Data and Reality:
Implications for Record-Keeping by Organizations

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Although William Kent's book entitled *Data and Reality* is clearly targeted at a technical audience, its scope extends beyond computer technology. "The questions," he says, "aren't so much about how we process data as about how we perceive reality, about the constructs and tactics we use to cope with complexity, ambiguity, incomplete information, mismatched viewpoints, and conflicting objectives." (p. xv)

Moreover, he asserts the scope extends not only beyond computer data processing into the realm of how we perceive the world but also into our inner domain, encompassing such issues as:

- Identity – What is our true nature? What needs, goals, outcomes define who we really are?

- Attributes – What kind of individuals are we? What are our values, assets, and limitations?

- Relationships – Kent argues, "This is the core of it all." What is the quality of our interactions with parents, lovers, spouses, children, siblings, friends, colleagues, and other acquaintances? What are our connections with things material, social, spiritual, and otherwise? … What are the issues and problems? How can they be improved?

- Behavior – What should we plan to do in various situations? How should we do it? What might be the consequences, both intended and otherwise? What contingencies should be anticipated?

- Modeling – How accurate and useful are the constructs we use to explain all these things? How effective are these kinds of explanations in helping us change what needs to be changed? (p. xvi)

Kent argues that we lack a clear and commonly agreed upon set of notions about data, including such issues as what data are, how they should gathered and

maintained, and their relationships to the design of programming languages and computer operating systems. (p. xxi)

However, if it is true, as he suggests, that our own personal identities are bound up in these issues, there should be little wonder that agreement is lacking – because such agreement would mean that we all are willing and able to perceive ourselves in exactly the same way. While it might be possible to conceive of such a notion being more widely acceptable in societies valuing conformance above personal expression, it seems unlikely to prevail in the "land of the free and the home of the brave."

Nevertheless, Kent says, "People in the data processing community have gotten used to viewing things in a highly simplistic way, dictated by the kind of tools they have at their disposal." (p. xxii) However, he cautions, "An information system (e.g., database) is a model of a small, finite subset of the real world." Moreover, in noting, "We expect certain correspondences between constructs inside the information system and in the real world," Kent unintentionally further reinforces the point – data in and of itself is not reality and should not be mistaken for it. (p. 1)

On the other hand, to the degree that we may conduct business on the basis of clearly specified data created in electronic information systems, it is now possible to maintain complete and nearly perfect records of our agreements, transactions, and the results they beget.

Kent suggests, "Many of the concerns about the semantics of data seem relevant to any record keeping facility, whether computerized or not [but] the problems appear to be aggravated in the environment of a computerized database." (p. xxii-xxiii)

However, rather than aggravating such problems, it seems more likely that electronic systems merely make such problems more explicit and salient and, thus, more likely to be addressed. Without the aid and inducement provided by reliable records maintained and made more usable and shareable in electronic systems, lack of resolution of semantic issues is likely to go unnoticed in many instances, while spawning misunderstanding, confusion, inefficiency, inaction (or at least lack of effective action), distrust, discord, litigation, disaster and even war in many other instances.

Kent notes it is difficult to divide topics into clear, unambiguous, and tidy categories the logic of which is readily apparent and agreeable to all people. Accordingly, he says, "it difficult to partition a subject like 'information' into neat categories like 'categories', 'entities', and 'relationships'." Nevertheless, he points out, "it's much harder to deal with the subject if we don't attempt some such partitioning." (p. 18)

"In a record processing system," Kent observes, "records are created and destroyed, and we can decide with some certainty whether or not a given record exists at any moment in time. But what can we say about the existence of whatever entities may be represented by such a record?" (p. 19)

Consider we ourselves as people, for example. What are we to make of a system in which we can routinely be "created" and "destroyed" as entities quite apart from our actual conception and death? However, that is the very sort of logic espoused by so-called experts in enterprise architecture, data modeling and database design.[1]
To the degree the intent of models is to reduce "needless" data redundancies and inconsistencies, which are we to take as needlessly inconsistent – the models concocted by others, or our own perceptions of reality? Moreover, from the perspective of each of us as individual human beings, which are we more likely to consider to be needlessly redundant – our own minds or records that conflict with our recollections of reality?

Insightfully, Kent proffers, "It is often said that a database models some portion of the real world. … It ain't necessarily so. The world being modeled may have no real existence. It might be historical information (it's not real now)... It might be falsified history (it never was real) or falsified current information (it isn't real now)… It might be planning information, about intended states of affairs (it isn't real yet). It might be hypothetical conjectures – 'what if' speculations (which may never become real)." (p. 19)

However, having invested much time and great effort in concocting our models, we may become overly enamored with them, to the exclusion of reality – past, present, or future.

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[1] See, for example, the instructions provided by Melissa Cook in her book entitled *Building Enterprise Information Architectures: Reengineering Information Systems* as quoted at http://ambur.net/PushShove.html#cook

Moreover, as Kent notes information is often so complex that no individual human being can comprehend all of it, and even when information is not overly complex, it may simply have not yet been discovered by anyone. (p. 19) Thus, in the face of uncertainty and doubt, powerful incentives exist for us to try to "capture" complexity and information that is as yet unknown in models we can control, even though such models themselves may bear relatively little relationship to reality.

Computers and database technology enable us to create, elaborate, propagate, and share such models far more easily and effectively than was possible in precyberhistoric times. Yet, as Kent observes, "… there are certain characteristics of computers that have a deep philosophical impact on what we do with them. Computers are deterministic, structured, simplistic, repetitious, unimaginative, unsympathetic, uncreative." (p. 23)

Moreover, he notes data architects, database administrators, and other information management professionals tend to interpret the term "information system" to be virtually synonymous with the term "integrated database." However, applying such limited definition artificially constrains consideration only to information that "can be perceived as some formal structure of relatively simple field values (as is computerized file or catalog processing)," thus excluding "text based systems, with their capabilities for parsing, abstracting, indexing, and retrieving from natural language text." (p. 23)

Doing so automatically excludes the bulk of reality as it is documented in electronic records because in fact most such records are relatively unstructured. The fact that we commonly do so is further evidence of the possibility that we care more about the simple and orderly beauty of our models than often messy complexity of the truth.

Kent observes, "The traditional construct that represents something in an information system is the record... In manual (non-computerized) systems, it could be one sheet of paper, or one card, or one file folder." Sometimes records don't have much structure but merely a recognized convention for distinguishing one from another. In traditional paper-based record-keeping systems, the correspondence of records to reality has been tenuous and unclear, and in computer systems, Kent says the concept of "record" is "equally muddy." (p. 40)

Unfortunately, the concept of a record has been muddy not just to computer technicians but also in the minds of records managers and the theories of records management as a discipline, which poses the illogical existence of "nonrecords". However, the ISO 15489 standard has begun clarify the concept by outlining four attributes of a record: authenticity, reliability, integrity, and usability.

Each of those attributes provides a basis on which the quality of a record can be assessed. It would be more logical to consider the quality of each bit of information based upon the degrees of each of those attributes that it possesses, rather than to try to dismiss the existence of the information altogether. While the existence of *disinformation* is logical, as people do actually try to mislead others, there is no such thing as *noninformation* nor is it logical to suggest the existence of *nonrecords*. The fact that policies have been written to enshrine the concept of nonrecords may be taken as further evidence of the human proclivity to deny reality when it conflicts with our own motives and memories.

With respect to motivations for information systems, Kent cites the aim of identifying a "single construct that we can imagine to exist in the repository of an information system, for the purpose of representing a thing in the real world." However, he notes, "In many current information systems, we find that a thing in the real world is represented by, not one, but many records." (p. 42)

Thus, he suggests, "One objective of a coherent information system … is to minimize this multiplicity of records… In the first place, these various records usually contain some common information … it takes extra work to maintain all the copies of this data, and the information tends to become inconsistent … Secondly, new applications often need data from several of these records." (p. 42)

However, as we strive to make reality conform to our models, Kent notes, "Systems that depend on symbolic associations for paths (e.g., the relational model), as opposed to internal 'unrepresented' paths between entities, cannot readily cope with changing names …" (p. 61) Moreover, he notes that most words have multiple meanings, thereby further compounding our difficulty in making reality conform to our models. (p. 66) Not only do the names that we ascribe to concepts change over time but, in many instances, the terms apply to multiple concepts at any given point in time. Accordingly, Kent insightfully observes:

> Ambiguity appears to be inevitable… The set of concepts that might enter our minds appears to be quite infinite, especially if we count every shade of meaning, every nuance and interpolation, as a separate concept. On the other hand, the number of words of a reasonable length (say, less than 25 letters) which can be formed from a small finite alphabet is quite small in comparison. It seems inevitable that many of these words would have to be employed to express multiple concepts. (p. 66)

He quotes J.A.Goguen, as follows:

> … fuzziness, far from being a difficulty, is often a convenience, or even an essential, in communication and control processes. It might be noted that in ordinary human communications, the ability to stretch and modify word meanings is essential. … *Vagueness* (or fuzziness) is closely related to *generality*, the possibility of referring to more than one object. In fact, without generality, language would be almost impossible. Imagine if we had to give each chair a new proper name before we could talk about it! (p. 66 & 67)

In an example that is particularly relevant in a litigious society like ours, Kent observes, "The complexity of legal jargon testifies to the difficulty of being precise and unambiguous." (p. 67) Not only is the massive cost of civil litigation a testament to the difficulty in sharing precise meaning but it is also a symptom of failure to create and effectively manage and use good and complete records.

Discovery of evidence is often the most expensive part of litigation, which is merely another way of saying that our records are not as readily accessible as they should be. It is not hard to understand why many nefarious and perhaps even well-meaning characters prefer as much, since they may prefer the risk of litigation to the certainly of having their "mistakes" – intentional or not – revealed in clear and unambiguous detail.

Moreover, Kent notes that if we listen carefully, all sorts of ambiguities constantly occur in our daily conversations. Indeed, he says, "If you listen too carefully, it could drive you out of your mind." (p. 67) Why would any sane person want to be subjected to such torture? Thankfully, most of our daily conversation is not recorded and thus is unavailable for "play back" to reveal our inconsistencies, irrationality, and deceit. However, to the degree that E-mail and instant

messaging make it very easy for us not only to "run off at the mouth" but also to automatically create records as we do so.

Addressing the general concept of models, Kent points out that "data models are techniques for representing information, and are at the same time sufficiently structured and simplistic as to fit well into computer technology." However, he voices a frustration felt by many: "***The term 'model' is so over-used as to be absurd***." (p. 107, emphasis added)

Indeed, as the Federal Enterprise Architecture (FEA) was issued in series of models, the term "model fatigue" was coined to capture the thought that the threshold for human comprehension, much less effective response had been exceeded. Subsequently, the new term of art being used to describe additional FEA documentation is "profile," such as in the Security and Privacy Profile, the Records Management Profile, Geospatial Profile, etc. However, no one has taken the time to clearly define, much less gain consensus on what a "profile" is or how changing the name of the documents can help to make the information humanly comprehensible to relieve the fatigue. Be that as it may, the following is what Kent had in mind as he wrote his book:

- A model is a basic system of constructs used in describing reality. It reflects a person's deepest assumptions regarding the elementary essence of things.

- A model is more than a passive medium for recording our view of reality. It shapes that view, and limits our perceptions. ***If a mind is committed to a certain model, then it will perform amazing feats of distortion to see things structured that way, and it will simply be blind to the things which don't fit that structure.*** (p. 107, emphasis added)

If a model reflects a person's deepest assumptions about the essence of things, it should not be surprising that it may be difficult to achieve deep and broad consensus on models that are themselves deep and broad. Achieving such consensus may simply require too many people to make too large a leap of faith, and such difficulties may prompt the true believers to try to coerce consensus that simply does not exist.

Kent notes, "the data processing community has evolved a number of models in which to express descriptions of reality" but those models are "highly structured,

rigid, and simplistic, being amenable to economic processing by computer." (p. 108)

Moreover, he observes, "Some members of that community have been so overwhelmed by the success of a certain technology for processing data that they have confused this technology with the natural semantics of information. They have forgotten any other way to think of information except as regimented hordes of rigidly structured data codes …" (p. 108)

Kent says, "All the problems [addressed in his book] converge on the conceptual model," and he asserts, "An enterprise is going to have a large amount of time, effort, and money invested in the conceptual model." However, he argues, "***any formalism we adopt as the basis of the conceptual model will still be an artificial structure***," and thus, "***A lot of energy will go into forcing a fit between the model and the enterprise***." (p. 108, emphases added)

Kent encourages us to "Think of a small army of technical personnel who have been indoctrinated in a particular way of conceptualizing data, and who have mastered the intricacies of a new language and the attendant operational procedures." (p. 109) Yet, he cautions, "***Most models describe data processing activities, not human enterprises.***" (p. 111, emphasis added) He cites, "The relevance of semiotics (a branch of philosophy dealing with the theory of signs) to data processing has been stressed by such authors as Zemanek and Stamper." And he notes, "It is a natural connection, since a computer deals only with the signs which represent things, and not with the things themselves." (p. 111) Kent observes that "***most database systems emphasize the questions of how data may be stored or accessed, but they ignore the questions of what the data means to the people who use it or how it relates to the overall operations of a business enterprise***…" (p. 117, emphasis added) Moreover:

> If we intend to use a record to represent a real world entity, there is some difficulty in equating record types with entity types. It seems reasonable to view a certain person as a single entity … But such an entity might be an instance of several entity types, such as employee, dependent, customer, stockholder, etc. It is difficult, within the current record processing technologies, to define a record type corresponding to each of these, and then permit a single record to simultaneously be an occurrence of several of the record types. (p. 121)

Thus, Kent points out, "To fit comfortably into a record-based discipline, we are forced to model our entity types as though they did not overlap. We are required to do such things as thinking of customers and employees as always distinct entities, sometimes related by an 'is the same person' relationship." (p. 121)

Note the irony of the use of the term "our" in conjunction with so-called entities who happen to be people, such as employees and customers – as if we "own" other people. While it may be fair to think that companies own the time of employees for which they are paid, to suggest that customers might be "ours" belies the customer focus and service orientation touted by so many companies in their marketing hype.

Likewise, in Government, *citizen-centricity* is supposed to be a guiding principle for all eGov initiatives under the President's Management Agenda (PMA). However, few, if any agencies, lines of business (LOBs), or so-called "one-stop" eGov project managers have taken the time to understand what the concept truly means – although it is not particularly hard to comprehend, based upon the plain meaning of the terms: The citizen, not the agency, LOB, or eGov application should be placed first and foremost at the center of the development effort.

That means citizen "entities" are not "ours" to define in eGov information technology systems. Instead, citizens should be allowed to define not only themselves but also the software applications they prefer to use. All that is properly within the province of government are the elements of data that are truly and uniquely "inherently governmental" in nature.[2] It is such data elements that distinguish agencies, LOBs, and eGov projects from each other.

Kent points out, "Record structures work best when there is a uniformity of characteristics over the population of an entity type... Most fundamentally," he says, "it is presumed that the entire population has the same kinds of attributes." (p. 124) However, in a democratic, pluralistic society, diversity is considered a

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[2] OMB Circular A-76 defines inherently governmental functions as those which are "so intimately related to the public interest as to mandate performance by Government employees" because they "require either the exercise of discretion in applying Government authority or the use of value judgment in making decisions for the Government." Circular A-76 is available at http://www.whitehouse.gov/omb/circulars/a076/a076.html

strength as well as an attribute to be celebrated. Indeed, the opening clause of the Constitution calls for the formation of a "more perfect Union" – the very essence of which recognizes differences even as it calls for coming together on interests we hold in common.

Even without reference to such lofty ideals, Kent observes, "Many entity types come to mind for which considerable variability of attributes is likely to occur …" (p. 125) Yet, he notes:

> Another implication of record formats, and of the file plus catalog configuration, is that the attributes applicable to an entity are pre-defined and are expected to remain quite stable.[3] It generally takes a major effort to add fields to records. While this may be acceptable and desirable in many cases, there are situations where all sorts of unanticipated information needs to be recorded, and a more flexible data structure is needed.
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> The need to record information of unanticipated meaning or format is crudely reflected in provisions for "comments" fields or records. These consist of unformatted text, in which system facilities can do little more than search for occurrences of words. There is no way for, say, a query processor to know which words in the text name specific things (analogous to field values), which words specify their relationship to the thing being described (analogous to field names), etc. Thus ironically, we have the two extremes of rigidly structured and totally unstructured information – but very little in between. (p. 125-126)

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[3]By "file plus catalog configuration," Kent apparently means using a database to store metadata (i.e., "catalog" records) about documents/records maintained in either electronic or perhaps paper filing systems. In that context, a file catalog record and a database record are both rows (tuples) in a database table. The only difference is that one or more of the columns in the table references the logical, if not also the physical location of the "file", i.e., the document/record. Part of the problem with understanding and thus optimizing resolution of records management problems is the failure to distinguish clearly between concept of a row in a database and a "record" as it is commonly understood by the average person, as well as the legal system.

Kent's book was last copyrighted in 2000 and, fortunately, with the emergence of Extensible Markup Language (XML), the dichotomy he cites is no longer true. With XML is easy to incorporate as much structure as presently required and possible while at the same time providing flexibility to accommodate information that cannot yet be specified in highly structured form, as well as providing for extensibility in adding data and information as the need and capability arises in the future. Because each XML-formatted record stands on its own and does not have to fit neatly into anyone's artificially constrained database structure, it can more fully and accurately reflect the depth and breadth of reality as it is perceived by the author of each record at any point in time. At the same time, any XML-enabled application can "consume" and "understand" the elements of such records, to the extent of the application's own "intelligence" at any point in time (history).

Kent cites an example of a problem with traditional database record structures that is not only of special interest to each of us as human beings but also particularly relevant to the discipline of records management:

> The creation and destruction of records might have various semantic interpretations in the real world. Occasionally it might really signify the beginning and end of an entity (e.g., the birth and death of a person). More often, however, "create" or "destroy" are really instructions to the system to "notice" or "forget" an entity, quite unrelated to the beginning and end of the entity. … historical records are likely to be kept long after an employee terminates, or a person dies. Thus one still has to explain somewhat what semantic is implied by the creation or destruction of a record. In structured files, record deletion carries with it problems of cascading delete (which related records must also be deleted?). The rules dictated by the file structure have to be very carefully correlated with the semantics of "existence dependence" among the real entities… in the long run, it's probably better to specify explicitly what we intend for the create/destroy semantics of an entity, rather than relying on the behavior of the corresponding records in the system. (p. 144)

It is disturbing, if not insulting to human dignity to think that we might continue to allow others, regardless of whether they are corporate or government officials, to capriciously decide when to create and destroy records of our existence and personal attributes. However, to the degree that companies, organizations, and agencies are allowed to continue to lord such dominion over our virtual selves, as

least, as Kent suggests, they should explicitly specify the "semantics" of the rules by which they intend to exercise such creative and destructive powers.

Indeed, not only should they be required to clearly understand the meaning of such God-like acts but they should also be required to publish them on the Web in a manner that we can easily discover and be aware of instances when our personal interests may be affected, which, by definition, is whenever anyone documents information about us as individuals. In fact, many governments have enacted privacy laws requiring that notice be given to customers and/or citizens when data about them will be gathered and maintained. For example, the Privacy Act requires U.S. federal agencies to publish notices in the *Federal Register*.[4]

However, the lack of an international standard for the publication of such notices in readily accessible XML format on the Web means that it is impossible for each of us to be aware of, much less effectively keep track of the instances in which our digital personas are being "captured," maintained, and used (misused) by others.[5]

With respect to the distinguishability of records, Kent notes:

> If some kind of file structure is available, such as ordering or a hierarchical structure, then that structure can be used to distinguish records which are identical in content... In systems without any such file structure, such as the relational model, records can only be distinguished by their content. The relational model does in fact require this distinguishability; duplicate records are not permitted. Rather than comment on such constraints directly, let me just illustrate some behavior of real entities which doesn't conform to such constraints. We don't always need all entities to be distinguishable, even though we want them to be modeled as distinct. That is, we may want to know there are several of them, and want to be able to say distinct things about them in the future, but at the moment we

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[4] The text of the Privacy Act is available at http://www.usdoj.gov/04foia/privstat.htm

[5] The W3C's Platform for Personal Privacy Preferences (P3P) is aiming in the right direction but its scope is limited to the sites that we visit on the Web. http://www.w3.org/P3P/

> don't care which is which. There doesn't have to be any difference in the facts we know about them. (p. 145)

Regarding simplicity, Kent observes that it can be achieved either by using a small vocabulary or concise descriptions, and both approaches have value. However, he suggests a third kind of simplicity may be even more important with respect to the description of data and that is *familiarity*. In that regard, he says, "The easiest system to learn and use correctly may well be the one that is closest to something already known, regardless of how objectively complex that may be." However, he cautions the problem with that approach is that it is subjective and depends upon who is applying it. Moreover, he notes, "the apparent familiarity can also lead users astray, in those cases where the system does not behave the same as the thing they are familiar with." (p. 171)[6]

Kent cites *irreducible relations* as "an area of relational theory which attempts to reconcile record structures with the requirements of accurate information modeling. The general idea is to model information in terms of elementary facts, generally (but not always) leading to binary relationships analogous to records having just two fields." (p. 172)

Kent notes that recoverability is the essential test of reducibility. That is, a record is reducible if shorter records can be defined which can be combined to recreate the original record, in which case the record has not been decomposed into its most elementary facts. By contrast, irreducible records represent single elementary facts and cannot be reconstructed from smaller units of information. However, Kent cautions that the reconstruction process may generate spurious and false data. (p. 172)

At another level, this problem is compounded by the separation of content from its presentation for storage in relational databases. It is as if the original records are shredded to fit into the row-and-column structure of the database. Subsequently, in order to be accessible to human beings, they must be

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[6] In *Sources of Power: How People Make Decisions*, Gary Klein uses similar terms to describe *recognition-primed decision making* (RPD), which he observes to be the way that we commonly make decisions in naturalistic settings – by focusing on that which is familiar in any situation and the first solution that comes to mind, without considering alternatives. For more on Klein's views in relation to records management, see http://ambur.net/rpd.htm

reconstructed and may or may not look anything like they did before. Separation of content from presentation is commonly considered by technicians to be a strength, since it enables presentation on different devices, e.g., personal digital assistants, etc. However, separation of content from presentation destroys the integrity of the record, ignores the legally important concept of the "four corners of the document," and injects risk factors enabling waste, fraud, and abuse.

Kent cites the *connection trap*, through which erroneous inferences may be drawn from the "join" of two relationships on a common domain. He says such mistakes are not the fault of the data model, but a user error in ascribing the wrong meaning to the results. He further explains, "The user error arises out of mistakenly taking such relational operators as 'project' and 'join' to be inverse operations, expecting that performing the two in succession returns the original information. A projection can decompose one relation into two; joining these two does not necessarily re-create the original relation." (p. 186)

While Kent may be right, technically speaking, another way of viewing the problem is that the role of information systems is to help human beings overcome problems and weaknesses – not to lead them into "traps," relational/connectional or otherwise.

Another problem Kent notes is that entities are commonly not modeled independently of the relationships in which they participate. (p.188) Conceptually, he says, "it would help to always have a notion of an existence list, whose purpose is to exhibit the currently known set of members of that type. Put another way, one ought to be able to assert the existence of something separately from providing assorted facts about it." (p. 189) However, particularly if the "something" whose existence one wishes to assert existence is another human being, the question arises as to why any of us should be free to exercise such God-like powers rather than deferring to a more "authoritative" source, as well as the other person him or herself.

Setting aside the issue of who has the right to model what, Kent observes that most models focus initially on drawing distinctions between such constructs as entities, relationships, attributes, names, types, and collections. Such constructs are generally assumed to be mutually exclusive. By contrast, Kent starts from the unifying premise that all of those constructs are in fact entities. "Each of

these phenomena, and each of their instances," he argues, "is a distinct integral concept, capable of being represented as a unit item in a model." (p. 192)

Following that logic, he suggests, everything in the repository can be considered to be an "object" – a term often used interchangeably with the terms *surrogate*, *representative*, and sometimes *thing*. Kent asserts the existence of four kinds of objects – simple objects plus three more complex kinds, including symbols, relationships, and executables. By his classification scheme, simple objects merely represent entities and are very common and numerous. They have few general properties that apply to all objects, primary among which are: 1) They can be related to each other, and 2) their existence can be detected by the processor. (p. 193)

Concluding his treatise with a series of philosophical observations on reality and tools, Kent says:

> I have tried to describe information as it "really is" (at least, as it appears to me), and have kept tripping over fuzzy and overlapping concepts. This is precisely why system designers and engineers and mechanics often lose patience with academic approaches. They recognize, often implicitly, that ***the complexity and amorphousness of reality is unmanageable. There is an important difference between truth and utility. We want things that are useful – at least in this business; otherwise we'd be philosophers and artists***. (p. 217, emphasis added)

Kent allows that the mismatch between tools and theories may be inevitable due to inherently opposite qualities. Theories aim to distinguish phenomena, are analytical, and strive to identify all the elements and functions. They abstract unifying explanations, describe relationships and interactions but the same time try to preserve the distinctness of the logically separable elements.

By contrast, he observes, "Good tools ... intermingle various phenomena. They get a job done (even better, they can do a variety of jobs). Their operation tends to intermix fragments of various theoretical phenomena, they embody a multitude of elementary functions simultaneously." Indeed, he argues, "That's what it usually takes to get a real job done. The end result is useful, and necessary, and profitable." Whereas theories tend toward completeness and are considered to be defective if they don't account for all aspects of a

phenomenon of function, tools incorporate only those elements that are useful and profitable. (p. 217) Kent says useful tools:

- Have well defined parts, and predictable behavior
- Solve problems we consider important, by any means we can contrive, often using a tool designed for another purpose
- Are available to be used
- Don't cost too much
- Don't work too slowly
- Don't break too often
- Don't need too much maintenance
- Don't need too much training in their use
- Don't become obsolete too fast or too often
- Are profitable to the toolmaker
- Preferably come with some guarantee, from a reliable toolmaker
- Don't share many of the characteristics of theories.

Kent argues, "Completeness and generality only matter to the extent that a few tools can economically solve many of the problems we care about." Acknowledging that data models "... do not contain in themselves the 'true' structure of information," he says they are nonetheless useful tools. (p. 218)

He says that difficulties in applying models are usually perceived as failures to comprehend the underlying theory, with the "expectation that perseverance will lead to a marvelous insight into how the theory fits the problem." However, he asserts that much of the "learning" that occurs in that regard is really "a struggle to contrive some way of fitting [the] problem to the tool," such as by changing the way we think about information, experimenting with alternative ways of representing it, and perhaps even abandoning some aspects of our desired applications because available tools can't handle them. Thus, Kent suggests ***much of the "learning" process is really a conditioning of our perceptions to "accept as fact those assumptions needed to make the theory work, and to ignore or reject as trivial those cases where the theory fails***." (p. 219, emphasis added)

Accordingly, he observes versatility is a very desirable property in our tool sets, and that it is useful to understand the characteristics of our tools as distinguished from the nature of the problems to which they can be applied. (p. 219) With

respect to differing points of view about problems and models as tools to solve them, Kent notes:

> A conceptual model, by its very nature, needs to be durable – at least in form, if not content. Its content should be adjusted to reflect changes in the enterprise and its information needs – only. The form of the conceptual model – the constructs and terms in which it is expressed – should be an impervious as possible to changes in the supporting computer technology. (p. 219)

Moreover, he observes that "a durable conceptual model should be based on constructs as close as possible to the human way of perceiving information." However, he says, therein lies the catch:

> ... the implicit assumption that there is just one "technology" by which all people perceive information, and hence which is most natural and easy for everybody to use. There probably isn't. Human brains undoubtedly function in a variety of ways. We know that some people do their thinking primarily in terms of visual images; others hear ideas being discussed in their heads; still others may have a different mode of intuiting concepts, neither visual nor aural. Analogously, some people may structure information in their heads in tabular form, others work best with analytic subdivisions leading to hierarchies, and others naturally follow paths in a network of relationships. (p. 219)

With respect to the view of reality posed in his book, Kent proffers:

> … ***life and reality are at bottom amorphous, disordered, contradictory, inconsistent, non-rational, and non-objective***. Science and much of western philosophy have in the past presented us with the illusion that things are otherwise. ***Rational views of the universe are idealized models that only approximate reality. The approximations are useful. The models are successful often enough in predicting the behavior of things that they provide a useful foundation for science and technology. But they are ultimately only approximations of reality, and non-unique at that***. (p. 220, emphases added)

Kent observes that sociobiologists are presenting evidence that living beings, including humans, are not the units of evolution and survival. Rather, it is genes

that are motivated to survive and perpetuate themselves. Individual beings are "merely vehicles whose survival serves that higher purpose." Moreover, he notes our self image is being challenged from another quarter, as scientists question whether a clear distinction can be drawn between the categories of "man" and "animal." Thus, he exclaims, "'People' might not be a well defined category!" (p. 221)

Kent quotes biologist Robert Trivers: "The conventional view that natural selection favors nervous systems that produce ever more accurate images of the world must be a very naïve view of mental evolution." (p. 223)

Finally, Kent says he is convinced, "***no two people have a perception of reality that is identical in every detail***. In fact," he says, "a given person has different views at different times – either trivially, because detailed facts change, or in a larger sense, such as the duality of my own views." (p. 227-228, emphasis added)

He does allow: "Views can be reconciled with different degrees of success to serve different purposes," and by reconciliation he means a "state in which the parties involved have negligible differences in that portion of their world views that is relevant to the purpose at hand." (p. 228)

However, he asserts, "***If the purpose is to arrive at an absolute definition of truth and beauty, the chances of reconciliation are nil.***" On the other hand, "***for the purposes of survival and the conduct of our daily lives … chances of reconciliation are necessarily high.***" Moreover, "***If the purpose is to maintain the inventory records for a warehouse, the chances of reconciliation are again high***." Yet, "If the purpose is to consistently maintain the personnel, production, planning, sales, and customer data for a multi-national corporation, the chances of reconciliation are somewhat less: the purposes are broader, and there are more people's views involved." (p. 228, emphasis added)

The bottom line Kent suggests is that "***the thrust of technology is to foster interaction among greater numbers of people, and to integrate processes into monoliths serving wider and wider purposes. It is in this environment that discrepancies in fundamental assumptions will become increasingly exposed.***" (p. 229, emphasis added) Depending upon one's perspective, that may be either a bad or a good dose of reality to contemplate.