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Operational Definitions in Management Information Systems Theory Building

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Abstract

This paper presents the role of definitions in the construction of management information systems theory. Using Bridgman's technique of operational definition (1927) as a discussion backdrop, MIS can begin to assess our definitional status as a discipline. In short, theory construction and clear definitions must proceed simultaneously.

Introduction

... no matter what assumptions a critic makes about the nature of the MIS approach, a proponent can always reply that his use of the term is different from others. (Dearden 1972)

Widespread agreement exists that management information systems (MIS) lacks well-developed theories that command acceptance. However, agreement halts at this point. The nature of theories and the best way to begin to build a theory are matters of dispute. The term "theory" is itself used in many different ways. I will be using it to refer to a set of interrelated, rather high-level principles or laws that can provide an explanatory framework to accommodate a broad range of phenomena. Phenomena of interest in MIS include, but are not confined to, systems development, patterns of system use, relations between organization and information systems, as well as aspects of social, political, and economic organization of information systems.

It is obvious that our understanding of empirical phenomena is enhanced when we are able to see connections among things that at first seemed utterly disjoint. Theories fulfill this function, and provide a broad perspective for ordering and arranging not only isolated facts, but also various regularities that the facts exemplify. Ideally a theory, or a comprehensive system of theories, would be broad enough to account for all the observed regularities recognized by MIS and also be detailed enough to account for any specific MIS phenomenon. Comprehensive and detailed theories of this sort are extremely rare, even in the most advanced sciences. The construction of such a theory of MIS would seem to be merely an ideal, not a realistic goal.

A few scientific theories, such as Newton's theory of the motion of particles, have been strikingly successful at doing the things that theories are designed to do. It is only natural then that various aspects of such theories are taken as patterns or guides for theory building in other areas. One feature of such theories is the apparent emphasis on careful

definition of their crucial terms. Accordingly, in MIS, and in other disciplines, one approach to theory building has been to start by providing a set of definitions.

Another aspect of some highly successful scientific theories is their deductive structure. At least since the time of Descartes, there has been a strong commitment to the view that success in science can be achieved by constructing theories on the model of Euclidean geometry (Kuhn 1962).

Each of the above approaches to theory building borrows from successful theories, but what is borrowed is a method rather than anything substantive. A substantive sort of borrowing also sometimes occurs. In such cases, the theory-builder may either try to fit MIS with some existing theory, or take over-perhaps with modification-substantive principles from another discipline such as psychology or anthropology.

These different strategies form neither an exhaustive nor an exclusive set of ways to deal with the challenge of theory building.

The Definitional Approach

In advanced sciences, such as physics, there seems to be a certain "crispness" of vocabulary that is absent in MIS. Physicists may disagree sharply about theoretical matters, but generally the parties of such disputes do not doubt that they are using terms in a uniform manner, even highly theoretic terms that do not refer to observable entities (such as "electron"). Terminology in business school disciplines, by way of contrast, ranges from common-sense expressions to esoteric jargon, with disagreements about meanings at every level. Among MIS researchers, for example, it is common to find disputes about terms as basic to the discipline as "information," "knowledge," and "technology."

Surely if it prevents successful communication, terminological confusion is a serious problem even when no testing is involved. However, it seems that a *particular kind* of attention to definition, found too often in current literature, is more correctly viewed as contributing to a terminological morass than alleviating it (see for example: technology (Orlikowski 1992); or IS function (Saunders and Jones 1992)). The problem, briefly stated, is this: terminological clarity is perceived as a *prerequisite* to conceptual clarity and theory construction, rather than part and parcel of these latter. In an attempt to achieve terminological clarity, certain techniques of definition are employed. But there is an inadequate understanding of the limitations of these techniques. The consequences of failing to recognize the limitations range from the introduction of useless jargon to the production of serious misunderstandings.

Operational Definition

Since the introduction of the technique of operational definition (Bridgman 1927), scientists in many fields have been attracted by the hope this method offers for firmly anchoring the claims of science in a set of publicly repeatable physical operations. Depending on the outcome of such operations, a term is correctly applicable or it is not. Terms thus tied to reality, it seemed, would be prevented from taking on new sets of meanings that could allow a wide variety of interpretations, depending on the user's or listener's past experiences. Operationally defined terms were thought to provide the satisfactory basis for a truly objective account of science.

Working out the details of this exciting proposal turned out to be extraordinarily difficult, however, and careful critical analysis shows that any broad branch of sciences contains terms that do not yield to operational definition. For example, even fairly simple *dispositional* terms, such as "soluble," resist complete operational definition. We usually attribute dispositional properties to things just in case they *would* react in certain ways *if* they were put to certain tests. It seems too strict to withhold the label "soluble" from a bit of salt that has not been tested, though this is what strict operationalist criteria require. There have been attempts to solve such problems by providing partial reductions of sentences containing dispositional terms to sentences containing only terms amenable to operational definition. This has not been entirely successful, though most scientists would count simple dispositional terms like "soluble" as satisfactorily defined when operations that could be performed are so clearly specified. But even such weakening of the operationalist program has not allowed it to provide definitions for highly theoretic terms (such as "electron") of advanced sciences (Hempel 1965).

In spite of its demonstrated inadequacies, the program of operational definition has some merit, and moreover, it is not without champions. Researchers should understand what can and cannot be done with this technique so that they will be able to use and evaluate operational definitions correctly.

At issue is the technical meaning of "primitive term," which depends upon a certain formal way of viewing the languages containing such terms, and of the two different genres of definitions: those that present an equivalent linguistic expression, and those that indicate extralinguistic referents of a term. Primitive terms are undefined expressions, in that they are not reducible to more basic linguistic expressions in the specified language in which they occur. For example, you might specify a language that consisted only of certain primitive terms, such as "line," "intersects," and "between." New expressions could be added to the language by defining them in terms of the primitives: "point" is "the intersection of two lines." "Point" then is a *defined* term, relative to this language.

Such languages may be interpreted or uninterpreted. In an uninterpreted language, neither the primitive terms nor the defined terms are assigned to extralinguistic referents. One might nevertheless study certain interesting formal or structural relationships among the various linguistic elements. To interpret a language is to assign its primitives (and thus also its defined terms, because they can all be reduced to primitives) to some referent outside the language. To assign referents, is in another sense, to define the terms. For example, a possible interpretation of the language just discussed might assign "line" to

paths of light rays, and "intersection" to the physical operation of paths crossing one another. If a language is interpreted, then all of its terms, primitive and defined, have meanings (i.e., are defined in this second sense). If the language is uninterpreted, then primitive and defined terms alike lack meaning in this sense.

The whole point of operational definition is to provide a suitable link between language and extralinguistic entities. If the program of operational definition is to be accomplished, it must provide connections for any formal languages that purport to be applicable to empirical reality. This means that the primitive terms of such languages are the expressions in greatest need of operational definition. A systematic empirical science cannot be built upon the basis of primitive terms of an uninterpreted formal system of language. Such a proposal is adverse to every operationalist goal.

The basis for the distinction between theoretical terms and observational terms is the contrast between the remoteness of such abstract concepts as "electron" from any sensory experience, and the apparently close link between sense impressions and such terms as "red spot" and "shrill noise." Many writers believe that the observational-theoretical distinction is too glibly drawn and will not withstand careful scrutiny (Hesse 1974; Papineau 1979). Although I agree that a sharp distinction between observational and theoretical vocabularies is indefensible, a crude scale that admits that some terms are much more theory-laden than others seems quite plausible, and is useful for many purposes.

The observational-theoretical distinction is intimately related to the operationalist program, for expressions containing only observational terms are, presumably, those most amenable to operational definition. Originally the hope was to replace theoretic terms by equivalent complexes of observational expressions, thus securing the operational definition of theoretic terms as well. This attempt at reduction has not succeeded. Theoretic terms have resisted even the type of partial operational definition that has been somewhat helpful in dealing with dispositional terms. This failure to offer satisfactory definitions of the theoretic terms have been the chief weakness of the operationalist program.

Conclusion

In this discussion of the uses of operational definition, the following points have emerged. Operational definition, that is, specification of the meanings of terms by presenting publicly observable criteria for their application, has an important role in MIS, as in other sciences. Such definitions do provide some fundamental link between language and the world scientists are trying to describe and explain. However, it is not possible to conduct the program of operational definition with anything like the thoroughness its original proponents envisaged. It is not possible to define many important MIS terms in this way, nor is it possible to perform reductions of the expressions in which these terms occur to expressions that contain only terms capable of operational definition. In particular, theoretical concepts, used to *explain* what is

observed, are rarely reducible in this manner. Such explanatory terms do have empirical import, but they gain this through their role in theories, and other criteria are used for judging the success of theories. For these reasons, it would be unwise to demand complete operational definition of all terms as a first step in the construction of management information systems theory.

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