interventions which have some chance of changing global organizational culture. Some senior managers in the organization have a sense of what broad cultural patterns they *believe* are required for the organization to remain viable within its context and these are *not* the patterns currently observed. The purpose of the case study was to gain insight into processes which generate and maintain those undesired patterns in order to design interventions which had a chance of disrupting them and which might support the emergence of alternative and more desirable patterns. This is, of course, a common enough challenge in organizational change and so the case has wide potential relevance. The detailed results of this study form the basis of a forthcoming publication and are beyond the scope of this paper. Here we focus on the degree to which this approach has been helpful in expanding our understanding of the dynamics associated with micro to macro emergence.

The case has involved two related data collection cycles both using a similar methodology. In both cases the cycles were aimed at collecting data relevant to understanding:

1. The existing patterns of behavior in relation to 1) collaboration and 2) innovation).

2. The impact of existing formal and informal structures on the reciprocal interplay between individual sense-making and macro level behavior.

We assumed that we needed three forms of data: 1) an account of an actual series of events that individuals in the social system had experienced and how it was that they saw them as related; 2) how each individual construed those events; 3) a group (macro-level) view of the degree and depth of sharing across the group of alternative construal. The first of these data provide a diachronic (historical narrative) account from an individual and collective perspective: The second provided information on the granularity and heterogeneity of sense-making around that event and: The third told us of the extent to which the individual construal had converged to form a consensual linguistic domain – including which constructs formed the core of that domain.

For the first data set, we chose the method of narrative. The use of narrative within Complexity has grown in popularity, within social research and organizational study over the past few decades (Rhodes & Brown, 2005). We are assuming that a set of shared events will be alternatively construed. It is this difference that contributes to the emergent pattern at the macro-level– each individual acts to extend his/her historical account – to continue the narrative as he/she sees it. Narrative provided the individual's account of how a particular event unfolded – based on their current sense-making and of their role within it.

For the second data set, that pertaining to the individual sense-making of the participants, we chose the repertory grid technique. Repertory grid is derived from George Kelly's Personal Construct Theory (Kelly, 1963), has a constructivist basis and is somewhat epistemologically consistent with autopoietic theory. The approach

provides insight into which constructs in each individual's meaning-system primarily orientate their behavior. In addition, measures such as *intensity* and *ordination* generated within Idiogrid (Grice, 2002) reveal how tightly held and therefore subject to change these constructs are. Intensity measures the correlation between constructs in a respondent's grid. Respondents with high *intensity* scores tend to have fewer alternative ways of construing events (Fransella et al., 2004). The *ordination* scores reveal the location of a construct within the respondents construct hierarchy, with higher scores suggesting higher ordination or more meaningful (and abstract) constructs (Landfield & Cannell, 1988). Individuals are less likely to be willing to change higher order constructs as they have significant implications for how they makes sense of their world (Bannister & Fransella, 1989; Kelly, 1963). In combination these scores provide an indication of the level of flexibility the respondents have when it comes to changing the way they perceive events. This willingness to change, as will be discussed below, is extremely important in terms of understanding the emergent dynamics of a social system.

The third data set, the group level construal, was also derived from the individual repertory grids. We conducted a thematic analysis across the constructs of the entire group (see Jankowics, 2004 for a systematic process for doing this). This analysis revealed the degree to which there were commonalities to the sense-making among respondents.

From the combined analysis of the three data sets it was possible to discern three primary distinctions that orientated respondents toward one another and influenced their willingness to collaborate:
- Not in my team / haven't worked with them vs In my team/worked with them before.
- Different knowledge base / perceived as specialized vs Same knowledge base as me / more of a generalist.
- New to the bank vs long time bank employee.

Approximately two thirds of the respondents had one or more of the above as key characteristics in the way they distinguished collaboration between members of the group. These three distinctions appear to form the basis for the creation of sub-groups within the broader team, where people of like characteristics have a much higher propensity to trust and collaborate with each other rather than those they perceived as being different.

The combination of depth with which these constructs were held and the degree to which they were shared across the group strongly drove the eventual outcome of the particular activity we studied. For example, a group that was supposed to be collaborating on a set task instead split to create sub-groups closely aligned to the constructs described above. What is interesting here is that overtly, all the participants wanted to collaborate, and indeed initially did collaborate around the problem they had been set, thus creating a new pattern of interaction that had not existed before. However, over a relatively short period, this new pattern broke down with a slightly modified version of the pre-existing pattern of interaction emerging and conforming to the pattern predictable from the identification of these primary orientating constructs.

Mapping these three data sets together allowed us to identify what we refer to as the key drivers of the emergent pattern. It also provided an appreciation of which drivers could be easily changed and which could not. The results showed quite clearly that,

where certain constructs were both deeply held by an individual **and** strongly shared by the group, these constructs would drive the emergent pattern of activity despite a change to the environment of the system.

These observations have lead us to propose the following model (see Figure One) as a way of informing any proposed attempt to change existing organizational patterns. The simple two by two matrix places the depth with which a construct is held on one dimension and the level to which it is shared on another. By mapping the constructs onto this matrix it becomes very clear very quickly which constructs or drivers will be difficult to address, and indeed if not addressed, will work against any proposed change. It also helps with the identification of the characteristics of the social system which are trivial and will have very little impact on the dynamics of the social system.

Insert Figure one about here.

Importantly, in terms of our broader research program, these observations provide us with a perspective on the way in which the micro level and macro level interact. It provides a guide to intervention – identifying those constructs which are a) most influential on the emergent dynamics and b) those which are most amenable and least amenable to change.

Case Two – Wikipedia

In this case the concern is to understand how widely dispersed and heterogeneous (in terms of having different skills, knowledge, goals and resources) agents can be brought together to produce precise, accurate, well crafted information resources in the form of encyclopaedic articles on a wide range of specific and tightly framed topics.

This case is being undertaken as a part of the EU funded research project titled Emergence in the Loop (EMIL). EMIL is explicitly concerned with the micro-macro problem and is using both empirical and computer simulation methods to advance our understanding of it. The insight behind the EMIL project is that this two-way interpenetration of micro and macro levels is fundamental to 'normative action' in social systems. Agents perceive higher order social structures (norms) and (perhaps) change their (micro) behaviour in response, thus at the same time acting on the norm (perhaps reinforcing it or diminishing it). The case studies chosen therefore involve the study of the emergence of social norms. First among the cases to be used in EMIL is that of Wikipedia.

Wikipedia is of interest as the individuals that that have participated in creating it have, through their collective action, emerged a set of permissions, obligations, rules and norms which arguably serve to bring it into being and to maintain it as a social system. Significantly, this was not intended or foreseen by those who initiated it (Sanger, 2005). From a governance perspective there are very few means within Wikipedia by which formal control can be exercised and it therefore relies on this emergent normative self-regulation to function despite significant perturbation from 'vandals' (task saboteurs), 'trolls' (social saboteurs), and turnover of contributors in the context of a task which may require the resolution of emotionally and value based conflict.

Normative theory reflects the confusion surrounding the macro-micro problem. There remains considerable confusion, for example, as to whether 'norms' are best ascribed as 'in' the environment or 'in' the agent. There is debate also as to whether normative order is the result of agents applying rules or reflects pattern which appears 'as though' it is rule based. Wikipedia can therefore help us to understand:

- How people influence one another and converge on common expected patterns of behaviour;

- The emergence and role of explicit rules and norms in self-regulation of open volunteer communities where there is little to no hierarchy and limited capacity for formal sanction;

- How these norms and rules are invoked and maintained through communicative and administrative acts;

- The relationship between goal, technical artefacts and social structures and the exercise of individual agency.

This case is the subject of a paper being presented in one of the stream sessions of this conference (Goldspink, 2007) so we won't detail it here but again will simply reflect on its place within the development of our thinking.

In Wikipedia there are two classes of activity:

- editing activity; and

- conversation about editing activity.

As this study was not concerned with the productive activity but with the self-organising and self-regulating phenomena which make it possible, the Discussion pages of a sample of controversial articles were analysed. Controversial articles were chosen as they were more likely to involve the need to resolve conflict and hence place greater demand on effective normative regulation.

The activity on the Discussion pages comprises a series of 'utterances' or speech acts between contributors about editing activity and the quality of product. The only means for editors to influence one another's behaviour is through these utterances. On the face of it then, these pages should provide a fertile source to support analysis of how social norms operate. It was anticipated, however, that the process may involve quite subtle use of linguistic cues.

The pages were coded to a high level of resolution using the Verbal Response Mode (VRM) taxonomy (Stiles, 1992). VRM is very attractive where there is a need (as in this case) to capture many of the subtleties of natural language use that derive from and rely on the intrinsic flexibility and ambiguity of natural language yet map them to a more formal or axiomatic system needed for computer simulation. A range of additional codes were applied, including whether a listener accepted or 'validated' an utterance, the explicit invocation of norms or rules and the associated deontic, and the style and focus of the utterance.

The results of the analysis revealed the following.

- The more detailed and specific behavioural etiquette which has emerged and been formalised within wikipedia over some years seems to have little influence on the overall character and style of interaction within the Discussion pages of the controversial articles.

- The overall quality of interaction of editors falls short of the range and quality of communicative style characteristic of a 'community' and is in-consistent with what one would expect given the demanding nature of the task (they are superficial and non-discursive).

- Most regulation is achieved without the need for frequent explicit invocation of rules or norms. Rather, behaviour seems to accord to a convention which editors quickly recognise and conform to and which minimally accommodates what needs to be done to satisfy the task in a context of somewhat heterogeneous personal goals.

Overall then there was a lack of evidence of active negotiation of expectations and standards and convergence of behaviour towards a norm. Within the discussion pages there appeared to be an accommodation of a set of conventions and little obvious norm innovation, evolution, adaptation or extension. This suggests that on first encounter with Wikipedia, editors read a set of cues as to what constitutes appropriate or acceptable behaviour and then make operational a script which accommodates it and stays relatively constant. This suggests complex cognitive processes and is not consistent with a 'norm as rule following' behaviour but rather involves agents noticing emergent pattern and then adjusting their behaviour accordingly. This is suggestive of analogical reasoning rather than deductive reasoning of simple rule following. It also suggests a very direct path between macro observation of emergent pattern and micro behaviour.

The next stage is to model this process using computer simulation. This is, however, a non-trivial task. In the recent past a great deal has been made of the potential for social simulation. As Sawyer (2003) notes, however, to date most projects have involved emerging macro structure from local micro interactions or building in macro structures and allowing them to impinge on micro processes – none have involved both. One of the goals of the EMIL project is to build a simulator which can help us come to terms with the micro-macro interplay by building a simulator which can support the reciprocal process of bottom up and top down simultaneously. The capability for such a simulator has been determined but not yet implemented.

Reflections and Conclusions

There is a long way to go in resolving the long term problem pertaining to the interplay between micro and macro level social phenomena. However, over the recent couple of decades two important changes have occurred 1) we have begun to take seriously the extent and implications of non-linearity and its consequences for our understanding of natural and social phenomena through the conceptual tools developing under the banner of complex systems 2) we have begin to build the tools needed to explore such systems, in particular the technique of multi-agent modelling. This allows us to revisit and reapply more established methods for the study of situated dynamics in real social systems, beyond the constraints of micro-macro discipline specific boundaries.

Based on our past experience as practitioners and a wide reading of the literature we have outlined an approach which we believe at the very least models some of the characteristics essential to an effective theoretical solution and at best provides a platform upon which one might be based. It is designed to support naturalistic enquiry as well as systematic exploration using the formalisms of multi-agent simulation. While still very much 'under development' and by no means the only possible way

forward, it helps to contrast the limitations of many existing theoretical approaches. It serves also to bring some new clarity to some of the perennial dimensions of debate – in particular that around the concept of emergence.

We have argued that systems science does not take us far due in part to its generality and to its intrinsic bias towards the macro perspective. Useful insights can be taken from Complex systems but it needs to be recognised that social systems are complex systems of a particular class and the class specific characteristics have yet to be fully come to terms with. In particular we have highlighted that the study of non-reflexive emergence does not take us very far toward understanding social emergence in human systems.

It is important that future work not only be philosophical but that theoretical advance go hand in hand with empirical work. While the theoretical framework we suggest has no associated methods, we demonstrate through the case studies that often there are a range of existing methods which can be used in the exploration of the relationship between micro and macro but that this generally entails a creative blending of techniques outside of the traditional discipline or paradigm specific environments in which they were developed.

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Figure One