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Real-izing information systems: critical realism as an underpinning philosophy for information systems

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Abstract

The paper begins by pointing out the diversity of philosophical positions within IS, and the range of reactions to this diversity. It then discusses problems within the underlying philosophies of science—particularly positivism and interpretivism. With this as a background, the paper proposes critical realism as an underpinning philosophy that has the potential to overcome both sets of difficulties. The theoretical arguments are practically illustrated by critiques of (positivist) statistical analysis and (interpretivist) soft systems methodology.

1. Introduction

Historically, most IS research and systems development, particularly in the US, has been underpinned by a positivist (more generally *empiricist*—see later) philosophy. This has been demonstrated in several surveys of the literature (Mingers, 2003b; Nandhakumar & Jones, 1997; Orlikowski & Baroudi, 1991; Walsham, 1995a) as well as in more theoretical contributions (Banville & Landry, 1989; Benbasat & Weber, 1996; Goles & Hirschheim, 2000; Hirschheim, Klein, & Lyytinen, 1996; Iivari, Hirschheim, & Klein, 1998).

During the 1980/1990s several streams of work based on different philosophies emerged. The main one is interpretivism (more generally *conventionalism*) (Lee, 1999; Lee, Liebenau, & DeGross, 1997; Walsham, 1993, 1995a,b) which emphasizes the inherent meaningfulness of the social world. Several different strands can be identified—for example, ethnography (Harvey & Myers, 1995), hermeneutics

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(Boland, 1991; Myers, 1994; Olson & Carslisle, 2001), ethnomethodology (Bhattacharjee & Paul, 2001; Crabtree, Nichols, O'Brien, Rouncefield, & Twidale, 2000) and phenomenology (Boland, 1985; Coyne, 1995; Dreyfus, 1996; Introna, 1997; Mingers, 2001b). Other approaches based in distinctive philosophical traditions are critical theory (Janson, Cecez-Kecmanovic, & Brown, 2001; Lyytinen, 1992; Lyytinen & Klein, 1985; Ngwenyama, 1991; Ngwenyama & Lee, 1997), postmodernism (Ciborra, 1998; Greenhill, 2001; Robinson, Hall, Hovenden, & Rachel, 1998), and actor-network theory (Walsham, 1997).

There has been a range of reactions to this plurality of philosophical approaches. Imperialists[1] argue for the dominance of one particular paradigm (usually positivism), either on epistemological grounds or in the belief that it is necessary to create a strong discipline (Benbasat & Weber, 1996; Pfeffer, 1993). Isolationists tend to accept the arguments of Burrell and Morgan (1979) that there are distinctively different paradigms and that these are generally incommensurable—therefore research should develop separately within each paradigm (Deetz, 1996; Parker & McHugh, 1991). Finally pluralists accept, and indeed welcome, a diversity of paradigms and research methods. Within this group, we can distinguish between those who welcome diversity for its own sake (Van Maanen, 1995a,b), those who see different methods as being more or less appropriate for particular research questions or situations (Landry & Banville, 1992; Robey, 1996), and those who argue that research should strive to be trans-paradigmatic, routinely combining philosophically distinct research methods (Goles & Hirschheim, 2000; Mingers, 2001a). Information systems is not unique in respect of this diversity—most social sciences, for example, organization theory, sociology, economics or geography, are equally split.

However, it is often not recognized that there are significant problems within the underlying philosophies—of science and of social science—themselves. Positivism has been extensively critiqued and the resulting consensus around a weak empiricist position leads to an impoverished view of (realist) ontology and causality. Within the social sciences, extreme constructivist and postmodern positions have undermined even the most basic tenets of science and rationality. This paper proposes a particular philosophy of science—critical realism—as a way of resolving or dissolving most of these issues and providing a consistent and coherent underpinning philosophy for information systems.

2. Problems in the philosophy of natural science

In general, a *realist* understanding of science takes the view that certain types of entities—be they objects, forces, social structures, or ideas—exist in the world, largely independent of human beings; and that we can gain reliable knowledge of them. However, especially during the 20th century, "naïve realism" has been under constant attack from empiricism (which restricts science to mathematical formula-

[1] The terms "imperialist" and "isolationist" follow Reed's (1985) analysis of organization studies.

tions of empirical regularities) on the one hand, and many different forms of conventionalism (that deny human-independent existence) on the other.

2.1. Empiricism

Empiricism refers to those philosophies that see science as explaining events that can be empirically observed. Events are expected to display regularities or patterns that can be explained as being particular instances of universal laws of the form "given certain conditions, whenever event X occurs then event Y will occur". Science is seen as the systematic observation of event regularities, the description of these regularities in the form of general laws, and the prediction of particular outcomes from the laws. This must apply equally to social science.

This view of positivist science was developed most strongly as *logical empiricism* by the Vienna Circle philosophers (Neurath & McGuinness, 1987) who aimed to specify a truly scientific conception of knowledge and the world. These propositions rested on particular fundamental assumptions:

(i) the idea that observation and perception were unproblematic—simply providing a mirror on nature;
(ii) the Humean (1967) principle that the observation of one event following another (e.g., one ball hitting another) did not enable us to prove some underlying causal mechanism—all that we can claim are "constant conjunctions of events";
(iii) the principle of induction—that *universal* laws could be derived from a set of *particular* observations accompanied by the deduction of predictions from the laws.

This view of science was extensively critiqued. The idea of pure, objective perception and observation was exploded by psychologists (Gregory, 1972; Piaget, 1969), sociologists (Cicourel, 1973) and philosophers (Hansen, 1958; Merleau-Ponty, 1962; Popper, 1972); Hesse (1974), Popper (1972), Wittgenstein (1958), and Kuhn (1970) showed that observational terms were not an atomistic picturing of reality but part of a pre-given linguistic structure—in short that all observation was theory-dependent; and Popper (1959, 1969), based on Hume, rejected the possibility of verification and induction, replacing it with falsification and deduction.

In response there developed the "deductive–nomological (D–N)" or "hypothetico-deductive" method. Science was still seen to be based on empirical observations, although recognizing their theory-dependence. From such observations, theories were generated and expressed in terms of universal (nomological) laws. Explanation, or prediction, then consisted of the logical deduction of particular events given some antecedent conditions and a set of laws. It was accepted that the laws might only be expressed in terms of statistical probabilities, and that they could not be *proved* to be true inductively. Hume's view of causation and his skepticism concerning anything not directly observable was still largely accepted leading to debates about the existence of "theoretical entities", i.e., theoretical concepts

that could not be observed fairly directly. Ontologically, the criterion for accepting the existence of something was its ability to be perceived.

The D–N approach also suffers from a range of problems which will be explained in the next two sections.

2.2. Conventionalism

Problems with the empiricist view of science center around the impossibility of pure, unmediated observation of empirical "facts". So, the term conventionalism covers a wide range of philosophies that all emphasize the inevitable dependence of scientific theories on human perception, conceptualization and judgement[2].

The first position, *pragmatism*, derives from philosophers such as Dewey (1938) and Peirce (1878) and has been developed most radically by Rorty (1989, 1980). At a general level, pragmatism is a view about the purpose of science—that it is essentially a practical activity aimed at producing useful knowledge rather than understanding the true nature of the world. Thus, Peirce developed a pragmatist theory of meaning such that the meaning of a concept was specified purely in terms of the actual practical effects that it would have; and a consensus theory of truth as that which would come to be believed by a community of scientists in the long term, rather than as correspondence to reality (Habermas, 1978). Dewey saw knowledge and truth as the outcome of processes that successfully resolved problematic situations.

The second position on the nature of science comes from those who study the actual practices of scientists and find little correspondence with the standard philosophical theories. Kuhn's (1970) identification of major paradigms of thought throughout science is so well known as to need little exposition. This view leads to a much greater recognition of the social and psychological nature of scientific activity. A paradigm develops through consensus within a social community of scientists through many practical mechanisms such as learned societies, journals, or funding bodies. Individual scientists come to accept the underlying assumptions concerning research practice, theoretical validity, and core values as they become members of the community. Theoretical innovations that challenge the paradigm are generally rejected without serious consideration.

The idea of paradigms replacing each other over time has developed, particularly within social science, to the idea of there being competing paradigms existent at the same time (e.g., positivist, interpretive and critical). This is often combined with the claim that paradigms are incommensurable. Clearly, the Kuhnian view has major relativistic implications for empiricism. It highlights the constructed, conventional nature of scientific theorizing, and truth is that which is accepted by a scientific community rather than correspondence to some external reality. The

[2] I use this term following Keat and Urry (1981) in a very general sense. I do not imply anything specific about the nature of the conventional element, in particular, I do not assume that it is at all socially determined.

incommensurability thesis is even more undermining since it makes it impossible to judge between paradigms or even assert that a later paradigm is actually superior to an earlier one.

3. The relationship between natural and social science

So far, the discussion has centered around the nature of natural science on the assumption that this was most relevant to information systems, but in recent years, there has been persuasive arguments that since IS is conducted within social organizations, social science is also of relevance. This then brings into the picture major philosophical debates concerning the nature of social science in relation to natural science that can only be sketched here (for overviews see Burrell and Morgan (1979), Giddens (1976), Keat and Urry (1981), Outhwaite (1987)).

Broadly, there are three possible positions: (i) the *naturalist* view that there is one general approach to science that applies to all domains. Within this category, positivists hold that for anything to be scientific it must follow the canons of positivism/empiricism and thus be based on universal generalizations from empirical observations. (ii) The antithesis is the view that the social world is intrinsically different to the natural world, being constituted through language and meaning, and thus involves entirely different hermeneutic, phenomenological, or social constructivist approaches. The argument here would be the idealist one that ontologically social objects do not exist in the way physical ones do (i.e., as subject independent), and that epistemologically there is no possibility of facts or observations that are independent of actors, cultures or social practices. (iii) The most radical position denies the possibility of objective or scientific knowledge at all, in either domain. Arguments here come from the strong sociology of knowledge program; post-structuralists such as Foucault (1980); and more generally post-modernists (Best & Kellner, 1991) who attempt to undermine even the most basic categories of modernist rationality.

4. An introduction to critical realism

Critical realism has been developing for some years (Archer, Bhaskar, Collier, Lawson, & Norrie, 1998) in response to the fundamental difficulty of maintaining a realist position in the face of the criticisms, outlined above, of an empirical and naturalist view of science. Its original aims (which this paper will concentrate on) were: (i) to re-establish a realist view of *being* in the ontological domain whilst accepting the relativism of knowledge as socially and historically conditioned in the epistemological domain; and (ii) to argue for a critical naturalism in social science. CR is becoming influential in a range of disciplines—geography (Pratt, 1995; Yeung, 1997), economics (Fleetwood, 1999; Lawson, 1997), organization theory (Tsang & Kwan, 1999), sociology (Sayer, 2000), and research methods in general (Layder, 1993; Sayer, 1992).

4.1. Arguments establishing a stratified ontological domain

Bhaskar's (Archer et al., 1998: p. 23) starting point is to argue, specifically against empiricism and positivism, that science is not just recording constant conjunctions of observable events but is about objects, entities and structures that exist (even though perhaps unobservable) and generate the events that we observe. The form of the argument is a *transcendental* one. That is, it begins with some accepted phenomenon[3] and asks what the world must be like for this to occur. This use of the term "transcendental" is clearly based on but distinct from that of Kant (1933). Kant proposed universal conditions for the possibility of knowledge at all, namely that our minds structure our experience of reality in terms of space time and causality. This position can be called transcendental *idealism*. In contrast to this critical *realism* asserts that the conditions for knowledge do not arise in our minds but in the structure of reality, and that such knowledge will not be universal and ahistorical.

In this case, what is accepted by both empiricism and many forms of idealism is that we do have perceptual experience of the world, and that science is carried out through experimental activity in which scientists bring about particular outcomes. The argument is that neither empiricism nor idealism can successfully explain these occurrences and that they necessitate some form of realist ontology. With regard to perception, we can note that as human beings we have to learn (as babies) to perceive things and events; that our perceptions can change (e.g., visual illusions); and that scientists, for example, have to be trained to make observations correctly. These all imply that there must be a domain of events that are independent of our perceptions of them (what Bhaskar calls an *intransitive* domain). And, indeed, that these events would exist whether or not they were observed or there even were observers. There is thus a domain of actual events, only a (small) subset of which are perceived and become empirical experiences.

Moving on to experimental activity, we can note: (i) that the experimenter causes (i.e., brings about) the experimental conditions but does not cause the results, these depend upon the causal laws that are operative; (ii) that the regularities that are expected may or may not occur depending on how well the experiment is carried out rather than on whether the presumed laws are or are not working; (iii) that in fact the occurrence of empirical regularities (i.e., constant conjunctions) in general is fairly rare—that is why the experiment is necessary to try to bring them about; but that, despite this, results do in fact hold outside the experiment. The implications of this are that causal laws must be different from and independent of the patterns of events they generate, and that the experimenter aims to produce a constant conjunction of events by *closing* what would otherwise be an open system. Thus, the intelligibility and success of experimental activity demonstrates the existence of an intransitive domain of casual laws separate from the events they gener-

[3] By phenomenon I mean very generally events (that may be occurrences or non-occurrences) that are experienced and agreed on by both sides in the argument.

ate, and the corrigibility of perception demonstrates the separation of events from particular experiences of them. The empiricist identification of causal laws with observed empirical regularities thus involves a double reduction—that of laws to events and events to experiences.

The argument can be expressed in terms of the mistake that both empiricism and strong forms of idealism or conventionalism make—that is, the *epistemic fallacy*. The essential mistake is in reducing the ontological domain of existence to the epistemological domain of knowledge—statements about being are translated into ones about *our* (human) knowledge or experience of being. For the empiricist, that which cannot be experienced cannot be. For the conventionalist, limitations of our *knowledge* of being are taken to be limitations on being itself. In contrast, the realist asserts the primacy of ontology—the world would exist whether or not humans did.

What exactly are causal laws? Or, rather, what is it that causes or generates events given both the regularities that can be established in experiments, and the common absence of regularity outside? Equally, how can we assure ourselves that event regularities are based on necessary connections rather than simply coincidence? The answer is that there must be enduring entities, physical (e.g., atoms or organisms), social (e.g., the market or the family) or conceptual (Bhaskar, 1997) (e.g., categories or ideas), observable or not, that have powers or tendencies to act in particular ways. The continual operation and interaction of these entities generates (i.e., causes), but is independent of, the flux of events. Entities may have powers without exercising them at a particular time (it may need an experiment to trigger them), and powers may be exercised but not become manifest in events because of the countervailing operation of some other generative mechanism. The heart of this argument is that of a *causal* criterion for existence rather than a perceptual one. In other words, for an empiricist only that which can be perceived can exist, whereas for a (critical) realist having a causal effect on the world implies existence, regardless of perceptibility.

4.2. Critical realism and natural science

For Bhaskar, reality is both intransitive (existing independently of humans) and stratified (Archer et al., 1998: p. 41). The first form of stratification is between mechanisms; the events that they generate; and the subset of events that are actually experienced. These are known as the domains of the *real*, the *actual*, and the *empirical* (see Fig. 1). The real contains mechanisms, events, and experiences—i.e., the whole of reality; the actual consists of events that do (or do not) occur and includes the empirical, those events that are observed or experienced. These distinctions arise from the transcendental arguments above—namely that we should not reduce all events to only those that are observed, and we should not reduce enduring causal mechanisms to events.

A second form of stratification is within the realm of objects themselves (Archer et al., 1998: p. 66) where causal powers at one level (e.g., chemical reactions) can

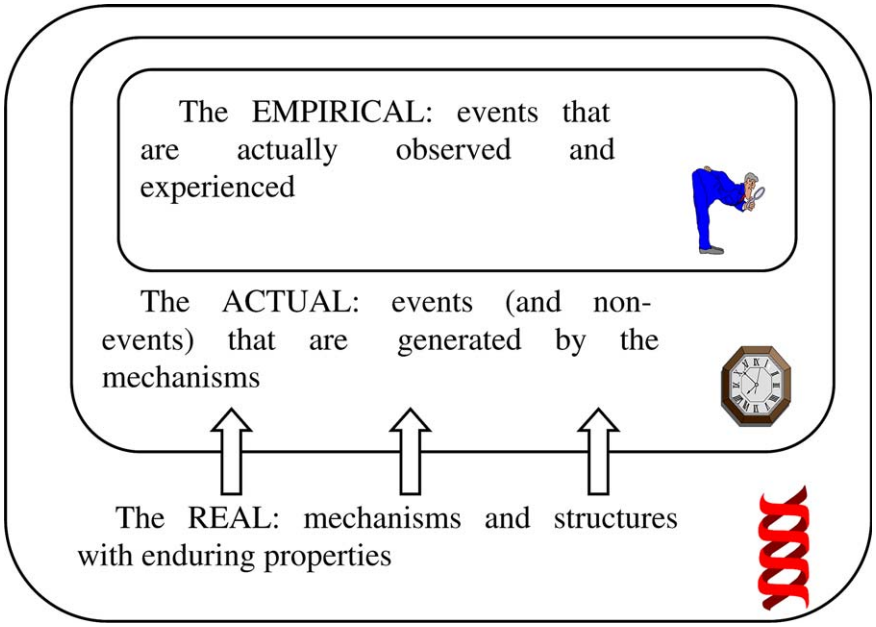

Fig. 1. The three domains of the real.

be seen as generated by those of a lower level (atomic valency). One strata is emergent from another (what Bhaskar terms "emergent powers materialism"). The picture of the real is thus one of a complex interaction between dynamic, open, stratified systems, both material and non-material, where particular structures give rise to certain causal powers, tendencies, or ways of acting, often called by Bhaskar "generative mechanisms" (Bhaskar, 1979: p. 170). The interaction of these generative mechanisms, where one often counterbalances another, causes the presence or absence of actual events.

Having established the intransitive *objects* of knowledge, we must recognize that the *production* of knowledge is very much the work of humans, and occurs in what we could call the *transitive* dimension (Bhaskar, 1989: p. 18). Acknowledging the work of sociologists, the practice of science is a social process drawing on existing theories, results, anomalies and conjectures (the transitive objects of knowledge) to generate improved knowledge of science's intransitive objects. This distinction allows us to admit the *epistemic* relativity of science, the fact that knowledge is always historically and socially located, without losing the ontological dimension. We should also note that such epistemic relativity does not imply a corresponding *judgmental* relativity, i.e., that all views are equally valid and that there are no rational grounds for choosing between them.

We can now characterize the realist method of science as one of *retroduction* (this is the same as "abduction" as developed by Peirce in contrast to induction and deduction) where we take some unexplained phenomenon and propose hypo-

thetical mechanisms that, *if they existed*, would generate or cause that which is to be explained. So, we move from experiences in the empirical domain to possible structures in the real domain. This does not of itself prove that the mechanism exists, and we may have competing explanations, so the next step is to work towards eliminating some explanations and supporting others.

It could be objected that how do we *know* that such hypothetical mechanisms actually do exist rather than being merely interesting ideas. At one level, the answer is that we can never know for certain, since science is always fallible. More practically, however, the intransitivity of real structures means that they will always have the potential for effects that go beyond us, i.e., are out of our control, and the methodology means that we should aim to eliminate alternative explanations by testing in some way for their potential effects.

4.3. Critical realism and social science

We now move to the second major argument of critical realism, that social science is essentially similar to natural science in its realist character albeit with modifications to reflect the particular nature of the social world. We can begin by asking, what would rule out a realist approach? The answer being that there are no intransitive objects for social science to investigate. Such an argument could come from the extreme constructivists (or superidealists as Bhaskar calls them) who would also apply it to the natural world, or from those who would argue for the distinctive nature of social phenomena as being intrinsically meaningful and not existing independently of social actors.[4]

The primary argument (Bhaskar, 1979: ch. 2) is against methodological individualists who argue that all explanations can be couched in terms of individual's beliefs and actions and that therefore there is no such thing as an intransitive social structure. The first refutation concerns emergent properties—there are attributes that can be applied to people that concern physical features, height, weight; there are attributes that we share with other animals such as pain or hunger; but there are many attributes, essentially human ones, that are unavoidably social, for example, ''bachelor'', ''banker'', or ''nun''. These are only intelligible within the context of a social institution or practice. The second argument is that many activities we undertake, most obviously perhaps language, must already exist and be available for people to learn and then use. As Wittgenstein (1958) argued, there can be no such thing as a private language—every time anyone has a conversation, uses a credit card, or waits for a train they are assuming the existence of a structured, intransitive domain of resources, concepts, practices, and relationships. The successful occurrence of social activities warrants the existence of causally efficacious, although unobservable, social structures.

[4] We can note that subject dependence is also accepted within natural science such as physics with the Heisenberg uncertainty principle. It is however qualitatively different in the social sciences. As Giddens (1979) has indicated with his concept of the ''double hermeneutic'', the objects of social science are already socially structured whereas those of natural science are not.

Bhaskar does accept, however, that social phenomena are inherently different from natural phenomena and that this does put limits on the nature of social science.

- Ontological
  1. Social structures do not exist independently of the activities they govern or, put another way, they exist only in their effects or occurrences. Social structures enable social activities and through that activity are themselves reproduced or transformed. Thus, they are themselves the result of social activity. In contrast, the laws of the natural world are not affected by their own operation.
  2. Social structures do not exist independently of the agents' conceptions of what they are doing. Thus, agency always requires some degree of interpretation and understanding of the meaning of the actions undertaken (Giddens' (1979) "double hermeneutic"). Although this does not imply that agents cannot be mistaken; and it does not require that they be fully aware of the consequences of their activity. In contrast, natural phenomena are independent of our conceptions of them.
  3. Social structures are localised in both space and time, unlike natural laws or tendencies that are generally universal.
- Epistemological
  1. Social systems are inherently interactive and open. Whilst the same is true for natural systems, it is the case that they can be artificially closed or controlled in the laboratory, and this indeed is the principal reason for experiments. This, however, is not (generally) possible in social systems. The main effect is that it is difficult to test theories since predicted effects may or may not occur depending on a multitude of factors. It focuses attention on a theory's explanatory rather than predictive power.
  2. The possibilities of measurement are very limited since intrinsically the phenomena are meaningful, and meanings cannot properly be measured and compared, only understood and described.
- Relational
  1. Social science is itself a social practice and is, therefore, inherently self-referential. This means both that social science knowledge can itself affect the social world, and perhaps change it (e.g., the self-fulfilling prophesy); and that it is itself a social product and therefore will be shaped by the social conditions of its production. This does not make social science totally transitive—once an event has occurred, or some theory been produced, it becomes intransitive relative to possible explanations of it.
  2. I would draw a second conclusion from this, that social theories must be self-consistent in not contradicting their own premises since they are part of their own domain.

All of the above place limits or constraints on the practice of social science, but do not make it different in principle from natural science. It is still driven by the

existence of an intransitive domain of generative mechanisms; a recognition of the epistemic (but not judgmental) relativity of knowledge; and a retroductive methodology that explains events by hypothesising causal mechanisms.

5. Applying critical realism to IS research

Critical realism is important for IS because: (i) CR enables us to take a basically realist stance whilst accepting the major critiques of naïve realism; (ii) it addresses both natural and social science and thus encompasses the main domains of IS; and (iii) does potentially fit well with the reality of IS as an applied discipline. In terms of its relation to existing paradigms, it is conventional to split IS into positivist, interpretive and critical although as mentioned in Introduction, it is possible to pick out others as well. In these terms, I would argue that critical realism subsumes all three of them. It points out the limitations of positivism and interpretivism individually whilst recognizing the contribution that research methods from these paradigms can make. It also subsumes critical theory, at least in its traditional Habermasian form, through the idea of the essentially emancipatory and transformative capacity of social science (Bhaskar, 1986, 1993) although we do not have the space to follow this line of development here.

To back up the theoretical arguments, I will discuss two antithetical IS research approaches. Statistical analysis (e.g., regression) because it is arguably the dominant research method within IS (Mingers, 2003b) and yet is apparently incompatible with critical realism, embodying an empiricist philosophy; and soft systems methodology (SSM), an important method for both research and intervention, which would seem to conflict with critical realism from the opposite direction, namely interpretivism.

5.1. Statistical modeling—the empiricist approach

In this section, I shall show the weaknesses of the conventional interpretation of statistics, but also how it can be better employed within a realist framework. Consider first multiple regression, a technique used in a range of social sciences as well as in IS. It claims to be a causally oriented technique (in comparison with, say, ARIMA modeling) that aims to explain the variation in a dependent variable in terms of a set of supposedly causally related independent variables. A linear functional form is assumed and parameters are estimated from a sample of data. Inferences are drawn towards a wider population.

In practice, where it has been used extensively, for example, in econometrics, its predictive ability has been extremely poor (Sherden, 1998). From a CR viewpoint, this is hardly surprising since there are severe limitations in this approach (Mingers, 2003a):

(i) The notion of causality is impoverished, being essentially the Humean one of a constant conjunction of events which underlies empiricism. The main problem

with this is that it remains in the superficial world of the empirical, with no attempt to get at underlying mechanisms that may be responsible for the observed regularities.

(ii) The procedure rests on an implicit assumption of closure which, as we have already seen, cannot be expected to occur in social systems. The stability of the coefficients, and their statistical significance, rests on assuming that the factors that have not been included, usually because they are unknown or impossible to measure, have only a small and essentially random effect. In practice, the effect may well be large and there is no way of knowing what the influence will be outside of the sample data.

(iii) The main assumptions of regression—multivariate normal distributions, independence of variables, one-way causality, linearity, etc.—are highly implausible to say the least.

(iv) All of this makes it very difficult to choose between competing models for the same data. Elaborate methods have been devised—e.g., stepwise, best-subsets, fragility analysis—but in practice, many different models are developed and choices made on essentially subjective grounds such as experience, usefulness, or perhaps just intuition.

Given these problems, it might seem that CR would abandon statistical analysis all together, especially since empirical verification is not a necessary feature of a realist scientific explanation (since causal tendencies may be possessed but not actualized). This is not the case, but it does require a re-thinking of the purpose of such analysis, and also a differentiation between different techniques.

Critical realism proceeds by trying to discover underlying structures that generate particular patterns of events (or non-events). Statistical analysis can help in several areas. (i) it can be very useful in the exploratory stage in detecting particular patterns within the data. Any non-randomness must imply some structure or set of constraints that is generating it, although, of course, this may be just as much a result of the mechanism of data production as any underlying generative mechanism. Nevertheless, detecting such patterns within large sets of multivariate data is very difficult and methods such as principal components, factor analysis, cluster analysis, and regression are very valuable. The results, though, will merely be the starting point for more substantive investigations. (ii) Some techniques do lend themselves more towards identifying underlying structures, especially something like factor analysis that aims to identify common factors generating observed variables, or path analysis that involves a series of inter-related equations. Even here, however, the results are merely suggestive, not conclusive. (iii) Perhaps the main use might be in validating possible explanations by corroborating, or falsifying them. This could be done either by testing the implications of a theory through collecting and analyzing data, or, more sophisticatedly, by regarding the analysis as a quasi-experiment, inducing artificial closure on a system by controlling for the influence of normally uncontrolled factors.

5.2. The interpretive approach: soft systems methodology

SSM could also be seen at first sight as being antithetical to CR. Checkland (Checkland & Holwell, 1998) denies the ontological reality of "systems" as actually existing in the world, instead reserving this concept for our *thinking about* the world. He also distinguishes strongly between natural and social science, or rather positivist and interpretivist approaches within social science, and allies SSM clearly with the phenomenological tradition. The main problem is that Checkland takes positivism as the only alternative to interpretivism as a philosophy of (social) science. This inevitably means that he has to adopt a full-blown phenomenological position that then generates all kinds of contradictions and problems in dealing with a "real-world" external to the observer that is, after all, what SSM aims to improve. The major advantage of a critical realist approach is that it maintains reality whilst still recognizing the inherent meaningfulness of social interaction.

It might be said that SSM only concerns ideas or concepts (root definitions or conceptual models) and that these are somehow less real than objects, or that it is strongly relativist in accepting all viewpoints as being equally valid. Against this, critical realism demonstrates that ideas, concepts, meanings and categories are equally as real as physical objects (Bhaskar, 1997). They are emergent from, but irreducible to, the physical world, and have causal effect both on the physical world (e.g., in the generation of technology) and the social and ideational world. They are also inevitably social products and participate in transformations of the social world, just the sort of transformations that SSM aims to bring about. With regard to relativism, CR makes a distinction between epistemic relativism and judgmental relativism—people may well hold different beliefs about processes in the world but this does not mean that we are unable to rationally judge between them and prefer one to another given some particular purpose. Equally, ideas once expressed are no longer wholly subjective—they become intransitive and available for investigation, debate and judgement by others.

A final point is the weakness of SSM with regard to the origin of the Weltanschauungen that it explores, and an understanding of the difficulties of individual and organizational change. These both stem from the individualistic social theory that it embodies. With a critical realist interpretation, both these are avoided. On the one hand, we can generate explanations of why particular actors may hold the beliefs they do in terms of their social and organizational position; their history of experiences particularly as these relate to underlying social characteristics such as gender, race, and age; and, of course, their individual personalities. We are also in a position to understand the psychological and social structures that may impede or facilitate learning and change.

5.3. Critical realism and research methods

CR does not have a commitment to a single form of research; rather it involves particular attitudes towards its purpose and practice. First, the critical realist is

never content just with description, whether it is qualitative or quantitative. No matter how complex a statistical analysis or rich an ethnographic interpretation, this is only the first step—CR wants to get beneath the surface to understand and explain *why* things are as they are, to hypothesise the structures and mechanisms that shape observable events. Second, CR recognizes the existence of a variety of objects of knowledge—material, conceptual, social, and psychological—each of which requires different research methods to come to understand them. And, CR emphasizes the holistic interaction of these different objects. Thus, it is to be expected that gaining knowledge in any particular situation will require a variety of research methods (multimethodology, Mingers, 2001a), both extensive and intensive. Third, CR recognizes the inevitable fallibility of observation, especially in the social world, and therefore requires the researcher to be particularly aware of the assumptions and limitation of their research. A more detailed discussion about practical research methods within a critical realist framework can be found in Layder (1993), Mingers (2003a), Pawson and Tilley (1997) and Sayer (1992).

6. Conclusions

This paper has made a case for the contribution of critical realism as a philosophy for IS. It has approached this in two ways. First, in terms of the unresolved problems within the philosophy of science, whether it be natural or social, that CR successfully addresses. In particular, the impoverished view of explanatory theory within empiricism; the major critiques of observer- and theory-independence that empiricism assumes; the logical problems of induction and falsificationism; the dislocation between natural and social science; and the radical anti-realist positions adopted by constructivists and postmodernists. Second, it has demonstrated across research methods from competing paradigms how CR's retroductive methodology can shape the practice of IS research.

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