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REMOVING THE POSITIVIST STRAIGHT JACKET FROM INFORMATION SYSTEMS DESIGN SCIENCE RESEARCH

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Abstract

Information Systems Design Science (ISDS) as a research community is limited by a small number of research frameworks with considerable influence. The small triad of influential ISDS research, consisting of Walls, et al (1992), March and Smith (1995), and Hevner et al (2004) have primarily limited ISDS research to the positivist paradigm and the IT artefact. In contrast, Herbert Simon's intentions for design science never had such restrictions and intended a broader perspective. This essay explores Simon's intentions for design science, the Simonian stream of thought that includes The Sciences of the Artificial, as well as much of his most notable research, and offers an 'informed view' of design science in the tradition of Rortyian neopragmatism.

Keywords: Design Science, Pragmatism, Philosophy of Science.

1 Introduction

Information Systems Design Science (ISDS) as a research community has been constricted by a considerably small number of research frameworks. We find the triad of influential ISDS research, consisting of Walls et al (1992), March and Smith (1995), and Hevner et al (2004) to be inextricably linked to positivism, the IT artefact, and subsequently, limiting to the ISDS research community. In contrast, design science, as explicated by the canonical work of Herbert Simon in *The Sciences of the Artificial* (Simon, 1996) intended a much wider aperture for the study of human artefacts. Contrary to influential ISDS research, design science is not inextricably linked to the positivist perspective, but an open-ended theoretical lens for scientific enquiry. Simon (1996) contains no such explication for ontology, epistemology, or any such specification for approaches, methods, or techniques. Increasingly, ISDS and other design science communities are realizing the impetus to expand to more 'soft' forms of human artefacts. This paper analyses the philosophical traditions of design science vis-à-vis the Simonian perspective and explicates a lens we believe captures Simon's original intentions.

Considerable discourse exists on the ontological and epistemological underpinnings of design science. For example, Vaishnavi and Kuechler (2011) viewed design science as a paradigm similar to positivism and interpretivism; Meng (2009) viewed Simon (1996) as having many open-ended constructivist trajectories, while Hevner et al (2004) viewed design science as dichotomous to behavioural science. Several previous arguments have also been made to expand design science research. In ISDS the argument centres on design science epistemology (MacKay and Marshall, 2005; MacKay and Marshall, 2007; Niehaves and Becker, 2006; Niehaves, 2007; Carlsson, 2006; Carlsson 2007; Iivari, 2007), as well as looking at design science from additional perspectives such as pragmatism (Purao, 2002; Järvinen, 2007; Hovorka, 2009). In general design literature, arguments have been made to expand design science to include reflection-in-practice and instrumentalism (Schön, 1983; van Aken, 2001; Almquist and Lupton, 2010). While the aforementioned perspectives seem logical Simon never specified a particular philosophical position and, as a consequence, design research should exercise due care in making such assessments. This paper differs from the many attempts to find a 'paradigmatic home' for design science. We reject the ontological and epistemological arguments made in much of the ISDS literature in favour of an instrumentalist treatment for design science in the tradition of Rortyian neopragmatism (Rorty, 1979). "Theories (and presumably concepts) should be viewed as 'instruments' not answers to enigmas" (James, 1907). A pragmatist treatment for design science sidesteps the ontological and epistemological debate and affords a worldview in relation to its purpose, versus a truth building activity in the explanation and prediction of human artefacts.

Simon (1996) offered an overarching lens for which to view these artefacts. "An artefact can be thought of as a meeting point – an 'interface between an inner environment, the substance and organization of the artefact itself, and an outer environment, the surroundings in which it operates." Simon never made any specification as to what is considered a product of human artefacts, what constitutes knowledge on design, or any language for which to engage in a scientific discourse. This open-ended explication of a design science lens is quite different from Simon's logical positivist leanings (Simon, 1979; Simon, 1982; Eisenstadt and Simon, 1998). For those who believe scientific theories should be couched in terms of paradigmatic frameworks such as Burrell and Morgan (1979), the lack of a paradigm for design science research is an issue. However, if viewed from a pragmatist perspective, design science could be seen as inclusive to a number of paradigms, approaches, methods, and techniques with the sole purpose of improving the explanation and practical application of phenomena rather than an advancement towards 'truth' (whatever 'truth' is).

This research essay prefers the pragmatist perspective for design science. Our essay also differs from other ISDS research (Purao, 2002; Järvinen, 2007; Hovorka, 2009) in how we use pragmatism. Whilst other ISDS research has linked design science and pragmatism from a reflection-in-practice perspective, here we focus on the application of pragmatism as a treatment to the ontological and

epistemological debate. As a philosophy of science, pragmatism employs an instrumentalist perspective where concepts and theories are looked at only as useful instruments that improve our ability to explain and use phenomena. For the purpose of design science, the pragmatist perspective avoids the nominalist / realist ontological debate as well as the anti-positivist / positivist epistemological debate. Pragmatism and instrumentalism move the evaluation of research away from whether or not phenomena mirrors nature and gravitates towards truth to an analysis of whether what has been evaluated fits with what has been observed (Kuhn, 1962). Whilst classifying research according to paradigms (Burrell and Morgan, 1979) might seem convenient, this convenience comes at the cost of 'narrowing the aperture' through ontological and epistemological constriction.

This essay is not making the claim that current ISDS research is not design science in the manner Simon intended. Quite the contrary, as positivist enquiry was very much a part of the Simonian tradition. In contrast, this essay claims ISDS research has viewed the aforementioned triad as canonical in its interpretation of Simon and never questioned what really qualifies as design science. At present, Hevner et al (2004) is used as more of a workflow than a research framework, and while it certainly suffices as both, the time has come to 'inform the view' of design science (MacKay and Marshall, 2005; MacKay and Marshall, 2007). This paper does the following: (1) The Simonian perspective to research is outlined and contrasted to Simon's explications of a lens for design science, (2) the Simonian view of design science is outlined with special emphasis paid to his analysis of softer forms of human artefacts, specifically, the science of economics, and of the human mind, (3) a design science research lens is presented in the tradition of pragmatism, and (4) a discussion is provided on the types of research ISDS is now afforded using this lens.

2 Delineating Simonian research and design science

Simon's history of research should not be confused with what he explicates as a new perspective for science. While the Simonian approach to research is one of logical positivism (Cruise, 1997; Diamantopoulos, 1997; Subramaniam, 1963), Simon (1996) left many open-ended trajectories, to be pluralistic and incorporate the use of different philosophical paradigms such as positivism, interpretivism, or constructivism (Meng, 2009); multiple approaches such as language analysis, phenomenology, or action research; and multiple methods such as structural equation modelling, lab experiments, ethnography, or case studies. A pragmatist treatment of design science allows it to move beyond positivism and towards enquiry into human artefacts that explore the full range of information systems.

2.1 Pragmatism

Traditional pragmatist philosophy was the creation of C.S Pierce, William James, and John Dewey. Over the course of the twentieth century it enjoyed renewed interest from W.V.O Quine and Wilfred Sellars as a philosophical tool to critique the dominance of logical positivism. More recently, the work of Hilary Putnam and Richard Rorty have given rise to what is commonly termed 'neopragmatism' or 'linguistic pragmatism'. Putnam (1994) puts forth a four-point doctrine on the ideas for which classical pragmatists tended to gravitate: (1) antiscepticism: the idea that doubt requires just as much justification as does belief, (2) fallibilism: the idea that humans can be wrong about their beliefs and understanding of the world and that there are no metaphysical guarantees that limit us from revising any particular belief, (3) anti-dualism: rejection of the idea that mental phenomena can be non-physical, and (4) reflection-in-practice: the idea that practice, properly construed, is primary in philosophy. Rorty (1979) assumes a naturalist position that moves pragmatism to avoid the three 'essentialisms' of 'truth', 'reality', and 'experience' and modifies the traditional pragmatist position on three basic tenets: (1) the idea that Dewey and Pierce should be applauded for repudiating many of the methods and goals in traditional philosophy, (2) that they should be repudiated in their attempts to reconstruct what should not be reconstructed (e.g. the three

essentialisms), and (3) that we must accept the idea that language is the only available tool to "furnish philosophy's materiel". Similarly, Goles and Hirschheim (2000) define pragmatism as a philosophical position that emphasizes: "what works while abstaining from the use of metaphysical concepts such as truth and reality". For the purposes of this discourse, modern pragmatism can be summarized by the following five pillars: (1) anti-essentialism: a rejection of the three essentialisms of truth, reality, and experience, and subsequently, the traditional ontological and epistemological debate, (2) anti-scepticism: the idea doubt requires just as much justification as does belief in the development of knowledge, (3) fallibilism: the idea that knowledge is fallible and that language is our only tool for knowledgeable discourse, (4) anti-dualism: the idea that mental phenomena cannot be non-physical, and (5) instrumentalism: the idea that theory is grounded in practice and that scientific theory is simply a useful instrument in understanding the world. This research essay applies the Rortyian form of neopragmatism as a treatment to Simonian design science and explicates the view that a treatment of the design science as principally anti-essentialist and instrumentalist, whilst sustaining the other three pillars, will facilitate a worldview that is more inclusive to a number of paradigms, approaches, methods, and techniques.

2.2 Simonian Thought

Herbert Simon made contributions to a multitude of fields ranging from economics, computer science, management, operations research, and philosophy of science. Embedded in the Simonian perspective is the computational theory of the mind (Putnam 1961). In this theory, the human mind is thought of as an information processing system, and thinking is synonymous with the activity of computing. This stream of thought is pervasive throughout Simon's research on artificial intelligence (Newell and Simon, 1976; Simon, 1995). Also throughout much of Simon's research is the use of predicate logic and mathematics. Simon frequently used this notation as language to explain causal relationships found through empirical analysis, such as computer games, and reported this research in an objective manner. Given the nature of this research, there is similarity between the Simonian perspective and the five pillars of positivism (Goles and Hirschheim, 2000): (1) Unity of the scientific method, (2) Search for Humean causal relationships, (3) Belief in empiricism and universal generalizations from empirical observations, (4) Science and its process is value free, and (5) The foundation of science is based on logic and mathematics. Furthermore, Simon's "logical analysis of language" (Carnap, 1968) and his pervasive use of "abstract reasoning concerning quantity or number, modulo modern math and logic" position the Simonian approach to research firmly within the bounds of logical positivism.

Simon used logical positivism on a range of topics ranging from artificial intelligence (Simon and Newell, 1972) to models of human thought (Simon, 1979). In one of Simon's most widely cited publications, Human Problem Solving (Simon and Newell, 1972) human thinking and the spectrum of human thought were described as simple cognitive processes able to be modelled by machines in the form of symbol systems. These symbol systems take physical patterns (symbols), combine them into structures (expressions), and manipulate them using processes to produce new expressions (Newell and Simon, 1976). Symbol systems constitute one of the principal philosophies on artificial intelligence. A symbol system can be represented as a computer, where the symbols are the zeroes and ones of computer memory (the structures), and the processes are the operations that alter the state of memory. In a similar vein, intelligent human thought can also be modelled as a symbol system. Symbols are encoded in our brains where our thoughts are structured expressions and the act of thinking represents the processes that alter the state of human thought. Symbol systems form the basis of philosophy on artificial intelligence, as well as a basis for enquiry into the artificial. This description of symbol systems is important because it illustrates the widespread applicability of Simon's theories in his enquiry into the artificial, particularly its seamless transition from the physical to behavioural sciences. An enquiry into the artificial in all its philosophical, scientific, technological forms is design science so long as the artefacts under investigation have human-purposive goals (Rosenbluth, et al, 1943; Simon, 1996).

This brings us to a division between the Simonian perspective and Simon's intentions for design science. Simon's research contributions to fields such as computer science, economics, psychology, management, operations research, and philosophy of science are almost exclusively logical positivist (Dasgupta, 2003; Simon, 1977). Logic and mathematics as well as the application of utility theory and statistical decision theory are part and parcel to the Simonian perspective (Simon, 1959; Simon, 1979; Simon, 1983). However, Simon (1996) only provides a cursory mentioning of how to use these theories when devising curriculum for professional engineering schools (Simon, 1996 p.118) and makes no mention of positivist techniques to analyse human artefacts. Rather, the practice of scientific enquiry into human artefacts is left open. For example, in Simon's chapter on economic rationality an ontological prescription is sidestepped in the following quote, "In this chapter I have tried not to evaluate these forms of individual and social organizations, but to simply describe them as commonly used solutions to the central problem of accommodating to our bounded rationality" (Simon, 1996 p. 49). Simon is clearly interested in the "tools of procedural rationality" (Simon, 1996 p. 49), but as something to investigate, not as prescription into what constitutes artefacts for design research in creating the "veridical picture of economic actors and institutions". Similar open-ended intentions are found in Simon's chapters on the human mind. In these sections, Simon is particularly concerned with enquiry into the "thinking person" as human artefact: "there are only a few 'intrinsic' characteristics of the inner environment of thinking beings that limit the adaptation of thought to the shape of the problem environment. All else in thinking and problem-solving behaviour is artificial – is learned and is subject to improvement through the invention of improved designs and their storage in memory". Throughout these sections, Simon provides examples of cognitive processes investigated in his prior research, for example: search strategies (Simon, 1956), the parameters of memory and chunking (Chase and Simon, 1973), the mind's eye (Chase and Simon, 1973), and semantics of processing natural language (Newell and Simon, 1956). All of the above examples are clearly logical positivist, however, these examples are only mentioned as active areas of research, particularly in psychology and cognitive science, rather than what constitutes design knowledge. In Simon's words on experiments conducted on the semantics of language processing, he states "this approach *might* (italics added) be used to explain the resolution of syntactic ambiguities by use of semantic cues." This statement is echoed when he states the limitations of his experiments in relation to design science, "The experiments are mostly significant in what they show about the broad commonalities in organizations of the human information processing system as it engages in different tasks". Clearly, Simon intended his prior research to be examples rather than an ontological or epistemological foundation. We find further evidence of his 'prototype' for a design science in the following quote:

"A scientific account of human cognition describes it in terms of several sets of invariants. First there are the parameters of the inner environment. Then, there are the general control and search guiding mechanisms that are used over and over again in all task domains. Finally, there are the learning and discovery mechanisms that permit the system to adapt with gradually increasing effectiveness to the particular environment in which it finds itself. The adaptiveness of the human organism, the facility with which it acquires new representations and strategies and becomes adept in dealing with highly specialized environments, makes it an elusive and fascinating target of our scientific inquiries – and the very prototype of the artificial" (Simon, 1996, p. 110).

This delineation between Simonian research and design science is important for IS research. If phenomenological enquiry into human artefacts is constrained to an investigation of knowledge vis-à-vis the use of logical positivism, we ostensibly constrain the multitude of phenomena to be investigated under these auspices.

3 The Simonian view of design science

An artefact exists as a 'thin interface' between an inner and outer environment. The inner environment is the substance and organization of an artefact, while the outer environment is the surroundings in which the artefact operates (Simon, 1996, p.4). Cognition and behaviour is just as

much an artefact as a software application or computer system, so long as the artefact was synthesized for human-purposive goals. The goal of design science is to investigate artefacts exclusive of nature, however nature and human artefacts are inseparable as nature is embedded in them: "A plowed field is no more a product of nature than an asphalted street, and no less" (Simon, 1996, p.3). Simon provides a general distinction of design science using the following four indicia (Simon, 1996 p.5): (1) artificial things are synthesized (though not always or usually with full forethought) by human beings, (2) artificial things may imitate appearances in natural things, while lacking, in one or more respects, the reality of the latter, (3) artificial things can be characterized in terms of functions, goals, and adaptation, and (4) artificial things are often discussed, particularly when they are being designed, in terms of imperatives as well as descriptives.

Two of Simon's theories, substantive and procedural rationality (Newell and Simon, 1976) and symbol systems (Simon, 1973) can act as vehicles for interpretation. However, they do not have to, as evidenced from the aforementioned indicia. As an example, either of these lenses can be applied to human behaviour. In the case of substantive and procedural rationality an observed behaviour is a substantive artefact while the process of adapting the behaviour to an outer environment is procedural. In turn, the inner character consists of the actions and thoughts that constitute the procedural action. Substantive and procedural rationality are closely aligned with Simon's explication of economics as a science of the artificial, but it is clear he is concerned with an understanding of the rational choice of the economic actors themselves: "We are especially lacking in empirical information about how economic actors, with their bounded rationality, form expectations about the future and how they use expectations in planning their own behaviour". The example provided shows how an innumerable amount of lenses could be applied to this understanding in the tradition of design science. Similarly, in the case of symbol systems, our present thoughts can be artefacts where the inner environment consists of symbols, and patterns of symbols, 'encoded' in our brains. These symbols are adapted through the process of thinking to alter the state of human thought – the outer environment. As Simon states, "the external environments of thought, in both the real world and long-term memory undergo continual change. In memory the change is adaptive. It updates the knowledge about the real world and adds new knowledge…A scientific theory of human thinking must take account of this process of change in the contents of memory." Thus, an artefact can be biological, physical, or cognitive depending on what the design scientist seeks to investigate so long as the artefact in question is logically manifested for human-purposive goals.

Again, Simon (1996) never placed any ontological restrictions on the artefact, its inner character, or outer environment, nor did he place any epistemological restrictions on what constitutes design knowledge. In a similar vein, Simon's prior research also never placed any limitations on what could be conceived as a symbol, symbol system, processes, expressions, or what constitutes substantive and procedural rationality. The essence of Simon's many theories on artificial intelligence is that they would be logical in representation to both human and artificial systems. Hence, the only boundary is scientific discourse – what the scientist can conceive, observe, and disseminate to the scientific community.

The sections below discuss two important streams of thought from Simon (1996) in his development of a lens for design science. Important in understanding these two streams of thought is that within these topics Simon provides examples that range from tangible human artefacts to cognitive artefacts that again leave design science with open-ended trajectories and affords pragmatism as a treatment to the ontological and epistemological debate.

3.1 Economics: Human artefacts and the science of scarcity

Simon considered economics the purest form of human design. Economic rationality is a social activity where the artefacts manifest themselves as behaviours in the allocation of scarce 'things' such as land, money, time, fuel, and attention (Simon, 1996 p. 25). Economic artefacts are manifested through human behaviour vis-à-vis individual actors, organizations, markets, and interactivity between

them. Human artefacts can be the scarce things themselves, or the behaviours exhibited in their allocation. Simon presents an application of design science to economics where the outer environment is the aggregation of behaviours by individuals, firms, and markets, the inner environment is the capability for rational adaptive behaviours, and human artefacts consists of the goal-driven behaviours in the allocation of scarce things. However, anything considered 'scarce' by humans – "land, money, time, fuel, attention, and many other things" – are human artefacts (Simon, 1996 p.26). Thus, a material construction exists on the same plane of scarcity as a construction of the mind.

Central to an understanding of how inner and outer environments interact is the concept of substantive and procedural rationality. Substantive rationality represents the product of adaptation, while procedural rationality represents the process. Simon's concept of adaptive complexity (Simon, 1996:7) provides an example: A complex system is any system composed of a series of interconnected parts where the whole exhibits properties exclusive of the properties of the individual parts. A complex system is adaptive when it is capable of changing from experience. The stock market is one of the purest examples of a complex adaptive system. Substantive rationality is illustrated by its adjustments to changing conditions (e.g. other markets), while procedural rationality is the knowledge and computational processes used to discover appropriate adaptive behaviour. Simon believed that complexity 'unmasked' affords us a view of simplicity: "Human beings, viewed as behaving systems, are quite simple. The apparent complexity of our behaviour over time is largely a reflection of the complexity of the environment in which we find ourselves" (Simon, 1996 p.53). Although this particular quote may seem reductionist, there are many other aspects to design science that are non-reductionist as evidenced by his study of complex adaptive goal-oriented systems "as wholes" (Simon, 1996 p.173).

Adaptive complex systems are created by assumingly simpler symbols, combined into expressions, and manipulated using processes to create new complex adaptive systems (Simon, 1996 p. 215). Knowledge of symbols, their intended structure, and the processes by which they are adapted to an outer environment is known from *a posteriori* knowledge. Thus, knowledge for adaptation is created for, and by, means of knowledge (Mingers, 2000; Bhaskar, 1978, Simon, 1996). From the standpoint of scientific investigation, substantive rationality is intransitive and realist, while procedural rationality is transitive and knowledge dependent. Thus, while economics provides a macroscopic view of human behaviour, human cognition and behaviour presents a more microscopic view of enquiry into human artefacts.

3.2 The human mind: Cognition as a science of the artificial

In Simon's thinking about 'thinking', a cognitive architecture "must somehow be organized in the human brain to work together in a coordinated fashion" (Simon, 1990). From a biological perspective, cognitive capacity is realized through the process of conversion from short to long-term memory. According to theories found in the evolving field of neuroplasticity, this occurs when binding proteins enact segments of a cell's DNA, which leads to the production of special proteins that change the structure and activity of nerve cells for days, weeks, or longer (Schwartz, 2003). Whether or not we find the above hypotheses plausible, an agreement can be reached that the process of remembering and learning causes minor changes in our biological makeup.

For the intelligibility of scientific enquiry into human artefacts, Simon considers memory less a part of our biology, and more a part of the outer environment to which memory adapts (Simon, 1996 p. 53; Eisenstadt and Simon, 1997). The 'thinking person' is a product of human artefacts where the design of cognitive processes and requisite behaviours can be equally investigated. The "cocoon of information" (Simon, 1996 p. 110) is also part of the human environment that we spin and store in long-term memory and literary forms. "The external environments of thought, both in the real world and long-term memory, undergo continual change" (Simon, 1996 p.100). Similar to his theories on economics, Simon refers to the thinking person as an adaptive system, which again, given that

memory undergoes continual change, gives rise to the concepts of substantive and procedural rationality.

Behaviour can be thought of as the substantive rationality of the thinking person, while procedural rationality is the adaptation of previously acquired behaviours to an outer environment. Human-purposive goals are the impetus for procedural rationale, and subsequently, substantive adaptation. In the thinking person, procedural rationality is manifest through the process of cognition. Knowledge becomes embedded in our memory stores and scientific enquiry of the thinking person reveals many properties of cognitive procedure and behavioural substance. Simon believed scientific enquiry into the thinking person would reveal very little about the 'physiological machinery' that enables a person to think. Thus, psychology is a design science as all is learned and subject to improvement through the invention of improved designs (Simon, 1996 p. 54). The human mind designs and adapts to an outer environment through two major components: real objects *sensed* through "eyes, ears, and touch, and *acted* [italics added] upon by leg, hand, and tongue" (Simon, 1996, p.86).

Design research into the thinking person contains innumerable open-ended trajectories. The design must identify artefacts of human thought and describe the goals for which it was intended, the outer environment it is adapting to, and inner character and processes by which cognitive adaptation is taking place.

4 The pragmatist lens for design science research

From the above outline of the Simonian stream of thought, coupled with Simon's intentions for design science, we arrive at an 'informed view' for the study of human artefacts. A lens for design science has the following characteristics: (1) it is normative and concerned with the science of *oughts* vs. *is* (Simon, 1996 p.5) as human artefacts are adapted to goals, (2) it is inseparable from nature as nature is "embedded in human artifice" (Simon, 1996:4), (3) it is a view of the world that depicts human artefacts vis-à-vis an inner and outer environment, and (4) it is pragmatist in that science should employ whatever philosophical and/or methodological approach that works best for the particular research stream (Goles and Hirschheim, 2000). Within the lens for design science is the scientific process of discovery about the inner environment and the process by which the inner adapts to its outer environment. This process of discovery *can* apply Simon's theories on substantive and procedural rationality, and/or his theories on symbol systems.

Using this lens, design science is unchained from a particular ontology or epistemology, particularly positivism. It is also aligned with pragmatism, as it should be looked at as an instrument for a particular use, rather than an ontological or epistemological position that attempts to march science towards the three essentialisms of truth, reality, and experience. While Herbert Simon, one of the most prolific researchers in modern times, was unequivocally logical positivist, design science as a worldview can be applied using a variety of research paradigms, approaches, methods, and techniques.

This 'informed view' for design science research can be summarized as follows: *(1) A design science consists of an (a) outer environment: the environment to which we adapt to for human-purposive goals, (b) an inner environment: the character and composition of what has been adapted for human-purposive goals, and (c) human artefacts: the thin interface between the inner and outer environments. (2) Human artefacts can consist of any human design artefact such as land, money, time, altruism, cognitive processes, behaviours, etc. (3) Human artefacts can be conceptualized in terms of (a) substantive rationality: how well an intelligent system has adapted to its outer environment in light of its goals, and (b) procedural rationality: the reason and logic by which it was discovered how an intelligent system has adapted, and/or (c) symbol systems: physical patterns (symbols) combined into structures (expressions) and manipulated using processes to produce new expressions (Newell and Simon, 1976). (4) Design science differs from much of the natural and behavioural sciences by an emphasis on normative vs. descriptive science, but is not exclusively one or the other.*

The above description describes a lens that is quite different from influential research in ISDS. Design science does not exist on the same plane as positivism or interpretivism, but through a pragmatist view of the artificial world where different models for research could be used to explain the manifestation of human artefacts in pursuit of human-purposive goals. Design science is not locked in to any particular type of artefacts, nor is it bound to any particular paradigm, method, or technique in scientific investigation.

5 Discussion and Implications

Design knowledge in ISDS is considerably centred on the triad of influential ISDS research. Much of ISDS uses the Hevner et al (2004) framework and subsequently assumes their ontological and epistemological positions. The seven Hevner et al (2004) guidelines for design science research are as follows: (1) design-science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation, (2) the objective of design-science research is to develop technology-based solutions to important and relevant business problems, (3) the utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods, (4) the utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods, (5) design science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact, (6) the search for an effective artefact requires utilizing available means to reach desired ends while satisfying laws in the problem environment, (7) design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences. We contend these guidelines have produced an impoverished view for ISDS. Guideline 1 is the principal culprit as it restricts the other 6. If the goal of ISDS is to produce an IT artefact in the form of a "construct, model, method, or instantiation" we are not engaging in producing an understanding of new phenomena but rather using ISDS research as a surrogate for engineering. Mandating artefact production only affords ISDS the appearance of a normative science and prevents design science from exploring the full range of human artefacts.

This essay provides a lens for ISDS crafted in a teleological sense rather than an ontological or epistemological basis. This 'informed view' affects the ISDS research community in several capacities. From a philosophical perspective, design science can now move beyond the current positivist myopia and towards more pluralistic research. This also moves ISDS away from mandatory prescription of IT artefacts, and away from the dichotomy between natural/behavioural and design science. We have also argued for pragmatism as a treatment for design science research. To be clear, we are advocating pragmatism as a treatment for how to deal with a tradition of design science, not as philosophical underpinning for a model of research. Purao (2002), Järvinen, (2007), and Hovorka (2009) have already made these fruitful contributions to ISDS discourse. Instead, we align with neopragmatism and its treatment of ontology and epistemology as matters of sociology and cultural politics rather than foundational justification. In Rorty's words: "I linguisticize as many pre-linguistic-turn philosophers as I can, in order to read them as prophets of the utopia in which all metaphysical problems have been dissolved, and religion and science have yielded their place to poetry" (Saatkamp, 1995). Simon's design science is far more concerned with its purpose as a way to view the artificial world rather than as practice-transcending legitimation. Design science is not concerned with what is, or is not design, whether human artefacts are real and immutable versus subjective constructions of the mind, or what types of expressions constitute design knowledge. In the same capacity that Rorty sought "to move epistemology and metaphysics into matters of sociology and cultural politics, and from claims to knowledge and appeals to self-evidence to suggestions about what we should try" (Rorty, 1979) is the same manner that ISDS communities should understand Simon's view of the artificial world. If this position is taken, ISDS can distance itself from the behavioural/design science dichotomy, transcend from techno-centric enquiry to many different forms of human artefacts, and possess an explanatory (Baskerville, 2010) as well as prescriptive aspect to design science.

Moving design science beyond its current conceptualizations will also 'correct' the ISDS view of Simon's distinctions between the sciences. In ISDS, the discourse centres on a dichotomy between the natural/behavioural sciences and design science. March and Smith (1995) term the natural/behavioural and design sciences as "two different species" where design science is concerned with "devising artefacts to attain goals". In a similar vein, Hevner et al (2004) state the behavioural paradigm seeks to find "what is true", while design science seeks to "create 'what is effective'". The difference between what March and Smith (1995) call 'natural science' and what Hevner et al (2004) call 'behavioural science' is negligible. Both are discussing Simon's notion of a descriptive science in terms of '*is'* instead of '*oughts'*. However, this discourse, which is in intended to parallel Simon's, is misrepresented. Early in Simon (1996) a distinction is made between descriptive and normative science where descriptive science is concerned with what *is*, while normative science is concerned with *oughts*. Simon takes the pure empiricist's position in this argument and declares irreducibility from "*ought* to *is*" (Simon, 1996, p.5). However, the similarities end there. While March and Smith (1995) consider the purpose of design science research to devise artefacts to attain goals and Hevner et al (2004) consider the purpose of design science to create what is effective, Simon sought the treatment of artificial or goal-seeking as phenomena, without commitment to their goals (Simon, 1996 p. 5). Furthermore, Simon's consideration of *oughts* has more to do with investigation of the artificial things themselves rather than the practice of a design science. The distinction is made as we move from "natural to artificial phenomena" not from natural science to design science. Thus, design research can be explanatory or descriptive as well as normative and prescriptive, and is certainly not forced to include the creation and instantiation of artefacts. The arguments made in March and Smith (1995) and Hevner et al (2004) further diverge from Simon's arguments, as there is no mentioning of his distinction between engineering and science. "A science of the artificial will be closely akin to a science of engineering – but very different" (Simon, 1996 p.5) as "engineering is concerned with synthesis, while science is concerned with analysis" (Simon, 1996 p.4). ISDS has incorrectly concerned itself with engineering and synthesis, rather than scientific analysis. ISDS as a research community must move beyond the artefact-centric notion of design science towards research that performs enquiry into the full range of human artefacts. It is rather tautological in the sense that IS already investigated much of this phenomena. However, it is Simon's lens in which to view human artefacts that would make design science research distinct from other types. As we have stated, while we believe ISDS research to be in line with Simon's explication for design science, ISDS has never questioned what else can qualify.

One of the last points to be made during this discussion is the lack of examples and quotes from Simon (1996) Chapter 5 – "A Science of Design". This has been a bit of a red herring for ISDS. The discourse in ISDS (Baskerville 2008; Baskerville et al, 2009; Baskerville, 2010; Gregor 2007; Gregor and Jones 2007; Gregor 2009) has used this chapter in a manner other than how it was intended. Chapter 5 does not outline what it means to conduct a science of design, but rather an approach to curriculum and pedagogy on design in engineering schools. In contrast, this research essay has looked holistically at Simon (1996), and what it means for a science of design and ISDS.

6 Conclusion

This essay has provided ISDS the 'informed view' of design science in the tradition of neopragmatism. The Simonian perspective to research was outlined and contrasted with Simon's view for design science, and a lens for design science was provided as the central contribution of this essay. In explicating this lens, we analysed and outlined different forms of human artefacts which design science could investigate. We believe the pragmatist tradition to offer a philosophical stance that avoids the positioning of design science amongst an ontological and epistemological debate and also avoid convenient classification within paradigmatic frameworks such as Burrell and Morgan (1979).

When a relatively small number of research frameworks have created a protective belt around a 'normal science' (Kuhn, 1962) there is considerable reason for concern. This essay is not alone in its

concern as there has been considerable discourse on expanding the perspective of design science, both within ISDS and other design science research communities. This essay differs considerably from previous research in that we do not seek an ontological and epistemological home for design science, but rather offer the pragmatist perspective as a treatment to allow the design science community the opportunity to explore human artefacts using a multitude of paradigms and research models for explanation, prediction, and even prescription for human artefacts. It is a sincere hope this essay appropriately compounds the growing concern in ISDS and in design research to expand what it means to conduct scientific enquiry into human artefacts, and subsequently, remove the positivist, artefact centric straight jacket from ISDS research.

7 References

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