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LEO ARTICLE

Information Systems Research and the Quest for Certainty

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"If a man will begin with certainties, he shall end in doubts;
But if he will be content to begin with doubts, he shall end in certainties".
Francis Bacon

This paper is written for information systems (IS) scholars who may be researching design problems of considerable complexity and who seek approaches and ideas that can increase their confidence in understanding and tackling these problems. The subject of the paper is the notion of '**certainty:'** the certainty of a researcher's performance and that of his or her research targets. How can researchers be sure that they are studying the right things in the right way in novel situations? How can they predict the certainty of success in situations where information technology (IT) innovation involves novelty and affects multiple stakeholders like users, developers, and managers? In order to answer these questions, researchers may need to critically evaluate and assess the ways they handle uncertainty in IS research.

Certainty and IS research

Scholars need to be clear about what they are studying, so we need to first define what we mean by **certainty.** The Oxford English dictionary defines 'certain' as determined, fixed, not variable, sure, reliable, unfailing, having no doubt. There can be certainty based on knowledge, dogmatic certainty, certainty without evidence, and certainty based on trust. The principal context in which we handle certainty in this paper is in the field of information technology and its use in a changing world. A simple definition of certainty for IS research is, therefore, doing the right thing to secure desired objectives, while believing in the correctness of one's actions. Hence, certainty, as defined in this paper, is based on the knowledge of what is going to happen in the present and the future. This knowledge can take different forms and will always be partial rather than comprehensive. The purpose of IS research is to increase the amount of certainty based on knowledge that is an improvement either in scope or degree.

Certainty can have different levels. For example, one may say, "I know this action is right," or "I am pretty certain it is right," or "I think it is right, but of course I may be wrong." It is also related to time. Again, one may say, "I am certain now, but I may not be so sure tomorrow," as doubts may have creep in or new knowledge emerges. Improvements in instrumentation and technology affect our concern for certainty, as these provide measures of things that researchers and IS users consider to be important. (Bourdieu, 1998).

Certainty can be either negative or positive. In other words, we can be certain that something will turn out well or will turn out badly. Accordingly, research targets can experience both negative and positive certainty (Shermer 1997). Negative certainty is an understanding of the things they must not do in order to avoid disastrous results, while positive certainty is the opposite, or an understanding of the things they must do or want to do to achieve positive results. There can also be false negatives and false positives. For example, a manager may say, "I don't need to involve users in design because senior management isn't interested," when in fact it is. "I must always use the most advanced technology, as my firm expects this," but the firm wants the cheapest not the latest.

IS researchers cannot function adequately without certainty. It requires confidence and logic, and draws upon evidence by inferring conclusions in ways that give confidence (scientific method) to outcomes. Certainty also comes from reason and lateral thinking, understanding how one thing relates to another. It is influenced by our customs, traditions, and values. IS researchers generally welcome a high degree of certainty in their research, although the study of new applications and application situations may lack this and even decrease it. Increased levels of certainty achieved by research can produce a virtuous cycle in which people become more certain as they perceive the certainty of others as espoused by theories and experience. But certainty can also be dangerous when it is wrong, resides in wrong theories and fallacious reasoning, and creates misplaced confidence.

An opposite of certainty--uncertainty--is defined in the Oxford English dictionary as something that is not definitely known or knowable. Information system scholars need to be aware that some groups and situations that they study are characterized by a higher level of uncertainty. They are limits to what can be known, such as how organizations introduce new technology, recognize and manage its organizational impacts, and ensure that innovation enhances people's lives. IT innovations both create new uncertainty and embody uncertainty of what can be known. Further disturbance to certainty is caused by the continuing evolution of a technology that requires a rethinking of both business practices and company organization if it is to be used effectively.

Today, IS researchers face more uncertainty than certainty about themselves and the needs and futures of their research targets. A challenging research question for the community is: "Can uncertainties related to IT design and use in organizations be reduced and, if so, how?" Important and related research questions are: "To what extent is uncertainty related to IT research increasing as the pace of change exceeds people's abilities to adapt?" "How can this best be dealt with?" "Can today's uncertainties related to IT design and use be turned into tomorrow's certainties?"

Certainty of scientific knowledge and procedures

It is important that IS scholars are aware that scientific principles are not always static and immutable and that ideas, explanations, and values can change as knowledge increases or attitudes change. For example, for many years certainty in research came from an approach called positivism, or logical positivism, which was based on the view that all true knowledge is scientific and it must be the result of scientific enquiry. Scientific enquiry was defined as the systematic study of observable phenomena, an activity that produced 'facts.' Scholars believed that the only sound way of producing scientific results was through careful and neutral observation with the use of experiments in which the results could be replicated. The scientific method incorporated *induction*, forming generalized laws by drawing conclusions from existing facts; *Deduction,* making specific predictions (hypotheses) based on these laws; *Observation,* gathering data to check hypotheses; and *verification*, testing the predictions against future observations as an effective way to arrive at certainty.

But in 1962, Thomas Kuhn challenged this approach in a ground breaking book, *The Structure of Scientific Revolutions* (Kuhn 1962), where he argued against the positivistic view of science as the accumulation of observations and laws. He postulated that science changes as the environment in which it operates changes, as do the ideas and objectives of researchers. There is an 'essential' tension in science, Kuhn noted, between total commitment to the status quo and certainty and the blind pursuit of new ideas and uncertainty. He believed that revolutions in science depend on a proper balancing of these two forces. When a large portion of the scientific community, especially those in power, are willing to abandon certainty codified in orthodoxy in favour of a new paradigm, revolution can occur. The power to affect revolution accrues from those who become professors, get grants, and publish their work. Scientific progress is the cumulative growth of both uncertain and certain knowledge over time, in which useful ideas are retained and non-useful ones abandoned based on paradigm shifts.

Kuhn argued further that paradigms are not permanent and offer alternative descriptions of reality. As situations alter and certain explanations lose credibility, he said, new paradigms can emerge. His theory suggests that what we think of as 'true' at any one time is always related to where we are in history (Holloway, 2001). These views resonate with the philosopher Hegel's concept of reality as a state of constant flux with the tension between opposite ideas and forces leading to change.

IS researchers, if they accept Kuhn's position and take a broad social perspective to the research, need to ask how they can make sense of an increasingly uncertain world with an increasingly uncertain base of scientific enquiry. How can they identify with certainty major problems and solutions if they draw upon uncertain paradigmatic foundations? Indeed, there has been a paradigm change in the approach to IS research, and this fact is increasingly accepted in universities as IS scholars recognize that problems reflect the environments in which they occur and are subject to changes in these environments, including the scientific communities. This new understanding requires flexible methodological approaches as included in theories of socio-technical design, qualitative research and environmental studies.

Certainty, theories of change and traditions

IS researchers work in contexts where change is endemic, and therefore, they need to understand how constant change relates to the idea of certainty. There are many theories of change, and the one or ones that IS scholars accept will affect their interpretations of research results and their impact. These theories are powerful because they are accepted by influential groups, which means they will endure and affect deeply our cognition of the IS environment. Certainties that endure often become traditions, or sets of practices, normally governed by overtly or tacitly accepted rules of a ritual or symbolic nature, which seek to inculcate certain values and norms of behaviour by repetition (Hobsbawm and Ranger, 1983). Such traditions are expected to have a considerable influence on subsequent beliefs and behaviour of both IS scholars and their study subjects.

Tradition co-creates certainty because it involves fixed and formalised practices. It does not preclude change and innovation, but confers on these the sanction of precedent and continuity. On the whole, a research tradition is a good thing. It is reinforced by books, conferences, and journals, which, as a rule, describe the currently approved ways of doing things. Researchers may find that traditions also provide some order in volatile situations. While there are some scholars who enjoy lives of total uncertainty in research environments that are exciting but unstable, most of us want a degree of certainty in some aspects of our work. Hobsbawm (1999) points out that tradition brings the members of groups together and gives them an identity. Hence all traditions tend to use history as a legitimator of action and a way of cementing group cohesion. However, researchers are likely to find that while a tradition can act as a motivator and reinforcer, it can also place a restriction on activities such as career progression.

In line with Kuhn's theory, from time to time an IS researcher will find that new developments have led to a major jump in thinking and approaches to the design and use of IT, and that these ideas are creating new traditions. Consequently he may need to re-consider the tradition he had adopted and develop new ways to approach study domains. An example of this process at work is the transformation of the belief that the best computing solutions emerge from the engineering discipline. This thinking led to a focus on engineering solutions and problems as the only means for addressing IT-related problems and certain research traditions arose that followed the canons of engineering principles. Because of these traditions, researchers tended to give priority to engineering factors rather than the needs of organizations or people, which consequently led to the failures of many large British national computer systems where the critical success variable turned out to be the ability to meet the social needs of the citizens.

The research question, therefore, is, "What kind of certainty needs to be valued in the IS research domain and how is this being achieved?" (Mumford, 2003).

Definitions of change and how these affect the use of IT

IS researchers need to be cognizant of how researchers in other disciplines respond to change and the lack of certainty, and how their ideas can become relevant to them. There is much dissent over the nature and concept of change: how it happens and what form it takes. Evolutionary biologists are among the most influential scholarly communities that have tried to define change. Biologists see change as a process of evolution, although they often disagree on how this takes place. Darwin and his followers saw change as the process of continual, but relatively gentle, evolution, with species changing gradually as their needs and environment are altered (Dawkins, 1986). In contrast, American paleontologists Niels Eldridge and Stephen Jay Gould, espouse a theory called 'punctuated equilibrium,' suggesting that change proceeds slowly and steadily until a set of circumstances produces a sudden and rapid burst of major change (Gould, 1980).

Richard Dawkins makes a distinction between Darwinian evolution and cultural evolution (Dawkins, 1986). He sees the latter as being greatly influenced by positive feedback, and he believes that positive feedback processes have an unstable, runaway quality.

The influence of a new variable is unchecked until either a major disturbance occurs, often leading to disaster, or the opposite process of negative feedback comes into play. Negative feedback here means that change is slowed down and controlled so that uncertainty is reduced and replaced by a degree of certainty. This concept has led to an interest in chaos theory, which has its origins in the work of the French physicist Henri Poincare and argues that when something is chaotic and "out of control," tiny changes may have surprising and drastic consequences (Buchanan, 2000). Therefore, such systems cannot be controlled with certainty as their complexity is too high.

Robert Chia argues for a different concept of change and certainty that applies to the environment in which technical change takes place. He argues that the conventional ideas of organization can become dysfunctional as they seek to slow things down when what is required is a greater speed of response (Chia, 1999). He argues that companies are increasingly finding themselves under pressure to creatively adapt and respond to change in order to remain economically viable. Yet, they are often unaware of the complexity of their environment because they have ingrained habits of thought regarding order, stability and identity. These attributes slow their behaviors when what they need are quicker response mechanisms in order to bring about new forms of control that can increase certainty. In this view, change is no longer punctuated equilibrium or a transitory stage between two stable states of certainty. Change is a continuous process that must accordingly be studied and explained in terms of the overall environment in which it is taking place. Thus, IS professionals are the instigators of continuous and rapid change and IS researchers need to have an understanding of the processes of change and its outcomes, and how these increase the uncertainty of the system designer's role.

An important unrecognized social question for IS researchers is: "Does continuous and rapid change produce what people want?" Most people value the ritualistic continuity of family life and the support of common-minded friends. Many have great loyalty to the organizations in which they work, to the teams and individuals with which they work, and to the nations or religions to which they belong, and do not see this as dysfunctional. Yet Chia (1999) argues that we must all be able to embrace and accept continual change. IS researchers may help discover the extent and conditions of our ability to do this, or whether it will be necessary to do it always.

All of these concepts of change must be of continued theoretical and empirical interest to IS researchers. Darwin's smooth, regular, and controlled theory of change or the punctuated equilibrium theory are both relevant and can be tested when new disruptive technologies appear and cause considerable upheaval and uncertainty. Eventually they become part of the technological environment, only to be replaced by yet another advance. How does this process take place, under what conditions, and what organizations can effectively execute the process?

Overall, IS researchers need to ask whether system design and IT innovation will produce more rather than less certainty for themselves and for the organizations in which they operate. In his book, *Enterprise COM*, Jef Papaws (1998), president and CEO of Lotus Computing, provides a positive vision of the 'market-facing' enterprise in which all relationships and functions are enhanced through technology. He believes that technology will substitute for many of today's less advanced communication processes and maintains that in the networked economy the activities of business can be coordinated around the world to make the most of the advantages that different countries offer. On the other hand, Jeremy Rifkin, a fellow at the Wharton School, believes that the global market is unlikely to be a source of continuing global stability (Rifkin, 2000). In his view, alliances between firms, industries, and countries will lead to success for some, but disasters for others; and because the global production system is now so interlinked, a problem in one country may easily cross national boundaries. By the same token, a new system may provide more relevant information at the same time it creates uncertain changes. The reorganization of work that happens with a new system creates patterns and acts as a simplifying mechanism, which may provide more stability. However, systems designers often overestimate the positive consequences of the increase in information they have brought about. There are many unintended and unanticipated consequences that can introduce more complexity to an already volatile situation, especially for the users of a new system.

Certainty and ethics

IS researchers also need to assess how major changes of the kind discussed above relate to ethics and values. Leo Award Winner C. West Churchman argues that because the world is uncertain and relative there is a need for global ethical management. He believes that the world must be managed in a way that is good for everyone, and defines 'good' systems as the best systems we humans can create at any period of time. Ethics must always be an important factor in systems design, Churchman believes, and information systems research should involve a branch of ethics (Porra, 2001).

The British Chief Rabbi, Dr. Jonathon Sacks (2002) supports this idea of ethics in systems design. He argues that certainty can only be increased through the acceptance of the moral principles of control, contribution, creativity, cooperation, compassion, and conversation. But even when following moral principles, systems designers may find themselves facing a dilemma when trying to make decisions since different cultures have vastly conflicting ideas about the world that will contain their new systems. How can systems designers make choices with certainty? Unfortunately, new technology and its use is replete with unfamiliar and uncertain problems to which traditional ethical principles may not be fully applicable. Many innovations will have both beneficial and adverse consequences, often for different groups, and IS researchers will need to learn how to distinguish them and how ethics and uncertainty are inherently intertwined.

Certainty and control

Certainty relates also to having control, and in this sense is an important and necessary attribute for most IS design interventions. Ideally, IS designers need to have the certainty of knowing that they are introducing the right systems in the right way at the right time and that they can control the process. In order to do this, they need to also understand that their innovations can create uncertainty for those who use them and they should strive to reduce this uncertainty. They need to ask themselves, "Can new technology be designed and introduced in a way that provides both designers and users with more rather than less control over their environments?" This requires an evaluation of both the nature of new technology and how it will be used.

One of the first writers to address the consequences of information technology was James R. Beninger. He used the term "the control revolution" to describe the transition from the industrial age to the information age (Beninger, 1986). Beninger saw information technology as a powerful "controller," and argued that mid-nineteenth century industrialisation had created so much complexity that it had caused "a crisis of control" that required new control technologies for production, distribution and consumption. Control, as he saw it, depended on the creation of new and beneficial forms of bureaucracy that would lend more predictability and certainty to operations. Many researchers have praised Beninger's analysis, but Andrew L.Shapiro believes Beninger did not go far enough in addressing the political issues of control associated with IT (Shapiro, 1999). Shapiro suggests that modern control systems must be understood more broadly with greater attention paid to how they are used and who uses them. He notes that recent decades have witnessed: 1) the potentially monumental shift in control from institutions to individuals made possible by new technologies, 2) an increasing conflict over such change between individuals and powerful entities (governments, corporations, the media), and 3) the unexpected, and not always desirable, ways in which such change could reshape our lives.

IS researchers will need to continuously explore the tightly woven relationships between technology, certainty, and control. Technology has given us the means to change many aspects of our lives--how we learn, how we work, and how we participate in social and political activities. Technology can also alter who is in control of these activities: traditionally teachers, managers, and politicians. Because they now have more knowledge, technology can provide these groups with more certainty and confidence. But there is an active debate taking place regarding the allocation of control. Do we want certain groups to control certain aspects of information and knowledge, or do we want this knowledge to be available to everyone? Shapiro (1999) argues that there is a need to strike a continuous balance. In his view, individual power can be pushed too far. For example, if we remove power from elected politicians, we may forfeit the benefits of representative democracy.

Arising from the issue of control and certainty is the issue of progress. To be sure, when technologies change, control also changes and may pass to new and different groups. But will too much certainty and the confidence and stability that it provides make us less receptive to innovation? Some groups who are in control may avoid making the critical decisions that affect their communities and countries, fearing that they will lose control and thus power.

Summary of ideas

This paper has dealt with an emerging and complex subject that I believe is critically relevant to the IS community and worthy of more research. I discuss the concept of certainty and make the point that those who study IT face a particular dilemma. While seeking certainty for themselves and others by trying to provide knowledge about how people can design and deliver friendly, reliable, and appropriate systems, IS researchers may at the same time cause a great deal of uncertainty. While the desirable end product may be the building of greatly needed systems, the route to change may be full of unexpected problems and challenges. This paper examines and discusses how making certainty a research topic can help provide more relevant knowledge on the following:

a) How to achieve better clarity of objectives and to determine whether systems will increase certainty.
b) An understanding of how the past influences the future.
c) A realization that change is becoming increasingly complex, taking on different forms and definitions and diverse objectives. Increasing certainty of our knowledge requires that these are better understood.

d) A conviction that clear ethics and values are required to achieve certainty and order in human affairs. There is a need to study what these ethics and values are.
e) A recognition that the IT design and implementation process is dynamic and fast. How can faster change be associated with greater certainty?

To activate these questions, consider the following situation. You are researching a new systems design, and you need to identify those aspects of the project in which you have certainty and are reasonably sure of what will happen (primary causalities and dependencies). This certainty will come from your experiences of other similar projects, from your analysis of the present situation and analogous reasoning, and from your knowledge of relevant theories of the field. Divide a circle into four quadrants and give each quadrant the different headings of people, technology, work organization, and environment. Then, sort the factors and regularities of which you are certain into each quadrant. Outside the circle create a Zone of Uncertainty in which you identify and document the things and events about which you are uncertain. After this, decide how you will gain more knowledge about these so that you can move them into the Circle of Certainty. Consider also how and why the factors and regularities inside and outside the circle may change while the research progresses. This record might later provide you with an interesting history of the uncertainty of our knowledge of IS design behaviors as it develops and an understanding of how our knowledge has increased over time.

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