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Valuable or Stagnating? An Essay on Axiomatic Theories in IS Research

Full Paper

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Abstract

An axiomatic theory is theory whose premise is so self-evident that it can be accepted as true without controversy or much empirical confirmation. In this paper, I entertain the contention that theorizing in information systems (IS) research is mostly axiomatic. If so, among the many ramifications are questions regarding the value relevance of such research. After all, if the field engages in creating and testing theories that are in plain-view, self-evident, and can be deduced using common sense, what is the knowledge contribution of such endeavors? Is there value in producing such theories or is the effort invested in testing such theories a waste of precious resources? Most importantly, has our preoccupation with axiomatic theories led to theoretical stagnation in the field? In this essay, I investigate the nature of axiomatic theories and make the case that much significant research in IS is not axiomatic. I also address the contention that axiomatic research is not valuable and make the case that theoretical stagnation in IS did not occur as a consequence of axiomatic theories in general. The paper concludes with a brief discussion on takeaways for future theory development in IS research.

Keywords
Theory, theories in IS research, IS philosophy, axioms, axiomatic theory, TAM, theoretical stagnation

Introduction

An axiom is a premise that is so evident that it can be accepted as true without controversy. For example, Euclid's axioms, unarguably the most recognizable examples of axioms and axiomatic systems, indicate that "it is possible to draw a straight line from any point to any other point", "it is possible to describe a circle with any center and any radius", and "it is possible to extend a line segment continuously in a straight line." These axioms form the fundamental bedrock upon which a thriving mathematical system of Euclidean plane geometry is based. Axioms can be defined as a set of undemonstrated propositions accepted by convention, sometimes intuitively, or established by practice as the basic building blocks of some conceptual or theoretical structure or system. The axiomatic method is a way of arriving at a scientific theory in which axioms are postulated as the basis of the theory, while the remaining propositions of the theory are obtained as logical consequences of these axioms (Wilder, 1967). Axiomatic theory can thus be defined as a statement of relations among concepts within a set of boundary assumptions and constraints where either the relations themselves are axioms or are derived from axioms. In the context of theory, and more particularly to the subject matter of this paper, we may interpret "axiomatic theory" colloquially as "theory that does not need empirical proof," or "theory that cannot be negated by empirical data." The source of justification for axiomatic theory is the common sense of professional people and ordinary people, or sound judgment based on a simple perception of the situation or facts. While some common sense may vary across time, culture, and professional community, the vast majority remains consistent.

Given the context of 'axiomatic theories', consider a scenario where a contention is made among cohorts, a gathering of peers, as a talking point in a formal or informal conversation, or simply to verbalize a personal self-evident belief (an axiom!): that theorizing and theories in information systems (IS) research are axiomatic. The technology acceptance model (TAM)) (Davis et al., 1989) is provided as evidence. You are told that Steve Jobs knew TAM simply through common sense i.e., he designed devices and applications that are easy to use and useful on the basis of the simple self-evident truth that things that are easy to use and useful will be voluntarily used by people. There is no formal model or empirical evidence needed since the "theory" is axiomatic. The central premise of TAM can be reached simply by asking professionals or by observing life in organizations. In a similar vein, there are other theories in IS research that can be easily deduced using common sense and are therefore axiomatic theories. For example, theories in IS research on knowledge sharing indicating that a greater intention to share knowledge in organizations arises from a favorable attitude toward knowledge sharing by individuals (Bock et al., 2005).

A number of questions are intertwined in the above stated, seemingly simple contention. *Are most theories in IS research indeed axiomatic?* If most of the theorizing in IS is reasonably 'self-evident' *is there any value in producing such (axiomatic) theories?* If the theories are 'self-evident' such that their premise can be easily deduced by using commonsense, observation, or simply by asking professionals, *is it really worth investing too much time, effort, and resources into testing such theories?* Above all, by dedicating significant resources, time, and effort in testing such theories, *has the emphasis on axiomatic theories in IS research led to theoretical stagnation?* These are neither very pressing nor easy questions to answer. Some may even question the relevance of such questions. Nevertheless, pondering upon such questions and looking back at the evolution of theoretical research in the field provides an opportunity to chart a path, add a small piece to the much larger schema of IS research by understanding where we were, where we stand today, and how as stewards do we direct future theoretical development in the field.

The rest of the paper is organized as follows. In the sections that follow I first establish criteria to recognize axiomatic theories and argue that while a number of theories in IS research are axiomatic, there are numerous theories that are non-axiomatic. Examples of non-axiomatic theories in IS research are provided. Next, I argue that axiomatic theories do add value to IS research by making explicit what is implicit and allowing for more sophisticated theories to be constructed. Addressing the topic of stagnation I argue that whilst axiomatic theories (like TAM) should not cause stagnation, nevertheless in the case of IS this was indeed the case because it remained in use for many decades resulting in little growth of knowledge. Here I note that contemporaneous factors and the axiomatic nature of TAM together bear the responsibility for theoretical stagnation. Finally, in the takeaways section I suggest the way forward to encourage the growth of knowledge in IS research.

Are Most Theories in IS Research Axiomatic?

Axioms can be defined as a set of undemonstrated propositions accepted by convention, sometimes intuitively, or established by practice as the basic building blocks of some conceptual or theoretical structure or system. The axiomatic method is a way of arriving at a scientific theory in which axioms are postulated as the basis of the theory, while the remaining propositions of the theory are obtained as logical consequences of these axioms (Wilder, 1967). Axiomatic theory can thus be defined as a statement of relations among concepts within a set of boundary assumptions and constraints where either the relations themselves are axioms or are derived from axioms[1]. Axiomatic theories by this conceptualization is a subset in the bigger supra set of scientific theories. Following Bacharach (1989) I define theory as "a statement of relations among concepts within a set of boundary assumptions and constraints" (Bacharach, 1989 pg. 496).

Researchers in mathematics studying the axiomatic method have made some important distinctions about axiomatic systems of mathematical theories. Mueller (1969) draws out the following important distinctions. First, many axioms are self-evidently true but this is not always the case. Many axioms can be arbitrary and may be assumed for the "sake of the game". Second, the utility of axiomatic systems is gauged by how well it explains the specific phenomena to which they are proposed to be applied and not by the number of different phenomena that can be explained by a given axiomatic theory. Thus, Euclidean geometry is fine for terrestrial spaces, but Lobachevskian geometry is better for inter-stellar spaces (Guba & Lincoln, 1982). Third, axiomatic systems are not judged on the grounds of their self-evident truth, their common-sense qualities, or their familiarity to the inquirer, but in terms of their fit to the phenomena into which one proposes to inquire.

[1] Definition derived using the definition for theory by Bacharach (1989) and descriptions of axioms, axiomatic systems, and the axiomatic method (Mueller, 1969; Wilder, 1967).

Axiomatic systems, like theories, are entropy reduction tools (they reduce uncertainty regarding a phenomenon by explaining it). In achieving this objective, however, axiomatic systems usually constrict the domain of the phenomena rather than broaden it and risk having inconsistent axioms. There can always be another axiomatic system that explains the 'non-fitting' parts of the phenomena. Two properties of axiomatic theories in IS research deserve to be enumerated. First, axiomatic theories have propositions that are self-evident. Second, because breadth of application across different phenomena is not of primary importance in formulating axiomatic theories, axiomatic theories are phenomenologically narrow. By phenomenological narrowness I mean narrowness in describing the phenomena to be studied, the context in which the phenomena is studied, and the factors that are considered to be a part of the phenomena. As illustrated in figure 1., IS theories that are not self-evident and phenomenologically narrow are classified as non-axiomatic. Using this criteria, a select few theories in IS research can be classified as axiomatic. Similarly, a number of theories in IS research can be classified as non-axiomatic. Some native and non-native, non-axiomatic theories in IS research are described below.

According to the task-technology fit (TTF) (Goodhue & Thompson, 1995) theory, individual performance is more likely to be positively impacted by technology if there is a good fit between the individual task characteristics and characteristics of the technology. The measure of TTF consists of numerous factors such as quality, compatibility, production timeliness and system reliability. TTF goes beyond simple utilization by including performance impact also as a significant outcome, thereby making the theory less phenomenologically narrow. While the propositional logic is fairly self-evident, the theory is amenable for adoption across a wide range of IS phenomena involving use and performance.

DeSanctis & Poole's (1990, 1994) adaptive structuration theory (AST) suggests that system designers build systems with their own preconceived notions about how the system will be used by users. However, users adapt these systems according to their own needs and consequently use the system in unintended ways. As a result, new social structures arise that are incorporated by the designers in subsequent versions of the system. A precursor to AST, Markus(1983) proposed the interaction theory for technology adoption resistance when after studying the dynamics between power, politics and IS in an organizational setting she found that people determined and system determined theories failed to explain resistance to technology. The resistance to technology adoption arose as result of the technology changing the existing social structure in the organization by vesting new power in one department while usurping it from another. Both AST and interaction theory are non-axiomatic as they are not very self-evident, nor do they consider a very limited set of factors to explain the phenomena.

Daft and Lengel's (1986) media richness theory (MRT) is another example of non-axiomatic theory with fairly self-evident reasoning but wider applicability across organizational domains. Its central premise is that various media (including IS) can be used to reduce equivocality and uncertainty regarding information. Richer media can be used when equivocality reduction is desired, while formal mechanistic systems can be used when uncertainty reduction (by increasing information processing) is desired. The central tenets of MRT are very useful for designing appropriate organizational structures. Media synchronicity theory (Dennis, Fuller, & Valacich; 2008) makes the MRT mesh even finer by explicitly drawing out five capabilities of IS media that influence the development of synchronicity and thus the successful performance of the conveyance and convergence communication processes.

Clemons et al.'s (1993) move to the middle hypothesis presents a counter-intuitive rationale for why increasing IT-ization will not necessarily lead to market-like structures between buyers and suppliers. They contend prior claims (Malone, Yates, and Benjamin, 1987) that by reducing co-ordination costs, information technology will lead to an overall shift toward proportionately more use of markets rather than hierarchies to coordinate economic activity. Rather, Malone et al. hypothesize that lower investment in transaction specific assets will reduce transaction costs and increase explicit co-ordination among buyers and suppliers. The move to the middle hypothesis states that IT-enabled explicit co-ordination will not only enable firms to realize production economies of outside suppliers (a hallmark of market relationships), but that it will also make value added partnerships formed with a smaller set of suppliers (a hallmark of vertically integrated relationships) more attractive. The recent surge in co-creation of value through explicit co-ordination and the use of cloud-based IT resources lends credence to the 'move to the middle' hypothesis.

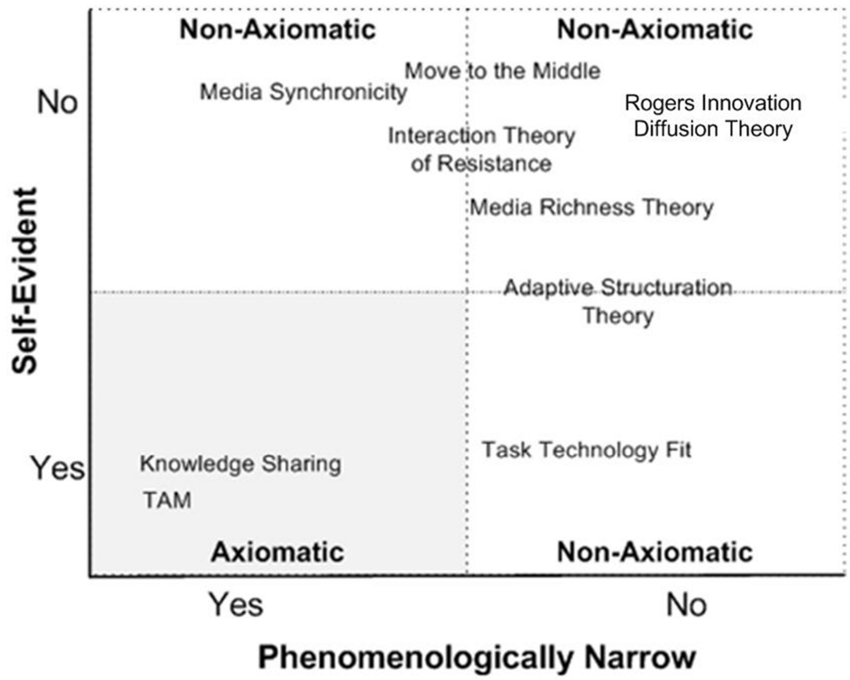

Figure 1. Axiomatic and Non-axiomatic Theories

Rogers' innovation diffusion theory (Rogers, 1983) describes innovation diffusion as a process of reducing adoption uncertainty among potential adopters. Potential adopters of new technology seek to reduce uncertainty regarding the superiority of new technology in solving problems and exploiting opportunities. To reduce uncertainty, potential adopters look to peers and referent groups that have adopted the technology. Rogers describes this process as a sequence of steps involving knowledge, persuasion, decision, and implementation. Based on the process of adoption, Rogers also predicts adopter distribution over time and characterizes and categorizes different groups of adopters. The theory includes a number of different factors such as the nature of innovations and adopters, the effectiveness of communication channels, and the influence of social systems on innovation adoption.

Clearly, there is sufficient variation in theories used in IS research along the dimensions of 'self-evidence' and 'phenomenological narrowness'. The theories highlighted in this section provide evidence that at the very least, some of the more significant and impactful theories used in IS research are non-axiomatic.

The Value Relevance of Axiomatic Theories

Do axiomatic theories contribute towards the theoretical development of the field? Is it even worthwhile empirically testing such theories? As Hall and Lindzey (1957, pg. 9) point out, "the function of theory is that of preventing the observer from being dazzled by the full blown complexity of natural or concrete events". Bacharach (1989, pg. 496) describes theory as a "linguistic device used to organize a complex empirical world" where theoretical statements have the two-fold purpose of organizing parsimoniously and explaining or communicating clearly. Can axioms and axiomatic theories adhere to the above stated ideals? They most certainly can. Consider Euclid's first three axioms: i) A straight line segment can be drawn joining any two points; ii) Any straight line segment can be extended indefinitely in a straight line; iii) Given any straight line segment, a circle can be drawn having the segment as radius and one end point as center.

Each of the aforestated axioms is of a different kind (Mueller, 1969). The first axiom describes permissible constructions, the second states an assumed assertion, and the third states a definition. But there is value in these three axioms as they are things that organize and clearly communicate fundamental precepts based on which an orderly and unconfused development of mathematics can take place. Thus, suggesting that axiomatic theories have little or no value simply because its propositions are self-evident, i.e. they are derived by using common sense or sound judgment based on a simple perception of the situation or facts, is wrought with pitfalls. Putnam (1967) provides three arguments for why this may be so. First, self-evident truths held as axioms may not be so self-evident upon deeper reflection or to someone who has a different worldview. Second, the axioms that are self-evident may be false; and third, the axioms that are true may not be self-evident at all. In the paragraphs that follow I will use Putnam's first and third points to make a case that axiomatic theories provide value.

The first point is relevant given the low paradigm nature of the information systems field (Culnan, 1986). By and large as researchers in IS we approach a phenomena of interest from some theoretical point of view by using theory as a lens through which we focus on the phenomena of interest, magnifying the relevant portions while filtering out portions that can then be considered to be noise. When conducting affairs in such a manner, commonsensical or implicitly held assumptions can serve to undermine and inhibit the study of a phenomenon at hand as noted by Weick: "...implicit theories impede understanding; they act as blind spots... Because believing is often seeing, implicit theories become undeliberated assumptions, which are imposed and appear to be self-confirming. People see what they expect to see" (Weick, 1984, p. 113).

Axiomatic theories serve the function of making these implicit assumptions explicit, no matter how commonsensical or obvious their premise may be. Further scrutiny of such theories aids in eliminating the blind spots through the process of externalization, verification and where necessary elimination or vilification. The resulting theories can then be integrated into the process of making sense of complicated and often times contradictory real-world phenomena (Truex et al., 2006). Venturing further with this line of thinking I contend that much like Euclid's axioms led to the development of Euclidian geometry, axiomatic theories such as TAM led to the accumulation of knowledge in the IS field in the area of individual use of technology. Over the years, the additions that have been made to TAM include constructs such as cognitive absorption (Agarwal & Karahanna, 2000), trust (Gefen et. al., 2003), job relevance (Venkatesh & Davis, 2000), self-efficacy (Igbaria & Livari,1995; Hong et al., 2002), result demonstrability (Venkatesh & Davis, 2000), image (Hsu, 2004; Hong et al., 2006), information satisfaction (Wixom & Todd, 2005), disconfirmation (Hong et al., 2006), personal innovativeness (Agarwal & Prasad, 1998), top management commitment (Lewis et al., 2003), system quality (Yang et al., 2005), information quality (Ahn et al., 2007), computer anxiety (Moon & Kim, 2001), perceptions of external control (Venkatesh, 2000) , and computer playfulness (Van der Heijden, 2004; Hackbarth et al., 2003).

Putnam's third argument that "the axioms that are true may not be self-evident at all" may perhaps be better explained using an example from non-Euclidian geometry. Non-Euclidian geometry relies on indirect proofs. In such proofs, one assumes the direct opposite of what one wishes to prove and then show that the opposite assumption leads to absurd conclusions (Godel, 1999). One example of non-Euclidian geometry is Lobachevskian geometry which begins with the opposite of Euclid's fifth axiom, a seemingly absurd premise that given a line and a point not on that line, it is possible to draw an infinite number of lines through the point, all of which are parallel to the given line (Guba & Lincoln, 1982). One of the theorems that is derivable from Euclid's axioms is that the sum of all angles in a triangle is always 180 degrees. In contrast, by using the opposite premise stated above one can prove that that the sum of angles in Lobachevskian triangles is not always 180 degrees but rather approach 180 degrees as triangles become small. This theorem is of great value to astronomers who use astronomically large sized triangles in their distance calculations rather than smaller Earth-sized triangles. This example highlights how axiomatic theory can be morphed (in this case using negation) to create new knowledge that provides a better fit to explain another phenomena.

Putnam's second argument, "axioms that are self-evident may be false", highlights the role of testing and data analysis in axiomatic theories. Testing and data analysis for axiomatic theories is seen in the same way researchers and philosophers see it for other theories. In general, philosophers of science writing in the tradition of the physical or natural sciences are likely to see theory as providing explanations and predictions and as being testable. For example, Popper (1980) held that theorizing, in part, involves the specification of universal statements in a form that enables them to be tested against observations of what occurs in the real world. Mintzberg (2005, pg. 356) provides a more pragmatic purpose for data analysis when he states that "(testing) is useful; we need to find out, if not that any particular theory is false (since all are), at least how, why, when and where it works best compared with other theories." More specifically stated, data analysis of axiomatic theories serves the purpose of clearly delineating the conditions under which such self-evident truths are true as they are not likely to be true under all conditions.

Axiomatic Theories and Stagnation

Have axiomatic theories caused theoretical stagnation in IS? The simple answer to this question is 'no'. The field has not stagnated due to axiomatic theories, but rather due to one axiomatic theory in particular. To illustrate this point let us compare the trajectories of two axiomatic theories: the technology acceptance model (TAM) (Davis et al., 1989) and the behavioral intention formation model for knowledge sharing (Bock et al., 2005). TAM investigates the antecedents of system use and finds that individuals form a behavioral intention to use IT if it is useful and easy to use. Similarly, theoretical research on knowledge sharing shows that an individual's attitude towards knowledge sharing, subjective norms and organizational climate are significant antecedents that lead to the behavioral intention to share knowledge. Both theories have roots in Fishbein and Ajzen's (1975) theory of reasoned action/ theory of planned behavior. Both axiomatic theories were preceded, accompanied or followed by competing models/theories. For instance, models and theories on individual acceptance include Rogers theory of innovation diffusion (Rogers, 1983), task technology fit (Goodhue & Thomson, 1995), combined TAM and TPB (Taylor & Todd, 1995), model of PC utilization (Thompson et al., 1991), and social cognitive theory (Compeau & Higgins, 1995; Compeau et al., 1999). For knowledge sharing, competing models proposed theories derived from social capital theory (Kankanhalli et al., 2005), social cognitive theories (Chiu et al., 2006), and social network trust perspectives (Chow & Chan, 2008). In spite of their similarities, TAM managed to dominate research effort in IS and stagnate knowledge creation for almost a decade and a half. By any account, theoretical research on knowledge sharing has not had a similar effect. A combination of the relative adolescence of the IS field (when TAM was published) along with the promise of a dominant paradigm, that could be made contextually malleable by making additions, and the security and legitimacy afforded by sticking to the dominant paradigm (Benbasat and Zmud, 2003; Benbasat and Barki, 2005) probably explains the stagnation of the field better than the axiomatic nature of TAM does by itself.

With respect to TAM, institutional reasons may also have lead to stagnation. As Goodhue (2007, pg. 221) points out, "for a researcher to go beyond the powerful conceptualization provided by TAM is both risky and difficult .... (but the blame also rests on) doctoral education programs, in which we emphasize so heavily that research must be 'theory–based'... (meaning that)... all research must start with an existing theory and make a small addition to it." A researcher's perception of risk may also have been exacerbated by the "take-no-prisoners style of reviewing" of elite journals where submitted papers are expected to be methodologically and theoretically flawless (Valacich et al., 2006). As a consequence of this, it is quite possible that researchers hedged their publication bets by focusing on methodological rigor while making smaller increments to a dominant paradigm (going for the 'low hanging fruit') thus playing it safe on the theoretical development side. It is conceivable how such an approach can lead to stagnation in theory development efforts. The IS field's preference for theories that both explain and predict (66% of the sample in Gregor's (2006) study) also suggests that researchers may have been theorizing only to the extent where the theory can be tested against empirical evidence. Perhaps, this is another reason for stagnation and the preponderance of constrictive, and narrow axiomatic theorizing in IS research.

Moving Forward: Takeaways

Popper (1980) described theory as follows (pg. 59): "Scientific theories are universal statements. Like all linguistic representations they are systems of signs or symbols. Theories are nets cast to catch what we call "the world"; to rationalize, to explain and to master it. We endeavor to make the mesh even finer and finer." To make the mesh finer as Popper describes it, one must start with broader more encompassing theories. On the other hand, theory development may also progress as an endeavor in aggregation. So how should the field move forward in theory development?

Where theory building progresses by making additions, intervene periodically by drawing attention toward aggregating the growing body of knowledge as reviews, schemas, or meta-theories published in special issues or dedicated segments in journals. This can have two benefits. First, a well done aggregate article, by organizing and summarizing the state of theory development, can effectively communicate the core attributes of the theory, take stock of the domain and highlight avenues for fruitful research. A common understanding of the theory may lead to shared schemas in the research community and provide a baseline reference for communication of future theoretical development. Second, aggregated articles can also serve as valuable references on IS phenomena for other disciplines thereby hastening the progress of IS as a reference discipline.

Where narrow and prescriptive theories are desired, encourage synergies between academic research and industry such that the prescriptions provide solutions to real world problems. Instead of consigning such research to lower level journals, highlight the best prescriptive, design and action research in a dedicated recurring section in our premier journals. This will not only bridge the gap between theory and practice but also open avenues for pragmatic research.

Encourage conceptual theory development without the restraints of theorizing only that which can be tested (Type I & II theories in Gregor's (2006) typology). Such a move may foster more creative and abstract theoretical development where the researcher can focus solely on articulating conceptually rich (possibly broad) theories. Dedicate journal space or journals for such theory development endeavors.

In addition to positivistic research encourage other knowledge creation ontologies such as interpretive or combined positivist and interpretive approaches to knowledge creation. Also, encourage 'pluralism in research methods' such as case studies and grounded theory methods to create new knowledge. Such approaches will require greater embeddedness in the environment where the phenomena being studied occurs and may necessitate changes in the criteria for evaluating faculty tenure.

Where predictive theories are desired, encourage innovative methods that utilize qualitative or even visual data. The rationale here is that where theorizing can be constricted due to paucity of quantitative data, we must tap into the ever-growing source of data generated from social media, and revolutionary software avenues such as eye tracking or facial imaging. Developing robust methods to utilize such sources of data can yield dividends in future theory development.

Conclusion

This paper highlights the nature of axiomatic and non-axiomatic theories in IS research and makes the case that there are indeed a number of instances of non-axiomatic theories in IS research. I also argue that axiomatic theories are value creating and that any notion of theoretical stagnation was a result of a confluence of conditions rather than due to an over emphasis on creating axiomatic theories alone. Moving forward, I suggest a number of avenues to encourage richer, non-axiomatic theorizing in IS research.

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