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ABSTRACT

Being an essentially multi-disciplinary field, Information Systems does not appear to be informed by a single dominant underlying philosophy. Since IT is an integral part of IS, its philosophical roots are associated with *logical positivism*. While logical positivism has several merits, its proponents have been unable to respond to criticisms leveled by the Humean Skeptics. *Logical empiricism* took an asymptotic view with the concept of 'gradually increasing confirmation' through 'inter-subjective certification'. It was challenged and *relativism* was touted as the epistemologically superior philosophy. However, relativism could not sustain its prominence in IS because of its inherent reliance on tautological arguments. In the last decade, *Scientific Realism* seems to have emerged as a viable philosophy. In this paper, we argue that *Critical Realism*, a variant of Scientific Realism, has considerable potential to become the dominant philosophical tradition in the field of Information Systems.

Keywords

Critical Realism, Philosophy, Information Systems

INTRODUCTION

The field of Information Systems (IS) is essentially multi-disciplinary. It is enriched by several disciplines such as Artificial Intelligence, Computer Science, Sociology, Psychology and Management. Contributions from many diverse areas make it even more difficult to identify a common underpinning philosophy. Moreover, since the field of IS is comparatively new, it does not seem to be informed by a single dominant underlying philosophy. Scientific Realism can be a viable philosophy for IS (Hunt 2003). This exploratory paper is an attempt to examine and argue for the suitability of a specific type of Scientific Realism - Critical Realism - as the underlying philosophy for the field of Information Systems. We believe that Critical Realism is a relevant philosophy for the progress of Scientific Inquiry in IS.

IS RESEARCH STREAMS

The field of IS stems from, but is not limited to, Information Technology (IT). A very simplistic view of IS could be the study of all endogenous variables (such as Automation, Technology Adoption, Innovation, System Development, IT Strategy etc.) and exogenous variables (such as Market dynamics, Cash Reserves, Business Strategy, International Economics, Politics, Exchange Rate etc.) affecting the use of IT in Organizations. Broadly speaking IS research may be categorized into two streams of research identified – Natural Science and Design Science (March and Smith 1995). Natural Science traditionally has been considered as the study of natural phenomena. Study of Physics, Chemistry, and Biology (so called hard sciences) can be grouped under Natural Science. Many scholars believe that the Social Sciences (so called soft Sciences), dealing with human interactions form a different stream of research. Philosophies such as hermeneutics, phenomenology etc have traditionally informed the thought in area of soft sciences. Hard sciences on the other hand have been traditionally informed by rationalism, empiricism etc. Though these two areas could be considered separately, but Information Systems has both technical and social aspects quite closely knit together. Moreover since we wish to contrast the Natural Science with Design Science, we would consider both technical and behavioral aspects within the domain of Natural Science. Though this classification is done from IS perspective as to aid in understanding, in the spirit of philosophical discussion, it is pertinent to point out that these groupings in many cases may have overlaps and some areas may draw from more than one stream of research. Table 1 below captures the differences between the two approaches to IS research.

Comparison Factor	Natural Science Approach		Design Science Approach
	Science	**People**	**Technology**
Nature	Descriptive	Descriptive	Prescriptive
Question	Seeks to answer WHY	Seeks to answer WHY	Seeks to answer HOW
Phenomena	Both natural and artificial phenomena could be studied.	Both natural and artificial phenomena could be studied	Only artificial phenomena are studied and constructed
Method	Can incorporate both observational studies and experiments but mostly empirical in nature	Can incorporate both observational studies and experiments but mostly qualitative (ex. ethnography)	Primarily experimentation, though observations can be made to judge performance, functionality etc.
End Products	Models, frameworks, and theories as applied to natural phenomena	Models, frameworks, and theories as applied to processes involving people	Design artifacts – frameworks, architectures, and software product (ex. Prototypes)
Theme	theorize and justify	theorize and justify	build and evaluate
Hallmarks of theory / design	Parsimony, completeness and empirical rigor	Parsimony and completeness (and preferably, statistical rigor)	A better framework, architecture or artifact ('a better mouse trap')
Dominant philosophies	Positivism, Empiricism, Rationalism etc	Hermeneutics, phenomenology, Interpretivism etc	Pragmatism ,Functionalism, Empiricism etc

Table 1: Comparison of Natural Science and Design Science

For our study, our understanding of Natural Science involves the study of natural phenomena that are inclusive of physical, biological or behavioral domains. Design Science, on the other hand, attempts to create objects and artifacts that serve human purposes. For example, research on Technology Acceptance is a Natural Science research as it incorporates the behavioral aspects. Technology Acceptance Model uses Perceived Usefulness and Perceived Ease of Use in assessing the acceptance of new technology by Organizations (Venkatesh et al, 2003). In contrast, research in Agent based Information Systems is largely a Design Science research. Distributed Learning System, which improvises Group Problem Solving by using Artificial Intelligence (AI) techniques such as Genetic Algorithm, Machine Learning etc, is focused upon enhancing the computational performance by generating more efficient and effective algorithms (Sikora and Shaw 1996). Agents, which are inherently technological artifacts, strive to model the real life behavior in terms of mathematical formulations using algorithmic methods and techniques. Design Science stream of research deals with creation of physical artifacts or prototypes and is based on the concept of measurement. Consequently, this focus on Empiricism limits it to the observable events.

ANTECEDENTS TO CRITICAL REALISM

Since IT is an integral part of IS, the philosophical roots are normally associated with Logical Positivism and Logical Empiricism. A prominent problem with most philosophies having roots in Positivism (or lately Empiricism) is that they cannot explain Causality in light of Humean Skepticism (Hunt 2003). David Hume divided all knowledge in two mutually exclusive categories – 'relations of Ideas' and 'matters of fact' (Emmanuel 2001). He claimed that causal relations can not be accepted as 'necessary truths' as they cannot be deductively arrived at from 'matters of fact'. According to Humean Skepticism, for instance, it cannot be a 'necessary truth' that the Sun will rise tomorrow, though it may have been the case since times immemorial. Logical Positivism could not establish the existence of a phenomenon necessarily for the $(t + 1)^{th}$ time, that is the observed phenomenon at time 't' can be said to exist with certitude at time t+1, even when the phenomenon is observed for any finite 't' number of times. Therefore, even though the phenomenon is observed for a number of epochs over a span of considerable time period, the Humean Skepticism argument challenges the tenability of Logical Positivism as the dominant underlying specific philosophical school for Information Systems.

Logical Empiricism could embrace Humean Skepticism by taking an asymptotic stand on truth and come up with the concept of 'gradually increasing confirmation' - as if the scientific research was ever getting closer to the truth but never quite getting

there. Moreover, the 'intersubjective certification' criterion for Scientific Inquiry discussed by Hunt (2003) was challenged and Relativism was suggested as the epistemologically superior philosophy (Anderson, 1983). However, Relativism was again not without criticism, even the improvised version of Critical Relativism suggested by Anderson (1986) was not beyond debate (Siegel, 1988). Relativism showed some promise on epistemological grounds but soon it became apparent that there were many loopholes, such as tautological arguments amongst others, which need to be plugged before it can be accepted as an underlying philosophy in Information Systems domain (Wilson, 1999). Yet, the issue of observable versus the unobservable phenomena remained a controversial one.

Scientific Realists believe that the truth (reality) exists independent of the observer, irrespective of whether the event occurs or not (and irrespective of whether it is observed or not). Scientific Realism embraces Humean doubt unlike many of the predecessors. Thus, in the debate Scientific Realism seems to emerge as the new and viable philosophy for Scientific Inquiry in the last decade. Among the various versions of Scientific Realism, Critical Realism seems to have gained currency lately. Critical Realism is becoming influential in areas such as Management (Tsoukas, 1989) Organization Studies (Reed, 1997), Sociology (Sayer, 1992), Economics (Lawson, 1997), and Marketing (Easton, 2002) etc.

Most scientists who favor Scientific Realism acknowledge that theoretical terms employed by them refer to real objects that are independent of their theorizing. However their assessment of objects is still embedded in empiricism. It goes beyond the limitation of empirical assessment and observable reality, and takes a metaphysical stand on realism. Critical Realism neither presupposes nor justifies a realistic interpretation of any scientific theory and thereby preserves the possibility of criticizing specific practices of Scientists. It is put forward as a philosophy in which the reality is critically examined and evaluated. Critical Realism is generally accepted to be the contracted form of 'Transcendental Realism' (general philosophy of Science) and 'Critical Naturalism' (special philosophy of the human sciences) (Collier, 1994).

Transcendental Realism

Science has two distinct aspects of scientific knowledge, within the realm of Transcendental Realism: 1. Social character and 2. Independence from the objects of scientific thought.

In Critical Realism there are two types of objects of knowledge – transitive and intransitive (Archer et. al, 1998). Transitive objects are affected by, and based upon, human intervention and include all the theories, models and techniques which have been established until then. Intransitive objects of knowledge on the other hand have an existence independent of human activity. Magnetism, Gravity, Solar Wind, Black holes existed even when they were not observed by humans at a point in time. The reality of objects is not dependent upon the fact that it is observed or not, rather it 'transcends' to an independent existence of its own. This fundamental concept has a deeper implication for the field of Information Systems.

Critical Naturalism

In his philosophy of Critical Naturalism, Bhaskar (1979) argues that societies are irreducible to people. Instead of considering Society as composed of individuals and therefore believe in atomism, whereby causal powers are vested with individuals, Critical Naturalism suggests a transformational model social activity based on relational conception. Critical Naturalism extends the idea of Marx 'Society does not consist of individuals (or groups), but with an understanding that the sum of the relations within which individuals (or groups) stand'. Further, social forms are a necessary condition for any intentional act. Their pre-existence establishes their autonomy as possible objects of scientific investigation. Their causal power establishes their reality (Archer et al, 1998).

REINTERPRETING INFORMATION SYSTEMS

Natural Science is focused on studying the phenomenon as it occurs in Nature. Models, laws and theories are means as well as ends in this stream of research. Natural Science Research is carried out in two stages – Discovery and Justification. (March and Smith, 1995) While justification is mostly based on hypothetico-deductive method, the process of Discovery is believed to be mainly inductive. Hence, Natural Science delves into both transitive and intransitive objects of knowledge.

The primary activities in Design Science research are categorized under 'Build' and 'Evaluate' (March and Smith, 1995). The evaluation criterion can be explained using Logical Positivism, Logical Empiricism or even, though in a limited sense, Relativism using epistemological dimension as discussed earlier.

From a Critical Realist perspective, Design Science is essentially a social process; we are dealing with transitive objects of knowledge. Development, testing, evaluation and improvisation of artifacts or prototypes are inherently social processes. But, we must recall here that a social process if studied in itself, then it would fall in the domain of Natural Science in our study.

The object of study thus is the design process and not the social process. Therefore, from a Critical Realist perspective, the distinction between Natural and Design Sciences is indeed 'artificial'. What we refer to as 'Critical realism' is a contracted form of Transcendental Realism (extending Kantian Realism) and Critical Naturalism (Collier, 1994). Bhaskar (1979) defined 'Naturalism' as "the thesis that there is (or can be) an essential unity of method between natural and the social sciences" (Roy 1979). He gives the ontology of Critical Naturalism which asserts that the structure of generation of Knowledge is the same for both natural and social sciences. The stress on Structure (or Mechanisms) is the key concept in the philosophy of Critical Realism. It has three basic domains – Empirical (Observable - Experiences), Actual (existing in time and space - Events) and Real (transfactual and more endearing than our perceptions about it – Mechanisms) as shown in Figure 1.

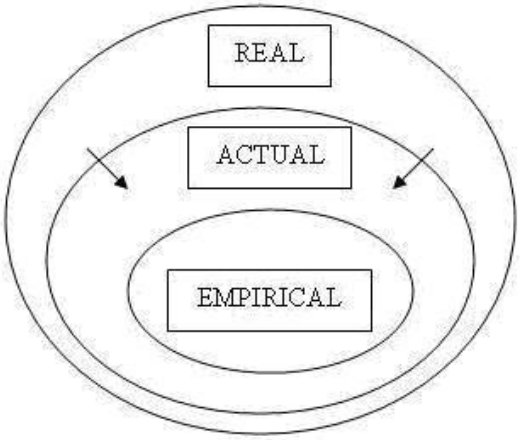

Figure 1- THREE DOMAINS OF MECHANISMS
(adapted from Mingers and Willcocks (2004)

Reality is deeply embedded in Structures. Empirical evidence emerges from these structures. Figure 1 represents our understanding of reality, which from a positivist viewpoint, goes in the opposite direction, thus creating an artificial divide between Design and Natural Sciences.

We can also apply another set of 'signposts' to check the suitability of Critical Realism in the discipline of Information System. Sayer (2000) emphasized the eight basic tenets of Critical Realism for Social Sciences. An examination of how each of these relates to the field of Information Systems follows.

First, there is an independent existence of reality which provides the fundamental ontological basis to Critical Realism. The Natural Science stream of research seems to abide by this ontology, as in principle the research is an attempt to understand the phenomena better; hence the existence of phenomena is implicitly implied.

Second, the knowledge of the world is fallible and theory-laden. Construct validity, which chains backwards to theory, is an issue in research in most areas of scientific inquiry and Information Systems is not an exception.

Third, Knowledge develops wholly neither continuously nor discontinuously. Much research on Use and Impact of Information Systems acknowledges the Change Management literature. Agile as a leading methodology in IS, is a response to how to cope with change. Within IS, both evolutionary and revolutionary changes are considered and indeed a continuum is recognized (Sircar et al, 2001) which essentially imbibes this particular tenet of Critical Realism.

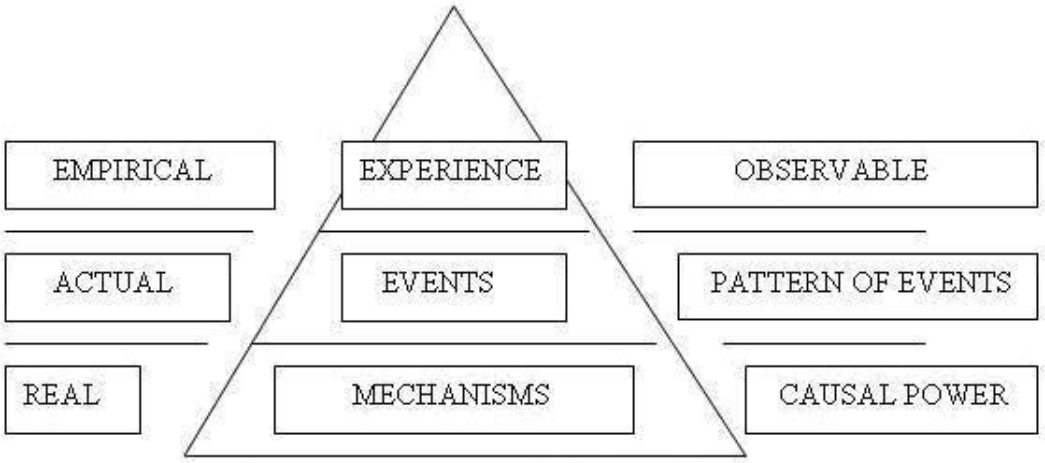

Figure 2 - FUNDAMENTAL TENETS OF CRITICAL REALISM

Fourth, Objects necessarily have particular causal powers and susceptibilities. Critical Realism is focused on Mechanism and Structures which drive the events which may or may not occur. The emphasis on Mechanisms and Structures makes Critical Realism quite different from any other form of Philosophy.

Figure 2 shows that the domain of 'Real' incorporates the mechanisms and structures which are vested with the Causal power. They do not come under the observable domain, and yet are principal in the philosophy of Critical Realism. Causality is a key area of Critical Realism and imbibes the Humean doubt. Critical Realism asserts that concurrence of two events should not be interpreted in terms of causality, as the causal powers rests in the underlying mechanisms and structures. The occurrence or non-occurrence of events is quite inconsequential in terms of Causality. Most of the experimental research done in Information Systems seems to focus on causality while controlling for exogenous factors. Concepts of Regression, Moderation or Mediation are based on the basic notion of Causality (Baron and Kenny, 1986). Most published research in the US utilizes Statistical tools while in European research there seems to be a lower emphasis on statistical approach. Yet it would be pertinent to point out that mostly research is prone to assign causality to observables and the concept of Mechanisms with causal powers is yet to take roots in Information Systems.

Fifth, the world in differentiated and stratified, consisting of objects with structures which can generate events. Critical Realism maintains that Causal laws are ontologically different from patterns of events. As shown in Figure 2, the patterns of events come under the domain of actual events which may or may not be observed. Further, the pattern of events may or may not be generated as the Causal Power is within the domain of Real with Mechanisms and Structures. Natural Science and Design Science should be seen at two levels of the same reality. This aspect of Critical Realism seems to go counter to most of the current research done in Information Systems. If IS could incorporate this tenet in its research, we can expect many new insights in future.

Sixth, Social phenomena are concept dependent (akin to the second tenet). In IS, technology acceptance has been a critical issue and many papers have been written on this confluence of Technology and Social Sciences (Bagozzi et al, 1992; Davis et al, 1989; Venkatesh and Davis 1996). IS research is still being influenced by Technology Acceptance Model (TAM) and mostly the same line of thought is being developed further. A new conceptual way of looking at the social phenomenon would require new interpretations of all the findings.

Seventh, Knowledge is context and linguistic based. Information Systems field recognizes Tacit and Explicit Knowledge. Explicit Knowledge is formally expressed while Tacit Knowledge is more like a skill, which cannot be formally expressed (Nonaka and Takeuchi 1996). Tacit knowledge is deeply embedded in context. Research in Information Systems has explored ways and means to evolve strategies with the view to harness the power of IS maximally (Hansen et al, 1999). There has been effort towards capturing the contextual knowledge from the operations of an organization (Kwan and Balasubramanian, 2003).

Finally, Social Science need be critical of its objects. This indeed is the fundamental tenet of Critical Realism.

To critically examine and evaluate the events, non-events, paradigms, methods, techniques, theories etc is the only way in knowing, or getting closer to, the independently existing reality.

CRITICISM OF CRITICAL REALISM:

Some researchers believe that there is nothing new suggested by Critical Realism as a philosophy. The concept of objectivity and causality, as interpreted in Information Systems and Critical Realism, is challenged by Monod (2004) who argues for a 'Copernican Revolution' in IS research. He suggests 'methodological distinction' and 'conditions of possibilities' within Kantian framework rather than objectivity and causality in Critical Realism (Monod, 2004). Klein (2004) claims that Critical Realism lags behind Hermeneutics and Critical Social Theory in epistemological, ontological and action oriented value formation (Klein, 2004). Kemp (2005) argues that the philosophy of Critical Realism for the social sciences cannot be accepted as an ontology as the ontological claims can only be derived from the research which is widely held to be empirically successful (which is not the case in social sciences) (Kemp, 2005).

Most of the criticism of Critical Realism is due to the fact that many researchers do not clearly differentiate between ontological and epistemological framework and commit what is termed as 'epistemic fallacy' (Mingers, 2004). Further, as Bhaskar (1989) talked about in Reclaiming reality, by shifting the focus from the apparently appealing to the senses (like the observables) to the underlying structures and mechanisms with causal power, we not only in a way admit (and incorporate) the limits of human understanding in our analyses but also keep our minds open to new ideas and further development. It is tempting to observe concurrence of two events and confer causality. But as students of philosophy we need to have a deeper understanding of the phenomenon.

LIMITATIONS AND AREAS OF FUTURE RESEARCH:

This paper is exploratory in nature. Due to the very nature of the topic, it is not possible to be able to address all the issues or cover all the aspects of IS. Firstly, the Causality and Pattern of Events need to be further reinterpreted in IS. This is an already debatable topic and an area of future research. Secondly, more evidence needs to be gathered to convince the research community of the existence of Mechanisms and Structures. The nature of such evidence will be an interesting debate, which will shed new light on the philosophy of Scientific Inquiry within the IS field.

CONCLUSION

Critical Realism can be applied as a holistic philosophy to the inherently multi-disciplinary field of IS. It shows promise of ontologically integrating different streams of research in IS. Both the empirical and conceptual types of researches can be informed by Critical Realism. Different theories about IS areas like Knowledge Management (Tacit v/s Explicit Knowledge), Innovation (Technology Adoption Model), Software Development (Agile methodologies) etc. have people and technology as the focal points of study. Different frameworks of Critical Realism can be effectively applied to reinterpret the research in the field of IS. Such a reinterpretation is going to lead to useful insights in the phenomena and help us understand the intricacies of the field better. Discussion among different researchers and 'critical' evaluation of the applicability of Critical Realism to IS is mutually enriching to both, the philosophy and the field, and it is quite in the spirit of the philosophy of Critical Realism.

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