The Role of Visualization in Communication

January 29, 2007 (Revised 1-14-17)

Introduction

I posted the following on cac.ophony.org.

> Visual Communication
>
> Published by James Drogan January 27th, 2007 in Uncategorized. 2 Comments
>
> Today, Smart Mobs has brought my attention to a visualization site — Many Eyes — established by IBM. This then set me to thinking about how we contend with the increasing flood of data, information, and knowledge that assaults our senses. This leads to the notion of pattern matching.
>
> My hypothesis is that pattern matching could be an essential tool for communication in the emerging world.
>
> I don't recall much conversation about visualization and pattern matching in our discussions on communication.
>
> Deborah Gambs commented.
>
> > Deborah Gambs Jan 27th, 2007 at 2:53 pm
> >
> > I think this raises an interesting question Professor Drogan. In particular, I am wondering if you really meant 'pattern matching,' or 'pattern recognition.' Either way, I would like to hear more about what role you think it might play in visual communication. Or at least in our sorting of the visual information that is so abundant these days!
>
> I replied.
>
> > James Drogan Jan 28th, 2007 at 8:53 am
> >
> > Similar to Fermat's Last Theorem ("I have a truly marvelous proof of this proposition which this margin is too narrow to contain."), the area in this blog may be too small, Deborah, to say what I want to say about this.
> >
> > Please give me a bit of time to put together a little piece on this.
> >
> > Jim

The Run-up to Pattern Recognition

Gambs is, I think, correct in calling attention to "matching" versus "recognition." My basis for coming around to her way of thinking is based on the notion of the Sense, Interpret, Decide, Act, and Learn cycle.[24]

[24] James Drogan, Information System Fundamentals, 2005, Available: http://jmsdrgn.squarespace.com/storage/Information%20System%20Fundamentals.pdf, January 28, 2007.

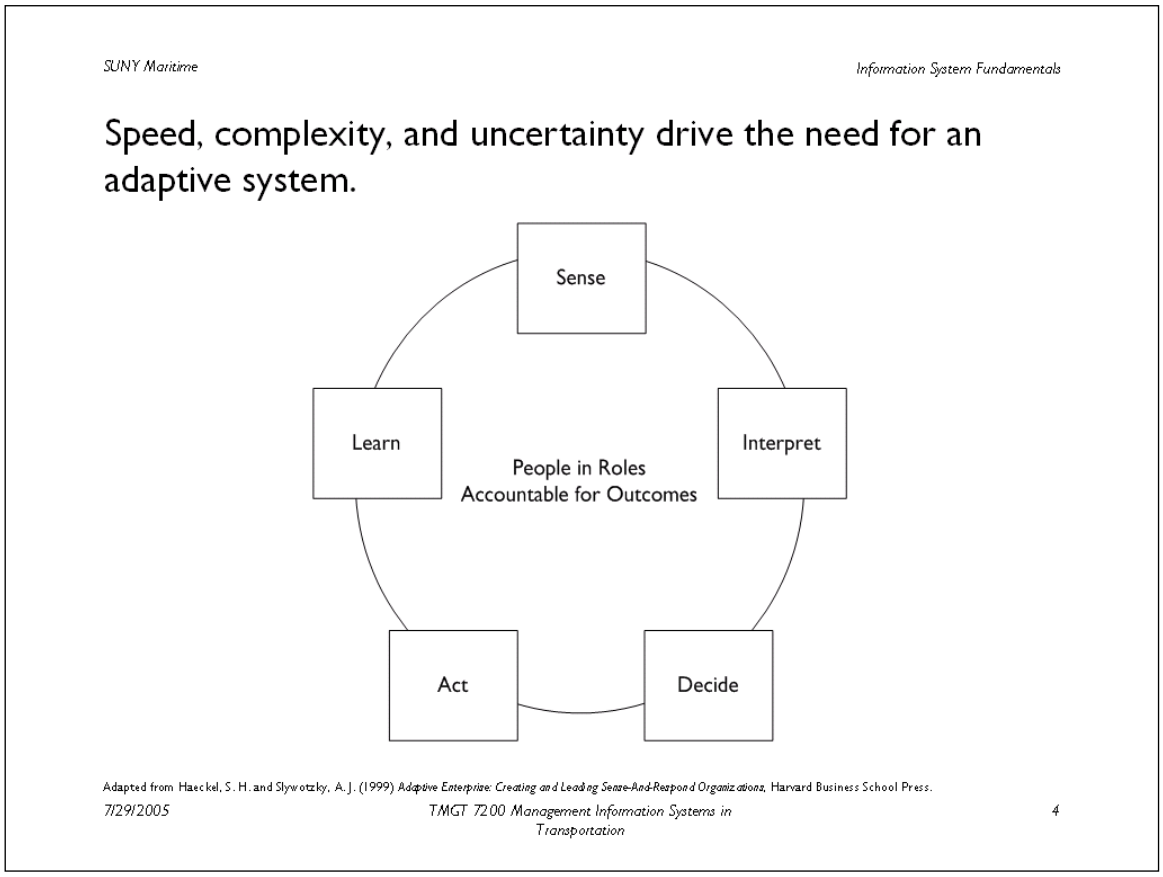

Figure 1 Sense, Interpret, Decide, Act, Learn Cycle

I link the word "matching" with Sense, the word "recognition" with Interpret. Matching is seeing; recognition is understanding. Seeing without understanding is of little value.

So let's accept Gambs' recommendation because it is a more powerful idea and moves us around the cycle toward action.

What, therefore, need we do in the context of "…the increasing flood of data, information, and knowledge…" to make an advantage of visualization?

We can begin to find the answer by revisiting the principles of communication.[25]

1. The grammar and syntax of the messages being exchanged is easily understood
2. The information communicated in the messages is relevant
3. The medium of communication is acceptable
4. There is a desire to communicate (i.e., to exchange value)
5. There is confirmation of understanding.

The grammar and syntax of visual messages is different – very different – from that associated with written and oral communication.

[25] James Drogan, Another Look at Communication Effectiveness, 2006, Available: http://jmsdrgn.squarespace.com/storage/another%20look%20at%20communication%20effectiveness.pdf, January 28, 2007. The fifth principle was added subsequent to the preparation of this document

Figure 2 An Example of Visualization[26]

Consider Figure 2 An Example of Visualization. The implications for grammar and syntax are very significant. They are defined not by words, but rather one's grasp of history, current affairs, culture, vocations. The intent of the sender is to invoke a certain understanding in the mind of the receiver. Does it work? How do we know? How do we confirm understanding? Is this communication or cleverness?

My personal experience with visualization[27] goes something like this.

1. An idea emerges in the fabric of the mind.
2. I reach for a tool (e.g., paper and pencil, Visio ©, MindManager ©) and begin to sketch the idea.
3. If need be, I gather data in support of the visualization.
4. I complete the packaging of the idea. When creating visual objects for papers, such as I've done here, packaging always includes a related narrative. Yes, when doing this I'm hedging my bet in order to assure understanding.
5. I then step away, try to put myself in the mind of someone looking at the visualization, and draw a conclusion as to odds of my communication being successful.

   Does the pattern (i.e., results of this visualization process) I have sketched match the pattern in my mind? Do I recognize what I have done?

As an aside, you may find it of interest that when I decided to put in these few words about my personal experiences I first reached for Visio ©. The pattern did not emerge in a meaningful way. Hence, the numbered list. The lesson? Don't use visualization to use visualization. Use it because it brings more value to the conversation.

The five-step process outlined above suggests a set of knowledge, skills, and experience, and inclination to approach a matter of communications in a certain way. The knowledge and skills can be taught. The experience accumulated. But what about inclination?

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[26] Baruch College, New Rules: Convention and Change in Communication, January 28, 2007, Available: http://faculty.baruch.cuny.edu/blsci/main/symposium2007.asp, January 28, 2007.

[27] All my written communications are generally marked by a reasonable large percentage of the content being visual objects. Visualization is an inherent part of my thinking process. It consequently biases this note.

Inclination has some other source and, if missing, discounts the knowledge and skills in visualization that have been learned.

The second principle of communication – The information communicated in the messages is relevant – also needs some consideration. Edward R. Tufte is the expert in this area I know best.

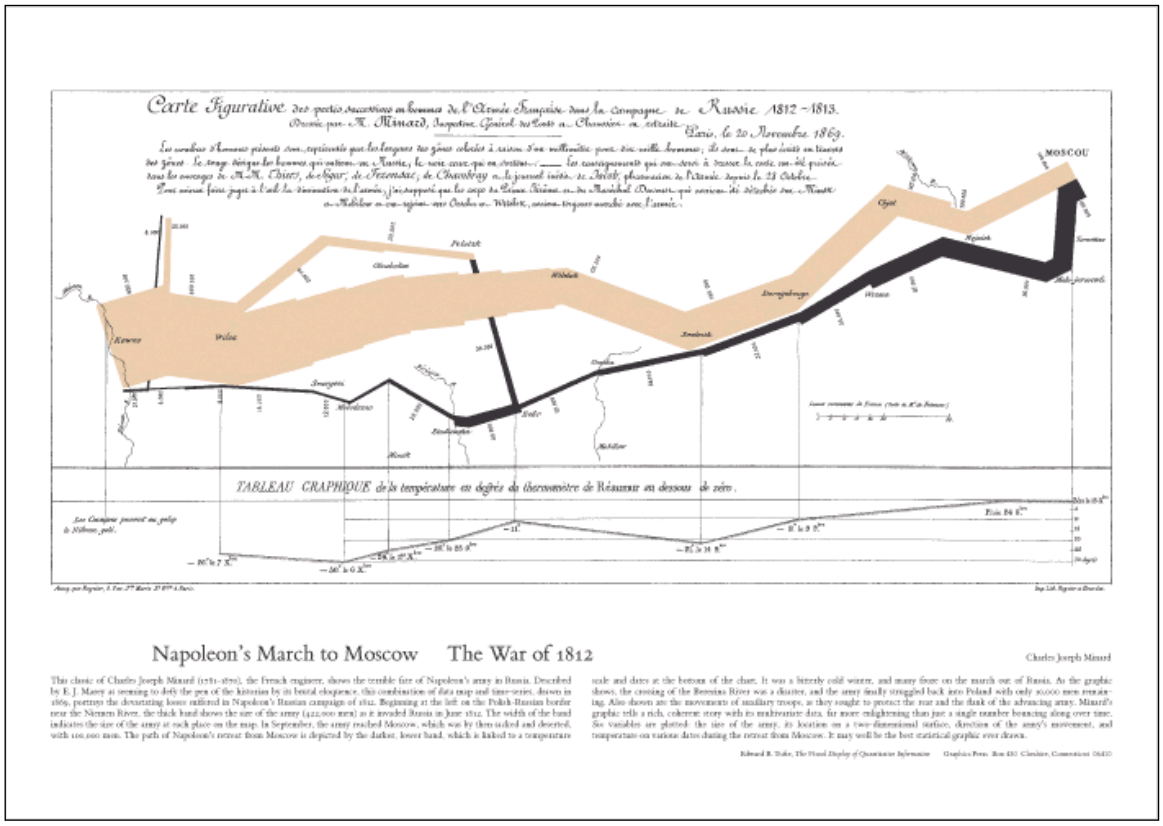

Figure 3 Napoleon's March to Moscow - The War of 1812[28]

Tufte considers this "Probably the best statistical graphic ever drawn, this map by Charles Joseph Minard portrays the losses suffered by Napoleon's army in the Russian campaign of 1812. Beginning at the Polish-Russian border, the thick band shows the size of the army at each position. The path of Napoleon's retreat from Moscow in the bitterly cold winter is depicted by the dark lower band, which is tied to temperature and time scales." As such there is a considerable amount of relevant information clearly communicated in this visual.[29]

The word "relevance" has been used several times. Without relevance communication is meaningless. Relevance means that the data, information, and knowledge communicated will lead to the desired outcome.

Suppose, as an example, you wished to inform someone of the value of the US dollar versus G-10 countries.[30]

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28 https://www.edwardtufte.com/tufte/posters [January 28, 2007]

29 Edward R. Tufte, The Visual Display of Quantitative Information, 2nd ed. (Cheshire, Conn.: Graphics Press, 2001).

30 Federal Reserve Bank of St. Louis, Series: TWEXMTHY, Trade-Weighted Exchange Value of U.S. Dollar vs G-10 Countries (DISCONTINUED SERIES), Available: http://research.stlouisfed.org/fred2/series/TWEXMTHY?&cid=105, January 28, 2007.

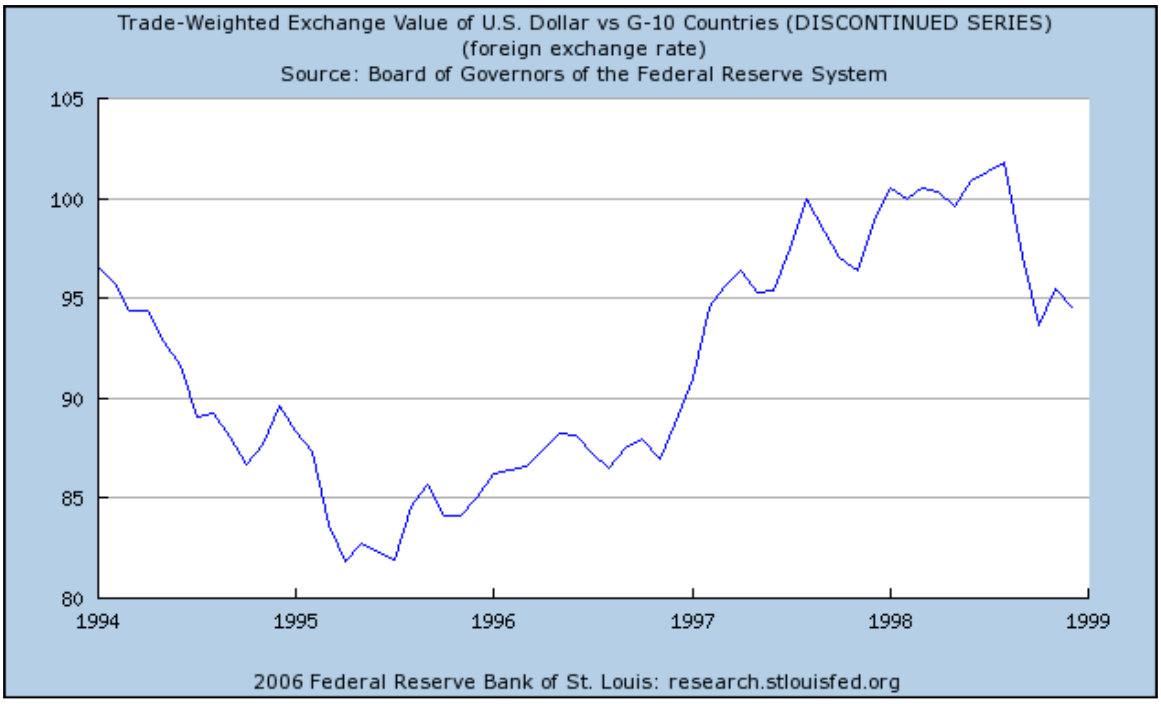

Figure 4 Value of the US Dollar versus G-10 Countries

Another way to do this is to show the underlying data.

1971-01-01	120.400	1975-01-01	96.349	1979-01-01	87.774	1983-01-01	117.725	1987-01-01	101.125	1991-01-01	83.506	1995-01-01	88.299
1971-02-01	120.227	1975-02-01	94.772	1979-02-01	88.247	1983-02-01	119.697	1987-02-01	99.459	1991-02-01	82.118	1995-02-01	87.295
1971-03-01	120.177	1975-03-01	93.930	1979-03-01	88.394	1983-03-01	120.710	1987-03-01	98.989	1991-03-01	88.115	1995-03-01	83.688
1971-04-01	120.227	1975-04-01	95.391	1979-04-01	89.495	1983-04-01	121.820	1987-04-01	97.089	1991-04-01	91.411	1995-04-01	81.807
1971-05-01	119.392	1975-05-01	94.807	1979-05-01	90.308	1983-05-01	122.052	1987-05-01	96.048	1991-05-01	92.288	1995-05-01	82.726
1971-06-01	119.284	1975-06-01	94.794	1979-06-01	89.565	1983-06-01	125.160	1987-06-01	97.782	1991-06-01	95.176	1995-06-01	82.267
1971-07-01	118.981	1975-07-01	98.734	1979-07-01	86.926	1983-07-01	126.620	1987-07-01	99.361	1991-07-01	95.192	1995-07-01	81.904
1971-08-01	117.821	1975-08-01	101.578	1979-08-01	87.244	1983-08-01	129.766	1987-08-01	99.434	1991-08-01	93.466	1995-08-01	84.586
1971-09-01	115.778	1975-09-01	103.036	1979-09-01	86.728	1983-09-01	129.737	1987-09-01	97.230	1991-09-01	91.179	1995-09-01	85.689
1971-10-01	114.699	1975-10-01	102.535	1979-10-01	87.668	1983-10-01	127.504	1987-10-01	96.650	1991-10-01	90.689	1995-10-01	84.104
1971-11-01	114.431	1975-11-01	102.579	1979-11-01	88.120	1983-11-01	130.259	1987-11-01	91.490	1991-11-01	87.983	1995-11-01	84.137
1971-12-01	112.282	1975-12-01	103.511	1979-12-01	86.320	1983-12-01	132.840	1987-12-01	88.700	1991-12-01	85.654	1995-12-01	85.068
1972-01-01	110.319	1976-01-01	103.358	1980-01-01	85.516	1984-01-01	135.074	1988-01-01	89.289	1992-01-01	86.089	1996-01-01	86.233
1972-02-01	108.890	1976-02-01	103.497	1980-02-01	86.371	1984-02-01	131.710	1988-02-01	91.087	1992-02-01	88.038	1996-02-01	86.421
1972-03-01	108.358	1976-03-01	105.122	1980-03-01	90.263	1984-03-01	128.069	1988-03-01	89.728	1992-03-01	90.444	1996-03-01	86.575
1972-04-01	108.553	1976-04-01	106.126	1980-04-01	91.091	1984-04-01	130.020	1988-04-01	88.953	1992-04-01	89.835	1996-04-01	87.462
1972-05-01	108.396	1976-05-01	106.481	1980-05-01	86.957	1984-05-01	133.986	1988-05-01	89.740	1992-05-01	88.300	1996-05-01	88.283
1972-06-01	108.237	1976-06-01	107.054	1980-06-01	85.291	1984-06-01	134.310	1988-06-01	92.576	1992-06-01	85.909	1996-06-01	88.160
1972-07-01	108.634	1976-07-01	106.837	1980-07-01	84.653	1984-07-01	139.298	1988-07-01	96.526	1992-07-01	82.573	1996-07-01	87.254
1972-08-01	108.876	1976-08-01	106.392	1980-08-01	86.092	1984-08-01	140.205	1988-08-01	98.289	1992-08-01	80.973	1996-08-01	86.543
1972-09-01	109.065	1976-09-01	105.703	1980-09-01	85.498	1984-09-01	145.704	1988-09-01	97.906	1992-09-01	81.982	1996-09-01	87.464
1972-10-01	109.572	1976-10-01	105.771	1980-10-01	86.593	1984-10-01	147.563	1988-10-01	95.100	1992-10-01	85.030	1996-10-01	87.985
1972-11-01	109.859	1976-11-01	105.881	1980-11-01	89.310	1984-11-01	144.916	1988-11-01	91.906	1992-11-01	90.040	1996-11-01	86.974
1972-12-01	110.059	1976-12-01	105.326	1980-12-01	90.987	1984-12-01	149.238	1988-12-01	91.875	1992-12-01	90.496	1996-12-01	88.714
1973-01-01	109.976	1977-01-01	105.240	1981-01-01	91.384	1985-01-01	152.826	1989-01-01	95.118	1993-01-01	92.360	1997-01-01	91.013
1973-02-01	104.364	1977-02-01	105.429	1981-02-01	96.023	1985-02-01	158.430	1989-02-01	95.775	1993-02-01	93.824	1997-02-01	94.516
1973-03-01	100.000	1977-03-01	105.195	1981-03-01	96.224	1985-03-01	158.140	1989-03-01	96.992	1993-03-01	93.647	1997-03-01	95.599
1973-04-01	101.275	1977-04-01	104.694	1981-04-01	98.800	1985-04-01	149.564	1989-04-01	97.238	1993-04-01	90.618	1997-04-01	96.391
1973-05-01	100.010	1977-05-01	104.496	1981-05-01	103.595	1985-05-01	149.924	1989-05-01	100.807	1993-05-01	90.244	1997-05-01	95.292
1973-06-01	96.489	1977-06-01	104.355	1981-06-01	106.860	1985-06-01	147.706	1989-06-01	103.089	1993-06-01	91.806	1997-06-01	95.417
1973-07-01	92.713	1977-07-01	102.543	1981-07-01	109.874	1985-07-01	140.943	1989-07-01	99.123	1993-07-01	94.590	1997-07-01	97.485
1973-08-01	95.016	1977-08-01	103.238	1981-08-01	112.287	1985-08-01	137.550	1989-08-01	100.442	1993-08-01	94.322	1997-08-01	99.958
1973-09-01	95.114	1977-09-01	103.769	1981-09-01	107.976	1985-09-01	139.140	1989-09-01	101.872	1993-09-01	92.075	1997-09-01	98.293
1973-10-01	94.479	1977-10-01	102.146	1981-10-01	106.339	1985-10-01	130.712	1989-10-01	98.921	1993-10-01	93.294	1997-10-01	97.072
1973-11-01	98.727	1977-11-01	100.730	1981-11-01	104.529	1985-11-01	128.084	1989-11-01	97.986	1993-11-01	95.475	1997-11-01	96.368
1973-12-01	101.477	1977-12-01	98.360	1981-12-01	105.214	1985-12-01	125.803	1989-12-01	94.882	1993-12-01	95.729	1997-12-01	98.821
1974-01-01	107.076	1978-01-01	96.728	1982-01-01	106.960	1986-01-01	123.648	1990-01-01	93.003	1994-01-01	96.541	1998-01-01	100.517
1974-02-01	104.435	1978-02-01	96.190	1982-02-01	110.364	1986-02-01	118.770	1990-02-01	92.253	1994-02-01	95.791	1998-02-01	99.929
1974-03-01	101.568	1978-03-01	94.802	1982-03-01	112.450	1986-03-01	116.051	1990-03-01	94.111	1994-03-01	94.353	1998-03-01	100.475
1974-04-01	99.819	1978-04-01	94.560	1982-04-01	114.071	1986-04-01	115.672	1990-04-01	93.509	1994-04-01	94.386	1998-04-01	100.303
1974-05-01	98.423	1978-05-01	96.312	1982-05-01	111.030	1986-05-01	113.274	1990-05-01	92.044	1994-05-01	92.792	1998-05-01	99.613
1974-06-01	100.017	1978-06-01	94.736	1982-06-01	116.970	1986-06-01	113.768	1990-06-01	92.426	1994-06-01	91.597	1998-06-01	100.905
1974-07-01	100.178	1978-07-01	92.439	1982-07-01	118.910	1986-07-01	110.382	1990-07-01	89.677	1994-07-01	89.056	1998-07-01	101.382
1974-08-01	102.041	1978-08-01	89.987	1982-08-01	119.632	1986-08-01	107.504	1990-08-01	86.551	1994-08-01	89.257	1998-08-01	101.799
1974-09-01	102.911	1978-09-01	89.513	1982-09-01	120.929	1986-09-01	107.145	1990-09-01	86.100	1994-09-01	88.083	1998-09-01	97.168
1974-10-01	101.605	1978-10-01	86.037	1982-10-01	123.160	1986-10-01	106.582	1990-10-01	83.435	1994-10-01	86.658	1998-10-01	93.685
1974-11-01	100.296	1978-11-01	88.856	1982-11-01	124.272	1986-11-01	107.902	1990-11-01	82.117	1994-11-01	87.713	1998-11-01	95.460
1974-12-01	98.592	1978-12-01	88.522	1982-12-01	119.219	1986-12-01	106.541	1990-12-01	83.345	1994-12-01	89.637	1998-12-01	94.605

Table 1 Value of the US Dollar versus G-10 Countries (raw data)

Clearly the trend is better shown in Figure 4 Value of the US Dollar versus G-10 Countries than in Table 1 Value of the US Dollar versus G-10 Countries (raw data). That is, the data has been made more relevant.

This is a simple example of the visualization of data that increases its relevance. However, it is illustrative of the knowledge and skills necessary to make data as relevant as possible.

Before we get into the heart of Gambs' comment – pattern recognition – a few words should be said about the third principle – The medium of communication is acceptable.

I encourage my students to produce written material that contains visual objects and that is submitted to me in a revisable form over the Internet. I discourage "hardcopy" submissions. That is, my preferred medium is the Internet. The communications process is simply much more effective when using the Internet and it is generally the preferred medium outside of academia.

The Internet is also conducive to visualizing data.

Pattern Recognition

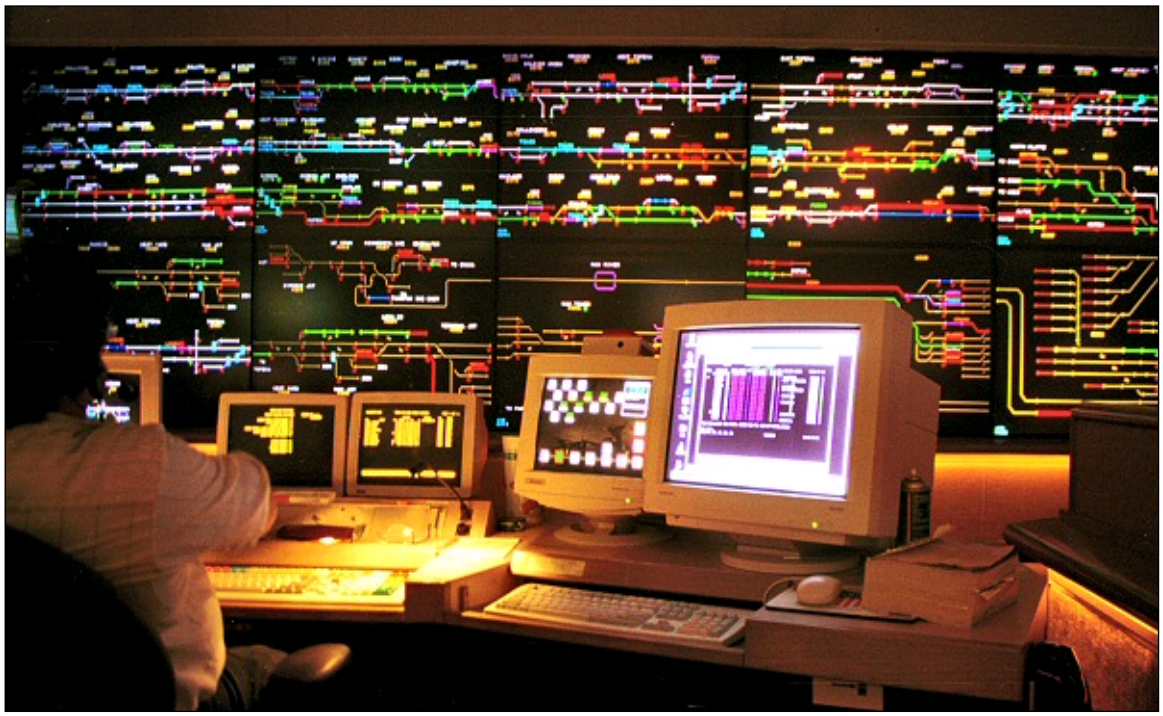

Figure 5 Union Pacific Railroad Dispatching Center[31]

Figure 5 Union Pacific Railroad Dispatching Center represents a portion of the Union Pacific rail network. It is depicted in a schematic form and the colors represent the state of various portions of the network. An experience operations person can, at a glance, get a overall view of the health of the operation. Colors, symbols, and the way they are presented are designed to draw the attention of the operators to those areas needing their attention.

The power of visualization is in drawing attention to that which needs attention.

It does this by presenting information as a pattern that is then compared to patterns that are in the mind of the receiver.

There are two important points here.

[31] http://www.gatewaynmra.org/prototype/UP_Dispatching_Center.jpg [January 28, 2007]

First, a relevant pattern must be presented to the observer.

Second, the observer must be able to interpret these patterns.

Now in written and oral communication the same points apply, but the patterns are different.

square	zhèng fāng xíng[32] 正方形	■

Figure 6 A Simple Example of Different Patterns

An English speaker would recognize the left and right pattern; the Mandarin speaker the center and right pattern.[33] The visualization of the concept at the right is more easily understood by more people.

Suppose one wanted to determine the most influential people in an organization. One might hypothesize that those who seem to be in the midst of most of the communications would be considered amongst the most influential.

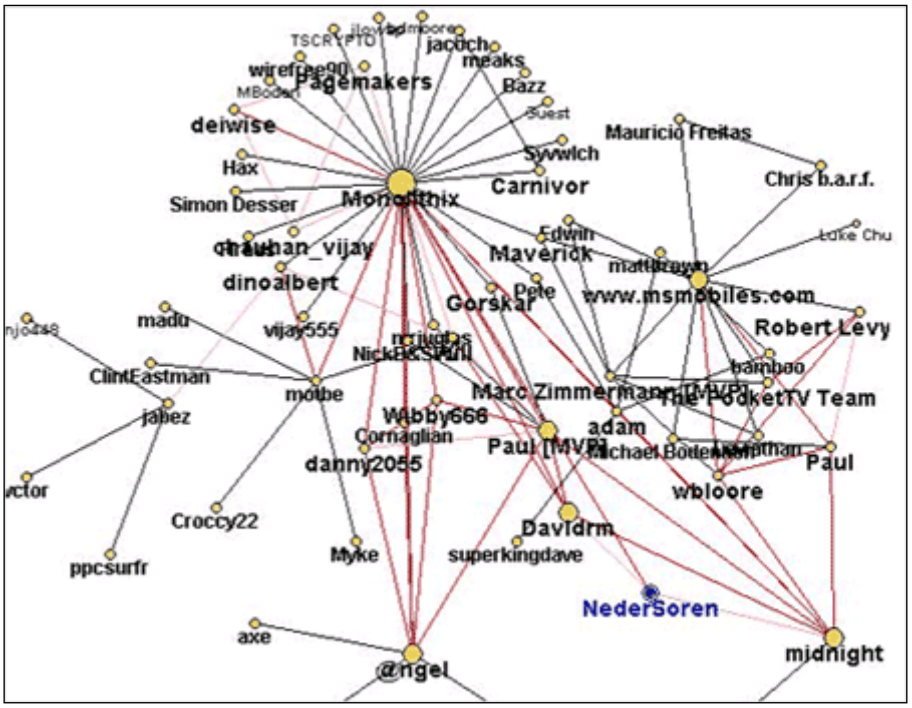

Figure 7 Social Network Analysis[34]

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[32] On-Line Chinese Tools, http://www.mandarintools.com/ [January 28, 2007]. I am grateful to my student, Shi Win Jing, for assuring me that my interpretation of Mandarin is correct.

[33] Shi Win Jing advises me that the latter part of this sentence is not entirely true. She advises me that older Chinese will understand the pictographs, but not the pinyin.

[34] Nielsen Buzzmetrics, www.nielsenbuzzmetrics.com/technology.asp [January 29, 2007]

Visualizing the interactions causes the influential to clearly stand out. This information is important when developing and managing change management strategies. What the data tells you when presented is likely to have little relationship to the organization chart (the organizational pattern most of us carry in our heads).

Suppose you wanted to quickly know the themes in a written work.

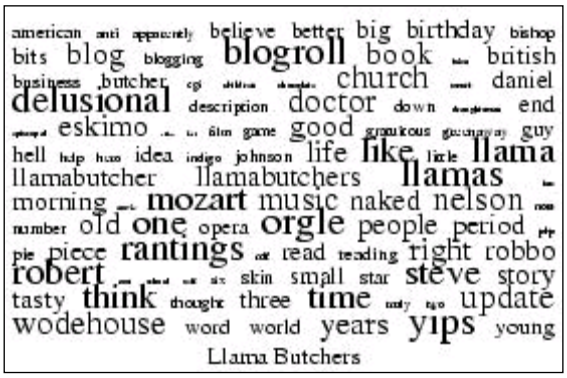

Figure 8 A Word Cloud[35]

Word clouds are a visualization of words contained in documents. The more prominent the appearance of the word in the document, the more it stands out in the cloud. Suppose one was performing a literature search using a search strategy based on words. The resulting word clouds could give you patterns that you could match with your mental patterns thereby leading to more useful search results.

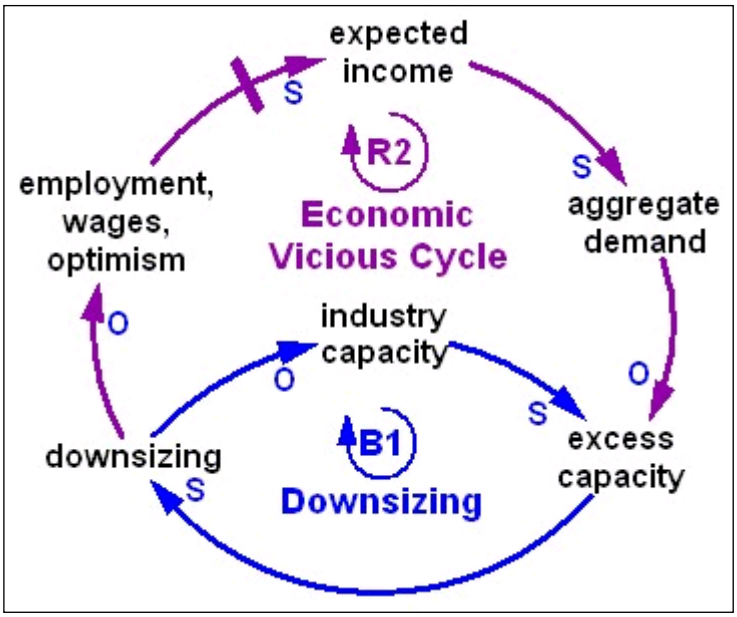

Figure 9 Systems Thinking[36]

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35 http://llamabutchers.mu.nu/Word%20Cloud.jpg [January 29, 2007]

36 http://www.exponentialimprovement.com/cms/uploads/downsize363.jpg [January 29, 2007] 'Loop B1 shows that individual companies make rational decisions to downsize to reduce company expenses; this reduces industry and excess capacity. But loop R2 shows the sum of all the downsizing decisions has an

Here is a visualization of potential impact of downsizing. A visualization of processes can be a powerful way to understand how goals and objectives are accomplished.

Haeckel and Nolan have written about the need for visualization of data in business operations.[37] They present their argument for this in the context of businesses of greater complexity needing to deal with ever increasing rates of change, risk, and uncertainty.

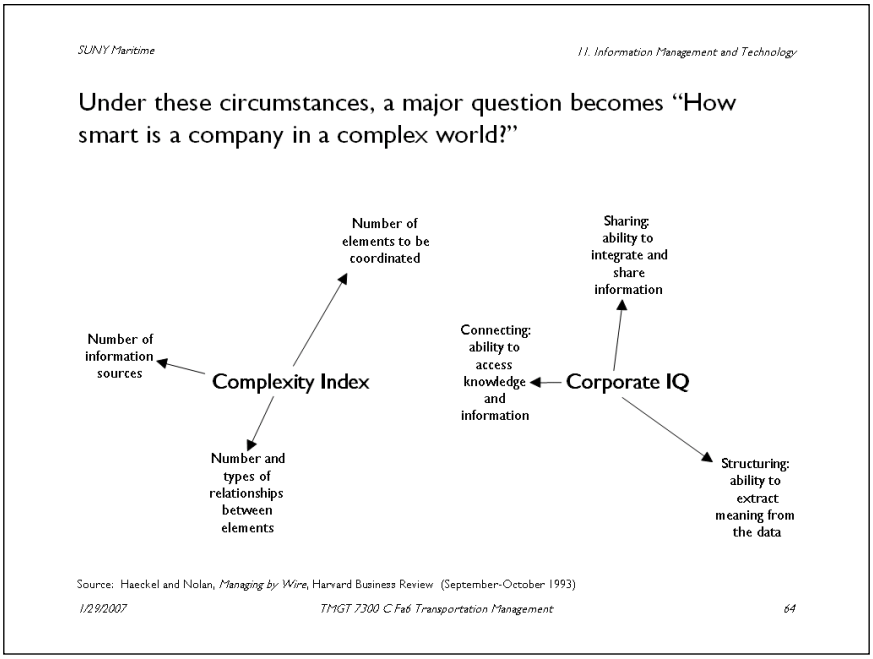

Figure 10 Complexity and IQ

My sense is that visualization will play an increasingly prominent role in enabling the communications necessary for companies to thrive in the emerging business environment.

There is also the concept of smaller and smaller decision windows.

overall industry "side-effect" of reducing employment, income, and demand to create even more excess capacity. This economic vicious cycle can lead to overall economic collapse. From Sterman, "The Long Wave Decline and the Politics of Depression."'

37 Stephan H. Haeckel and Richard L. Nolan, "Managing by Wire," Harvard Business Review.September 01, 1993 (1993).

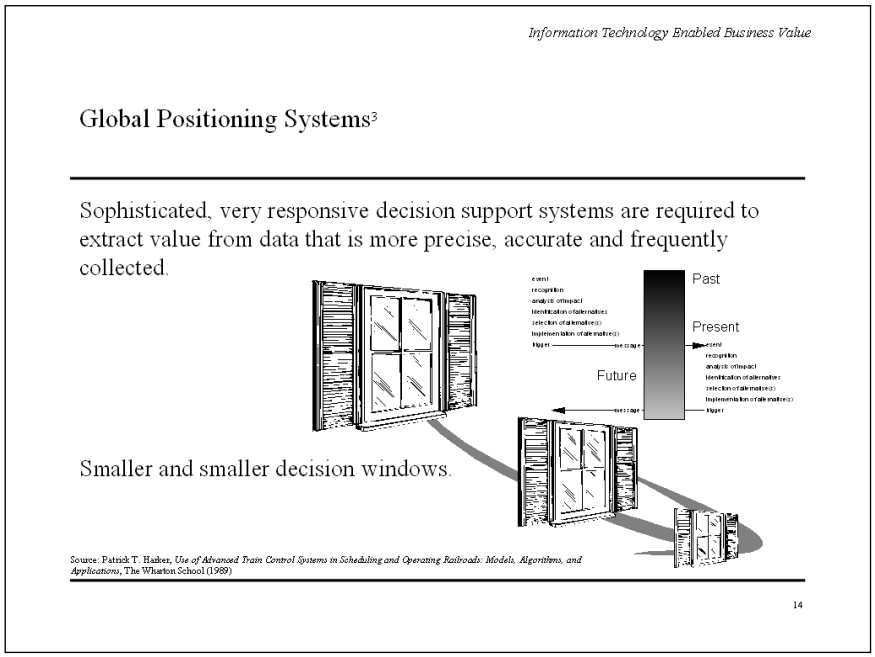

Figure 11 Decision Windows[38]

In a world of increasing complexity and speed, on the one hand, and smaller decision windows, on the other hand, we need to find a way to increase the bandwidth available in support of Sense, Interpret, Decide, Act, Learn cycle. I argue that visualization is a means to do just that.[39]

[38] James Drogan, A Note on Fact-Based Hypothesis-Driven Thinking 2005, Available: http://jmsdrgn.squarespace.com/storage/A%20Note%20on%20Fact-Based%20Hypothesis-Driven%20Thinking.pdf, January 29, 2007.

[39] Related to this is the issue of the acquisition of knowledge necessary to make decisions. James Drogan, Homer, Great Books and Modern Life, http://jmsdrgn.squarespace.com/droganbloggin/2006/12/28/homer-great-books-and-modern-life.html [January 29, 2007]

Coda

Pattern recognition is part of every day for most of us. We glance out of the window in the morning and check the weather pattern. We check the pattern of the people queued at our favorite coffee shop to decide whether or not we should detour to an alternative shop. We look at the pattern of traffic before deciding to cross in the middle of the block.

Pattern recognition and visualization are so commonplace we tend not to give either much consideration. However, imagine you had been blind from birth. Pattern recognition in the context of visualization would be an alien concept.

Inasmuch as most of us are broadly familiar with pattern recognition and visualization, we ought to strengthen these abilities for the reasons mentioned above.

Visualization is not about pretty pictures that excite (or not) the emotions. It is about developing a deeper understanding more quickly than would otherwise be possible.

What's required is an understanding of the knowledge, skills, and experience required for effective and efficient communicate across the oral, written, and visual modes of communication.

	Oral	Written	Visual
Knowledge			
Skills			
Experience			

Table 2 What We Need to Know

We need to know which mode is most effective and efficient when. We need to know what the long-term trends for communications are in the various modes. We need to know what is required to be effective and efficient in a particular mode.

Then we need to use this knowledge of communication to develop ways of learning how to be better communicators.

James Drogan
January 29, 2007

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