# The System is a Mirror: Turbulence and Information Technology

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Everything I know about online documentation, information technology, organizational process management, and post-industrialized economic models can be, in its most elemental form, reduced to and explained by Figure 1, below. The Straight Line, moving from A to B, is the old way of doing things. The Circle, encompassing A through B and back to A, is the new way.

It is a quintessential schema for the great promise and many problems we are experiencing in both corporate and non-profit institutions.

My objective, for this article, is to explain Figure 1, drawing comparisons between current academic research, basic communications and systems theory, and real-life examples from my career as an Information Technology consultant. I will identify the organizational stresses caused by this change, and recommend a decision-making process for understanding and managing problems that occur in our teams and our information systems.
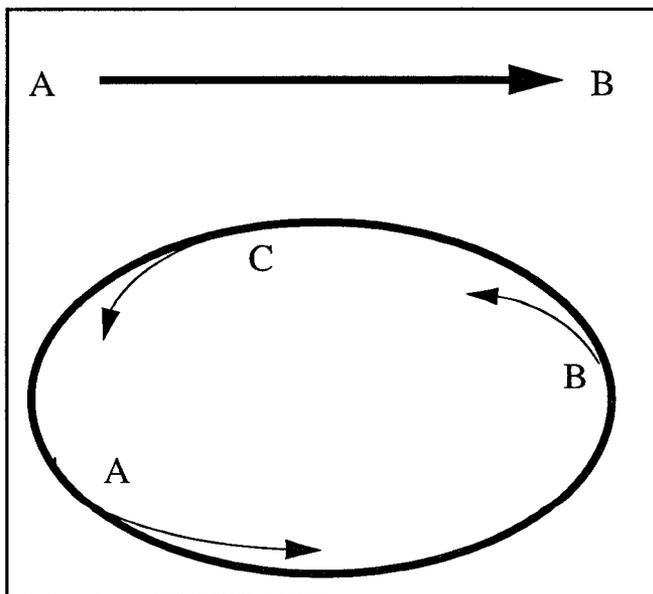
The straight line represents how business has been done for the past two hundred years. A very simplistic example should suffice:

I make a ceramic pot (A), and establish fair market value. Let us say that the assigned value is $5.00. I then sell the pot to a customer, who gives me $5.00 and receives, in turn, the ceramic pot and all rights of ownership to it (B). I can then use the $5.00 to purchase something I value, or re-invest the profit in my factory, allowing me to make more pots, and increase my income.

Most economic exchange, until the middle of the nineteenth century, was based upon this model. We made things, we sold them, and we made more things. In fact, many large companies continue to support themselves in such a manner, balancing Cost of Goods and Return on Investment in a competitive marketplace: automobiles, appliances, real estate, computer hardware - all examples of this basic goods-for-value economy.

Beginning in the nineteenth century, however, with the "electrification" of certain technologies, a new state of economic development began to emerge, establishing information itself as a commodity and moving us, slowly, forward to our current state, an information-based economy.[1]

The Circle represents how most business is done in a service-based or information-based economy:

In this scenario, I no longer sell pottery: I am a consultant. Perhaps you hire me to perform management systems analysis. After some evaluation, I present my ideas (A) to you in return for the consultant fees you have paid.You do not "own" the ideas, though you can add your own value to them and circulate them throughout your organization (B). I still "have" my ideas, and can resell them, again, to someone else, adding what I have learned from working with you (C).[2]

In such an environment, how can we place an absolute value on the idea itself?

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Consider the possible consequences of this change in our economic interactions. Instead of the Thing of Ultimate Value (for example, the Mona Lisa: one-of-a-kind being most valuable *because* it is one-of-a-kind), the value of an idea or a piece of information is best appreciated by *how many people share it*. A good idea (a good essay, a good poem) by itself, known only to one person, is of little societal value until it is communicated to an audience; the greater the influence of the idea or information, the higher the potential value of that idea. We are only in the midst of this change in economic models: it is a change in the role and value of information. Instead of private ownership, it is wide distribution and shared use that is valued in an information-based economic system.

How does a change in global economic models affect our day-to-day business in computer documentation?

What difference does it make that certain academic economists and systems theorists believe we are moving to a (radically) changed economic system?

Finally, why should the publishing community care about a shift in the balance of value or power when we have our own issues of survival?

These changes impact information professionals in a variety of ways, at varying levels, and in most cases, have already transformed most corporate publishing communities. The following example identifies what I believe is the fundamental transformation in the information community, and also illustrates the convergence with models presented on the previous page.

Our Shift to Online Information

Following the advent of computer documentation, the definition of "product" began to include not only the software or hardware but the how-to information shipped with it. Since the beginning, we have been creating books: installation guides, reference manuals, user guides, beginner tutorials. Hundreds of writers (content creators) struggling to explain arcane engineering jargon or complex software concepts in ways that a new customer might understand. Books (A) were the products that we, as information specialists, created and sent to our customers (B).

That was the old way of doing business: we shipped a book to our customer in the same Straight Line method as the ceramic pottery described earlier.

During the past decade, variations of this classic information paradigm began to appear - online help, hypertext, full-text retrieval, computer-based tutorials - and most importantly, with the advent of the WorldWide Web, networked delivery of today's information today.

In this paradigm, customer service staff in one part of the country adds a bit of information to the database and it is immediately available to their customer halfway around the world; in some instances, this information comes from the customers themselves: a piece of information can be created outside of the hierarchy of a company, submitted to the company and quickly incorporated into the structured database that is (almost immediately) available to all networked users.

In other words, we have moved from the Straight Line (books and chapters shipped in boxes) to the Circle, in which information is continually added and enhanced via the Internet. The value of that information is its timeliness and its wide availability: the latest information made available as soon as possible, to those that need it most.

This should be a good thing. But there has been resistance to the new information methods, even from within the information community. We have all seen examples: the professional book people, individuals who likely came to this business because they were book people, struggling to adapt to a new way of delivering information, struggling to understand a database without tables of contents and indexes, without a front or a back.

The *thing* has become a *process,* and along the way, some of us have been left behind.

It is not only change itself that has distressed the information community (though change is difficult and often resisted for that reason alone). In this case, there is a double threat, because it represents the larger change in our economies, a shift in the way business will be done at all levels, and it evokes an emotional reaction far beyond the professional debate over standards and techniques. There are very special skills needed to create award-winning technical manuals, and the people with those skills have mortgages and children in college and dependent parents. The emotionalism of their reaction comes from a perceived threat to their livelihoods. And when that threat is a vague, systemic threat - it is not just our own management but an entire generation of companies forgoing books for the new, networked world - some of us simply don't want to let go.

Hardcopy vs. Online/Teaching vs. Learning

During the past ten years, I have helped companies[3], both corporate and non-profit, resolve Information Technology problems as they moved their information from the "hardcopy" model to the electronic model, from the Straight Line to the Circle.

Each of the database, semiconductor, software, publishing, educational, museum, or literary service institutions believed their problems were unique.

In fact, their difficulties were quite similar:

o Conflict resolution - between individuals, between teams, and between competitors - became difficult because institutional decision-making processes (about standards, directions, goals) were inadequate, and in some cases, entirely broken.

o The move to CD-ROM or networked delivery was urgently initiated by management to reduce publishing budgets or enhance revenues. To reap those savings quickly, little time was provided for research, planning, or usability testing. Ultimately, the customers were poorly served.

o Graphic clarity - the pictures on the screen - were less exact when digitized, often causing intense reaction to the new delivery vehicles. In some cases, entire policies were reversed in response to this single issue.

o The information itself was stored in rigid proprietary forms, with no attention paid to architecture or portability. Maintaining and/or updating the systems became difficult and expensive because the long-range issues had not been planned or designed.

However, one of the most provocative examples from my recent experience indicates that it is more than simply a change in the way we do business and publish information, but a change in the way we teach and learn.

At the conference on Art, Humanities, and the National Information Infrastructure held in Boston in 1994, I overheard a conversation between two professors of music, one from New York University and one from the University of Arizona.

Both described a growing schism between faculty in their departments: one faction advocated traditional teaching models in which tenured professors lectured to their students, and a second faction advocated a classroom model involving students in a participatory process, a process that de-emphasized the role of the instructor in favor of experiential growth.

I was not surprised to learn of the academic conflict because I have witnessed similar struggles within the training organizations of software companies: many of the technical trainers preferred the standard approach (presenting template labs in lecture format) while others were beginning to investigate interactive tools that involved a "self-guided" approach to software education. Rather than the traditional delivery of pre-designed lectures, a process based upon Electronic Performance Support Systems (EPSS) was being designed. In EPSS, training is not an event with a beginning and end, but a process that occurs over time, varying with each student.[4]

The lecture, a Straight Line from professor to student, is the old way of doing business. An interactive classroom or software tutorial is the new way, a circular process that is driven by and informed by each student.

In economic terms, the process of education is moving from a product-based model (lectures as a product delivered from A to B) to an information or service-based model (learning derived from the interaction of customers with an ongoing stream of information), and the change is having an impact on the very heart of our universities' planning and programming, the very heart of our corporate training programs, the very heart of how we, as information providers, lead the audience to discover what they need to know.

Yet, in each publishing or educational situation, efforts put in place to solve Information Technology problems instead created other problems; while the reasons for the new problems were complicated, common themes emerged. I am proposing that these secondary problems erupted, in part, because the effort to move products "online" create, in its wake, a series of institutional stresses that reverberate throughout an entire organization.

As our methods of creating, storing, delivering, and teaching information have changed, these changes have created an imbalance in our institutions, a kind of "turbulence" reflected in the mirror of Information Technology. The turbulence creates a "disequilibrium" which upsets the old way of doing business, when established principles are challenged and the traditional

support mechanisms of that business are undermined. But, in our move from one method to another, we misunderstand the turbulence, and often resist the changes simply because we do not understand or are threatened by them.

The next section of the paper identifies and explains several basic reasons for the distress that has emerged in our corporations and non-profit institutions.

The Technology is Changing

Those of us employed in the technology industry may take the following statistics for granted, yet they underscore a central cause of distress in our shift from old to new.

In 1980, business machines were capable of 330,000 calculations per second. At the time, this seemed revolutionary. Yet, in 1994, NCube systems boasted an ability to execute 6.5 trillion calculations per second.[5] As if that isn't remarkable enough, my present employer bases business projections on the expectation that silicon chips will *continue* to expand speed, capacity, and performance *ten times every three years*. Perhaps this gives proper prospective to the NCube milestone.

Because we are using these exponentially powerful computers to compile logarithms for the next generation of hardware and software, our technological momentum will continue, it becomes very difficult for me to understand the kind of machines my son will be using, in the first grade, five years from now.

Therefore, any list of causes for the disequilibrium of our lives must include the nature of the technology itself, which is dynamic, and evolutionary. Network systems and online information software are in flux; they will continue to change - even radically - for the next several years. Think of the first announced revolution in paperless office systems: desktop publishing tools, or What You See is What You Get. When the information community moved from troff to Frame, or Interleaf, or Microsoft Word, it was only a step, it was not the entire journey.

Now we are decomposing those same artfully designed pages into strings of text that can be hypertexted and browsed across the net. Ted Nelson's view of a grand library, completely connected by hypertext links, is not as impossible as it first seemed. (Remember: Mosaic wasn't even on the public scene three years ago.)

How can we make decisions amidst this seemingly chaotic environment? One answer to this question should refer to some historical precedents that are good indicators:

As with previous technological leaps - canals, railroads, telephones - the economic fabric of our culture is being massively transformed. (For example, something we now take for granted - daylight savings time - was actually a reaction to the new railway systems and the ability to deliver goods faster and farther.) History indicates that we will be far different, ten years from now, in ways directly related to the proliferation of network services.

> "Nothing has been of greater historical importance to relative economic development, in the U.S. and elsewhere, than the growth of networks: canals, railroads, highways, phones."[6]

Some of the changes are already affecting corporate enterprise, and are beginning to make themselves felt in non-profit institutions. Businesses that are thriving today are those that have moved from a product-based revenue stream (we make things, we sell things, we make more things) to a service-based approach. Ask Intuit about the importance of customer service. Ask Honda Motor Company about the value of customer service. Ask the management of EDS: an entire company (72,000 people) with nothing to sell other than the knowledge and experience of those employees.

Subsequently, institutions or businesses that are trying to select tools or make decisions about directions in publishing should no longer be comfortable picking one kind of service, one kind of software (or employees with one kind of skill), planning that the result will be adequate for years to come. Information strategies in any business, corporate or non-profit, must remain flexible and adaptive, incorporating the ongoing nature of change into their daily methods and decision-making processes. Yet it is human nature to resist change, particularly in difficult economic times. Our resistance creates, in turn, more turbulence in the workplace and in the economy.

The Socio-political Issues are Complex

In the introduction to this paper, I discussed value. Changes in the way economic and political value are determined are another reason for our distress.

If, as proposed, the value of the information is determined by the breadth and scope of its communication, then a corollary can also be proposed: with the shift in the locus of value, those who manage information - in our schools, our corporations, our government agencies - become the brokers of that value. The move from paper to networks implies a shift in the loci of power and value in each enterprise that is touched by the shift, causing disequilibrium in the decision-making processes of our companies, our economies, and our governing bodies.

When the basic value structure of a society is changing, as in the move from products to information/service, and when the value of the new commodity (information/ service) is difficult to establish in finite terms, the primary brokers of the commodity become "valued" in new ways.

In the case of information, machines and people that manage information now have increased value. The greater the capacity of a machine to process data, the more valuable it is in an information-based economy. And within our companies, the managers of information technology - those who process, control, secure, distribute, and disseminate that information - become the brokers of that value; as such, the management (control) of information and related hypertext technologies becomes an issue of *political* power within our organizations.

> "Those who hate dealing with politics need not apply."[7]

The politics of information and its management in a democratic, post- industrialized society provides additional understanding of the causes of turbulence and the subsequent changes wrought by the shift.

Project teams, matrix management, de-centralized organizations, and business unit autonomy have undermined the Straight Line. It is no longer an effective method for managing a business. In the vacuum created by the change, in our de-centralized product teams that require constant input from customers and other consultants to make and implement decisions, the struggle for power continues nonetheless. Wholesale reorganizations of corporate structures have been set in motion by the inability of a company to adequately address the political implications of an information and service-based economy, implemented by de-centralized teams.

The *relationship* between information, per se, and political power is not accidental, nor is it caused solely in the environment of human endeavor, where all things assume political qualities over the course of time. The reasons for a convergence of information and politics in our culture and in our companies is directly related to the commodification of information (the economic factor), and its link to our political processes.

On the other hand, successful companies and successful teams are most easily identified by those with a pluralistic approach to decisions, plans, and actions. In an information-based economy, a system in which the accrual of value is "circular," the management of that information must also be "circular," and inclusive, which is to say, pluralistic. Translation: consensus is not just something that would be a nice way to behave with people, or a savvy way to include those who feel excluded. Consensus-based strategies are the only reliable method to determine and implement policy in an information-based system.

> "From the perspective of network economics, cooperation and coordination are as important as competition for economic success."[8]

Subsequently, the current legislative and corporate battleground in Washington and in our State Legislatures, over the nature and breadth of the National Information Infrastructure, is comprehensible. Cooperation is difficult between parties with competitive interests. Telephone companies, online service providers, government agencies, libraries - all have a vested interest in the basic decisions being made. Internal tensions between corporations, or within newly-merged companies, about the standards and processes for information dissemination can also be understood.

Information serves as a reflection of the object(s) it describes or traverses; as a mirror of our organizations, the conflicts about information technology and processes help us identify what is right in our organizations, and what is wrong. "Too often," explains Edward Tufte in his information design workshops, "information architecture replicates the bureaucratic hierarchy..." of the group that designed or built the information architecture.[9]

Beneath the rhetoric and details, the basic question about information policy becomes political:

Who decides?

And the corollary question, *Can we ignore the decision* if we do not agree with it?

Too many of us have witnessed the following scenario in the arts, in government, and in our software companies:

Group X is unable to (or refuses to) participate in the early planning sessions of a cross-functional project. Groups Y and Z work diligently to incorporate diverse viewpoints and consider all possible options before arriving at their recommendations. A meeting is called to vote on the recommendations, but only members of Groups Y and Z attend, because the members of Group X feel they have been left out of the process. A decision is made, and soon thereafter, Groups Y and Z are publicly criticized by Group X for the inadequacy of the decision. Groups Y and Z implement the decisions made by committee, and Group X chooses to do something else. The project, or at least that portion of it that depends upon consistency, fails.

How many of us have participated in tumultuous internal conflicts in our organizations, conflicts out of proportion with the ostensibly trivial subject to be resolved: What phone system should the college use? What should the picture be on the front of our CD-ROM? Should this font selection be a square bullet or a round bullet? How much white space should there be on a reference manual page? Where should the "Click here to Go Home" button be?

As you might expect, the Straight Line and the Circle offer some understanding of the conflicts, and of our difficulty resolving them.

The Old Way of Doing Business was to have the Boss make the decision, and the employee follow his/her instructions for implementation. The decision and project path moved from Point A (Management Decision) to Point B (Employee Implementation). The new way of making decisions - matrix management, consensus-based product teams - are misunderstood and often resisted.

Infrastructures are mirrors of their larger systems; if the MIS groups of newly-merged companies cannot standardize, it is a reflection of the strife in the larger organization; if the documentation groups of newly-merged companies cannot agree on a single file format, it is a reflection of the strife in the larger organization. To address the turbulence at this level, governance itself must be examined.

By definition, the new way of business is participatory.

Subsequently, the models of governance that support this economic model must be participatory. In this economic model, the ability to be involved in the process is no longer a luxury but an obligation. We *must* each participate in the decisions that are being made, in our communities, in our business units, in our professions. If we are not included in the process, then we must introduce ourselves into it, not simply wait for results which we then refuse to acknowledge. In a participatory environment, everyone must add value, then share in the result.

If it is shared value that we strive to ensure in an information-based economy, that shared value brings with it the obligations of participatory design in decision-making processes.

In her lecture at the conference on the Arts, Humanities, and the National Information Infrastructure in Boston, Sandra Braman, from the Communications Institute at the University of Illinois, suggested that even artists, in contemporary society, are content providers of a network-based economy. As such, there is a responsibility, not simply to sit idly by, but to perform a primary role in the self-organization of that economy.

> "In a network environment in which the problem is now one of providing content for the extraordinary capacity that now exists and continues to expand, I would argue there is a moral responsibility to...ensure that a range of content is available."[10]

Whether the content provider is a storyteller on the Internet, a technical writer in a software company, a multi-media designer in advertising, or a contributor to a technical conference, the responsibility is both upon those around us to ensure that the access and participation is possible, and upon each one of us to actively pursue the evolving circular motion by adding value to what has come before.

The Straight Line method of decision-making (and blame) are appropriate for young children, novice craftspersons, and fledgling economies; the Circle method of decision-making and responsibility requires a shared contribution by all parties.

It is the obligation of pluralistic democracy in an information age.

Examine the System in the Mirror

In the previous sections of this paper, I have discussed three fundamental reasons for the turbulence in our information-based organizations: the *economy* is changing, the *technology* is changing, and the *models of governance* are changing.

The fourth and most provocative understanding of turbulence in the field of Information Technology is suggested by systems theory, communications theory, or what has been called "cybernetics."

A standard definition of a "system" is a group of interacting, interdependent elements forming (or regarded as forming) a collective entity or a functionally related group. The human body is a system. Any mechanical apparatus is a system. The NYNEX telephone network, the Panama Canal, families, legislatures, organizations within companies - are all systems.

Systems theorists argue that turbulence occurs naturally in complex human systems.

The theoretical correlation between information systems and human systems, therefore, can be used to identify why our own organizations are struggling with radical change: the move to a network-based or information-based economy requires a similar transformation in our organizational behavior. Attempts to resolve the turbulence in our organizations have often failed because we have not acknowledged our own role in these systems.

Chaos theory, or second-level cybernetics, identifies and defines the turbulence, accounts for it, and incorporates (rather than attempts to avoid) the natural elements of change that complex systems require. Applied to organizations, the *relationship* between organizational behavior and information technology is clear; indeed, organizations *are* information systems, identifiable by cyclical shifts in strategy, redistributions of power, changes in infrastructure, and periods of convergence. "Organizations, too, move from order to chaos and back."[11] For many in the corporate world, organizations are seen as "...pure information processing machines - nothing less, nothing more: Organizational structures, including hierarchies, capture, massage, and channel information."[12]

Information Technology (as represented by the systems, teams, and processes in our various institutions) is not the cause of our economic ills, or the rapid transformation of our society, but it is an exceptional and increasingly potent reflection of our institutions themselves. Once again, infrastructures are mirrors of their larger systems. The shift (from Straight line to Circle) has caused enormous turbulence in our workplaces, yet most of us prefer to blame our reflections, rather than look past the mirror, to the selves reflected in it.

How information is communicated and managed, at every level, is a direct reflection of the system itself. In other words, *to correct the problems in our information systems, we need to address the flaws in the system of relationships that created them.*

Where do we go from here?

> "The movement from static to dynamic, from changeless perfection to continual change...shows up as the crux of scientific thinking about complex systems, poised on the edge of chaos."[13]

Whether on the Internet, in the arts, or in Congress, the challenges of Information Technology force us to face some difficult parts of ourselves: we continue to resist new thinking, and we criticize what we do not understand. We claim to be excluded but we refuse to participate.

Blaming new technology for problems in our companies and our community organizations is neither accurate nor productive. The solution, instead, should be found by studying the underlying dynamic of the problems and, in response, incorporating new behaviors and models into our daily business.

These new behaviors - critical thinking, cooperative flexibility, a pluralistic approach to decisions - are crucial to the success of businesses, large and small, corporate and non-profit, as our interactions shift from product-based to information-based economic models.

In lieu of rigid, hierarchical structures, our institutions need creative teams of multi-disciplinary individuals allowed to make and implement decisions. Once included in the process, those individuals must fulfill the obligations of participatory decision-making. In lieu of closed, secure networks with proprietary methods of access and retrieval, our information systems must be built with a respect for the diversity of models, cultures, and cross-group relationships that our new social economy requires.

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Once opened, those information systems must ensure timeliness and reliability of the information they manage.

In summary, we have identified the causes of turbulence in our information systems and organizations.

We have also identified some basic behavioral changes that should occur in those organizations, to better adapt to our changed economic and political environment.

In closing, I would like to provide a guideline for implementing those behavioral changes.

Managing the Relationships

"Language is digital."[14] Gregory Bateson made this observation in his 1972 collection of essays about communications theory, cybernetics, and systems.

This was two decades before the Internet became a household word, and reflects Bateson's belief that the symbols of language and their arrangement have been invested by human beings with meaning that elevates them to something more than strings of arbitrary symbols. The *relationships* between the symbols is where the meaning can be found; concurrently, the delivery of information between humans establishes a relationship, and conveys meaning.

In order to understand any system, I have found that it is useful to identify at least three operant constituent elements. I call it the Triadic Theory of Systems.
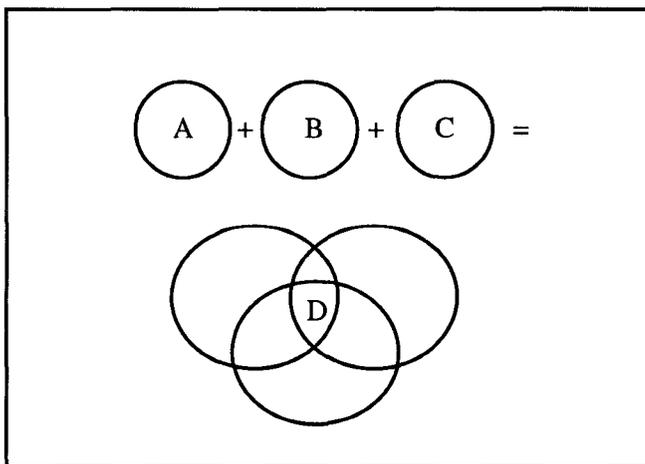
In the diagram, three independent entities overlap to

create a fourth possibility that can only exist within the combination. The common area (D, where three circles overlap to create a *triad* at their center) becomes a unique contextual framework from which additional thought/action can be derived, and is the focus of our examination; any problem in the functionality of a system can be identified by first seeking the triadic center, then determining which of the three circles is diminished, or otherwise out of balance with the consequent system.

A classic case study of this Triadic Theory of Systems can be found in the recent evolution of networked communication via the World Wide Web.

The uniqueness of the World Wide Web is found in the ability to establish connections between systems and objects. It is a *system* of *relationships*. Two machines, two databases, two sections of text can now be linked together - they inform each other, expand upon each other, and in some ways, provide a third possibility that could not be understood when they were independent objects.

It is not, then, a simple linear linkage of arbitrary elements, but the establishment of a *relationship between them*. This relationship, in turn, adds meaning to the individual (unlinked) components.

In the WWW, the three foundational elements are the Internet, the browsers, and the hypertext transfer protocol that links content. Those three, together, form the WWW that is the overlapping (common area) of the three elements. The Web can, in this definition, be interpreted not as a thing but as a *relationship* among things. The relationship itself is the system within which the elements operate. It is the Triadic Theory of Systems, and it is, in its most elemental form, a metaphor for consensus in an information economy.[15]

How does this involve management of information systems?

> "Next time you need to explain to your Board of Directors what they will get for the next hundred million dollars worth of client/servers...you should talk in terms of relationships."[16]

It is the relationship between components of any system which makes the system unique, allowing it to grow and change or, impacted by change, to become unbalanced and ultimately dysfunctional.

It is the relationship or process between management and employees, in cross-divisional project teams, that is required in customer-oriented software design. It is the relationships that lead to "...cross-functional teamwork, shared decision-making, and consensus"[17] which are so important in an information-based economy.

An analogous interpretation of information systems and process management is therefore needed.

By analogy, managing information across boundaries is much like managing people across boundaries. In this way, hypertext, in information systems, is the metaphorical equivalent to matrix (or cross-divisional team) management in human systems.

In that analogy, the following corollaries can therefore be derived:

1) Lateral (hypertext) relationships between individuals/ objects are more significant than the hierarchical structure(s) in which they are embedded.

2) *Managing the relationships* (for navigation strategy and link maintenance, or teambuilding and process) is the key factor in success or failure of the initiative.

3) The capacity of the system to adapt to new factors or influences (updating the information, reorganizing the team) determines the health/success of the system. The failure of the system can (almost always) be traced to corollary #1, listed above.

The flexibility (or adaptability) of the partner segments in the triad relate directly to the ability of the system to be self-corrective; this, in turn, allows the system to adapt to changing situations (turbulence) in positive ways.

Our information systems will reflect our own ability to adapt, serving as a mirror in which our systemic relationships can be examined. It serves little purpose to point at the mirror and demand that it be fixed, though it is human nature to do so.

In order to address changes in our organizations, we must attend to the relationships inside those organizations. By managing those relationships and fulfilling our obligations to them, we can better manage the systems themselves.

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References

1. Sandra Braman, "Harmonization of Systems: The Third Stage of the Information Society," p.133.

2. I have been challenged to justify this metaphor, based on the notion that customers have always given "feedback" to sellers of commodities, and that feedback has been considered in the creation of new products. My response is that normal market research (asking the customers what they want, and giving it to them) is not a truly circular development cycle. Using the metaphor of ceramics, the following *would* be a circular process: when I create my pottery, I include in my glaze some untempered chemicals that do not appear upon first firing, however, if you buy a piece of this pottery then splash some of your own unique glazing on it which, reacting to those chemicals, creates a new design, the value-add would be provided; if you then returned the enhanced pottery to me so that I could incorporate the changed piece of pottery into a larger ceramic sculpture, this would then complete the circle.

3. Among those companies/projects were: Valid Logic Systems and Cadence Design Systems, The Fine Arts Museum of Boston, the California College of Arts & Crafts, Sybase, Informix, Poets & Writers, Inc., the San Francisco Poetry Center, the Text Encoding Initiative (university libraries), and the Pinnacles Initiative (involving Intel, Motorola, National Semiconductor, and Texas Instruments).

4. Gloria Gery, Electronic Performance Support Systems, p. 18-22.

5. Tom Peters, Liberation Management, p.111.

6. Ibid., p.112.

7. Gloria Gery, Electronic Performance Support Systems, p. 284.

8. Sandra Braman, Boston, 1994, in her lecture "From Virtue to Virtu to the Virtual: Art in the Net."

9. Edward Tufte, speaking in Palo Alto, 1995. Tufte related the following anecdote from his consultations with a national art museum: their first attempt to produce information kiosks for museum visitors began with a 14 second video of the Chairman of the Board, welcoming the visitors, followed by a 7 second video of the Operations Director, welcoming the visitors. No valuable content (information) was provided, only a bureaucratic snapshot of the museum hierarchy.

10. Sandra Braman, Boston, 1994, in her lecture "From Virtue to Virtu to the Virtual: Art in the Net."

11. Sandra Braman, Journal of the American Society for Information Science, p. 360.

12. Tom Peters, Liberation Management, p. 110.

13. Richard Lanham, The Electronic Word, p. 253.

14. Gregory Bateson, Steps Toward an Ecology of Mind., p. 372.

15. The same diagram has been found in the following disciplines: Bateson's essays on the interaction between technology, the environment, and society's "hubris" or value system; the works of Jacque Lacan, describing the relationship between doctor and patient, in which the relationship itself becomes an entity that must be included in any discussion of the system itself; various essays on semiotics, discussing the relationship between writer, reader, and text; it is the primary explanation of the change in management theory, moving from dyadic to team-based decision-making; it is the technological interaction between the content, the database, and the delivery mechanism for online help systems; it is the central metaphor in program management, describing the relationship between people, process, and technology.

16. Paul Strassman, The Politics of Information Management, p. 67.

17. K. Holtzblatt and H. Meyer, Communications of the ACM, Vol. 38, p. 84086.