3-1-2005

Lessons that Action Research Offers to Design Science in Information Systems

Santa Susarapu
susarapusr@vcu.edu

Alan Lee

LESSONS THAT ACTION RESEARCH OFFERS TO DESIGN SCIENCE IN INFORMATION SYSTEMS

Santa R. Susarapu
Virginia Commonwealth University
susarapusr@vcu.edu

Allen S. Lee
Virginia Commonwealth University
allenslee@alum.mit.edu

Abstract

The cyclical nature and other features of action research can support and strengthen design science. Design science can take advantage of some features of action research where this would help to resolve the rigor-relevance dilemma. We offer a research framework that takes the features of theoria and praxis from a specific form of action research (dialogical action research) and transfers them to design science. The framework leads to lessons that action research offers to design science.

Keywords: *Action Research, Design Science, Information Systems, Philosophy of Science, Relevance, Research Methodology, Rigor.*

Introduction

The relevance of research in any scientific field refers to the practical or real-world applications of the theories that it develops. The academic discipline of information systems (IS) has long been striving to be regarded as a rigorous, scientific field; however, the rigor of its research does not necessarily guarantee that it has any relevance.

Benbasat and Zmud (1999) have provided a well articulated and widely accepted statement of the rigor-relevance dilemma. Briefly, it refers to the dynamic where enhanced rigor in IS research is accompanied by diminished relevance of the research, and where enhanced relevance in IS research is accompanied by diminished relevance of the research. They note that one consequence of this dynamic is that IS practice tends to lead academic research in IS. Equivalently stated, IS academicians end up chasing the practitioner world rather than leading it, which leads to the harmful result in which there is a lack of a cumulative IS research tradition.

Action research and design science have recently been gaining greater prominence in IS research. For instance, the journals *MIS Quarterly* and *Information, Technology and People* have recently published special issues devoted to action research. Also, *MIS Quarterly* has recently published a major article on design science whose authors include influential senior scholars in the IS field (Hevner, March, Ram, and Park, 2004).

Action research, in joining scientific research with real-world practice, offers one approach to resolving the rigor-relevance dilemma. Design science, in explicitly making practical problems the motivation for its rigorous research, also offers an approach to resolving this dilemma. Action research potentially offers lessons to design science, just as design science potentially offers lessons to action research. We will examine the former in this essay. However, because both types of lessons are important, an examination of the latter is also required, and therefore will receive attention in future research.

Action research and design science each pursue relevance in its own way. The gist of this essay follows from the premise that the different approaches taken by action research and design science can be joined so as to provide a promising way of approaching and possibly resolving the rigor-relevance dilemma. In this spirit, we will propose a framework that infuses some of the activities of action research into design science, where the framework can also help us in identifying the lessons action research offers to design science.

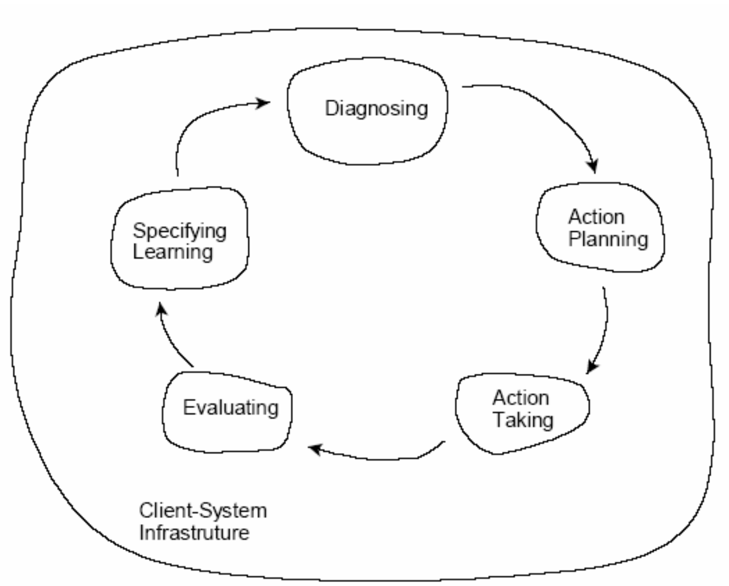
The next section provides brief descriptions of action research and design science along with our proposed framework. In the third section of the essay, we describe some general lessons that action research offers to design science from the perspectives of *theoria* and *praxis*. The last section provides concluding remarks.

Framework

Action Research

The concept of action research can be traced back to Kurt Lewin, who was interested in it for the purpose of solving social problems. Action research has evolved into diverse forms over the last few decades. However, even across most forms of action research, there is recognition of the cyclical nature of action research and recognition that the cycle includes one or another rendering of these activities: diagnosing, action planning, action taking, evaluating, and specifying the learning. Figure 1 embodies the action research cycle, which is taken from the work of Baskerville (1999).

Figure 1. The Action Research Cycle (This diagram is quoted from Baskerville 1999)



The different forms of action research reflect different epistemological and methodological assumptions. For example, in the form of action research that is known as *dialogical action rese*arch (Mårtensson and Lee 2004), the scientific researcher and the real world practitioner interact in periodic, one-on-one meetings situated away from the practitioner's setting. They engage in dialogue in which the scientific researcher steps into the world of the practitioner and, in that world, suggests possible actions for the practitioner to take. These suggested actions follow from the expertise of the scientific researcher, who intends the actions to ameliorate or solve the problems facing the practitioner. However, it is the practitioner and the practitioner alone who returns to the organization to apply the action, which the practitioner has already come to understand on his or her own terms.

Design Science

In the rendering of design science by March and Smith (1995), design science involves the creation of instantiation of artifacts, where the building and evaluating of the artifacts precede the scientific articulation of underlying constructs, models and methods. March and Smith also refer to Simon (1981) who states that design is the core of all professional training and design science is primarily concerned with devising artifacts with which real-world practitioners can attain goals and solve problems; this involves what Simon calls the interface between the inner environment and the outer environment. Figure 2 illustrates the design science research framework advanced by March and Smith (1995).

Figure 2. Research framework in Design Science (This diagram is quoted from March & Smith, 1995)

Research Activities

Research Outputs		Build	Evaluate	Theorize	Justify
	Constructs				
	Model				
	Method				
	Instantiation				

In this framework, March and Smith define *constructs* as the "vocabulary of a domain" that is used to describe the problems and to specify their solutions, *model* as a "set of propositions or statements expressing relationships among constructs," *method* as "a set of steps (algorithms or guidelines) used to perform a task", and *instantiation* as "a realization of the artifact in its environment." Essentially a design scientist builds and evaluates the artifacts that, once sufficiently perfected, can be used by practitioners to achieve certain goals in the real world (Simon 1996). The success or failure of the artifact, as built and designed, gives feedback to the design scientist.

Simon (1996) also points out that the designing of artifacts depends heavily on the tacit and intuitive knowledge of the designer. However, it is the design of artifacts that distinguishes design science from the natural sciences and the social sciences; design presumes intervention in the real world, while the natural and social sciences would consider this to be a form of contamination of the subject matter. Moreover, in design science research, the artifacts are built and evaluated by the design scientist so that good designs (i.e, designs that allow the building of artifacts that can help practitioners to solve problems or perform other tasks) are developed and can be subsequently implemented by practitioners.

Schön (1983) provides a good example of what we are calling "design scientists" who do action research. He observed engineering students who were trying to solve a real-world problem in an existing manufacturing process for a certain type of firearm. The engineering students modified their initial research approach after learning from their first round of mistakes. They then improved their understanding of the manufacturing process and designed an improved, successful process. They were also able to replicate the improved, successful process.

Proposed Framework

Some features of action research can be appropriated, and strengthened, by design science. First, so as to explicitly identify a role for the practitioner in the March and Smith framework, we recognize that the practitioner's voice can be necessary in the "evaluate" activity of the framework. (In this activity, the practitioner, from his or her own real-world perspective, can inform the scientific researcher about the efficiency and effectiveness of the designed and built artifact, e.g., "does it work?" and "how well does it work?"). Second, so as to incorporate the cyclical nature of action research, we extend March and Smith's design-science research activities of build, evaluate, theorize and justify by repeating the columns in their table *ad infinitum* (at least in principle). The diagram below indicates this with the three dots (…). Incorporating these two features of action research, the March and Smith framework for design science becomes:

Table 1. Proposed Framework

	Empirical Work$_1$		Theoretical Work$_1$		Empirical Work$_2$		Theoretical Work$_2$		…
	Build$_{1.1}$	Evaluate$_{1.2}$	Theorize$_{1.1}$	Justify$_{1.2}$	Build$_{2.1}$	Evaluate$_{2.2}$	Theorize$_{2.1}$	Justify$_{2.2}$	…
Scientific Researcher (theoria - scientific attitude)									…
Practitioner (praxis - natural attitude)	N/A		N/A	N/A	N/A		N/A	N/A	…

The scientific researcher engages in the following. In the build and evaluate activities, the scientific researcher applies and empirically tests his or her theory, as postulated in the previous cycle. However, in the first cycle, the scientific researcher brings to bear a theory or theories already accepted in his or her discipline; these theories inform the building of the artifact. The scientific researcher regards the results of the evaluation of the artifact as involving evidence that confirms or disconfirms his or her theory. If the scientific researcher considers the evidence to disconfirm her theory, then he or she must improve and replace it (this is the "theorize" activity) and then assure that it will be ready for subsequent empirical testing (this is the "justify" activity, where the empirical testability or falsifiability and the internal logical consistency of the theory are established)..

While the scientific researcher may be required to perform both the empirical work and the theoretical work, there is no need or reason for the practitioner to participate in activities pertaining to the scientific researcher's theoretical work, as the practitioner's interest and expertise are practice oriented. This results in the cells that are marked as N/A in the above diagram. A strength of this research framework lies in the fact that it recognizes and adopts the distinction between *theoria* and *praxis*, which are taken from Mårtensson and Lee's framework (2004) for action research. They define theoria as "scientific attitude which refers to the body of knowledge (academic theory, research literature) and manner of reasoning that characterize the thinking of Ph.D.-trained social scientists as scientific, whether they subscribe to positivist, interpretive, or critical research approaches." They define praxis as pertaining to the "natural attitude which refers to the body of knowledge and manner of reasoning (common sense and tacit knowledge) in use by a member of a naturally occurring (i.e., not created by an outside researcher) organization, society, or other social unit." If research is conducted using the extended March and Smith framework, theoria would guarantee rigor and praxis would guarantee relevance.

In the "build" activity, as depicted in the following table, the scientific researcher builds an artifact using a design based previous research theory or theories, T_1. In the subsequent "evaluate" activity, the scientific researcher judges whether the theory has survived the empirical testing (A) (see Table 2) and whether the theory has better explanatory power than previous theories (B). If testing shows the relative explanatory power of T_1 not to be satisfactory, the scientific researcher comes up with a new theory T_2 (this is the "theorize" activity) which would then need to be made to be logically consistent (C) and empirically testable (D) (this would be the "justify" stage). Again, the research enters the next cycle, where the scientific researcher builds a new artifact using a design based on her new or improved theory.

The practitioner engages in the following. In the "evaluate" activity, the practitioner uses his or her own expertise and tacit knowledge to evaluate the usage of the artifact with respect to effectiveness (i) and efficiency (ii). The practitioner's participation in the activity of evaluating also helps to ensure that the intervention, involving the designed artifact, is performed at the right time and in the right manner. It would be possible for the theory to be confirmed, but the artifact to be ineffective ("it does not work") or inefficient ("it does not work well").

For both the scientific researcher and the practitioner, the four activities of build, evaluate, theorize, and justify should be repeated until a satisfactory theory and a successful artifact have been found

Table 2. Proposed Framework with a generic example

	Empirical Work$_1$		Theoretical Work$_1$		Empirical Work$_2$		Theoretical Work$_2$	
	Build$_{1.1}$	Evaluate$_{1.2}$	Theorize$_{1.1}$	Justify$_{1.2}$	Build$_{2.1}$	Evaluate$_{2.2}$	Theorize$_{2.1}$	Justify$_{2.2}$
Scientific Researcher (Theoria-scientific attitude)	Build empirical test or experiment for theory T_1	Evaluate theory T_1 based on (A) survival of empirical testing (B) relative explanatory power	Based on evaluation results, come up with a better theoretical explanation (T_2)	T_2 must be justified based on (C) logical consistency (D) empirical testability	Build empirical test or experiment for theory T_2	Evaluate theory T_2 based on (A) survival of empirical testing (B) relative explanatory power	Based on evaluation results, come up with a better theoretical explanation (T_3)	T_3 must be justified based on (C) logical consistency (D) empirical testability
Practitioner (Praxis-natural attitude)	N/A	Evaluate practitioner's interventions, using the artifact, based on i) effective-ness ii) efficiency	N/A	N/A	N/A	Evaluate practitioner's interventions using the artifact, based on i) effective-ness ii) efficiency	N/A	N/A

What general lessons does AR offer to DS?

The first lesson that action research has for the design science is the cyclical nature of research. The feature of cyclical research would require design-science research to loop back to the theory-related lessons learned in the previous cycle, thereby leading to the formulation of a better theory, from which could follow a better design.

The second lesson that action research has for design science is that the expertise of the design-science researcher can be introduced to the world of the practitioner, just like the expertise of the scientific researcher in action research. This requires the design-science researcher to involve him/herself with the real-world work of the practitioner – which is no easy task. This would allow the practitioner's praxis to be present so as to influence the design-science researcher's theoria.

The third lesson that action research has for design science is that the design-science researcher can work with the practitioner so as to ensure that the practitioner understands the designed artifact and uses it in the way intended by the design-science researcher.

The fourth lesson that action research has for design science is the explicit recognition that no theory ever takes a finalized form. A theory is always subject to a new empirical test in the future, and therefore always has the potential to be improved. Just as no theory is final, no design is final.

Concluding remarks

Action research can offer helpful lessons to design science that would ensure the relevance of scientific research. The implementation of the research framework proposed in this essay promises to make IS research not only more relevant but also sufficiently rigorous so as to ameliorate the rigor-relevance dilemma. Space limitations have prevented not only the illustration and expansion of the research framework in more detail, but also the identification of lessons that design science can provide to action research. The expansion of the framework will be considered in future research possibility.

References

Baskerville, R. L. (1999) Investigating Information Systems with Action Research. *Communications of AIS* 2(19), 1-31.

Benbasat, I. and Zmud, R. W. (1999) Empirical Research in Information Systems: The Practice of Relevance. *MIS Quarterly* 23(1), 3-16.

Hever, A. R., March, S. T., Ram, S. and Park, J. (2004) Design Science in Information Systems Research. *MIS Quarterly* 28(1), 75-105.

March, S. T. and Smith, G. F. (1995) Design and Natural Science Research on Information Technology. *Decision Support Systems* 15(4), 251-266.

Mårtensson, P. and Lee, A. S. (2004) Dialogical Action Research at Omega Corporation. *MIS Quarterly* 28(3), 507-529.

Schön, D. A. (1983) *The Reflective Practitioner: How Professionals Think in Action*, New York, Basic Books.

Simon, H. A. (1981) *The Sciences of the Artificial* (2nd Edition), Cambridge, Mass., MIT Press.

Simon, H. A. (1996) *The Sciences of the Artificial* (3rd Edition), Cambridge, Mass., MIT Press.