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Applying Seven Images of Science in Exploring whether Information Systems Is a Science

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Abstract:

This paper contributes in two parts to a debate that McBride (2018) initiated. The first part focuses on clarifying the discussion topic. It defines science, information system, and the scope of the IS discipline because McBride does not define those terms clearly. The second part responds to particular aspects of McBride's arguments. It is framed around a multi-metaphor approach that proposes and applies seven "images of science".

Keywords: Information System, Science, Knowledge, Knowledge Object.

This manuscript was solicited by the Department Editor for Debates, Karlheinz Kautz.

1 Why Should I Care Whether Information Systems is a Science?

When invited to comment on McBride's (2018) paper "Is information systems a science", my first reaction was to wonder whether I cared. The question initially mattered to me roughly as much as whether the following areas of study whose names say they are sciences actually qualify as "sciences": computer science, information science, system science, data science, service science, management science, decision science, communication science, design science, Web science, and library science, not to speak of social science, behavioral science, and administrative science. Also, I wondered whether this debate would mostly rehash decades-old inconclusive discussions about the crisis in the information systems (IS) discipline, the boundaries of the discipline, the questionable value of research results, the excess or lack of rigor, and lack of impact in the world of practice.

Thanks for the initiative: I want to thank McBride (2018) for starting a debate about a topic that I found more interesting as I struggled with it. Thinking about some of his arguments—and especially his points related to the importance of narrative—led to personal insights about my own research.

Difficulties deciding how to respond: personal insights notwithstanding, my overall impression is that McBride (2018) generalizes too much from a subset of IS research that he dismisses as basically useless and unscientific because it cannot capture the complexities of human behavior in the IS context. Overall, I think that difficulty capturing complexities of human behavior is not sufficient evidence that IS is not a science. Also, I think that many papers published in the Senior Scholar's basket of eight and other journals in the last several years are interesting, valuable, and even scientific.

On first reading McBride's (2018) paper, I enjoyed the passion that propelled his arguments but also believed that some of my friends and colleagues would dislike having their preferred research approaches disparaged. In terms of content, I agreed strongly or mildly with some points, found other points somewhat or quite exaggerated, and knew of counterexamples to some of the paper's assertions. Further, I did not know whether some parts reflect a personal, idiosyncratic view of what science is or agreement or disagreement with other views of what science is.

Also, while rejecting pretensions of "scientism", McBride (2018) uses a maneuver that is surprisingly common in published IS research: making an extended argument without defining the central terms. Specifically, he does not define information systems, the topic of study in the IS discipline. He does not explain the scope of the IS discipline. His definition of science, which appeared tangentially at the end of a paragraph, disagrees with many dictionary definitions and would seem wrong to many scientists: "a study of deterministic, natural phenomena that can be measured and theorized in the same way as environmental ecology or quantum physics" (p. 165). That definition would disqualify archaeology and paleontology. Perhaps worse, it would disqualify physics, a quintessential science in the view of physics envy (Clarke & Primo, 2012) sufferers due to the role of probabilities in quantum mechanics and the Heisenberg uncertainty principle.

Defining terms and then applying seven images of science: this paper contributes in two parts to a debate that McBride (2018) initiated. The first part focuses on clarifying the discussion topic. It defines science in relation to knowledge objects (to be defined), defines information system, and describes the scope of the IS discipline. The second part responds to particular aspects of McBride's arguments. It is framed around a multi-metaphor approach that proposes and applies seven "images of science". These images mirror the spirit of Morgan's (1986, 2011) images of organizations: machine, organisms, brains, cultures, political systems, psychic prisons, flux and transformation, and instruments of domination. The proposed images of science could be improved and developed further in the future.

This short response cannot review the philosophy and history of science, nor can it even do justice to the many definitions of science and knowledge. It can present the results of searching for "images of science" in Google Scholar, however. Those searches found sources that mention "images of science" in isolated sentences but did not find published attempts to develop a Morgan-like framing of multiple competing images of science. Perhaps someone should develop that idea, which I only introduce here.

2 Basic Concepts for Discussing whether IS Is a Science

McBride's (2018) discussion of whether IS is a science exhibits what one might view as an unscientific failure to define basic terms and an equally unscientific reliance on emotive terms such as "positivist veneer", "scientific purism", "illusion of scientific accuracy", "pseudo-scientific paradigm", "veneer of objectivity", "illusion of scientific activity", abstraction (of social or organizational phenomena) as leaving us with "a bleached skeleton", "belief in scientism", and "the parody of information systems as a science". While I genuinely sympathize to some degree with some of those ideas (4.264 +/- 1.68 on a seven-point Likert scale), I focus on establishing a veneer of objectivity by characterizing the nature and scope of knowledge in general and defining information system and science. The following characterizations surely are not standard, but at least they clarify what I mean.

2.1 Knowledge, Knowledge Objects, Bodies of Knowledge, the Definition of IS, and the Domain of the Discipline

Considering only explicit knowledge that one can codify and reuse (e.g., not tacit knowledge such as how to run or eat lunch), knowledge comprises unitary or aggregated knowledge objects that may be abstract or non-abstract (see Figure 1). Non-abstract knowledge objects include information, examples, and stories. Abstract knowledge objects include vocabulary, generalizations, practices and methods, and other conceptual artifacts (Bereiter, 2005). Conceptual refers to:

> *Discussable ideas, ranging from theories, designs and plans down to concepts, like unemployment and gravity. Artifact conveys that these are human creations and that they are created for some purpose. …Conceptual artifacts have origins and histories; can be described; can be compared with other artifacts; have varied uses; can be valued or judged worthless; may be modified or improved upon; may have unforeseen attributes, uses or defects that may be discovered; and may be understood and used differently by people with different levels of skill.* (Bereiter, 2005, p. 65)

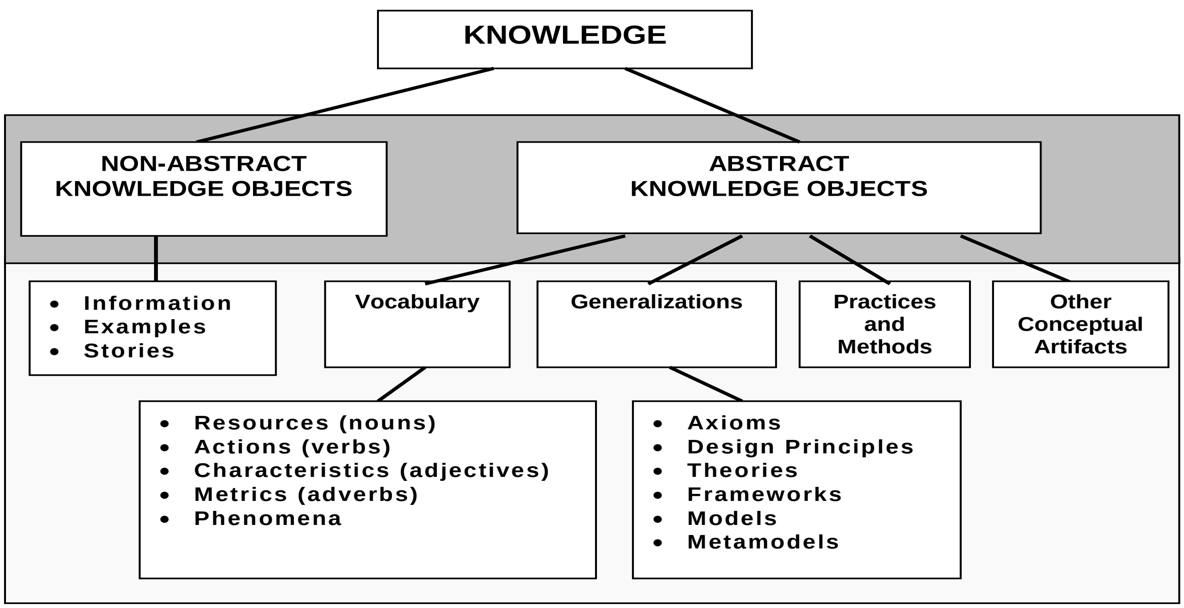

Figure 1. Categorization of Knowledge Objects Relevant for Information Systems (Adapted from Alter, 2017a)

Body of knowledge (BoK): a BoK refers to an organized accumulation of knowledge objects related to a particular field of study.

Definition of information system: Alter (2008, pp. 449-450) quotes 20 definitions of IS that range from largely social to largely technical. Largely social definitions of IS imply ideas that are implausible for largely technical systems and vice versa. I prefer the following definition of IS, which covers both sociotechnical and totally automated IS.

An IS is a work system all of whose activities focus on capturing, storing, retrieving, transmitting, manipulating, and/or displaying information. A work system is a system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific product/services for internal or external customers. The "and/or" in the definition permits both sociotechnical and totally automated IS (Alter, 2013). Many information systems are integral parts of work systems that they support—analogous to how a brain or heart is an integral part of a human body.

Domain of the IS discipline: the IS discipline's domain is the systems and phenomena that it studies. In practice, that domain extends beyond information systems per se just as a complete study of the brain needs to consider the circulatory system. It is not obvious how far the domain of IS should extend. For example, Alter (2003) argues that Benbasat and Zmud's (2003) proposal to focus more tightly on variables intimately related to the "IT artifact" creates unnecessary limitations and provides few of the benefits of an alternative vision centered on "systems in organizations".

McBride's (2018) failure to define information system plus his idiosyncratic view of the IS discipline complicate assessing his arguments related to whether IS is a science. He comes the closest to defining the IS discipline's domain in stating: "To study information systems is to study the complex interactions and networks that bind together complex societies and that enable economic activity both on a personal and global scale" (p. 171). That view of the domain may describe McBride's personal interests, but it surely does not cover many of the research topics discussed in tracks at ICIS, ECIS, AMCIS, and PACIS. Seeing complex social systems as the complete domain of the IS discipline treats some or all of the work of a majority of the members of the IS community (including me) as not part of the discipline. Also, that view of the discipline's domain is increasingly less satisfactory due to the increasing automation of important parts of real-world systems, trends toward subdividing and outsourcing work, supply chains that cross business ecosystems (e.g., Winter, Berente, Howison, & Butler, 2014), the Internet of things, cognitive computing, blockchain, personal and mandatory use of apps, and so on.

2.2 Definition of Science

A search on "definition of science" finds a variety of definitions, only some of which would permit the possibility that IS is a science. IS might qualify under definitions that refer to the natural and social world but would not qualify under definitions that mention only the natural world. Whether IS would qualify under definitions that emphasize an organized body of knowledge (BoK) depends on whether one believes that IS has or could have an organized body of knowledge. The remainder of this paper adopts the following idiosyncratic definition that uses the concept of knowledge object, covers natural and social systems, and includes topics that other definitions ignore or deemphasize.

> *Science is the creation, evaluation, accumulation, dissemination, synthesis, and prioritization of knowledge objects, including the reevaluation, improvement, or replacement of existing knowledge objects by other knowledge objects that are more effective for understanding important aspects of the relevant domain.*

Table 1 uses the format of a work system snapshot (Alter, 2013) to look at this definition in more detail. Starting at the bottom left, it says that participants in science include individual scientists or groups of scientists, the relevant scientific community, and others. Their major activities and processes include learning, identifying gaps, deciding how to perform research, performing research, and so on. Those activities produce new knowledge objects within or outside of the domain (see Weick's (1995, p. 385) related comments about theorizing). Those activities also include a synthesis or evaluation of existing knowledge objects and an updating, re-evaluation, retirement, and/or repudiation of obsolete knowledge objects. The beneficiaries (customers) include the scientific community, the participating scientists themselves, and other stakeholders.

The attempt to define IS, the domain of IS, and science, plus the elaboration of the definition of science in Table 1 start to provide a basis for evaluating McBride's (2018) assertion that "one cannot pitch it [IS] as a science" (p. 163). The content of the thousands of research publications that the IS research community has produced conforms to varying extents to the definitions of those terms and to the representation of science in Table 1. Someone might use those ideas to code a large sample of past research (e.g., selected papers in the Senior Scholars' basket of eight journals between years 19XX and 20YY) to characterize the extent to which published IS research qualifies as science. Aside from absorbing a lot of effort with little obvious benefit to mankind, many editors and reviewers would probably encourage researchers to exhibit the same underemphasis on ideas and overemphasis on quantification that McBride laments.

Table 1. Elaboration of a Proposed Definition of Science in the Format of a Work System Snapshot

Customers	Products/services
• Scientific community whose BoK is expanded by the new knowledge objects • Scientists whose reputations and resumes are expanded by publications • Other stakeholders who use knowledge from the domain or product/services based on that knowledge	• New knowledge objects within or outside of the domain • Synthesis or evaluation of existing knowledge objects • Updating or reevaluation of existing knowledge objects • Retirement or repudiation of obsolete knowledge objects

Major activities and processes
• Scientists learn the existing knowledge of the subject and relevant methods of science • Scientists identify gaps in existing knowledge or opportunities to develop new knowledge • Scientists decide how to produce new knowledge objects that will reduce the gaps in existing knowledge or will address the opportunities to develop new knowledge • Scientists perform research to create and evaluate new knowledge artifacts • Scientists disseminate scientific findings • Scientists re-organize and re-prioritize new and previously existing knowledge objects • Scientists replace or repudiate existing knowledge objects that are seen as invalid or irrelevant. • Scientists train other scientists to join the community studying the domain. • Other contributors who may not be scientists contribute in a wide variety of ways

Participants	Information	Technologies
• Individual scientists or groups of scientists • The relevant scientific community • Others who contribute to knowledge • People who are subject to study in some sciences	• Existing knowledge objects • Gaps in existing knowledge • Intuitions, guesses, theories, and other ideas that help scientists decide what research to pursue and how to do it	• Technologies used in performing research • Dissemination technologies that make existing knowledge objects available • Search technologies that help in finding knowledge objects

3 Applying Seven Images of Science to Consider whether IS is a Science

McBride (2018) says “that the view that information systems is a science in which general laws can be developed by applying statistical surveys and running laboratory experiments has negatively affected the development of the discipline. I argue that the discipline’s nature is such that one cannot pitch it as a science.” (p. 163).

This section’s response to McBride (2018) is organized around seven images of science, which Table 2 shows along with comments about related scientific challenges for the IS discipline. The seven images provide a way to isolate and consider specific ideas that McBride expresses. The comments for most of the images include relevant quotations from McBride and, in some cases, illustrate relevance to my research. In addition to introducing seven images of science that might be developed further, this section shows that McBride touches on many important problems and issues but that he might have etched the entire discussion more clearly if he had organized it in a more explicit way and used simpler rhetoric.

Table 2. Scientific Challenges for the IS Discipline related to Seven Images of Science

Image of science	Related scientific challenges for the IS discipline
1) Searching for enduring truths	Difficulty of identifying enduring truths or principles in IS due to the wide diversity of situations, multiplicity of variables, human variability, errors and accidents, continual change, and implausibility of replicating findings that rely on IT capabilities and/or IT-related norms and expectations that change rapidly over time.
2) Adhering to scientific method(s)	Recognizing that different methods are useful for different questions in different settings. Recognizing that methods often should not be followed literally and need to be adapted to the question and setting. Recognizing that methods are about doing research rather than packaging research to make it seem legitimate even though the research activities may not have followed the method completely. Overcoming groupthink and genuinely encouraging consideration of new ideas that may be valid even though they do not fit into established formulas or research methods (e.g., Burton-Jones, McLean, & Monod, 2015; Grover & Lyytinen, 2015).
3) Producing useful knowledge	Producing non-obvious knowledge that researchers and/or practitioners can use. Not just pretending that researchers or managers should be interested, and not confusing statistical significance with importance, especially for barely noticeable differences that seem statistically significant due to a sufficiently large sample size.
4) Linking abstraction and quantification	Defining abstractions clearly and explicitly; specifying the domain to which the abstraction applies most directly versus other areas where it might be marginally relevant and yet others where it is irrelevant. Explaining how data analysis supports specific abstractions. Identifying and casting doubt on situations where claims of significance for barely noticeable effects rest on complex statistical argumentation related to inherently imprecise variables such as opinions.
5) Advancing incrementally	At a time when IT, IT applications, and real-world practice are changing rapidly, devoting too little bandwidth to developing new ways to understand current and future topics and issues and devoting too much bandwidth to looking backward via classifying and analyzing previous research publications.
6) Establishing a body of knowledge	Difficulty organizing and updating knowledge at different levels of description in a discipline that covers diverse topics, many of which are changing rapidly. Difficulty explaining why data and conclusions related to one or more situations with certain characteristics pertain to situations in which only some of those characteristics apply.
7) Pursuing creative destruction	Creating new ideas and/or empirical results and demonstrating how those ideas and/or results supersede existing knowledge. Identifying existing knowledge that has become obsolete and replacing it with more relevant and useful knowledge. Assuring that the content of research publications is clear enough to recognize when that content has been superseded or has become obsolete.

3.1 Image 1: Searching for Enduring Truths

McBride (2018, p. 169) seems to reject the possibility that IS could have scientific laws:

> *What underpins the ideology of information systems as science is a materialism that views quarks, genes, organizations, and social systems as one and the same thing: one view, one lens, one method of explanation; a world underpinned by a physical theory of everything that explains all phenomena from Valentine's Day to vacuums.*

I have a different view that is unrelated to quarks, genes, or vacuums and also pursues a particular line of thought without assuming that only one lens or method could be useful. I think that it might be possible to identify basic ideas that probably applied in the past and that might endure for at least a while. After learning about axioms of service-dominant logic that Vargo and Lusch (2016) propose, I tried to identify basic ideas in the form of "axioms" that are meant to apply to all work systems and, hence (by the definition of IS in Section 2.1), to all IS (Alter, 2016, 2017b). An IS axiom refers to a statement that is assumed to be true for every IS and that can be challenged by providing a relevant counterexample. For example, one of 25 axioms in the most recent list says that an IS operates with the espoused intention of facilitating or producing beneficial outcomes for at least one beneficiary. In isolation, that axiom might seem obvious, but, in combination with other axioms, it might provide a starting point for new types of systems analysis and design methods and tools. I do not know whether McBride would see the validation or rejection of these axioms as science or whether he would agree with my belief that some form of positivist or interpretivist research might test them individually or in combination.

McBride (2018, p. 168) seems to argue that IS fundamentally concerns human behavior and seems to question whether a science of human behavior could exist:

> *If there is a science of human behavior, which is what some information systems researchers seem to be pursuing, it would need to omit all reference to intention, purpose, and reason (MacIntyre, 1981, p. 83) because such quantitative research would be examining deterministic cause-and-effect phenomena—natural interactions devoid of human free will and without purpose. Scientific fact must be value free, but in information systems it is not. As such, information systems researchers try to create an edifice of intention and purpose that is unsustainable and will inevitably crash to the ground.*

The above quotation combines questionable or misleading ideas. For example, I do not see how studies of IT-supported decision making or communication necessarily omit "all reference to intention, purpose, and reason" in the situations they study.

Elsewhere, McBride (2018, p. 164) says that "much research now revolves around technology adoption", and that this evolution avoids "negotiating the rapids of technological and social change". McBride correctly notes that rapid technological change challenges the possibility that IS research could provide enduring truths related to IT. Alas, for Orlikowski and Iacono's (2001) call to increase the presence of the "IT artifact" in IS research, almost any search for enduring truths that involves functions or features of recognizable IT artifacts would collide with rapid changes in both IT capabilities and societal norms and expectations about using IT. For example, assume the world's best researchers tried to produce enduring truths about IT-mediated communication just 20 years ago when some of today's IT functions and features were barely imaginable.

3.2 Image 2: Adhering to Scientific Method(s)

McBride (2018) questions whether IS is amenable to scientific practices such as experimentation and replication that often are viewed as hallmarks of proper science: "Using a laboratory situation gives a false sense of comfort that one has isolated something social and can examine it under controlled conditions. Additionally, one needs to recognize that laboratories are social environment, which adds further layers of social complexity." (p. 166). And, earlier, he notes: "are we so deluded as to expect such replication in the IS discipline where 'the object of study, humans, have free will and a diversity of automatic subconscious responses' (Dennis & Valacich, 2014)" (p. 165).

I have many doubts about the value of replication research in situations that rely significantly on IT capabilities and/or IT-related norms and expectations that change rapidly over time. I also doubt the value of laboratory experiments whose subjects and social situations are far distant from the real-world situations they purport to represent. On the other hand, appropriate laboratory experiments can be meaningful and valuable. Some of my colleagues performed a carefully designed study (Bolloju, Alter, Gupta, Gupta, & Jain 2017) to determine whether producing a work system snapshot (work system description in the format of Table 1) would help undergraduate students learn the scrum method for agile software development. The authors divided graded assignments that they collected from 160 undergraduate students into a treatment group and control group and found that the students in the treatment group produced fewer erroneous user stories. The authors clearly emphasize that the results come from students and note the importance of doing related research with IS professionals. The result was a step forward in research related to an important topic: improving the efficiency and effectiveness of agile development. I do not know whether McBride would view this research as unduly positivist since it featured several hypotheses that the authors tested. In that instance, hypothesis testing provided a readily understandable way to explain potentially useful results. Also, based on his definition of the IS discipline (see Section 2.1), I am not sure whether he would believe this experiment belongs in the IS discipline or elsewhere, such as in software engineering.

3.3 Image 3: Producing Useful Knowledge

McBride (2018) questions the usefulness of positivist IS research: "[Is the IS community pursuing] a scientific purism that is neither useful to practitioners nor philosophically justifiable?" (p. 164). A comment regarding an example states: "such a study masks the complexity of the information systems discipline and limits the practical use of such research" (p. 166).

Figure 1, included here as a starting point for identifying IS research that produces useful knowledge, shows that (useful) knowledge includes both information such as observations and stories and abstractions such as theories and models. Natural science and medicine have many examples of useful non-abstract knowledge (e.g., databases of drug interactions) and abstract knowledge (e.g., the periodic table of elements). In the world of IS, an example of useful non-abstract knowledge is a detailed account of many different types of IS workarounds that occurred in a hospital setting (Koppel, Wetterneck, Telles, & Karshm 2008, p. 408). Aside from being useful to both researchers and practitioners, that account and several hundred other accounts of varying quality found through Google Scholar formed the basis of an abstract knowledge object, a theory of workarounds that focuses on explaining how workarounds occur (Alter, 2014) and that many authors have cited in just a few years. Neither the compilation of workaround experience nor the attempt to theorize about workarounds was an exercise in scientific purism. Both were meant to be useful, and I think they have succeeded thus far.

Narrative: looking at an important aspect of useful knowledge, McBride (2018, p. 169) suggests "that information systems research would benefit from a return to the primacy of narrative. Even in the most concentrated quantitative studies, the value emerges in the narrative, in the resulting story.". At other points, he adds that "narrative should form the heart of efforts to not only present information systems phenomena but also develop understanding and explore context" (p. 169), that "narratives offer an immersion, involvement, and engagement with the world" (p. 170), that they "constitute a fundamental way of learning…[and] provide a platform for discovering and documenting wisdom" (p. 170), and that "such narratives can be distilled into proverbs, guidelines, and commentaries that encourage and enable wise behavior in difficult organizational situations" (p. 170).

McBride's (2018) emphasis on the primacy of narrative resonated strongly with me in an unexpected way. Previously, I had not thought about the possibility that both examples and abstractions related to IS provide a basis for narratives that researchers or business professionals might produce. Every type of knowledge in Figure 1 becomes useful when it helps someone tell a story that matters. That realization is relevant to most of my research, which has focused on developing and organizing ideas and methods that help people tell understandable and actionable stories about issues, opportunities, and possibilities related to systems in organizations. McBride's emphasis on narrative parallels Ramiller and Pentland's (2009, p. 474) argument that variables-centered research that focuses on "covariance among independent and dependent variables" and "appears to distance researchers from the organizational actors, such as managers, to whom they would give advice and counsel. Particularly disturbing is the systematic erasure of those very actors from the domain of inquiry. Erased, too, are their actions and means of acting".

3.4 Image 4: Linking Abstraction to Quantification

Sciences require both abstraction and quantification. Abstraction makes it possible to accumulate knowledge that is more organized than isolated examples. Quantification provides ways to evaluate theories, principles, or models and other abstractions. While links between abstraction and quantification are important for scientific work, an excess of either may make knowledge objects seem confusing, overly complex, difficult to communicate, and generally not worth the effort. Insufficiencies in either area appear as fuzzy, non-actionable concepts, as abstraction for its own sake, or as numerical information that does not imply action.

Quantification: McBride (2018) uses the term quantification four times. He says that "by overemphasizing quantification, the IS discipline short-changes itself" (p. 171) and that simplification inherent in positivist research "creates manageable quantification and a focus on one aspect of the system" (p. 168). In the premise of a question, he says that "the social and political complexities involved in deploying information systems in organizations and even how individuals use them defy quantification" (p. 169). On the other hand, he recognizes that "conducting science requires quantification (although, in fact, researchers present much of the output of science as narratives and stories that they have developed from interpreting the numbers))" (p. 167).

Whether or not many complexities defy quantification, many real-world situations that involve IS development and use do not defy quantification, such as in using tallies or other simple means to record observable aspects of business situations. For example, aspects of IT usage in social situations can be quantified and related to other quantitative measures (e.g., number of logons that involved workarounds, when those logons occurred, average waiting time of patients who had not yet been served at the time of the logon, and so on). Well-run businesses use this type of information for quality control. I see no reason to disparage quantification in general even though I am quite sympathetic with McBride's (2018) dislike of unnecessarily complex quantification.

Abstraction: McBride (2018, p. 169) seems to see abstraction as a seduction. He states:

> *The IS discipline aspires to be like the physical sciences such that the highest and most pure information systems model will be expressed in mathematical formulae. Abstraction is the prime aim (Midgley, 2002, p. 194). However, that aim dissolves the human, the organizational, and the social and leaves one with a bleached skeleton that is a far cry from the living breathing being and has lost more in description than would ever be gained through "science".*

Bleached skeletons aside, seeing abstraction as the prime aim does not conform to my perception of what most IS researchers either believe or care about:

1) Many IS researchers, including every IS researcher I know well, do not aspire to mimic the physical sciences in their IS research.
2) IS research that I am familiar with, even enterprise modeling research that focuses on models, does not primarily seek abstraction.
3) Abstraction is necessary for most knowledge sharing, especially for knowledge related to practices and principles.
4) Abstraction is necessary for analyzing and designing non-trivial systems.
5) Abstraction makes it possible to teach principles and practices.

In the latter four cases, abstraction is not the purpose but an important means to accomplish important ends. It is hard to imagine accumulating knowledge related to almost any intellectual endeavor without some degree of abstraction.

3.5 Image 5: Advancing Incrementally

A common image of science is a gradual accumulation of knowledge often in small incremental steps that build on prior research. McBride (2018) argues that incremental advances in IS have largely stalled. He cites Stein, Galliers, and Whitley (2015), Lui, Li, and Goncalves, and Kostakos (2016) and Palvia, Daneshvar, and Ghoshal (2015) as documenting troubling convergence rather than expansion in IS research, a drift into a "cul-de-sac" with IS becoming "a side subject that concerns technology adoption" with a "reluctance to pursue new avenues and take a systemic view of information systems as enshrined in the discipline's title" (p. 164).

The recent literature contains related discussions. Grover and Lyytinen (2015) suggest that overemphasis on theory per se leads to unproductive focus on creating and validating uninteresting mid-range theories by using what they call a "mid-range script". They propose expanding the breadth of IS research by including "on the one hand, inductive, rich inquiries using innovative and extensive data sets and, on the other hand, novel, genuine, high-level theorizing around germane conceptual relationships between IT, information and its (semiotic) representations, and social behaviors. (p. 271). Along the same lines as McBride's (2018) comment about the systemic, Demetis and Lee (2016, p. 116) say that "the academic discipline of information systems, in incorporating the word "systems" in its name…needs to take 'systems' seriously". They claim that, with only a few exceptions, the IS discipline "has not availed itself of the rich intellectual heritage of systems science" (p. 116). They propose requirements for systems theories that represent progress in that direction.

McBride (2018) offers several suggestions for breaking out of the cul-de-sac. First, he suggests that IS research "would benefit from a return to the primacy of narrative" (p. 169) as mentioned above. A more radical suggestion proposes "dance studies" as "the sister discipline" of IS (p. 169). Comments about dance and dance studies lead to the following statement: "Thus, we can see that the practice and research of information systems is really the practice and research of dance—whether the formal dance of an organizational and transactional context or the free-flowing abandoned dance of social computing" (p. 170).

Some aspects of McBride's (2018) comments about dance seemed quite interesting to me, but a mashup of dance and IS seems to me a leap too far. McBride and his colleagues might pursue that idea in fascinating ways, but asking even a significant fraction of IS researchers to jump from their current work to focusing on an analogy with dance seems implausible. I say that as someone who thought about a similar topic several years ago but relegated it to a folder of ideas for future reference. It seems to me that a great deal of the language of classical music performance might be adapted for application to operational systems (tempo, rhythm, attack, crescendo, retard, intonation, mutual adjustment, etc.). I may return to that in the future because I might find some way to apply those ideas to illuminate aspects of information systems.

3.6 Image 6: Establishing a Body of Knowledge

A discipline that is viewed as a science tends to have some version of an organized body of knowledge (BoK) that at least specifies its basic ideas and generalizations. McBride (2018) seems more concerned with limitations of individual scientific contributions rather than with the accumulation or dissemination of knowledge related to IS.

IS researchers have noted that establishing a BoK presents a significant challenge for the IS discipline (e.g., Hirschheim & Klein, 2003; Iivari, Hirschheim, & Klein, 2004). IS textbooks and AIS curriculum guides constitute steps in that direction—similarly for collections of useful papers from various viewpoints (e.g., vom Brocke & Rosemann, 2010). The most thorough effort that I am aware of in IS is Hassan and Mathiassen's (2017) attempt to develop an IS development BoK (ISDBoK) by distilling 6,643 papers published in the Senior Scholars' basket of eight through August, 2012, and selecting "940 citation classics, and from that list, 466 ISD articles that offer canonical ISD knowledge distinctive to IS and complementary to other disciplines" (p. 175). I know about that research because I have occasionally worked on a scaffolding for an IS BoK (more or less like a three-dimensional file cabinet for knowledge objects), most recently in Alter (2016). At this point, I have the impression that IS would seem more like a science if it had a reasonably well-accepted body of knowledge that one could convey and teach. However, the lack of agreement about what basic concepts mean presents an important obstacle to producing an IS BoK. For example, given the lack of agreement about what agile development means, it is unclear how one could evaluate the accuracy of the BoK's coverage of agile development.

3.7 Image 7: Pursuing Creative Destruction

The economist Schumpeter (1942) introduced the idea of creative destruction as a fundamental aspect of capitalism whereby product and process innovations continually supplant outdated products and processes. In his epilogue, McBride's (2018, p. 171) proposes steps in that general spirit for IS:

> *Information systems research has stagnated and requires nothing less than a remobilization. This remobilization requires the IS discipline to reject scientism and to stop viewing information systems as a science. It requires the discipline to reposition itself as a social humanity. It requires storytelling, a diversification of modes of expression, a renewed engagement with practices, a widening of the means of dissemination, an explosion of creativity, and of the development of new concepts and new approaches. It requires a serious engagement with philosophy and history and an open and free discussion of philosophical positions. Most of all, I would suggest, it requires an articulation of the political dimension of information systems and an engagement with the power structures that information systems underpin.*

I agree with McBride (2018) that the academic IS discipline would benefit greatly from a remobilization, although I believe his prescriptions are too tightly linked to his idiosyncratic preferences related to topics and methods. I think that most current IS researchers would have great difficulty trying to play on McBride's playing field. For example, the term political appears nine times (e.g., "unpredictable political alliances", "IS as a political discipline", "inherently political", and so on). I agree that political issues are important and sometimes mention them in my research, but I would not suggest that most of the people who attend ICIS try to reconstitute themselves as political analysts or as storytellers.

Even a limited version of conscious creative destruction requires stepping into areas of discomfort. Imagine, for example, a PhD consortium that requires each attendee to identify three concepts or generalizations from the Senior Scholars' basket of eight journals that have become completely obsolete or so unclear that the discipline should retire them. I provide an example in Alter (2015) that argued that the IS discipline should retire the concept of the "IT artifact" because it longer meant anything in particular as demonstrated by completely inconsistent definitions of that term in publications by leading authors. A more ambitious project would involve examining a subset of Hassan and Mathiassen's (2017) 466 articles that offer canonical ISD knowledge (see Section 3.6) to find conclusions and generalizations that seem obsolete and have been superseded by other ideas.

A more general step in that direction would encourage literature review papers to emphasize the question of obsolescence instead of mostly identifying past publications, cataloguing topics, and characterizing differences of viewpoint, emphasis, or methodology. Reviewing for journals should focus more on whether ideas in papers move beyond previous conceptualizations and less on whether they cite all relevant literature. Reviewers should welcome new ideas if authors support them reasonably well and should not reject them when authors do not pretend that they derived their ideas directly from gaps in the literature that they might not have considered when they first felt inspired to do their research.

Creative destruction also might try to redirect the culture of IS in directions that have been discussed many times. We continually say that IS is a fast-moving discipline but seem satisfied with glacial publishing cycles. Even papers that have been accepted for publication languish unseen for many months, which makes it seem that documentation of publication has higher priority than knowledge dissemination.

4 What about the Question: is IS a Science?

Whether IS is or is not a science is an uninteresting question in my view because the answer depends on one's preferred definition of IS and science. It is more valuable to ask about the extent to which IS is a science. The images of science could help in guiding that discussion. Developing and justifying a new or improved set of images and looking at IS through those lenses could provide a deeper and more valuable discussion about directions in making IS both more scientific and more valuable.

If required to propose an objective numerical scale for evaluating IS, computer science, data science, service science, system science, and the other candidates for ISO certification as a science, one might develop a "scienticity index" that quantifies the extent to which IS or any other purported science is a science. Start with the seven proposed images of science or an improved version. Define key terms such as information system to help in clarifying the domain that the discipline covers and the related domains that overlap with it or that are on its periphery. Reduce each image of science to a continuous dimension from 0 to 10 (i.e., from strong no to strong yes). Rate IS or any other certification candidate on each dimension. A linear combination of those ratings would constitute a scienticity rating. Unfortunately, its artificial nature would exemplify McBride's (2018) concerns related to quantification that produces numbers without illuminating meaning and nuance.

In IS, the rating itself would be much less valuable than the deliberations that produce the rating through serious consideration of how IS could be more scientific in relation to each of the images. Careful attention to the relevant domain and central definitions might help in clarifying what is being discussed or might demonstrate that participants in the deliberation about IS as a science are unable or unwilling to use basic vocabulary consistently (e.g., simultaneously using system as a synonym of technology and as an abstraction combining properties from general system theory; e.g., simultaneously saying that an IS necessarily is a sociotechnical system with human participants and also that information systems are used in the same sense that tools and mechanical devices are used). While I have difficulty caring greatly about the yes/no question of whether IS is a science, I hope that the discussion that McBride (2018) spawned will contribute to making the IS discipline more scientific and more valuable.

References

Alter, S. (2003). Sidestepping the IT artifact, scrapping the IS silo, and laying claim to “systems in organizations”. *Communications of the Association for Information Systems*, *12*, 494-526.

Alter, S. (2008). Defining information systems as work systems: Implications for the IS field. *European Journal of Information Systems*, *17*(5), 448-469.

Alter, S. (2013). Work system theory: Overview of core concepts, extensions, and challenges for the future. *Journal of the Association for Information Systems*, *14*(2), 72-121.

Alter, S. (2014). Theory of workarounds. *Communications of the Association for Information Systems, 34*, 1041-1066

Alter, S. (2015). The concept of “IT artifact” has outlived its usefulness and should be retired now. *Information Systems Journal*, 25(1), 47-60

Alter, S. (2016) Principles for “purposefully constructed activity systems”—a step toward a body of knowledge for information systems. In *Proceedings of the International Conference on Information Systems*.

Alter S. (2017a). Nothing is more practical than a good conceptual artifact… which may be a theory, framework, model, metaphor, paradigm or perhaps some other abstraction. *Information Systems Journal*, *27*(5), 671-693

Alter, S. (2017b). Service system axioms that accept positive and negative outcomes and impacts of service systems. In *Proceedings of the International Conference on Information Systems*.

Benbasat, I., & Zmud, R. W. (2003). The identity crisis within the IS discipline: Defining and communicating the discipline’s core properties. *MIS Quarterly*, *27*(2), 183-194.

Bereiter, C. (2005). *Education and mind in the knowledge age.* New York, NY: Routledge.

Bolloju, N., Alter, S., Gupta, A., Gupta, S., & Jain, S. (2017). Improving Scrum User Stories and Product Backlog Using Work System Snapshots. In *Proceedings of the Americas Conference on Information Systems.*

Burton-Jones, A., McLean, E. R., & Monod, E. (2015). Theoretical perspectives in IS research: From variance and process to conceptual latitude and conceptual fit. *European Journal of infoRmation Systems*, *24*(6), 664-679

Clarke, K. A., & Primo, D. M. (2012). Overcoming “physics envy”. *The New York Times*. Retrieved from https://www.nytimes.com/2012/04/01/opinion/sunday/the-social-sciences-physics-envy.html

Demetis, D. S., & Lee, A. S. (2016). Crafting theory to satisfy the requirements of systems science. *Information and Organization*, *26*(4), 116-126.

Dennis, A. R., & Valacich, J. S. (2014). A replication manifesto. *Transactions on Replication Research*, *1*(1), 1-4.

Grover, V., & Lyytinen, K. (2015). New state of play in information systems research: The push to the edges. *MIS Quarterly*, *39*(2), 271-296.

Hassan, N. R., & Mathiassen, L. (2017). Distilling a body of knowledge for information systems development. *Information Systems Journal, 28*(1), 175-226.

Hirschheim, R. A., & Klein, H. K. (2003). Crisis in the IS field? A critical reflection on the state of the discipline. *Journal of the Association for Information Systems*, *4*(5), 237-293.

Iivari, J., Hirschheim, R., & Klein, H. K. (2004). Towards a distinctive body of knowledge for information systems experts: Coding ISD process knowledge in two IS journals. *Information Systems Journal*, *14*, 313-342.

Koppel, R., Wetterneck, T., Telles, J. L., & Karsh, B. T. (2008). Workarounds to barcode medication administration systems: Their occurrences, causes, and threats to patient safety. *Journal of the American Medical Informatics Association*, *15*(4), 408-423.

Lui,J., Li H., Goncalves J., Kostakos, V., & Xaio, B. (2016). Fragmentation or cohesion? Visualising the process and consequences of information systems diversity, 1993-2012. *European Journal of Information Systems, 25*(6), 509-533.

MacIntyre, A. (1981). *After virtue*. London: Duckworths.

McBride, N. (2018). Is information systems a science? *Communications of the Association for Information Systems, 43*, 163-174.

Midgley,M. (2002). *Science and poetry*. New York, NY: Routledge.

Morgan, G. (1986). *Images of organization* (1st ed.). Thousand Oaks, CA: Sage.

Morgan, G. (2011). Reflections on images of organization and its implications for organization and environment. *Organization & Environment*, *24*(4), 459-478.

Orlikowski, W. J., & Iacono, C. S. (2001). Research commentary: Desperately seeking the "IT" in IT research—a call to theorizing the IT artifact. *Information Systems Research, 12*(2) 121-134.

Palvia, P., Daneshvar, M. K., Ghoshal, T., Uppala, V., & Wang, W. (2015). Methodological and topic trends in information systems research: A meta-analysis of IS journals. *Communications of the Association for Information Systems,* 37, 630-655

Ramiller, N. C., & Pentland, B. T. (2009). Management implications of information systems research: The untold story. *Journal of the Association for Information Systems*, *10*(6), 474-494.

Schumpeter, J. (1942). *Capitalism, socialism, and democracy*. New York, NY: Harper & Bros.

Stein, M.-K., Galliers, R. D., & Whitley, E. A. (2016). Twenty years of the European information systems academy at ECIS: Emergent trends and research topics*. European Journal of Information Systems, 25*(1), 1-15.

Vargo, S. L., & Lusch, R. F. (2016). Institutions and axioms: An extension and update of service-dominant logic. *Journal of the Academy of Marketing Science*, *44*(1), 5-23.

Vom Brocke, J., & Rosemann, M. (2010). *Handbook on business process management*. Berlin: Springer.

Weick, K. E. (1995). What theory is not, theorizing is. *Administrative Science Quarterly*, *40*(3), 385-390.

Winter, S., Berente, N., Howison, J., & Butler, B. (2014). Beyond the organizational "container": Conceptualizing 21st century sociotechnical work. *Information and Organization*, *24*, 250-269.

About the Author

Steven Alter is Professor Emeritus at the University of San Francisco. He served as vice president of a manufacturing software start-up that was acquired by Applied Materials. Upon returning to academia he wrote four editions of a major IS textbook. That effort led to research focused on developing systems analysis and design methods that business professionals could use for their own understanding and to help them collaborate more effectively with IT professionals, consultants, and vendors. The result was various versions of the "work system method (WSM)," which focuses on the business problem of creating or improving a sociotechnical work system, rather than the more limited technical challenge of creating or improving software that satisfies requirements. Most of his articles in journals and conference proceedings are related to WSM, work system theory (WST), service systems, and extensions of WST such as a theory of workarounds and a service value chain framework.