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RESEARCH ESSAY

GENRES OF INQUIRY IN DESIGN-SCIENCE RESEARCH: JUSTIFICATION AND EVALUATION OF KNOWLEDGE PRODUCTION

Richard L. Baskerville
Department of Computer Information Systems, Robinson College of Business, Georgia State University, Atlanta, GA 30303 U.S.A. {baskerville@acm.org} and
School of Information Systems, Curtin Business School, Curtin University, Bentley WA 6102 AUSTRALIA

Mala Kaul
Department of Accounting and Information Systems, College of Business, University of Nevada, Reno, 1664 N. Virginia Street, Reno, NV 89557 U.S.A. {mkaul@unr.edu}

Veda C. Storey
Department of Computer Information Systems, Robinson College of Business, Georgia State University, Atlanta, GA 30303 U.S.A. {vstorey@gsu.edu}

Appendix A

Terms: Application and Use in Management Information Systems Design-Science Research

Term	Application and Use
Design (verb)	The term design (verb) connotes the act of planning or creating something for a specific purpose or process that is goal-oriented, where the goal is solving problems, meeting needs, improving situations, or creating something new or useful (Friedman 2003). Design is a central activity of information systems practitioners (Denning 1997; Niederman and March 2012). It involves changing a given system to make improvements. A human being makes such changes by applying the knowledge needed to develop a new artifact.
Design (noun)	Design (noun) is concerned with how things ought to be in order to attain goals (Simon 1996). It connotes the process by which one devises "courses of action aimed at changing existing situations into preferred ones" (Simon 1996, p. 7). "Design cannot proceed without (1) an articulation of the goals of the designed artifact, (2) knowledge of the constraints imposed and affordances provided by the inner and outer environments, (3) mechanisms to produce design alternatives, and (4) understanding of the effects of design decisions, with respect to articulated goals" (Niederman and March 2012, p. 19). Design is concerned with how things ought to be in order to attain goals (Simon 1996).

Term	Application and Use
Design process	The design process is concerned with finding a satisfactory design, rather than an optimum design; "the shape of the design and the shape and organization of the design process are essential components of a theory of design" (Simon 1996, pp. 130-131).
Duality	Duality, according to Eastman (2004), denotes a comprehensive view similar to the notion of holism that exists in philosophical approaches such as in systems theory (Auyang 1999; Laszlo 1972), hierarchy or complexity theory (Kauffman 1993), evolutionary worldviews (Jantsch 1980), and varieties of holism in pragmatism and contextualism (Rescher 2000). Duality is distinguishable from dualism, which is "the division of an object of study into separate, paired elements" (Jackson 1999, p. 545). In duality, interdependent elements are characterized by emergent powers, so that any one aspect cannot exist independently but rather as a whole (Giddens 1979, 1984).
Genre of inquiry	Genres of inquiry are modes of reasoning that arise within the context of the philosophical assumptions. The standards of a genre help a researcher by clarifying the way in which a particular community will receive new work (Hacking 2012).
Idiographic knowledge	Idiographic knowledge processes involve the study of particular cases (Bullock et al. 1988).
Knowledge	A broad view of scholarly knowledge encompasses scholarly knowledge based on *erklären* (the causal explanations common in positivist science), but also scholarly knowledge based on *verstehen* (the shared understanding common in interpretive science) (Lee 1994). Knowledge can be scholarly because it relates to design theories, the instrumental outcomes of design-science, and product designs, implementation plans, and construction processes (Carlsson 2006). Knowledge establishes robust relationships in a given domain; relationships do not change under interventions (e.g., a change of parameters in a model as in a change in an experimental setting). Knowledge constitutes a representation of the outside world (Piaget and Wells 1972). Knowledge is classified as descriptive or prescriptive with prescriptive belonging to science of the artificial (Simon 1996). Knowledge captures the structure of the world, whether the world is natural or artificial.
Knowledge claims	A statement asserting original knowledge arising from the research study. The knowledge process establishes the merit of the knowledge claim.
Knowledge creation process	Activities in a research study that develop or support development of original knowledge. Concerned with finding a satisfactory design, rather than an optimum design; "the shape of the design and the shape and organization of the design process are essential components of a theory of design" (Simon 1996, pp. 130-131).
Knowledge criteria	Concepts regarding the quality of knowledge. Criteria are necessary for researchers to justify their knowledge claims, and by their audience to evaluate these claims.
Knowledge goals	Goal is the end toward which effort is directed (Merriam-Webster Online 2015). Design knowledge goals are generative and inventive; scientific knowledge goals are conventional and systematic. Design-science is characterized by a duality present in essential knowledge goals.
Knowledge moment	A unit of knowledge processing, triggered by a specific need for knowledge and addressed by the specific delivery of the knowledge in a manner that is aligned with a given context (Herder et al. 2003).
Knowledge role	The purpose or purposes served by artifacts in design-science studies in relation to the knowledge claims of the study.
Knowledge scope	Scope is the extent of treatment, activity, or influence (Merriam-Webster Online 2015). Idiographic knowledge scope is local and pertaining to a particular case or problem; nomothetic knowledge scope is more global and applicable to a general class of cases. Design-science is characterized by the duality present in essential knowledge scope.
Nomothetic knowledge	Nomothetic knowledge processes produce general theories or concepts that cover the entire classes of a given case (Allport 1962).

Term	Application and Use
Research (noun)	Research involves systematic investigation or inquiry aimed at contributing to knowledge of a theory, topic, etc., by careful consideration, observation, or study of a subject (OED Online 2013). Research is "original investigation undertaken in order to gain knowledge and understanding. It includes work of direct relevance to the needs of commerce, industry, and to the public and voluntary sectors; scholarship; the invention and generation of ideas, images, performances, artefacts including design, where these lead to new or substantially improved insights; and the use of existing knowledge in experimental development to produce new or substantially improved materials, devices, products and processes, including design and construction" (Paul 2008, p. 326).
Research (verb)	To engage in research upon (a subject); to investigate or study closely (OED Online 2013).
Science	Usage of the term science varies widely according to social and political contexts (Gieryn 1984; Moisander and Stenfors 2009). In information systems, the academic term is just as subject to the same breath of interpretation as in the fields of Philosophy of Science, Sociology of Science, and the History of Science (Lee 2004). It is an intellectual and practical activity that incorporates systematic methodology and knowledge based on coherent concepts that are anchored to evidence (Lincoln and Guba 1985).
Scientific pluralism	Scientific pluralism is a stance about the theories and methods of science according for which the explanation of some natural phenomena requires multiple theories and approaches. It values the existence of different perspectives in scientific research (Kellert et al. 2006).

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Appendix B

Quality Criteria Derived for Genres of Inquiry

Criteria	Definition	Sources	Illustrative Examples of Criteria Use
Prolonged engagement	Prolonged engagement includes the investment of sufficient time to achieve research purposes including learning, testing; The investigator is involved with the research sufficiently long to develop an appreciation of the local environment. Spending an extended period (at a site) allows locals to adjust to the presence of the researcher and also allows the researcher to evaluate his or her own developing perceptions.	Lincoln and Guba 1985 Guba 1981	Creswell and Miller 2000 Erlandson et al. 1993 Onwuegbuzie and Leech 2007 Shenton 2004
Persistent observation	"Extended interaction with a situation or a milieu" in order to develop "an understanding of the essential characteristics" or pervasive qualities. Persistent observation adds salience to the immersion of the researcher through prolonged engagement by helping identify those characteristics and elements that are most relevant to the problem. Thus, while prolonged engagement provides scope, persistent observation provides depth of understanding.	Guba 1981, p. 85 Lincoln and Guba 1985	Travis 1999

Criteria	Definition	Sources	Illustrative Examples of Criteria Use
Triangulation	Triangulation is the process of improving the probability of the findings through different means. This is achieved by various methods. Denzin describes four different types of triangulation: data triangulation, methodological triangulation, investigator triangulation, and theoretical triangulation. 1. Data triangulation: This may imply multiple instances from a single source, or alternately different sources of the same information. It also refers to contextual validity or the assessment of validity by comparing evidence with other kinds of evidence on the same point. 2. Methodological triangulation: Once a proposition has been confirmed by two or more measurement process the uncertainty of its interpretation is greatly reduced. 3. Investigator triangulation: If a research design is emergent, and its form depends ultimately on the particular interaction that the investigator has with the phenomena, then a team comprising multiple investigators can contribute towards the evaluation with the objective of establishing reliability. 4. Theoretical triangulation: The value of this strategy is the assurance that each study will be conducted with some theoretical perspective; however this strategy may be most appropriate in the absence of high theoretic coherence.	Lincoln and Guba 1985 Denzin 1978 Diesing 1972, pp. 147-148 Webb et al. 1966	Jick 1979 Kaplan and Duchon 1988 Markus 1994 Myers 1997
Principles (e.g., contextuali-zation, dialogical reasoning, sensitivity to multiple interpretations, and suspicion)	The principle of contextualization "requires critical reflection of the social and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerges" (p. 72). Moreover, in certain situations, competing explanations may arise. George and Bennett (2005) discuss the importance of examining alternative and perhaps even conflicting explanations. They state that "the plausibility of an explanation is enhanced to the extent that alternative explanations are considered and found to be less consistent with the data, or less supported by available generalizations" (p. 91) Klein and Myers (1999) described a similar notion as dialogical reasoning, which "requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings" (p. 72).	Klein and Myers 1999	Duranti and Goodwin 1992 Wegerif et al. 1999

Criteria	Definition	Sources	Illustrative Examples of Criteria Use
Credibility	Credibility is the confidence in the "truth" of the findings. In more naturalistic settings, the term credibility is the equivalent for the conventional scientific term internal validity and denotes trustworthiness of the findings. Some activities that can increase the probability of credible findings are prolonged engagement, persistent observation, and triangulation.	Lincoln and Guba, 1985	Baxter and Eyles 1997 Onwuegbuzie and Leech 2007 Patton 1999
Confirmability	Confirmability is the degree of neutrality of the extent to which findings of a study are shaped by the respondents and not researcher bias, motivation, or interest. Confirmability is the naturalistic equivalent to conventional evaluation criteria of objectivity. The question underlying the establishment of the confirmability criteria is: "How can one establish the degree to which the findings of an inquiry stem from the characteristics of the responders and the context and not from the biases and motivations and perspective of the researcher?" (Lincoln and Guba 1985, p. 218).	Guba 1981 Lincoln and Guba 1985	Baxter and Eyles 1997 Hoepfl 1997
Dependability	Dependability is the process for showing that the findings are consistent and could be repeated. The question underlying the development of this criteria is, how to "determine whether the findings of an inquiry would be consistently repeated if the inquiry were replicated in the same or similar contexts?" (Guba 1981, p. 80).	Lincoln and Guba 1985	Avizienis et al. 2001 Bondavalli et al. 2001
Transferability	Transferability is the characteristic of the findings in one context or pertaining to a situation, to be applicable in other contexts. Lincoln and Guba distinguish two different conceptualizations of transferability: (1) The first conceptualization (which views science from a more Kuhnian perspective), transferability, indicates that the findings in one case are applicable in all contexts within the same population. (2) The second conceptualization (which is more post-positivist or naturalistic) views transferability to be demonstrated when the researcher has provided adequate evidence and descriptive data to support that the original context and the transferred context are sufficiently similar for the findings to be transferred.	Lincoln and Guba 1985	Malterud 2001

Criteria	Definition	Sources	Illustrative Examples of Criteria Use
Applicability	Applicability is "how one can determine the degree to which the findings of a particular inquiry may have applicability in other contexts" (Guba 1981, p. 79). In scientific terms, it can be referred to as generalizability or external validity, and requires that the inquiry is conducted in such a way that chronological or situational variations do not impact the findings. This will ensure that the findings are relevant in other contexts. The truth statements then are context-free and will hold in any given context.	Guba 1981	Green and Glasgow 2006
Generalizability	Generalizations are assertions of enduring value that are context-free. However, they stress that inquiry that only sees value in generalizable knowledge while ignoring the knowledge from the unique, risks ignoring the alternatives that lie between nomic (nomothetic) generalizations on the one hand and unique, particularized knowledge on the other.	Lincoln and Guba 1985	Lee and Baskerville 2003
External validity	External validity is "the approximate validity with which we infer the presumed causal relationship can be generalized to and across alternate measures of the cause and effect and across different types of persons settings and time" (Cook and Campbell 1979, p. 37).	Bracht and Glass 1968 Cook and Campbell 1979	King and He 2005
Reliability	Reliability is synonymous with "dependability, stability, consistency, predictability, accuracy" (Kerlinger 1973, p. 422). Reliability suggests that it is reasonable "to assume that each repetition of the application of the same or equivalent instruments to the same units will yield similar measurements" (Ford 1975, p. 324) and is usually tested by replication. According to Lincoln and Guba (1985, p. 316) "since there can be no validity without reliability, (and thus no credibility without dependability), a demonstration of the former is sufficient to establish the latter."	Lincoln and Guba 1985	Morse et al. 2008
Consistency	Consistency (along with stability and predictability) is a key concept underlying reliability. Consistency can be interpreted as "a concept that embraces elements both from stability (implied by reliability) and from trackability required by explainable changes in instrumentation."	Guba 1981, p. 81	Ragin 2006

Criteria	Definition	Sources	Illustrative Examples of Criteria Use
Internal validity	Internal validity can be defined as the extent to which variations in the outcome (dependent variable) can be attributed to controlled variation in an independent variable. Cook and Campbell (1979) define internal validity as "the approximate validity [the best available approximation of the truth or falsity of a statement] with which we infer that a relationship between two variables is casual or that the absence of a relationship implies the absence of a cause" (Cook and Campbell 1979, p. 37)	Lincoln and Guba 1985 Cook and Campbell 1979	Petter et al. 2010
Objectivity	Objectivity denotes intersubjective agreement; if multiple observers can agree on a phenomenon, their collective judgment is considered objective.	Lincoln and Guba 1985 Phillips 1990	Kolbe and Burnett 1991
Inventiveness	"The inventiveness of the designer lies in a natural or cultivated and artful ability to return to those placements and apply them to a new situation, discovering aspects of the situation that affect the final design" (Buchanan 1992, p. 13).	Buchanan 1992	Brumec 1997
Innovativeness	Innovation requires "inventive leaps of generative reasoning" which facilitates trial and error that is crucial to creative resolution" (Martin 2009b, p. 147).	Martin 2009b	Lovelace et al. 2001
Originality	Originality results from the "willingness to experiment, spontaneity in response to a novel situation, and openness to trying something different than perhaps first planned or intended" and describes that it requires openness to the process of experimentation, trial and error and iterative prototyping (Martin 2009a, p. 166).	Martin 2009a	Pieters et al. 2002

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