12-31-2003

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Abstract

For the past three decades, Decision Support Systems (DSS) have looked to provide better decision-making support for difficult and complex semi-structured and unstructured decisions. However, debate continues over where DSS fits into the history of Management Information Systems (MIS), whether it is still the primary focus of MIS research, and in which direction DSS is heading.

In an attempt to address these and other questions, we can apply Thomas S. Kuhn's paradigm model from his text, The Structure of Scientific Revolutions, *to a DSS literature review. The literature demonstrates that DSS was indeed the paradigm for MIS, but MIS may currently be in a time of crisis whereby this paradigm could be threatened.*

Keywords: DSS, paradigm, DSS foundations

Introduction

In the 1970's, Decision Support Systems (DSS) arose from the need for better decision-making support with respect to difficult and complex semi-structured and unstructured decisions becoming the primary area of research in the Management Information Systems (MIS) field. This paper will look at the MIS sub-discipline, DSS, and demonstrate that DSS was the paradigm for MIS using Thomas S. Kuhn's paradigm model, as well as look at the state of MIS current and its current paradigm(s). An alternative view may be taken, like that of Naylor (1982) in "Decision Support Systems or Whatever Happened to MIS?," in which DSS is portrayed as an empty name with no meaning or practical substance, therefore DSS would be unable to function as a paradigm for the field. Because of these polarities in perspectives, the debate of where DSS fits into the history of MIS continues. Specific questions within the debate include: Is DSS still the paradigm for MIS? If not, has DSS been replaced or does it operate in parallel with another paradigm(s)? The questions still remained in 1987, when Keen (1987) prescribed research directions for DSS in the subsequent decade and still in 2002 when the Shim et al. (2002) paper extended the directions developed by Keen (1987) for the next decade. The next section will discuss Kuhn's model, followed by an application of the model to a synthesis of representative DSS literature from the past three decades to assess the paradigmatic nature of DSS. Finally, the paper will conclude with a discussion of the current state of DSS within MIS.

Kuhn's Model

In his *Structure of Scientific Revolutions*, Kuhn (1996) provides a useful model which demonstrates the development of historical advancements in scientific fields. He begins with the idea of a paradigm, which he defines as an unprecedented scientific achievement brought about by a crisis, leaving enough questions unexplored to be resolved by future researchers. Kuhn's paradigm model consists of three stages: preparadigm, paradigm, and post paradigm.

When an area of science is in the preparadigm phase there is no research tradition to build upon. Each practitioner or school of thought has to rebuild the foundations for their ideas with each change of thinking in their field. Kuhn gives an example of the preparadigm in the field of physical optics, "Being able to take no common body of belief for granted, each writer on physical optics felt forced to build his field anew from its foundations" (1996, p. 13). In the preparadigm stage there are several schools

of thought competing with each other, each claiming their own theory provides the correct explanation of a phenomenon. Kuhn defines a crisis as "the common awareness [within a field of research] that something has gone wrong" (1996, p. 181). This occurs when is only one school's theory provides the best possible answer, thus this theory becomes accepted as the first paradigm of a new scientific field and the field moves from preparadigm state to a paradigm state.

When a new theory has proven to answer the questions of the field better than the competing schools of thought, the theory becomes the basis for a new paradigm. However, the success of the paradigm is not the end of research. Kuhn explains that "to be successful is not … to be either completely successful with a single problem or notably successful with any large number" (1996, p. 23). The paradigm must still be open-ended enough to provide areas of further research. The field is now in a transition period where some researchers see the explanatory power of the new paradigm, while others do not accept the paradigm and may never see the field from the opposing point of view. At this point, experiments can be conducted to develop the foundation of the new paradigm. Once this paradigm is established the field will have a common starting point and researchers will no longer have to build their work from first principles—they can begin with the accepted paradigm. A new language, including new uses of old terms, and new journals are developed in conjunction with the paradigm, and as the paradigm becomes more generally accepted, the field begins to move into the post paradigm phase.

At the point of the post paradigm phase, most of a given paradigm's opposing schools of thought have died out. Experiments refine the paradigm by identifying the essential puzzles for a field to solve. Research is very strict and focused on developing the paradigm and solving the puzzles of the paradigm until anomalies develop which are unable to be explained by the paradigm. As these problems which the paradigm cannot account for are trying to be resolved; scientific research allows the acceptable boundaries for conducting research to loosen, so possible solutions may arise from non-standard practices or approaches to reconcile problems using the current paradigm. A new crisis may develop if the anomaly cannot be addressed by the paradigm. This crisis can take the established field to the point of a scientific revolution, much like the preparadigm phase, where a new paradigm will emerge and replace the existing paradigm. This cyclical process through the phases of the paradigm model continues as the field develops.

DSS and Kuhn's Paradigm Model

The field of MIS was in a post paradigm phase in the early 1970's, when the field was at a crisis/revolution point. Gorry and Scott-Morton (1971) point out that, up until this point MIS research had largely been dealing with structured decisions: "the SDS [Structured Decision Systems] area encompasses almost all of what *has* been called Management Information Systems (MIS) in the literature—an area that has almost nothing to do with real managers or information" (1971, p. 61). Their unprecedented idea of using technology to interactively help solve problems and aid in decision making attracted researchers from traditional MIS research to work on this new paradigm. The unprecedented nature of DSS represents a factor of a paradigm as defined by Kuhn: "Their [Aristotle, Ptolemy, Newton, Franklin, Lavoisier, and Lyell] achievement was sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity" (1996, p. 10). The shift in thinking proposed by Gorry and Scott-Morton is where the DSS paradigm establishes itself as the replacement paradigm for MIS. DSS came into existence as an idea but needed more development on the definition and framework Gorry and Scott-Morton provided. Therefore, another aspect of the preparadigm phase of the DSS paradigm arose at this crisis point, in which of several researchers were working independently on the same problem. Kuhn (1996) presents several examples, one of which is the discovery of oxygen by three researchers working separately but concurrently. Likewise, the early development of the DSS paradigm shows several researchers working in parallel on the formation of an answer to the same crisis—the definition of a DSS and the building of the subsequent DSS framework.

Several examples of this parallel work on the emerging paradigm can be seen in the synthesis work of Sage (1981), the studies by Bonczek et al. (1980), and the framework developed by Sprague (1980). The work done by Sprague and Bonczek et al. establishes a general framework that defined DSS and gave future researchers a general platform on which to build systems. Sprague acknowledges the crisis in DSS by pointing out the difficulty of defining DSS. He says, "a serious definitional problem is that the words have a certain 'intuitive validity;' any system that supports a decision, in any way is a 'Decision Support System'" (1980, p. 2).

Sprague also claims that part of the complexity in DSS is quite simply realizing and negotiating the wide range of perspectives of the decision-makers and designers in the development of a DSS. The proposed frameworks were aimed at developing a common definition and answering the complex challenge of reconciling these different perspectives involved in a DSS project. Thus, another key factor in defining DSS as a paradigm is provided by Bonczek et al. and Sprague, as their work establishes a

definition and a framework for the DSS paradigm and allows for growth through future studies and experiments. Bonczek et al. and Sprague are also important for defining a paradigm-specific language, which Kuhn claims is an important component in the definition of a paradigm.[1]

A review of literature in the DSS field demonstrates that the debate over whether DSS was the new paradigm or just another problem within MIS or management science has continued since the early 1980's. In his article "Decision Support Systems or Whatever Happened to MIS?", Naylor (1982) claims that DSS is simply a buzzword. He provides support for his argument by claiming that DSS, like MIS, lacks a definition and a framework. He warns, "The leaders of the DSS movement would do well to reflect on the history of the MIS movement—there may be some striking parallels between the two" (1982, p. 92). However, Kuhn mentions that there will be opposition to the new paradigm and claims that those who disagree will, "…run themselves out of the profession" (1996, p. 19). It stands to reason that if researchers do not accept the DSS paradigm, it would be impossible to use DSS in research and not have their research categorized as such.

Alternatively, Blanning (1983) and Watson and Hill (1983) give an earnest reply to Naylor in support of DSS. Watson and Hill claim that DSS is distinctly different from MIS and Management Science and feel that DSS has a sound definition. But, contrary to the argument posed in this paper, Watson and Hill state "DSS coexists with MIS" (1983, p. 87). This may have been the case as DSS had not been completely accepted as the paradigm for MIS and the focus of research had yet to shift solely on the puzzles presented by the DSS paradigm. Alternatively, Blanning argues from the standpoint of the academic validity of DSS. From either standpoint, the argument provided pushes for the continued exploration and development of the DSS paradigm.

Regardless of the lingering doubt surrounding the integrity of the paradigm, the 1980's and early 1990's passed with many studies conducted to help define, develop, and improve the paradigm and to establish a research tradition for DSS. The research opportunities in DSS fit the open-endedness required in the definition of a paradigm. Case, field, and laboratory studies in several areas within DSS demonstrate the refinement of the DSS paradigm. Some areas of research include DSS foundations, interfaces, model management, group DSS, multiple criteria DSS, and implementation taken from Eom (1996). Some examples of work in these areas include: Benbasat and Dexter (1982), Ariav and Ginzberg (1985), Bui and Jarke (1985), Sanders and Courtney (1985), Binbasioglu and Jarke (1986), and Dennis et al. (1988). Additionally, the work by Kasper and Cerveny (1985), Pracht and Courtney (1988), Sharda et al. (1988), Loy (1991), and the experiments analyzed by Dickson et al. (1977) and Courtney and Paradice (1993) and numerous others serve to provide structure and support to the definition of a DSS paradigm. In the early 1990's, data warehouses became a new area of research within the DSS paradigm. Decisions and data began to be viewed as less transactional and more analytical. According to Gray and Watson (1996), the data warehouses were another area where the DSS paradigm could be further studied and developed. In 1985, DSS added another characteristic of becoming an accepted paradigm by the introduction of its own specific journal, *Decision Support Systems*.

The rise of the internet brought old and new issues, such as interface design and e-commerce, to the forefront of MIS research. Even DSS issues that had been studied in detail were finding new applications through the internet. This new flurry of possible research streams could be a revolution in the field of MIS and may illustrate that DSS no longer adequately answers to the puzzles deemed most important for the field. Multiple schools of thought are now competing to become the paradigm for MIS. The proposed shifts in thinking could bring about a new paradigm to replace DSS and alter the stream of research moving the field from the post paradigm phase back to the preparadigm. But, as to whether only one paradigm win out, Kuhn says "… there are circumstances, though I think them rare, under which two paradigms can coexist peacefully in the later period" (1996, p. xi). The MIS field would be a good example of a rare case where paradigms may coexist because of the multiple reference disciplines it pulls from as well as the rapidly changing technology that it relies on.

Finally, where is DSS today and can it continue as a paradigm in MIS? Shim et al. (2002) set forth an agenda for continued development of the DSS paradigm, showing the continuing open-endedness of the paradigm as technology changes and the field continues to expand. The need for studies to develop the DSS paradigm are still being conducted. Courtney (2001) points out that, "more effective ways must be found to support the vast array of knowledge that will be required in these highly interconnected and wicked situations of the future" (2001, p. 36). His call for a merger of DSS and Knowledge Management Systems creates new puzzles to be solved in the DSS paradigm that may require continued research. Other acknowledgement of this stream of research is seen in the works of Benyon et al. (2002) and Bolloju et al. (2002). Only time will tell if DSS will remain part of the shared paradigm of DSS.

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[1]The importance of language to a paradigm has also been seen in other philosophy and history of science works, such as Feyerabend's *Against Method* (1975).

A Scientific Conclusion

Kuhn sets the paradigm as the bar for measuring whether a field is a science or not. He uses the 17th century field of Electrical Studies as the example of establishment of the paradigm: "Except with the advantage of hindsight, it is hard to find another criterion [other than a paradigm] that so clearly proclaims a field a science," (1996, p. 22). If the argument that DSS is a paradigm is accepted, can it then be extrapolated that DSS and indeed the field of MIS are sciences? Researchers in the MIS field, including DSS, feel the field has reached the level of rigor called for by Keen (1980). Indeed, those arguing for more relevance in research feel that the field of MIS has become too scientifically oriented. Given that MIS, including DSS, research is generally viewed by researchers as scientific, and understanding that DSS fits into Kuhn's paradigm model, then using Kuhn's argument above it can be said that the DSS field has reached a level of scientific achievement.

There are several research questions that will continue to be explored on the nature of the DSS paradigm in MIS. First, further discussion on the relationship of DSS and MIS is needed. Additionally, was DSS a complete replacement paradigm for MIS? Again, this development on the paradigm theme would provide insight on the relationship of the different research areas within the MIS field, as well as enabling the possibility of creating a view of the connections between MIS and other management and reference fields. How does the longevity of the paradigm like DSS affect a rapidly changing field like MIS? This would be an interesting step in further categorizing and predicting the effects of future paradigms in MIS research.

This paper presents the idea that DSS was the paradigm for MIS, traceable through and supported by three decades of literature on the subject. In thinking about the current state of MIS, it is possible to view the field in several ways. First, the position could be taken that DSS was the paradigm for MIS, but has now been replaced or at least operates in conjunction with another paradigm. As long as there are questions to be researched, the field of DSS will continue to exist within the structure of Kuhn's paradigm model until the DSS paradigm is no longer able to answer those questions and is replaced by a new paradigm for MIS. Another perspective would be that DSS is still the paradigm for MIS, continuing to develop and improve upon past work. Lastly, MIS could be at a crisis point with multiple research streams competing to become the new paradigm, including DSS as well as other topics in the field. Each of these perspectives can be supported by Kuhn's model in part. It is up to us as researchers in our field to determine the future focus of our research efforts.

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