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Failure to Inform: Errors in Informing Systems

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Abstract

The paper examines ways in which information systems can and do misinform clients. Using a common framework for understanding information systems, it uncovers four primary (and eleven secondary) methods by which systems can fail to inform. The paper uses research conducted in a variety of fields.

Introduction

This paper lays groundwork for experimental research into the human factors involved in the failure of information systems to inform. Its purpose is to develop a framework for this inquiry by drawing from research findings in a variety of fields, such psychology, journalism, and cybernetics. While this paper applies the work to information systems, the work is applicable to all the fields that endeavor to inform clients. These fields collectively are known as Informing Science (Cohen, 1999).

Over 30 years ago, Ackoff's (1967) suggested that those designing information systems misinformed their clients by building systems based on five unjustified assumptions:

1. the critical deficiency under which most managers operate is the lack of relevant information,
2. managers request the information they need,
3. if managers had the information they want, their decision making would improve,
4. better communication among managers improves organizational performance, and
5. managers need not understand how their information system works, just how to use it.

This paper builds on Ackoff original theme, although not his method. The theme of this paper is to show that information systems can and do misinform their decision maker clients and how this misinforming occurs.

The Traditional Framework of Information Systems and its Problems

The traditional framework of information systems is an application of the three-stage Systems model, shown in Figure 1. This, in one variant or another, is used in many introduction to MIS texts to represent how inform comes to be delivered to decision makers (for example, Cats-Barril & Thomson, 1997; Stair & Reynolds, 1998).

The pervasiveness of this framework demonstrates that, limitations and all, it has influenced the thinking of those working in the field. To understand the research on misinformation presented below, it is helpful to expand this framework. In doing so, we expose often-unstated steps and it is here where most problems occur. Figure 2 shows such an expanded framework.

data → processing of data → information

Fig. 1. The simple three-stage framework of information delivery.

Here we explicitly point out that 1) reality and the captured data are not the same, 2) decision making takes place within a context (described in the paper), and 3) only selected data are processed. In this way, the framework clarifies that decision-making is only indirectly influenced by reality; there are many steps that separate reality from the decision-making process.

reality → data recording → processing of selected data → decision maker ← context

Error Types: I. Data Recording II. Processing Stage III. Decisionmaking

Fig. 2. Expanded Framework on information delivery.

The author makes no claim that the framework shown in Fig. 2 is new. It isn't. Gupta (1996) for example uses it. What is new is applying the framework as a means to organize the types of errors that lead systems to misinform their clients.

Data Recording Stage – Type I Errors

Information systems do not deal with reality directly. Data, as proxies of reality, are recorded for later processing. A number of errors can and do occur in this stage. This paper calls errors that occur in recording Type I errors.

Type I errors have been studies in depth in two separate and disparate arenas. One of these arenas follows the methodology of human factors research. Researchers at Bell Laboratories noted that telephone records were full of errors and asked "why". They determined that about 80% of all errors in new systems are derived from data transcription alone (Mitchell, 1979; Bailey, 1973; Manley, 1973). Type I errors are insidious because, once errors have been introduced into a system, they are inherited by all new systems that rely on those data.

A second arena in which Type I errors have been studied is the psychology of human attention and memory mechanisms. People are not good at accurately recording and reporting reality, as seen in eyewitness accounts (Loftus, 1975, 1979a, 1979b, 1980, 1993, 1997). Justice system research reports dire outcomes from police and courts ignoring Type I errors and wrongly assuming that their eyewitness testimony and old memories brought to light by hypnosis accurately reflect reality. (Perdergrast, 1995; Rattner, 1988). For decision makers in other areas, such as business, relying on mistaken memories have less public consequences that are not as easily studied.

The above research on Type I errors show, in two separate arenas, that people making good faith efforts to accurately report and record reality fail. Another category of Type I errors occurs when people actively try to misrepresent reality. This effect has been studied in the news media (Solomon, 1999; Moorman, 1977).

Information systems that involve mudslinging with out-and-out lying and other forms of misrepresenting reality appear to be successful in political campaigns in the United States. However, the author has so far failed to uncovered research into information systems that deliberated misrepresent reality.

Processing Stage – Type II errors

In the processing stage, data are filtered and summarized. We will call errors that occur at this stage Type II errors.

Systems Bias. Information systems are designed and used by people and so by nature are biased. Information systems occur at the intersection of technology and human behavior. There are two categories of systems bias: designer bias and end-user bias.

Systems bias is difficult to understand or perceive because both the designer and end-user of the information system make assumptions (often unknowingly) that impacts the output of the information system. "The fish is the last to see the water" (Gause & Weinberg, 1982).

Perhaps the most publicized instance of systems bias is seen in the works of Geert Hofstede. Ethnographer Hofstede (1980) carried out what is arguably the most influential study of work and culture while employed by IBM in the 1970's. He became aware that his original survey instrument could be biased by his own cultural assumptions. To test whether he and his team biased the results, in the 1980's he arranged for his survey instrument to be translated into other languages in a sort of double-blind approach that isolated the product from the original team. The results of that study (Hofstede, 1997, 1998) clearly demonstrated the impact of systems bias, even in scientific endeavors.

System Designer Bias. Information systems that create management reports require the selection and filtering of data. They all possess Type II errors in that their designers had to select filters. They, as we all, live in the midst of hidden assumptions and so, despite their best efforts to avoid bias, filter data for our system in ways that reflect their bias. Builders of systems do not see or understand their own bias as it is invisible to them.

One example of system bias can be seen in group decision support systems (GDSS) that allow employees to post their input anonymously (for example, O'Connor, 1999). Note that the concept that ideas from employees of all ranks, sexes, and tenure with the company should be considered equally on their merit is based in meritocratic Western modes of thinking. Many other societies value the thinking of selected individuals (such as the oldest) with higher regard than others. Bias in GDSS has been ignored by the MIS literature.

Chauvinism in design work is not limited to GDSS. In his book on software interface design, Fernandes (1995) explores this issue in great depth from the point of view of making software that is independent of culture. He points out that, due to the designers' cultural assumptions, the impact of the output on the user is sometimes different from what the designer anticipated. For example, "standard" icons for mail and trash are meaningless in places where the mail boxes and trash cans look different.

Nielsen (2000) used standard research techniques to study how users actually perceive web sites. His research on Web usability lead him to the same conclusion as Fernandes. Web designs contain the bias of their designers. Designers need to understand the end-users, their needs, and their assumptions to create successful webs.

System Users' Bias. A second category of systems bias involves end users. Type II bias is even more obvious in systems that allow the end user to select what to report. In this case, users bring to the system their own biases.

Pre-conceived notions drive (or at least influence) the discovery process. People tend to find what they are looking for. This is not to say that drill-down features are not useful. Rather it is to point out that users need to understand their own biases.

Data Smog. The problem with data for most firms is not lack of it, but too much of it. This phenomenon has been variously name: "Data Smog" by David Shenk (1997) and Data Deluge by John Gehl and Suzanne Douglas (1999). Shenk views the phenomenon as a threat; Gehl and Douglas, taking a McLuhan viewpoint, see it as an opportunity. (Shenk's viewpoint is echoed from the news reporting viewpoint by Sommerville (1999).

Decisionmaking Stage – Type III errors

Type III error are errors in interpretation of information systems' output. This type of error has been studied in many other fields, but not in Information Systems. One category of Type III errors comes from assuming that decision makers are fully rational.

Search for Meaning. Groundbreaking research by cognitive psychologists Tversky and Kahneman (1980) demonstrates clearly that decision makers are not rational all the time. Changing the sequencing and framing of the same facts can lead decision makers to make different choices. The choice can be based more on how the problem is framed in its presentation than on given facts of the case. This lack of rationality is how trial lawyers who argue the same facts can reach contrary conclusions. Question framing also explains why political and other polls are highly influenced by the wording and sequence of poll items.

Another category of Type III error comes from ignoring context. For the output of an information system to be understood, it must be viewed within a context (Checkland 1981; Winter, Brown and Checkland 1995; Beer 1999). Indeed, the mathematical definition of information is rooted in the ability of information to change (the decision characteristics of) the receiver (Shannon & Weaver, 1963). For this to occur, the decision maker must have a decision that needs to be made, hence context. Yet, information systems themselves do not commonly provide context.

For example, consider the output of an information system that reports dropping sales from the Northwest region this month. Without context, this "information" might lead to concern that the Northwest region had a problem. Now view that information in the following context: Storms and flooding put the Northeast in crisis. Workers cannot leave their homes. Without the context, the meaning of the information is lost and the information could lead to misinformation.

Within a Social Context. The meaning of information and information systems exists in a social context. Kling (1999) wrote "*One key idea of social informatics research is that the 'social context' of information technology development and use plays a significant role in influencing the ways that people use information and technologies, and thus influences their consequences for work, organizations, and other social relationships.*" Information systems created to serve one purpose can be used for other, even contrary, purposes and thus produce a Type III error. For example, during World War II, the United States Census data were used by the military to round up Americans of Japanese ancestry.

Solving the Wrong Problem: Type IV Errors

No discussion of information systems errors would be complete without mentioning the most widely investigated, solving the wrong problem. A Standish Group study (1998) indirectly cites getting this right as the top factor in project success and failure. Industry warhorses Donald Gause and Gerald Weinberg (1990) point out that without end user involvement, most projects are doomed to fail.

A quarter century ago, Lucas (1975) suggested breaking with the strict systems development life cycle by adding prototyping as a way to overcome systems failures. More recently Beyer and Holtzblatt (1998) recommended using ethnographic methods during the requirements definition stage of systems to ensure solving the right problem.

Conclusion

Table 1 summarizes the four types of errors in Information System. Note that none of these are the types of errors that are easily amenable to engineering solutions.

Error Type	Name
I	inaccurate recording of data – transcription, …
I	inaccurate recording of data – memory
I	inaccurate representation of data – deliberate misrepresentation
II	filtering of data – designer bias
II	filtering of processes – designer bias
II	filtering of data – end user bias
II	filtering of data – data smog
III	decision-making – misassumption of rationality
III	decision-making – ignoring context
III	decision-making – misapplication of tool to context
IV	solving wrong problem

Table 1. The Four Types of Errors that Create Misinforming Systems

The paper has studied ways in which information systems misinform clients. We have shown that each of the components in a common framework for understanding information systems is associated with types of errors. Using research findings conducted in a variety of fields and using a variety of research methods, this paper demonstrated four primary (and eleven secondary) ways in which information systems can fail to inform.

This work focuses on information systems. The work can be expanded elsewhere to include other fields of Informing Science, such as journalism.

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