

Communication Design Quarterly

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Communication Design Quarterly

ACM SIGDOC (Special Interest Group Design of Communication) seeks to be the premier information source for industry, management, and academia in the multidisciplinary field of the design and communication of information. It contains a mix of peer-reviewed articles, columns, experience reports, and brief summaries of interesting research results. Communication Design Quarterly (CDQ) is archived in the ACM Digital Library.

We invite you to contribute in any of the following areas:

- Peer-reviewed articles. Articles that cross discipline boundaries as they focus on the effective and efficient methods of designing and communicating information; disciplines will include technical communication, information design, information architecture, interaction design, and human-computer interaction.
- Experience reports. Experience reports present project- or workplace-focused summaries of important technologies, techniques, or product processes.
- Interesting research results. Short reports on interesting research or usability results that lack the rigor for a full article. For example, pilot studies, graduate student projects, or corporate usability studies where full details can't be released.

We are also interested in proposals for guest editing special issues. As a guest editor, you would be responsible for providing two peer reviewed articles on a specific topic and, potentially, coordinating with the column editors so their columns can complement the issue's theme.

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Editorial: SIGDOC at ATTW

Liza Potts

Co-Editor of Communication Design Quarterly

Hi SIGDOC members,

I want to give all of you an update on how I represented us (SIGDOC!) at the Association of Teachers of Technical Writing (ATTW) Conference. Their annual conference brings together primarily faculty and graduate students from various universities and institutions focused on technical communication. Their conference is shorter than ours, but it is jam-packed with pre-conference workshop, panels, career workshops, a business meeting, and a banquet.

As some of you know, SIGDOC sponsored ATTW's first annual women's luncheon at the conference. I represented us with the goal of letting ATTW know about the good work, opportunities, and collaborations that can be made across our organizations. During the luncheon, I was able to give a brief speech about SIGDOC, CDQ, and our upcoming conference. I also talked about how we can do better to share information across our groups. We also had a poster up about SIGDOC and we were part of their materials. ATTW's leadership and attendees were grateful for our

sponsorship. All were very excited about what SIGDOC is doing, and I trust that this will result in increased interest in our conference.

I also had several conversations about how we (all of the different groups related to DOC - ATTW, SIGDOC, CPTSC, IEEE:PCS, STC) could increase the ties between our organizations. I would encourage all of our members to reach out to these different organizations, reminding each other of our strengths, opportunities, and ability to partner in ways that can enrich all of us. In deciding whether or not to sponsor this luncheon, I looked through past and current leadership lists for both of our organizations and I was delighted to find a huge amount of

overlap. To see what I mean, take a look at their advisory board for their new ATTW book series:

<http://attw.org/publications/book-series>

and for their journal:

<http://www.attw.org/publications/tcq/editorial-board>

(e.g., Mark Zachry, Clay Spinuzzi, Bill Hart-Davidson, Jeff Grabill, Ryan Moeller and more, as well as Ginny Redish and JoAnn Hackos—both of whom won our RIGO award—many people who have published with us, presented at our conferences, helped run our conferences, held leadership positions, etc.).

It's really exciting to me that we can work together to make all of our organizations stronger. And if you have any ideas on how I or any other board member can do a better job at bridging across these or other groups, please let us know! It is my goal to continue to bring more awareness to our mission and your research work, furthering our SIG's visibility across the globe.

SIGDOC 2013 Conference Call for Presentations

You are invited to participate in the ACM Special Interest Group on Design of Communication (SIGDOC) 2013 conference, September 30th – October 1st, 2013 in Greenville, North Carolina.

The SIGDOC call for presentations is now available at:

<http://sigdoc.acm.org/2013/>

Please consider submitting a project report, research paper, or poster session on the design of communication for interactive systems in industry, education, recreation, scientific research, and social exchange.

SIGDOC conferences address issues of interest to people in interaction design, content strategy, information architecture, user experience, and technical communication.

Notes from the chair

Rob Pierce

IBM Software Group

Dear Members,

On March 14th I attended the ACM SIG governing board meeting in Chicago where I presented slides to the other SIG chairs and ACM executive committee about the progress we've made over the past year as a small but vital community in ACM and we received a two year viability approval with positive encouragement about the steps we've taken to help ensure and promote the ongoing health, visibility, and growth of SIGDOC. This is a wonderful result and bodes well for our current stability and ongoing potential for an improved future.

At the SGB last week, I was struck by how successful some of the SIGs are—they have ongoing support and stability due to a wider based of contributors who keep their SIG vital and relevant to their research and practice. One of the other SIGs with a relatively small membership got a positive viability review in part, I believe, because their perceived reach is far wider than their membership - while both our SIG and theirs have about 200 members, they (SIGSAM) have various group lists that people can join from their SIG web site with a total population of over 5000 members amongst those "communities." So, while they do not have membership revenue and conference results so very different from SIGDOC, they so have that much broader visibility that they can show as part of their community. I believe that we clearly have an opportunity to do something like that in the upcoming years.

Here are the slides I presented at the ACM meeting:

<http://www.acm.org/sigs/sgb/minutes/march-14-2013-sgb-meeting-materials/sigdoc%20slides.pdf>

Other ideas for improving our visibility:

- Let's consider new web pages on our SIGDOC website that serve a greater community as a repository of ACM SIG "DOC-related" videos, (as well as articles, audio recording, etc).
- Let's build up a history page for ACM SIGDOC to increase our visibility! I'm looking for a contributor to help work with ACM to create a new SIGDOC History page from this ACM history page: http://historywiki.acm.org/sigs/Main_Page Who would like to begin creating a new page for SIGDOC? (<http://historywiki.acm.org/sigs/SIGDOC>)
- Spread the news that the SIGDOC 2013 call for presentations is now available at: <http://sigdoc.acm.org/2013/>
- Spread the news that the International Conference on Information Systems and Design of Communication (ISDOC2013), a SIGDOC European Chapter event, was recently approved by ACM and this workshop will be held in Lisbon on July 11. See <http://eurosigdoc.acm.org/isdoc2013/index.html>
- SIGDOC member Scott Tilley is now an "ACM Distinguished Lecturer". See http://dsp.acm.org/view_lecturer.cfm?lecturer_id=3D4483#lecturer_id#

New publication policy

There's a new publications policy option for SIGs from ACM - a new model to make content more openly available. This change will allow us to make the current conference proceedings publicly available, much as we currently provide the current newsletter edition from our website. I believe this will help make our papers more visible and might attract more members and conference submissions and attendees.

In February ACM publication policy changes were sent to SIG chairs and, I checked with some other SIGDOC leaders and the consensus was: "We would love to keep the conference proceedings open access as long as possible. There is strong evidence to show that papers that are available openly have a far better rate of distribution and citation. So if our goal is to distribute SIGDOC

knowledge, open access is a key factor." These are two decisions each SIG was asked to decide on, and the choices I made:

1. Open Access During the Period Around SIG Conferences Option.

SIGs will have the option to make the proceedings from their conferences freely available via the ACM DL platform for up to two weeks before the event and up to two weeks after. Not only will this option facilitate easy access to the proceedings by conference attendees, it will also enable the community at large to experience the excitement of learning about the latest developments being presented in the period surrounding the event itself. If a SIG chooses this option, the conference chair of each conference will be able to choose whether and how to exercise the option. Some conferences already open their proceedings during the conference as a way to provide internet-based access to the proceedings. Conferences that wish to open the proceedings in advance of the conference start date must clearly notify authors of this fact in the call for papers.

A) To allow conference leaders to control their publication schedule, SIGDOC will delegate the decision regarding the timing of open access during the period around SIG Conferences to the conference chairs of its sponsored and co-sponsored events. It is understood that in the case of co-sponsored events, there must be agreement from all co-sponsors in order to provide an open access period.

2. Open Access for Most Recent Instance of SIG Conferences Option.

SIGs will have the option to maintain tables-of-contents for the most recent instance of its conferences on the SIG website or on the individual conference websites with ACM Author-Izer links that provide free access to the definitive version of the article maintained in the ACM DL. For conferences that are not in a recurring series, such access will be enabled for up to one year. When selected by the sponsoring SIG, this option provides open access to conference papers during the period in which they are of greatest interest. Some SIGs have made it clear that they are very interested in this form of making their content more widely

accessible. Others have questioned whether this form of access undermines the value they provide as part of their membership package. Because this access only applies to the most recent instance of a conference, a SIG must select yes or no for the full series--this isn't a decision that can be made year-by-year by different conference chairs.

SIGDOC will allow open access for the most recent instance of its sponsored and co-sponsored events through ACM Author-Izer links on the SIG website.

I hope you approve, and thanks for your support!

Introduction: Proceedings of Symposium on Communicating Complex Information

Michael J. Albers

East Carolina University

The 2nd annual Symposium on Communicating Complex Information (SCCI) was held February 25–26 in Greenville, NC on the East Carolina University campus. It was sponsored by East Carolina University and SIGDOC. For the call for papers and information on SCCI 2014, see <http://workshop.design4complexity.com/>

There were eight presentations (along with three cancellations because of snow or illness) given by 11 people. In addition, 15 other people attended and participated in the discussions that followed each presentation. Unlike many conferences, SCCI allocates each presentation an hour with the time split between the talk and discussion.

Recent scholarship in user experience and usability has called for a revamping of the methods we use when testing more complex systems. SCCI explored these issues as well as the relationships between and within the contexts that affect complex information, information design, information architecture, user experience, and usability. The various papers examined how design choices influence people's behavior when interacting with complex information, and how the knowledge of situation contexts improved the design of complex information systems.

A major impetus for organizing SCCI is that the future will see ever more complex purposes and problems in the design of information and communication technologies that serve that information. High quality designs must make the user experience, overall usability, and human-information interaction simpler, not more complex and difficult. The challenge facing information content professionals is figuring out how to harness complex phenomena in requirements,

design, and testing so that our systems support and enhance the effective communication of open-ended, dynamic knowledge work.

The SCCI keynote talk "Is Usability Putting Lipstick on a Pig?" was given by Tharon Howard of Clemson University. In the talk, he introduced a binary between "accommodationist" and "constructivist" approaches to user-experience design and argued that accommodating technology to meet users' needs is less successful in complex problem solving environments than are approaches to interface designs which attempt to "construct users" by creating social roles which adapt users to technologies. The presentation used Althusser's theory of interpellation to show how users are hailed or called into subject positions that provide them with powerful interpretive frameworks for understanding complex problems in interfaces. Instead of validating interface prototypes in which designers have already invested considerable time, usability researchers can turn to Bourdieu's concept of "habitus" and different types of "capital" to guide their studies of users. Field research which examines users' social, linguistic, cultural, economic, and educational capital can provide a much more valuable understanding of users which designers can use to create constructivist interfaces.

A short summary of the papers contained in this special issue.

Hailey extended the call for user-centric writing to include two other writing styles: persuasion-centric and quality-centric writing. All three are best applied to different situations and using the wrong writing style impairs the communication of the content.

Zobel discussed the results of his work applying Deleuze's assemblage concept to a mobile application. He considered how it allows us to get a firm grip on who the users are, what they need, and how to create content which fits those needs.

Blythe looked at how people routinely fail to comprehend complexity and anticipate long-term consequences of choices within a system. He then considered different modeling methods which attempt to capture the non-linear nature of human-information interactions and considered how technical communication fits within the development of these models.

Shirey, Charng, and Nguyen looked at how IT organizations maintain their infrastructure and how to develop visualizations that support the professionals maintaining that infrastructure.

Meloncon presented a case study of the factors which interdisciplinary teams need to consider as they research complex information. Working with a broad range of studies within environmental health and family and community medicine, she considers the different views different disciplines bring to the table and how it affects defining the use experience.

Passera and Haapio looked at contracts, a typically text-only document, and how the inclusion of graphical material can reduce misunderstandings (the two parties believing the contract says something different) and reduce the chance of litigation.

Kain and Covi presented a study of how different visual representations elicit different responses in people and how designers need to consider these response factors in their design. Using different methods of explaining possible sea level rise to people who would be directly affected by the change, revealed that the bigger scale information which is easily interpreted an expert proved less satisfactory. Instead, the users preferred strongly localized information, although this information did not improve their overall comprehension.

Richardson built an argument that often we consider good design as any design that scores high on a usability test, without seriously considering the design's usefulness. He builds a solid argument that design is a research-based, highly iterative process that explores different models of the user-system interaction.

Albers looked at the multitude of rules of writing and design and considered how we move into cargo cult design when we rigidly apply a design rule without a clear understanding of why the rule exists or whether it applies to the situation. Successful design requires deeply understanding and working within the situational context and not blindly applying generic rules.

ReaderCentric Writing for the Prosumer Marketplace: Proposing a New, Content-Based Information Architecture Model

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ABSTRACT

As usability experts describe the appropriate models for writing in digital, they consistently express the need to write in a user-centric format. While I agree with the importance of efficient navigation in Web content, I suggest that user-centric writing only applies to part of the content we find in a website. Other styles of writing are almost always required. Two additional styles are persuasion-centric and quality-centric writing. These two styles are required by almost all marketing writing and especially marketing writing for the prosumer community. In this article I extend the ideas found in user centered design to include user-centric, persuasion-centric, and quality-centric writing (which combination I call *ReaderCentric writing*).

I believe this impacts information architecture in a number of important ways, perhaps most notably in the way the various writing styles impact the mindset of the information architect.

I will explain why these writing models are important and demonstrate what happens when the models are ignored or not understood, plus how they may be successfully applied to marketing documents on the Internet. Finally, I will speculate on how information architecture may be adjusted to meet the needs of the content, writer, and reader.

Categories and Subject Descriptors

D.3.3 [Programming Languages]: Design, Human Factors, Management, Theory.

General Terms

Your general terms must be any of the following 16 designated terms: Management, Human Factors, Verification.

Keywords

Reader-centric writing, persuasion-centric writing, quality-centric writing, prosumer, marketing writing, information architecture, user-experience analysis.

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1. INTRODUCTION

Suppose for a moment that you are a professional photographer looking for a camera that will not only shoot world-class photos but will also enhance your reputation as a professional. As you are doing your research, you come across the \$28,000 Leica S2-P, medium format camera and this passage on Amazon.com [1].

Developed exclusively for digital photography without any compromises. With the size and handling of a 35 mm camera, its performance and quality set new standards for medium-format photography. The complete Leica S-System was developed together with professional photographers with the goal of offering high quality pictures and effortless operation and handling. The entire system is based on a totally new image sensor in Leica S-Format, 30 x 45 mm in size and the classic Leica aspect ratio [sic] of 3 to 2. The large area and integrated design afford optimal picture quality. With 37.5 million pixels, cropping is never a problem, even for large-format prints. The camera is the perfect instrument; the photographer can now focus on taking pictures rather than on the technology. The LEICA S2 components are the very best quality and finely tuned to one another, producing the perfect picture that is naturally sharp and does not require digital correction. The S2-P differs from the S2 due to the addition of an abrasive- and scratch-resistant sapphire cover glass to protect its LCD monitor. Additionally, the SP-2 includes Leica's Platinum Service package which adds an additional 2 years of coverage against breakage or manufacturing defects beyond the included 1-year warranty. Should the camera need repair, customers have the right to a replacement unit free of charge within 24 hours and for the period of the repair. Plus, first time maintenance by Customer Service is free of charge, and this also includes the camera shutter and lens (including 1 shutter replacement). FEATURES: Larger-than-full-frame Image Sensor - The 37.5 megapixel image sensor of the Leica S2 is almost 60% larger than a 35mm full frame image sensor - putting the Leica S2 in a class by itself. It is also specially designed to take full advantage of the latest Leica S Series lenses. <

This passage seems large and dense in the two-column format of these pages, but on Amazon's horizontally formatted page, it is actually only a few lines deep, and in that environment it looks like a reasonable segment of user-centric text doing what it is supposed to do – describe the camera.

In fact, the above copy does not do what it is supposed to. If we parse the paragraph, we discover that there are actually three different blocks of text, each serving a different purpose. The first,

“Developed exclusively for digital photography The complete Leica S-System was,” is marketing text—the kind you might expect to see on a page designed to market a camera.

Later in the paragraph, however, we see, “The S2-P differs from the S2 due to the addition of an abrasive- and scratch-resistant sapphire cover glass to protect its LCD monitor.” This is no longer marketing copy. It is more like a note, “NOTE: The S2-P differs. . . .” I should point out that it is not uncommon for a note to appear in marketing copy, but when it does it is usually identified as a separate thing from the sales oriented copy and often appears as a footnote. It also indicates that this ad is about the S2-P and not the Leica S-System discussed in the beginning.

Finally the copy shifts to the “FEATURES” of the S-2—which is a part of what was once a bulleted list reflecting not to the S2-p but to the S2 again.

What actions might have caused three different genres to be merged into a single paragraph? When people write by copy/pasting chunks of text, we will often see this kind of artifact. The smoking gun, in this case is the “<” found at the end of the paragraph. Somebody copy/pasted three different chunks of text from different websites and included the beginning of an HTML tag they picked up while doing the copying. If this were an exception on Amazon’s site, perhaps it would be unimportant, but on pages designed for the prosumer market, this is the norm.

Not all writing in the prosumer sections are so bad, however. There are also some excellent examples of masterful writing in the same sections. The purpose of this paper, then, is to identify some of the excellent writing, some of the really poor writing, and explain how to make the poor writing excellent using the ReaderCentric model I will propose, *and then* look at how that knowledge might impact the architecture of a webpage.

2. DEFINITIONS

It might be useful to define some of my terms before proceeding too far into the arguments. Many of the terms I use (e.g., *prosumer*) have multiple meanings. Others of my terms (especially terms I have coined) have new meanings which readers may never have seen before.

2.1 Prosumers

I have seen three definitions of *prosumer*. The first (#1) describes prosumers as a professional who buy products to support their professions (e.g., interior designer buys decorations, upholstery, etc; architect buys computers, software, etc). The second (#2) definition describes people who do work for themselves that would normally be done by professionals (e.g., hanging their own wallpaper, installing their own photovoltaic system, etc.). The final (#3) description is of people who make no differentiation when buying things for their professional use and their personal use (e.g., buying high-end computers and software for use at home, buying near-professional quality photographic equipment for personal use).

An important point to make about prosumers is they are all serious researchers. Prosumer #1, putting in a photovoltaic system, will need to know everything about the process before attempting it; prosumer #3, wanting photo equipment, will be looking for the best value, and the person purchasing design software will want the best, but will also be concerned with price. Depending on what I am doing (installing photovoltaics, videotaping industrial construction, or wildlife photography) I fit into all three categories, and I can safely say I virtually never buy

something for these purposes without researching all of the options.

2.2 User-Centric Writing

I suspect anybody who has spent any time around websites is fully cognizant of what this term means. It has become the standardized style of writing for websites. In *Letting Go of the Words* [2], Janice Redish says, “Most people skim and scan a lot on the web,” and “Most web users are very busy people who want to read only as much as they need to satisfy the goal that brought them to the web” (p. 2). She suggests that content be conversational (easy to read) and short.

Jacob Nielsen did a series of studies on how people read on computers (beginning before the web even existed), and accurately concluded that people tend to scan rather than read. Based on that, he devised a series of important and valuable design rubrics. They have become the standard for web evaluation. In *Designing Web Usability* [3], Nielsen lays out his fundamentals:

Be succinct. Write no more than 50 percent of the text you would have used to cover the same material in a print publication.

Write for scannability. Don’t require users to read long continuous blocks of text; instead, use short paragraphs, subheadings, and bulleted lists.

Use hypertext to split up long information into multiple pages. (p. 101)

The model presented by Nielsen, Redish and others has evolved into a model for how the entire website should be presented—a user-centric model where users can get to the products or services they need, but the products and receive the services and move on.

2.3 Persuasion-Centric Writing

Persuasion-centric writing encourages readers to linger while they are being persuaded. The last thing the author wants is for readers to hurry off before they have made up their minds. For example, returning to the search for the professional camera we might examine the idea of a \$3,000 Canon EOS 5D III. In the Amazon site, Canon’s authors produce a full 10 typewritten pages of persuasive text in the product description. Even the bulleted “Product Features” section is longer than the Leica copy. More important, however, is that everything is where it is supposed to be and nothing is patched together from other copy. The Canon copy is no accident. Nikon, Sony, and Panasonic do the same thing.

In contrast, Leica’s copy for a comparable \$23,000 camera is a single short paragraph (essentially 1/3 of the Leica paragraph I use above). It isn’t often that one sees a reviewer comment about marketing copy, but in this case there is a comment. [1]

Is it just me or has Amazon forgotten to mention anything about a lens other than above average glass. From the listing, you really can’t tell if a lens is included or not! Leica does make way above average equipment and this S2 is truly over the top. Unfortunately, I would have to disagree with another of the Amazon listed features: Affordable! Yeah, if your budget has room for another car payment.

If, as I claim, prosumers carefully research as they purchase expensive products, the Leica model is completely inappropriate. More appropriate is a style of writing that encourages the reader to linger and research while the text quietly persuades.

Ultimately, the defining characteristic of persuasion-centric writing is length (it is long), quality (it has to be very good), and purpose (persuade).

2.4 Quality-Centric Writing

A description of quality-centric writing will be much like a description of persuasion-centric writing. Quality-centric writing includes educational texts, articles, documentaries, reports, proposals, stories, novels, and reviews, to name a few (many can be relatively short but any can be very long). The thing they have in common is this: only if they are well done will readers stay with the texts until the last page (or moment with videos).

Quality-centric texts often have a persuasive edge, but it will never be overt. A good review, for example, will imply that it is safe to buy a product, while a bad review will imply that it is not.

2.5 Reader-Centric Writing

Reader-centric writing is a term I have coined to describe a model where the writing of content is carefully crafted with the assumption that the user is often a careful reader wanting more than just the quickest path to the product or service. Because any webpage will have at least two different genres (menus and something else) the reader-centric writers will understand the genres and keep the writing models they imply in mind as they craft their texts.

It is a simple task to identify web developers who do not do that. One needs only look at pretty much any webpage.

3. PROSUMER AS RESEARCHER

In Information Architecture for the World Wide Web, Morville and Rosenfeld describe four kinds of users [4], using an interesting collection of metaphors from fishing (2006).

The perfect catch

Lobster trapping

Indiscriminate driftnetting

I've seen you before Moby Dick (p. 33)

Prosumers fit nicely in each of these areas, but contrary to Morville and Rosenfeld's characterization of them as "users," three of the groups are more accurately described as readers and researchers. Only *the perfect catch* assumes prosumers will use the user-centric model to find the product or service and spend money. In this case, the prosumer knows what she wants and only needs to find it and buy it. For example, the prosumer wanting a really professional visual design and editing suite might begin with Adobe CreativeSuite 6 and want nothing more than the option to buy it. The rest of the models they describe approach prosumers take while researching before purchasing.

Lobster trapping refers to the act of finding as many results as possible. The prosumer thinking about purchasing a camera might examine Canon D60s, D7s, D5s (in ii and iii configurations) on Amazon, and on the websites of half-a-dozen major camera stores, and might do it for weeks before making a final selection.

Indiscriminate driftnetting describes the kind of shopper who is looking at a large project with many purchases and needs a great deal of information before beginning. I went through this process a few years ago. My cabin is off the grid and for years had no electricity. My project for about two years was to put together a photovoltaic system capable of providing power to the well and the cabin. I researched for months before buying a single thing.

Even then, I purchased and tested, purchased and tested until I was confident I could make decisions about which of the very expensive products I should buy.

I've seen you before Moby Dick Most of the shoppers I describe above don't just go to a site and then forever move on to other sites. Most of them come back again and again before finally giving up their cash. In my quest for solar power, I got to know some sites so well that I could type their URLs from memory. Even though their architectures were often mangrove swamp-like, I could still navigate them like a wilderness guide.

Having explained the four models Morville and Rosenfeld propose, I would like to add one more, and in keeping with their spirit of fishing metaphors, I would like to call this one *spear fishing*. This describes the consumer who identifies what he wants and is willing to defer gratification until he sees it available at an acceptable price, at which point he spears it. A person might see the ideal video camera for his purposes but might wait for next year's model comes out. When the older model drops in price he will grab it.

4. DIFFERENT GENRES IN WEBPAGES

It is possible to break webpages into their many genres to see how effectively the developers identify and work within them. An Amazon.com page, for example, will always use a menus (lots of different kinds of menus), brief descriptions (usually appearing as bulleted lists), comprehensive descriptions (usually in paragraph form and often very long), and reviews – plus an effective search engine.

Most of the genres on an Amazon page are auto-generated. Three genres that are not auto-generated are brief descriptions, detailed descriptions and reviews. Canon, Panasonic, and Sony will almost certainly have hired ad agencies to write their descriptions, and so they are very well done (although it might not always seem so). It is also possible to see when Leica has done the same thing. On Amazon, Leica's copy is sometimes much like Canon's. Their copy for the Leica D-LUX5 is 10 paragraphs long, describing the camera in great detail. The other thing it has in common with Canon, Sony, and Panasonic copy is they all begin with "From the manufacturer." The really bad copy for the S2-P I discuss above (and the S2, for that matter) is not from the manufacturer. It is either pulled together by Amazon or (more likely) by some camera shop (17th Street Photography in at least one of the cases).

It should already be clear that websites do not have genres, they contain genres. In short, a website is a collection of genres. Since a site put together to market to prosumers will have a rhetorical (sales or marketing) approach, many of the genres will be persuasion-centric.

4.1 On any Prosumer Website

What might a prosumer website look like? Let's look at the prosumers I described above. The first is the professional buying for professional use. A professional photographer buys a camera or an editing consultant buys a file sharing software or an interior decorator buys Tiffany shades for a row of lights. None of these people will just go to Amazon or comparable website and pay hundreds or thousands of dollars without doing some research. They want the best quality they can get for the best price.

The second prosumer I described above does his or her own professional work. As an example, I have remote cabin well off the grid. To get enough electricity to run my water pump and provide a little light in the cabin, I had to build a photovoltaic

system. To build the system, I had to spend a great deal of time buying books, viewing YouTube videos and touring green energy websites. It took about a year of research before I was confident that I knew enough to build a system. Even then, however, I discovered that all of the different panels had different capabilities that made them particularly useful for some purposes and less useful for others. Just as professional-consumers are researchers, so are DIY prosumers.

The final prosumers I described above make no distinction between products and services of the profession and those for their personal use. They will put the same (or nearly the same) research into the camera they buy or their home decorations that the professional does. In effect, an important defining characteristic of prosumers is they are researchers.

It follows that a page designed for prosumers will (or should) present them with a great deal of information about the products or services they investigate. This should be information they can really use in their decision-making. On a high percentage of pages (more than 50%) across the Internet, designed for the prosumer, this information is either lacking or completely wrong.

Leica makes a leather case for one of its cameras. The following lists the product features for that case [5]:

- Patent Technologies - Heat Transfer Technology - A unique L-shaped heat-sink to remove heat from the PSU / Hybrid Transformer - Unique design that combines heat-sink with transformer / Hyper Path - Places IC close to transformers leading to huge efficiency ratings
- Flat modularized cables provide easy cable management leads to better airflow
- Compliance with the latest Intel standard ATX 12V V2.3 Operation with intelligent fan speed control
- High reliability (MTBF > 100,000 hours)

The entire product description looks like . . .

Leica D-Lux 5 ever-ready case

The product features are for a heat sink, and the title of the page actually provides more information than the product description.

Even when details are available, they are often incomplete. What lenses is Canon's EF 2.0 telephoto extender compatible with? What camera? It turns out that it is not compatible with all Canon lenses or all Canon SLRs. How does one find out? On the Canon website one can look up lens compatibility but not camera. The only way to know that is to pay \$500 for the extender and see whether it works on my camera.

4.2 Outside Amazon

The problem with inappropriate content does not simply occur on Amazon. It pervades the Internet. Pick a topic, any topic . . . I know, let's pick one I am familiar with – photovoltaics. As one does research on photovoltaics, one truth quickly emerges: solar panels are made differently for different purposes. Someone wanting to tie a house to the grid will use different panels from someone wanting to run batteries for an off-grid system. And there are even different panels for different off-grid systems that may not use batteries (e.g., remote water pumps designed to work daily when the sun is out). Some panels produce more amps while some produce more volts. What kind of panel to get is just one of the many questions that arise but with answers almost impossible to find on green energy marketing sites. That isn't always the case, however. One site (WholesaleSolar.com) [6] starts out badly, but intermittently offers good information.

The first thing one sees on the homepage is an attractive banner atop a button bar. Below the banner is a welcome message

Welcome to Wholesale Solar, your source for discount prices on solar panels and renewable energy products for home power, back-up power, solar & wind power, off-grid & grid intertied residential, marine and RV power systems. Retail and wholesale pricing.

The message is persuasion-centric, but might be more persuasive if it were user-centric.

Welcome to Wholesale Solar, your source for discount prices on solar panels and renewable energy products for

- home power,
- back-up power,
- solar & wind power,
- off-grid & grid tied residential,
- marine,
- RV power systems.

Retail and wholesale pricing.

That list is followed by another, and it should also have been bulleted.

We design and sell renewable energy systems for

- for homeowners
- do-it-yourselfers,
- contractors,
- installers,
- electricians,
- developers.

Below the list is a very large button bar that links to Sections called "Solar Panels," "Backup Power," "RV and Marine," "Power Centers," and "Package Systems."

After this, the page becomes a completely chaotic collection of tables offering solar panels by the pallet, individually, grid tie systems, starter systems, and off-grid systems with virtually no additional information. If the buyers know exactly what they need, this information might be valuable for them. More likely, even for them, the page is simply made more difficult to understand. Still, it is easily navigated.

Immediately after the tables, we find persuasion-centric content designed to look like information.

You can eliminate the cost of batteries by going with a system that connects right into your home's main junction box and use the grid as your power source at night or on long stretches of inclement weather. These installations are known as grid-tied or grid-interconnected systems. This version of solar system enables you to sell any excess power you produce back to the utility companies who have chosen to support "net metering". Once you are signed up on a net metering program, your utility company will have a smart meter installed known as a Time of Use Meter, which will actually run backwards when you are producing excess power. It is wise to keep in mind that Grid tied systems without a battery backup, are only functional when the grid is operational.

This is a part of about two typewritten pages (equivalent) of information that any researcher who has done any research at all will probably already know. These are fundamental facts that could easily have been on some kind of basic information page. What would be more useful would be link to a decision tree that helps the purchaser know what to purchase—a design your own system page.

The page's architecture follows no guidelines I know of. It is a collection of postage stamp ads that link to other pages, a few short paragraphs (that should be bullet points) near the top, half a

dozen tables and approximately 3-typewritten pages of general descriptions of photovoltaics that could have been written by a high school student for a science class term paper. It has the clear fingerprints of someone who, faced with the daunting task of building a website, just “winged it” pouring in whatever available content he could find to fill the obvious spaces.

5. ARCHITECTURE OF AMAZON.COM

Amazon.com is a site with much better architecture. Everything has its place on the page for an easily identifiable purpose. The site makes an excellent model for marketing to a prosumer community.

The site is a complex information system, so it is not really possible to produce a meaningful wire frame. The linking of every page changes every time the user logs in. The structure even changes from browser to browser and for different monitors. Still, it is possible to describe the structure of the site in general terms. Basically, the site is made up of a home page, navigation pages, and product pages, with a variety of customer support pages available in the background. The actual configuration of the product page is somewhat differently for the various products. For example, the pages that sell prosumer objects are different from the pages that sell shirts or dresses.

In short, until the user reaches the product page the system is exceptionally user friendly. Navigation occurs when users click on easily identifiable links or type a key phrase into the search engine. If the user clicks on a link she goes to a product page. If she types in a key phrase she goes to a menu page offering her a selection of related products. Even if she types in a specific product, she still goes to the menu page. With the exception of the ubiquitous search engine, all navigation on the site occurs through these menus. Once she gets to the product page, however, things change

5.1 Amazon Product Page Architect

The product pages are also user friendly. On some pages it is clear the manufacturers have hired or used in house ad agencies to market their products, and the copy fits beautifully into several of the product description sections of the page. While the site as a whole has a simple enough architecture, the product pages are much more complicated and (when used right) effective.

The architecture of Amazon’s product pages effectively does ten things, depending on how one measures “doing.”

First, users immediately know whether they are on the right page. They immediately see what amounts to a banner with a good photo of the product (usually, but not always the right one). Typically, users are also given an opportunity to see more views of the product. I have used that feature to great success a number of times to make certain the product actually had the attachment I needed. This is usually an effective user-centric section.

Second, if this is the right product and the user wants it, he or she is given a number of purchasing options, including that **Buy now with 1-Click** button, and the product is on the way within 48 hours. This is also an effective user-centric section.

Third, immediately under the image of the product is a product features section. Done with bullet points, this is an excellent section to present the products best features. The copy for the Leica 2S-P has five bullet points that begin and end with the same, “LENS NOT INCLUDED – BODY ONLY.” So of the five bullet points, two point out what the buyer cannot have. One line points out the 32.5 million pixel resolution, but none of the other

camera features are mentioned. The page for the Canon 5d is different. Canon’s marketing people use this section to market the camera as they describe its features. Although they use bullet points, the bullet points lead into long and descriptive sentences (some making a pretty good paragraph). This looks like a user-centric section, but Canon’s people use it as a persuasion-centric section.

Fourth, Amazon takes a moment of the reader’s time to offer 0% financing for a year if the reader will just use an Amazon credit card. Persuasion-centric copy disguised as information.

Fifth, Amazon offers the reader a number of other choices that go with the product in two menus: (1) **Frequently Bought Together**, and (2) **Customers Who Bought This Item Also Bought**. This is really smart. If I am buying a camera body, I will also want the appropriate lens and the appropriate filter to protect that lens. This is where I could buy them. It may be strongly persuasive, perhaps, but it’s probably user-centric – as is number six.

Sixth, for the Canon EOS 5D Mark III, this is where they have a chance to buy manuals, pocket guides, utility manuals. It is also where the technical details, product details are spelled out (in two bulleted sections).

Seventh, the product description section is next, and it is the vendors’ best hope for persuading the reader to buy this product. Canon, Nikon, and Sony use this space well, Olympus not so well (a great deal of information but no eye candy – less persuasive), and Leica not at all. This should be purely persuasion-centric.

Eighth, in a section titled, “What Other Items Do Customers Buy After Viewing This Item?” Amazon dangles a few more purchasing possibilities, and in another two Amazon offers links to vendors selling similar products (no doubt with click-through prices on them).

Ninth, the reviews can make or break a product. The Canon reviews are largely positive, while the Leica reviews are largely ridicule. The most appreciated of the Canon reviews are very long and by very good reviewers. One on the Canon 5d page is ranked 234th among all of Amazon’s reviewers for all products. His review for this camera is rated “483 out of 499 people found the following review helpful,” and the review is 1745 words long (approximately 7 typewritten pages). This information is not overtly designed to sell. Rather, it is designed to inform, and inform it does. This is quality-centric writing (designed to encourage the reader to *linger* and be informed).

Tenth, The rest of the page is dedicated to offering readers (any who haven’t figured out when to quit reading) more opportunities to buy more products or go to different product pages.

The structural architecture of the product pages does exactly what it is supposed to do. Moreover, it changes appropriately for other pages offering products used for different purposes. For example, pages with shirts on them skip most of the above sections (not much use for the technical details of a shirt).

5.2 Including Genres in the Architecture

Let us suppose for a moment that we are putting together a marketing site.

First, we need the users to immediately know they are on the right pages, so we give them an excellent image with alternate views. But we need to consider something else. Photos are an amazing marketing tool. We need the photos to show the product in its best light. In effect, as user-centric as this text might be it can also be persuasion-centric.

If this is the object the customer wants, it should be immediately available with a purchasing button right there for regular customers (not just a shopping cart) – just like the Canon page on Amazon.com.

Second, there should be a section that spells out the nature of the product in bullet points. But once again, this can be persuasive. Canon's product features list is bulleted, but as I have pointed out, the bullets are in front of paragraphs, so although the content looks like it's user-centric, it acts more persuasion-centric – designed to encourage the reader to linger and be persuaded. In the vast majority of other pages on Amazon, the bullet points precede short lines of text – those are user-centric text.

Third, there should be an extensive product description, designed to inform the reader and sell the product. Depending on the product, the description might include how one uses the product, what the product is specifically good for, why this is the best product for its purpose, etc. This should be persuasion-centric, just like the Canon page on Amazon.com.

Fourth, reviews not only point to product strengths and weaknesses, but they also point to how the product should be used. Based on their reviews, Canon 5D users are still largely hobbyists and artists who want to shoot the best possible photos at the best possible price, while the 1D X users are fulltime professionals discussing how they use the cameras under various professional conditions. The reviews need to be comprehensive – quality-centric.

Although this Architecture involves fewer segments, it still basically follows what Amazon has done, implying that Amazon is an excellent model (or at least that I think it is). All of the other parts, leading to other pages and other resources can be added if IT has the resources and talent. But as similar as the structures seem, there is now a difference. This architecture includes the purposes of the texts, still basically the same structure, but conceptually different. It is designed with the understanding that the text is supposed to do something beside provide bare information, and it is designed to put the text in the best position to do that.

5.3 Architects Who Do and Who Do Not

Many architects design their sites with the texts' purposes in mind (clearly Amazon's do) but many do not. Still, although Amazon's architects appear to have considered the purpose of the texts, many of the people providing the copy do not understand that, and they often post texts with major problems, *and* these texts languish on Amazon, unrepaired, for years. Amazon appears to have little or no quality control. I suspect the cost of such extensive monitoring is more than they wish to pay. But they are unique in that. Most sites that market products cannot afford fifty percent, or more, of their marketing copy to be ineffective.

6. SOLUTIONS

I propose two solutions. The first is that information architects not be individuals but teams that include competent professional writers. These writers recognize that every piece of content on the website has a rhetorical purpose based on identifiable needs. The writer recognizes that these purposes change from paragraph to paragraph, from genre to genre. This writer should be able to weave these genres into a successful pattern, so that while the structural architect is designing the walls and rooms, the writer is designing the doors, windows, façade and sales force. The architect designs

the store but the writer makes it a place where customers want to be.

The second problem is ongoing quality control. We have all been in those tacky dollar stores where there is mop bucked in the corner, products are carelessly arranged on the shelves, where we wait and wait for someone to help us with a purchase (and when we get them, they are no help). Much of the time these places are run by teens and managed by them. Amazon has become one of those places. We would never accept that kind of shoddiness in an uptown store that sold expensive products – a Dillards or Nordstroms.

Marketing sites (especially ones designed for people as selective as prosumers) need excellent content management. That, however, creates a problem in complex information systems such as Amazon's. Most of the time when a writer sees a text it is in a database and out of context. A solution is to have a writer who ranges the site, seeing the content in context, searching out defective texts. A good freelancer could do it from a computer half-way across the country. This "ranger" would send in trouble reports for all the problem texts he finds. Hell, I'd do it for free if there were a place to send the report.

7. CONCLUSIONS

Sites such as Amazon represent only one approach to marketing. There are tourism sites that work within a completely different model, using completely different genres. Manufacturer sites tout their products without actually having to sell them. Commercial product sites (e.g., photovoltaics) demand yet a different model.

These sites need information architects who understand structures and navigation, but they also need information architects who understand how genre structures can be combined to powerful affect. Some sites have architects who can do the former, few have architects who can do the latter.

8. ACKNOWLEDGMENTS

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Engaging Complexity in Usability Through Assemblage

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ABSTRACT

In 2011, I faced a complex research problem: how could mobile device user experience (HCMVX) of visitors to Humboldt County, California, be measured and improved? Mobile visitors are visitors who actively use their smart mobile devices, like smart phones and iPads but not laptops, while on vacation. In 2011, there were no official records or policies regarding mobile visitors and little local awareness of mobile tourism in Humboldt County. No one had measured mobile visitors' experience in Humboldt County and few officials had any idea on how to improve these visitors' experiences. This information and policy gap also meant there was no clear way to contact mobile visitors or arrange for mobile usability tests. I faced a complex system with no clear starting point.

Traditional usability methods did not initially help because the majority of usability methods rely on clearly identified users, tasks, or goals. While I planned to use traditional usability methods once the users and usability problem(s) were identified, it was necessary to first locate and identify the users and their tasks and goals. Using Deleuze's assemblage concept, I approached the complex system of HCMVX, identified potential points of engagement, conducted field research and interviews, analyzed, and wrote up my results in less than six months. Local officials took my results and reshaped part of their policies and merchant training based on my data and conclusion. Deleuze's assemblage offers usability practitioners a means to approach complex systems and rapidly identify points of engagement.

Categories and Subject Descriptors

H.0 Information Systems: General

General Terms

Design, Human Factors, Theory.

Keywords

Deleuze, usability, complexity, complex systems, mobile devices

1. INTRODUCTION

Usability practitioners regularly face complex systems. A complex system's parts are close, interact a great deal, and have multiple relationships between different parts [1]. Complex systems create complex problems that are approached with

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complex tasks in complex environments. Redish and Scholtz list eight ways that show how complex tasks and problems, and thus complex systems, differ from simple problems; these simple problems are similar to what Mirel calls "well-structured tasks" [2,3]. Complex systems and problems' traits include: endemic information overload; incomplete information; and reliance upon visualizations as a method to understand complex systems and problems. Simple usable systems do not have these challenges.

Measuring and improving visitors' mobile experience while in Humboldt County (HCMVX), California, was one such complex system. There was no clear place to start, and measuring and improving HCMVX was not a matter of identifying simple systems or simple tasks. Encouraged by Redish's statement that "Usability specialists must rethink their roles and methods for formative evaluation" and Albers' claim that "Usability testing of a complex system must be regarded as fundamentally different from simple usability testing" so that the test will "capture, or at least account for, those complex interactions," I considered attempts to address complexity in usability as well as other fields [4,5].

2. WORKING WITH COMPLEX SYSTEMS

2.1 Complex Systems in Technical Communication and Usability

In technical communication (TC) and usability, a growing number of scholars have addressed complex systems and how they impact information ecologies and users. Spinuzzi uses assemblage to understand collaborative work environments and workplace ecologies—environments that easily qualify as complex systems. An assemblage helps "make sense of a heterogeneous jumble of infinitely recombinable parts not just semiotically but functionally" [6]. Albers presents a three-dimensional model to address a complex information system: knowledge level, detail level, and cognitive abilities [7]. Straddling usability and TC, Still's ecological approach is rooted in ecology and systems thinking and has been employed in usability testing. Still's approach acknowledges that an entire system cannot be measured and that problems rarely remain stable—new problems emerge or aspects of the problem change; at any one time, only parts of a system or problem can be measured [8].

Redish and Scholtz indicate an important problem in usability: most usability tests have been designed to evaluate simple systems and are constructed to have users attempt simple tasks [9]. Linked to this issue of simple tasks, Dilger indicates a growing percentage of usability practitioners engage in what he labels "extreme usability," a practice that centers on easy, simplified usability that ignores complex and developed usability concepts [10]. Howard's findings indicate that if researchers

assume a problem or system is simple, they will stop when they find a simple solution. Stopping with a simple solution closes off potentially interesting alternatives and solutions [11]. Given the emphasis on ease of use in usability, Redish and Scholtz state, “Usability specialists must rethink their roles and methods for formative evaluation” [12]. To help rethink the approach and avoid the temptation of only using or seeing simple solutions, fields outside of technical communication and usability were considered.

2.2 Addressing Complex Systems in Other Fields

Tourism’s approach to complex problems was appropriate for review as the HCMVX involves tourists and visitors. Several approaches to complexity were found. McKercher’s assertion that current tourism models are not accurate parallels Redish’s same point about usability testing, but McKercher’s attempts to address complexity in tourism and travel did not help address the HCMVX problem [13, 14]. McKercher’s work did indicate that thinkers in two different fields both understood that complex systems require different models. Zahra and Ryan build on McKercher’s work and offer, like Albers’ model for complex information, a three-dimensional model for tourism in relationship to its environment [15]. While interesting, more was needed.

Initial reviews of Deleuze’s assemblage, based on Spinuzzi’s work, led to De Landa’s work on assemblage [16]. This led to efforts by multiple organization studies scholars on assemblage, albeit they mostly center on De Landa’s work. Protevi, Thanem, and Palmas have helped develop De Landa’s ideas and apply them to complex organizational and social systems [17, 18, 19].

3. APPLYING DELEUZE’S ASSEMBLAGE CONCEPT

3.1 Selecting Assemblage

Based on organization studies and technical communication’s successful use of assemblage to understand and address complex systems, it seemed a viable approach to HCMVX. Given the ongoing and constant shifting in mobile devices, software, operating systems, and interfaces, an approach that adapted for constantly shifting elements and relationships was essential. One of Deleuze and Guattari’s definitions of an assemblage show why assemblage was so potentially viable: “An assemblage is precisely this increase in the dimensions of a multiplicity that necessarily changes in nature as it expands its connections” [20]. First, assemblage accounts for constant shifts and changes in the elements that create or define a system [21, 22]. Second, assemblage acknowledges relationships between elements and that these relationships change [23]. With the ever-present change in mobile devices, interfaces, software, uses, users, and capacity—not to mention the altering economic and environmental impacts on tourism in Humboldt County— assemblage offered an approach that accounted for and embraced change in complex systems.

3.2 Defining Assemblage

There is no singular or fixed definition of assemblage. Deleuze has multiple definitions for assemblage scattered through his works, and these definitions are rarely complete or in accord. To avoid those problems, I adopted Spinuzzi’s definition that an assemblage helps “*make sense of a heterogeneous jumble of*

infinitely recombinable parts not just semiotically but functionally” [24].

3.3 Using Assemblage to Identify Key HCMVX Elements: Location, Tasks, Experiences, and Populations

Initial analysis of the HCMVX system is overwhelming: it is comprised of mobile networks, national or international corporations, thousands of anonymous visitors, state and national tourist boards, and so forth. On a local level, almost every mobile tourist has a unique combination of software, apps, hardware, service provider, preferences, and activities. Working from a hardware, software, or task-based approach would not be easy or efficient.

Assemblage’s strength is that it can help make sense out of complex and changing collections of diverse actors, groups, and situations like these. These can be people, software icons, phone hardware, and whatever else defines the system. When viewed as an assemblage—a collection of multiple elements as opposed to being a single, holistic organism or system—HCMVX had several key elements that stood out: location, tasks, experiences, and populations.

Location: where visitors physically had experiences and used their mobile devices. Location also meant where the researcher could find the highest density of potential respondents. Tasks were how the visitors used their mobile devices. Populations were more complex. The primary population were mobile visitors. However, to assess what kind of tasks and uses mobile visitors engaged in, it was important to survey and interview local customer service and tourism workers and officials in person and online to determine the types of activities visitors engaged in. Multiple populations allowed for multiple perspectives on visitors, their use of devices, and the tasks they most often engaged in. Working with non-visitor populations allowed the creation of surveys questions for visitors. This also allowed others to describe visitors’ actions and activities beyond visitors’ own self-reporting of activities. This provided an important starting point to know what current visitor experience was and what tasks and experiences occurred during their visit.

3.4 Employing Still’s Ecological Approach in the Assemblage

Seeing the HCMVX as a complex ecology, not a single system, I adapted Still’s approach and went to where I could find tourists and people who worked with tourists and visitors [25]. Some sites, like the airport, were obvious. Other sites, like the Carson Mansion, Arcata Square, and Eureka Waterfront, were drawn from interviews and surveys with local officials and service workers. I actively solicited visitor surveys in all four sites—all but the airport produced few to no responses. Service workers’ responded to surveys in all sites but the airport.

Further adapting the ecological approach, I solicited and eventually recruited six visitors who completed the survey to participate in a brief mobile usability test. This recruitment was concurrent with surveying because, as I suspected, it was difficult to locate participants with only thanks to offer as compensation.

3.5 Gathering the Data

Viewing HCMVX as an assemblage with multiple events and elements occurring simultaneously encouraged the use of multiple research methods and data gathering approaches. Since HCMVX

and mobile use in Humboldt County was almost entirely unknown, seeking out breadth in data and understanding seemed more useful to myself and to local tourism and economic development officials who supported the research.

Two different surveys were used with visitors. The surveys shared core demographic questions, but one centered on the tasks while the other focused on the information types. A total of 766 people were queried. Of those, 410 self-identified as locals and thus were not eligible to complete the survey. Of the remaining 356 queried, 65 self-identified as visitors and agreed to respond to the surveys.

Multiple methods were used to understand the mobile visitor context in Humboldt County and to appraise local understanding of mobile visitors. Three interviews were conducted with local tourism subject matter experts with over fifty combined years experience in tourism, marketing, and hospitality; surveys with 32 local business owners and hospitality personnel were conducted online and in person in two tourist areas, the Arcata Square and Old Town Eureka.

During the visitor survey process, six visitors who agreed to participate in a 30-45 minute field usability test were located. The test asked them to use their mobile devices to solve three different kinds of visitor-related problems while recording their devices and Think Aloud Protocol on mobile video. Then, once they had solved the problem, evaluate how satisfied they were with the mobile resources using the UMUX scale. Finally, users were asked to list the resources they wished they had had to solve the problem.

3.6 Field Usability Tests

Initially, five usability tests based on Virzi's and Nielsen and Landauer's recommendations were planned; however, a sixth user volunteered at the last moment, so I included him [26, 27]. Users were presented with three complex problems: "Using your mobile device, locate a free WiFi hot spot close to your location"; "Using your mobile device, please select and get directions to a local restaurant for your next meal"; "Using your mobile device, please locate a hiking trail which meets the following criteria: goes through Redwood trees; does not have a park entry or admission fee; is accessible off of Highway 101." These three problems increased in complexity following the example of Howard and Still [28, 29]. The first two problems include getting directions—an important feature based on free-listing results reported earlier. WiFi hotspots were selected for the first problem because they are ubiquitous with cafes and airports and because many of survey respondents who had mobile devices were also using the airport's WiFi.

Following Tullis and Albert's description of scoring task success with a numeric value, users and I rated problem-solving success using this scale:

- Complete success (without assistance) = 1.0
- Partial success = 0.5
- Gives up or wrong answer = 0.0 [30].

Users rated success verbally after each problem; I rated success at home after the user had left.

Finstad's Usability Metric for User Experience (UMUX) was selected primarily because it emphasizes usability within the frame of user experience. Finstad's article asserts that UMUX correlates well with SUS and is reliable [31]. Given this correlation and UMUX's simplicity, it was selected over other available scales.

UMUX was also selected to measure users' self-reported usability because UMUX is efficient and correlates well with Brooke and Digital Equipment Co.'s System Usability Scale [32]. SUS has been tested and used for 15 years, and remains a standard metric in usability testing. Thus, while UMUX is relatively new, its correlation with SUS offers UMUX authority and validity.

UMUX's four core questions are somewhat general. UMUX's individual questions were modified to suit this usability test's contexts and concerns: finding information available online and solving complex problems.

3.7 Results

3.7.1 Surveys

Interesting results regarding visitors' ease of information access and resources for mobile visitors in Humboldt County were found.

3.7.1.1 Visitors' Mobile Use in Humboldt County

Visitors could select one or multiple ways they used their mobile device while in-county. The primary uses of mobile devices were: texting 74%, email 71%, and search 57%. Top searches were for directions 43%, food 34%, and GPS 20%. Twenty-three respondents (68%) to Visitor Survey 1 indicated that they had or would use their mobile device to conduct a web search about Humboldt County while visiting.

3.7.1.2 Ease of Information Access for Visitors

After asking about the types of information they had or would look up, respondents were asked to rate the ease of information access and their search results' information accuracy. Sixteen people responded; the other seven, having just arrived, had not yet conducted a search in Humboldt County. Results: 38% indicated information was very easy to locate; 44% indicated information was easy to locate; 19% indicated that information was neither easy nor difficult to find.

3.7.1.3 Mobile Resources for Mobile Visitors

If asked by a visitor about things to do or places to visit in Humboldt County, all 32 respondents (customer service workers and business owners) indicated that they would offer a personal recommendation. Sixty-two percent would indicate or offer a print publication, 31% would suggest a website, and 27% would direct the visitor to a visitor's bureau pamphlet or brochure. Sixty-two percent stated that they know of online resources for visitors to Humboldt County, while 38% stated that they did not. Those respondents who did know of online resources were then asked to name the resources; individuals could name multiple resources. In total, ten different sites were named a total of 32 times. The top three sites mentioned were the Humboldt County Convention & Visitors Bureau site (31%), Eureka Main Street (16%), and the Old Town Merchants site (16%). At the time, none of these sites were mobile friendly.

3.7.2 Usability Test Results

There was significantly more data generated than I was able to analyze or verify. As a solo field researcher, this presented a significant challenge: determining which data to seek and document while ensuring its reliability and validity.

3.7.2.1 UMUX

Once I was able to interact with and identify different visitors and conduct surveys, I solicited participation in brief file mobile

usability tests. These allowed for users to employ their own devices to solve problems relevant to various mobile visitors.

After each task, users rated the tasks on the UMUX scale. Then, on completion of all the tasks, users rated the overall information system they used for solving all the problems. Once these scores were obtained for each individual user's individual task, the scores were converted according to Finstad's directions. Following Finstad, all these scores were averaged to find the mean UMUX score for the system. As Finstad states, "It is this mean score and its confidence interval that become the application's UMUX metrics for a system's usability tracking and goalsetting" [32]. The mean usability score for the HCMVX system tested by six users is 73.25 (Total Usability Points: 1,758.1/ 24 items rated = 73.25).

Several potential patterns emerge. Users with the longest time or refusal to use their mobile to solve a problem, Users 1 and 6, gave the lowest usability rankings of the six. The fastest users, Users 2 and 4, gave moderate UMUX ranking between 70 and 75. The highest UMUX ratings came from the two users with times neither fast nor slow.

There is no apparent relationship between self-described level of expertise and UMUX rating or time: four users indicate 2 as expertise level and they also indicate the highest and lowest UMUX rankings. While the two users who owned their devices for the longest time, 24 months, their UMUX rankings were 58.3 and 70.8 while new device owners, Users 3 and 6, gave higher and lower UMUX rating. Similarly, experience with mobile devices had no apparent relationship to the UMUX scores.

3.7.3 Improving HCMVX

At the end of the usability tests, in response to open-ended questions, several users were vocal about what they believed would enhance their visitor experience. They indicated that restaurants and businesses should not only be available and accessible online through review sites like Yelp! Or Google Maps, but that, as customers and visitors, they preferred to patronize businesses that had more reviews, recent reviews, and reviews which featured pictures. Thus, while it is important to understand users and their behavior, as well as develop a resource for mobile visitors, an additional, relatively simple, solution for improving HCMVX exists as well.

4. DISCUSSION

Visitors use their devices in Humboldt County much like they do at home: they text, they check email, and they search. It was interesting to learn that about 30% of the people surveyed who visit Humboldt County do not run any web searches about the place they are visiting. For those who do conduct searches, 82% of the respondents stating that the information was either easy or very easy to locate, it appears that users sense little trouble in finding the information they need. Oddly paired with user satisfaction was the lack of any central, mobile-friendly online resource for visitors. Perhaps user satisfaction could be increased if local merchants, hospitality workers, and tourism officials could promote one or two relevant mobile resources.

Based on user feedback at the end of the usability test, it may be useful for rural regions like Humboldt County to improve mobile visitors' experiences by encouraging local businesses to get listed online. Then, they could support and encourage locals and visitors to evaluate businesses—and take pictures—to increase the online presence and relevance of the online listings.

5. CONCLUSION

This study demonstrated that when faced with a complex system that appears overwhelming, Deleuze's assemblage concept offers an approach that allows the usability researcher to see a complex system as a collection of diverse components and parts that have diverse and rich relationships with other components. Once the system can be seen as a collection of components and elements, assemblage allows the researcher to try and make sense of the elements and relationships that specifically interest them without being overwhelmed by the rest of the system.

Similarly, the assemblage method allows researchers to work with mixed methods and in a non-linear fashion while conducting their research. This can enable rich and rapid data collection.

While assemblage appears to offer a viable approach to working with complex systems, in this case it was effective because it was grounded in another tested approach to complexity in usability: Still's ecological method.

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Dynamic System Models and the Construction of Complexity

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ABSTRACT

Humans routinely fail to comprehend complexity and anticipate long-term consequences. Systems dynamicists try to overcome these weaknesses by developing computer-supported models that can account for multiple variables in non-linear relationships. Using programs such as STELLA and Vensim, systems dynamicists create stock-and-flow diagrams, equations, and, ultimately, interfaces that enable others to interact with the model. This paper describes how one such model was developed and speculates on roles that technical communicators might play in future projects.

Categories and Subject Descriptors

H.0 Information Systems: General

General Terms

Design, Measurement, Theory

Keywords

Computer-supported modeling, interface design, system dynamics, stock-and-flow diagrams, technical and scientific communication

1. INTRODUCTION

Two behaviors that have proven particularly difficult for humans to perform are comprehending complexity and deliberating over issues with long-term consequences. As Jones [6] writes, “Students of human choice... again and again find that people have great difficulties in working with probabilities, assessing risk, and making inferences where uncertainty is involved” (p. 273). Such difficulties lead to shortcomings in “planning and executing long behavior sequences” (pp. 273; see also [4] and [8]). These limitations do not mean that long-term planning over complex problems is impossible. It means, instead, that people must, as Kaplan [5] has suggested, “develop vivid images” of desirable and undesirable futures (p. 76).

This need to plan for possible futures requires humans to comprehend the interaction of complex systems, which in turn

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requires the use of complex representations. Such representations are important because, when done well, they “allow people to off-load some cognitive responsibilities (e.g., memorization, calculation) to objects in the task environment” [14, p. 332].

In this report, I describe a dynamic systems model as a set of representations designed to help others envision vivid images of possible futures. Specifically, I describe a year-long effort to develop a dynamic systems model of the ways that people react to heat waves. I describe how a dynamic systems model was developed and how various visual genres are used to construct and then interact with the model.

2. THE RESEARCH PROJECT

The information reported here was gathered during a grant-supported, year-long effort to model the effects of heat waves on public health. Climate change has caused public health officials in the upper Midwest to pay more attention to the effects of prolonged heat exposure on humans. I was part of a team that attempted to model these effects.

I acted as a participant-observer during the project. Beginning in the summer of 2011, I worked with two systems modelers, one an ecologist and the other a psychologist, to generate a list of interview questions designed to reveal the most significant factors to include in the proposed model. I attended all interviews, which were held across the middle and southeast portions of the state. To supplement these interviews, two graduate students were hired to search for existing reports and surveys of relevant ecological and health-related studies.

All interviews were taped and transcribed. We devised a coding scheme, which was important because it helped the two systems modelers to look for patterns in the interview data. The more times an issue was mentioned, the more likely it was to appear in the model.

I observed the two modelers during six meetings at which they worked on the model. These meetings began in October, 2011, and ended in April 2012, just before the model was shared at several meetings at which others were invited to comment on the model and its development. I created the meeting agenda for one of these and co-created the other. I also wrote a one-page handout designed to introduce the concept of a systems model to those who were unfamiliar with the concept and a report on the reactions of meeting participants to the model. Through all these experiences, I was able to follow the development of a dynamic systems model from beginning to end.

3. WHAT IS SYSTEMS DYNAMICS?

Systems dynamics refers to attempts to comprehend complexity by modeling relationships between apparently disparate factors.

3.1 Assumptions behind Systems Dynamics

Proponents of systems dynamics believe that factors—such as populations, temperature, pollution, development, and so on—can be identified and diagrammed, and that their often web-like inter-relationships can be calculated. Through such efforts, systems dynamicists believe they can reveal interactions (sometimes unexpected or counterintuitive) between factors, which may in turn reveal points at which interventions may be most useful. Although they want to contribute to discussions of policy, system dynamicists reject any claim to predict the future. They point instead to its heuristic value. In fact, some in the field share a concern that was already familiar to me—a concern for participatory design (see [2] and [10]). Others see great promise in using the modeling process as a way to spark collaboration and discussion. (For an overview of these concerns, see [13].)

Systems dynamics began in managerial studies. As a result, its reputation is perhaps a bit tainted in humanities circles. But systems dynamics has grown beyond that, or at least some parts of SD have done so. The systems dynamicists I have worked with draw from ecology and social science. They focus on feedback and complex, non-linear interrelations between multiple factors. Interestingly, they cross lines between natural and social factors.

3.2 How Dynamic Systems Models are Developed

A systems dynamics model is just that—a model. This means it can be compared to other models, such as models of work. Spinuzzi [11] describes how some designers use “fieldwork-to-formalization” methods by which they gather information and, from that, develop a model of work (p. 11). As Leont’ev noted, models are built through a “chain of actions” (cited in [11] p. 33):

- Action 1: data gathering (interviews and research)
- Action 2: identifying key variables and their relationships
- Action 3: checking the results of Action 2 with stakeholders
- Action 4: adding numbers and equations
- Action 5: testing with subject matter experts
- Action 6: testing with stakeholders
- Action 7: revising (which could include 1-5)

The actions people take in order to achieve that overall model-making activity include interviewing stakeholders, researching relevant literature, observing behaviors *in situ*, and other data gathering efforts. Systems dynamicists follow much the same chain of actions. They gather information in order to develop a model of some sort of complex arrangement of factors, such as ecological and economic systems.

4. WHAT CONSTITUTES A DYNAMIC SYSTEMS MODEL?

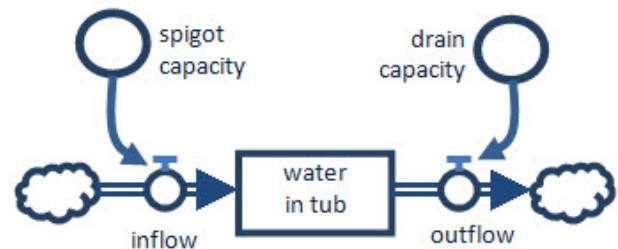
A dynamic systems model is a set of inscriptions constructed to reveal significant factors and their causal relationships. Much as Latour and Woolgar [7] observed in *Laboratory Life*, the practice of systems dynamics is centered on creating a set of inscriptions that will be taken as facts. In systems dynamics, however, the key is to place those “facts” in relationship to one another through the use of a form of symbolic logic. These efforts are supported, and shaped, by a modeler’s choice of software. STELLA and Vensim are two examples of software packages designed to enable the building of dynamic system models. Among other things, the software enables users to work in multiple genres, including sticky notes, graphs, stock-and-flow diagrams, program code, and interactive interfaces. In this section I describe the latter three types.

4.1 Stock-and-Flow Diagrams (the Map)

In the process I observed, the dynamic systems model began with a stock-and-flow diagram, which is akin to a flow chart. Such a diagram uses a set of shapes, lines, and text to reveal relationships between factors (see Figs. 1-2). A stock is typically signaled by a rectangle, and a flow is signaled by a spigot. Factors that influence the amount of a stock are often signaled by circles and arrows.

Meadows [9] describes stocks as “the elements of the system that you can see, feel, count, or measure at any given time.” The amount of water in a bath tub is a stock that can rise or fall given inflow and outflow of water. (Thus a rectangle represents the stock of water in Fig. 1.) Other examples of stocks include the number of people in a hospital, particulates in the air, and dandelions in an acre. Whereas a stock is a thing, a flow is an action. “Flows,” Meadows [9] says, “are filling and draining, births and deaths, purchases and sales, growth and decay, deposits and withdrawals, successes and failures.” To think of this distinction in another, perhaps oversimplified way, a stock is a noun, and a flow is a verb.

Another symbol used in stock-and-flow diagrams is the cloud, which represents factors moving into and out of a system. Or, put another way, the clouds represent the fact that a factor has moved beyond the scope of interest for the systems modelers.



**Figure 1. Water in a Bathtub:
A Simple Stock-and-Flow System**

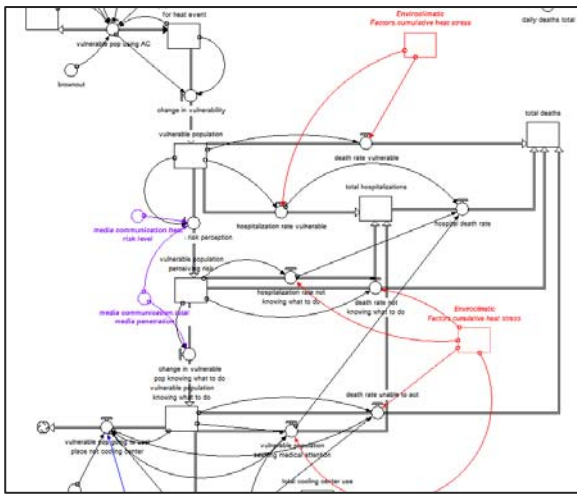


Figure 1. Excerpt of a Stock-and-Flow Diagram from the Heat Model

Of the chain of seven actions described in Spinuzzi [11], a stock-and-flow diagram is designed primarily for the second and third actions. Its importance is not so much as an artifact for an audience, but as an intermediary, heuristic tool for modelers. Bazerman and Russell [1] write, “signs on the page serve to mediate between people, activate their thoughts, direct their attention, coordinate their actions, provide the means of relationship” (p. 1). This is how a stock-and-flow diagram operates.

At many of the meetings during which the model was being developed, the two modelers used the diagram to guide conversations. (One iteration of that diagram is shown in Fig. 2.) Some meetings were focused primarily on the kinds of symbols in the diagram and their placement in relationship to one another. It was through these discussions about diagram design that the modelers developed the other parts of the model.

For example, one of the modelers spent time in one meeting poring over the connections to and from a stock labeled “total hospitalizations” (that is, the total number of people in area hospitals). The modeler noticed that there was no spigot symbol connecting the “total hospitalizations” stock/rectangle to “total deaths” stock/rectangle. Pointing to that part of the diagram, he asked, “Does that [lack of a symbol] assume that if you go to the hospital you won’t die?” At this point, a discussion ensued about the relationships between hospitalizations and mortality. The modeler continued, “Some people who go to the hospital might die, but the number may be trivial” which meant that no spigot was needed. To which the other modeler responded, “I’ll ask the research assistant. Is there a way to know whether those who were admitted also died? If there is, what percent died?” As this case illustrates, the stock-and-flow diagram structured the modelers’ discussion about human behavior and prompted a search for additional information. As often happened their focus during their meetings shifted repeatedly between facts on paper facts on the ground.

4.2 Program Coding (the Equation)

As Fig. 3 illustrates, another interface of a systems model is the page representing the program language. Using a program such as STELLA, a systems modeler can switch between the stock-and-flow diagrams, coding interface, and interactive interface (the model) by clicking the tabs on the left of the window. The program code, which differs slightly between programs like STELLA and Vensim, is a form of symbolic logic that activates the relationships between the elements identified in the stock-and-flow diagrams. The modelers I observed generally used the stock-and-flow diagram to work out general relationships between significant factors, and then the programming took place behind the scenes. Only one modeler did the programming. Although it did not occur as often as the efforts at the diagram, the modelers would look together occasionally at specific portions of the equation.

Figure 2. Programming Interface for a Dynamic Systems Model (in STELLA)

4.3 The Interactive Interface (The Model)

Once the diagram and coding reached a point at which it could be shared, one of the modelers created an interactive interface (see Fig. 4). The interface enabled the modelers and others to interact with the model by entering a set of conditions and then seeing how the model reacted. For example, a person could change the number of residents with central air conditioning, the number of cooling centers in the area, and even the percent of residents with pets. A person could also decide whether a brownout would occur because of excessive demand for electricity. Once these factors had been chosen, a person could run the model to see how many deaths and hospitalizations might occur under those conditions.

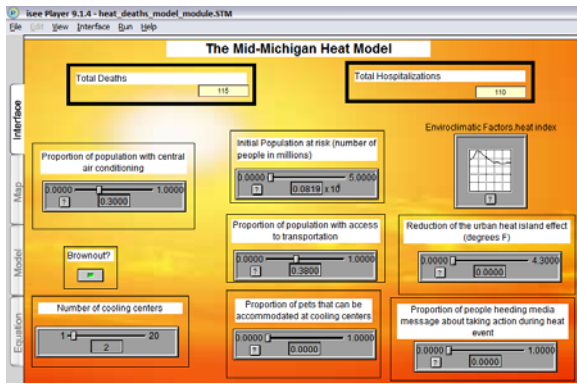


Figure 3. The Interactive Interface

5. 5. IMPLICATIONS

At this point, it is worthwhile to note again that the modelers with whom I worked saw the model as a heuristic, not as a valid prediction of an inevitable future. For example, based on the data that the modelers gathered, and the equations they used to represent relationships between the data, cooling centers looked like a poor use of resources. Upping the number of cooling centers did little to decrease hospitalizations and death in the model. This was counter-intuitive to public health experts who worked with the model. For the modelers, the purpose of the model was to spark discussion among the experts. Were cooling centers really less useful than people believed? If so, why? Could the centers be made more useful? Or should resources be directed elsewhere?

Because dynamic systems models can be used to spark discussions such as the one described in the previous paragraph, they are helpful tools in deliberative activities. I believe that technical communicators can play significant roles in the further development of these tools.

5.1 The Importance of Visualizing Complexity

As Tuomi-Gröhn and Engeström [15] write, “To a great extent, the affordances that enable our activities are properties of artifacts that have been designed so that those activities can be supported” (p. 25). Because humans have troubles understanding complexity and long-term exigencies, they need artifacts that support such activities. Dynamic systems models may be such a type of artifact. In fact, the very idea of complexity requires a set of visual and alphanumeric texts. In describing her book on systems thinking, Meadows [9] writes,

I have made liberal use of diagrams and time graphs in this book because there is a problem in discussing systems only with words. Words and sentences must, by necessity, come only one at a time in linear, logical order. Systems happen all at one. They are connected not just in one direction, but in many directions simultaneously. To discuss them properly, it is necessary somehow to use a language that shares some of the same properties as the phenomena under discussion. (Kindle edition)

If artifacts do indeed guide behavior, then it’s especially important to design artifacts that guide behaviors that humans are unlikely to achieve otherwise. As scholars, practitioners and citizens, technical communicators have a stake in long-term

planning and public deliberation. We may also have insights to bring to the table.

5.2 Why Not Us?

In “The Core Competencies of Technical Communication,” Hart-Davidson [3] asked, “Why not us?” (p. 142). The question, posed in the context of information economies, is equally valid in the context of public deliberations about long-term issues. As was mentioned near the beginning of this report, systems dynamics is designed to help people address the stasis of policy. Although modelers build models by relying on the stasis of conjecture (i.e., existence and cause), they do so in order to inform policy deliberations. Systems dynamics models are inherently public forms of communication. Systems dynamicists, bright and inventive and eloquent as they are, still need someone to focus on ways that their models get communicated with audiences.

For example, in the process that I observed, the interactive interface was assembled at the last minute because the modelers did not see the design of the interface as a significant challenge. The importance of the interface only became apparent later. In user testing, it became clear that the interface gave few to no clues as to how to interact with the model. As Fig. 4 reveals, there is no obvious starting point on the interface. What should be clicked first? Where does one look for results? Also, the sliders and buttons are arranged in a pattern that is poorly matched to stakeholder’s decision making processes. There is no clear path from one box to another, and the boxes do not mirror the sequence that stakeholders are likely to follow when making decisions about model inputs.

6. CONCLUSION

In the past 20-30 years, the focus in many corners of humanistic, technical, and scientific study has been on building ever more complex models. This makes Star’s [12] question all the more important: “How are formal (mathematical, computational, abstract) representations defining the space of our world?” (p. 89). The growing influence of these formal representations require the attention of technical communicators because, as Star writes, “When we accept formalism without being able to trace their genesis or impacts, we effectively distance ourselves from knowledge” (115). Technical communicators are well situated not only to help modelers create more usable models but also to trace the genesis of such models, thus helping others avoid “an illusion of completeness” (p. 112). This is an illusion that systems dynamicists themselves want to avoid.

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Researching and Communicating the Complexity of IT Image Management

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ABSTRACT

Today, the process of image management is extremely time-consuming for IT administrators. Until now, this complicated process has not been extensively explored by design researchers. During a recent research study at Citrix, we interviewed 17 IT professionals. We used a process we call “adaptive interviewing,” a flexible methodology that could accommodate the various infrastructures of IT organizations and the diversity of ways that administrators handle image management. While conducting our interviews, we worked with our information designer to create several visualizations of our data. Ultimately, we found that supplementing interviews with information visualizations is a powerful way to explore, understand, and explain the complex system of IT image management.

Categories and Subject Descriptors

H.0 Information Systems: General

General Terms

Design

Keywords

Citrix, Image Management, Information Design, Information Technology, Information Visualization, Interviewing, Research, Virtualization, XenClient

1. INTRODUCTION

For many Information Technology (IT) professionals, installing and managing employees’ operating systems and applications, or “image management,” is a time-consuming and tedious task. An “image” is a personalized master copy of an operating system that IT departments copy onto employees’ computers. IT administrators conduct image management in order to enforce security policies and maintain the health of company-issued computers. Yet the process of image management varies widely by company and industry and often involves several teams within one organization. In addition, companies use a wide variety of different tools to aid this process. Most of these tools do not

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integrate with each other, which means that IT administrators must switch between tools for different tasks and remember or re-learn the user interfaces each time. All these factors contribute to making the image management process complex and challenging to implement and maintain.

In January 2012, we embarked on a research project at Citrix, an enterprise software company, to study the complex process of image management in large corporations. We interviewed 17 IT professionals across different industry verticals, including healthcare, pharmaceutical, energy, and high tech. The research strived to uncover insights into the needs and pain points of IT professionals. Through this, we planned to highlight ways that Citrix could provide a holistic, simplified solution for image management processes.

2. GOALS & STAKEHOLDERS

The original request for this research journey came from our VP at Citrix, who hypothesized that understanding the existing pain points in traditional image management would validate current Citrix solutions and reveal new areas of opportunity. In particular, we focused on one of Citrix’s virtualization products, XenClient. Currently, XenClient simplifies the image management process by allowing users to create images through a web-based management console. The administrator installs an operating system on a server and creates a copy that is sent to the employee’s computer over the Internet. This process is called “virtualization”. In addition, the employee’s computer checks in periodically with the server to receive updates and to back up the employee’s data. Virtualization saves an enormous amount of time for the IT administrator, who would previously install, customize, and update each employee’s operating system manually.

Although current XenClient users are enthusiastic about its benefits, there was still a great deal of room for the product to gain market share. In addition, because many companies have not yet fully invested in virtualization, we believed that XenClient’s major competitor was not another virtualization product, but rather traditional image management processes. For this reason, we chose to focus our research on organizations that had not yet made the transition to virtualization. This allowed us to 1) validate XenClient’s value proposition and current features as being beneficial to administrators, and 2) identify possibilities for new solutions and features that we could offer to further improve image creation and management.

Our stakeholders included the VP of client virtualization, product engineers, and the Product Management and Product Marketing teams. We involved these stakeholders in every phase of the

process to ensure that our research incorporated their input and met the entire team’s goals.

3. RESEARCH METHOD

3.1 Research Approach

Our first challenge was to devise an effective qualitative research process that could encompass all the variables involved in image management. In order to meet this challenge, we developed a structured yet flexible methodology to accommodate the complexity of the data and the differences in participants’ industries, team sizes, and technical skill levels.

We began by conducting internal interviews within Citrix to test out our methodology and refine our research approach for subsequent interviews with other companies. At Citrix, the Manager of IT Support Services gave us a high-level view of what the image management process entails from the day a manager decides to bring on a new employee until the employee leaves the company. From this interview, we learned that there are many individuals involved, from the person who purchases the laptop, to the person who creates the image, and finally to the person who maintains and backs up all the data. Because of this, we decided to devise different sets of interview questions for each team we spoke with. The following sections outline our process, which we call “adaptive interviewing”.

First, we created preliminary questions that we revised and iterated based on input from various stakeholders. After completing the eight internal interviews and discussing the findings with the product team, we decided to narrow our scope to cover three main areas of focus that were most relevant to our product: image creation, updates, and backups.

We then embarked on the next stage of our research, in which we found other companies to interview. In order to do this, we created a survey that we distributed via Craigslist, targeting IT desktop professionals that matched the product’s primary persona. As we received responses, we screened participants to ensure they fit the appropriate criteria. Again, as we proceeded with the interviews, we often discovered we needed to interview multiple individuals from different groups within the same company to gain a holistic picture of the process. Since roles and responsibilities of our participants varied greatly, we were flexible in our interview process. We followed interviewing best practices by being open to change, revising our questions after each interview to accommodate for new insights we wanted to further explore: *“Questions may emerge in the course of interviewing and may be added to or replace the preestablished ones; However much you have done to validate the utility of your questions, you should think of them tentatively, so that you are disposed to modify or abandon them, replace them with others, or add new ones to your schedule”* [1].

3.2 Interviewing Participants

In total, we conducted 17 one-hour interviews with IT desktop professionals from ten different companies. Of the 17 administrators we interviewed, a variety of image management tools were used: eight separate tools for image creation, five to manage image updates, and nine to handle image backups. In

addition, we learned that these companies contained up to seven teams involved with the process.

Table 1. Industries and Job Titles of Participants

Industry	Job Title(s)
Software	Manager of IT, Desktop Engineer Analyst, IT Support Analyst, Group Manager of IT Operations and Engineering, Senior Manager of Information Security, Product Architect, User Experience Manager
Healthcare	IT Consultant
Healthcare	Director of National Accounts
Healthcare	Sr. Technology Architect
IT	Systems Engineer
Energy	Lead Admin
IT	Systems Engineer
Research	Sr. Systems Admin
Mining & Metals	Desktop Support Technician
Pharmaceuticals	Desktop Support

4. CREATING VISUALS

After completing our interviews, our second challenge was twofold: first, to analyze the large amount of data that we had collected, and second, to communicate and synthesize our research to our stakeholders in a way that would “advance the team’s understanding and decision making most effectively” [2]. Many authors have written about how information design can be used not only to present data to others, but also as a way to understand and analyze data. For example, “charts, diagrams, and figures can serve as useful aides in exploring patterns” [3]. In addition, as Norman writes, “the mind is well-equipped to retain large amounts of meaningful material, as long as the material has pattern and structure” [4].

For these reasons, we worked with our designer to create three visualizations of our data: a large time-based flowchart, a quick reference chart, and a one-page image map.

Our first visualization served as a way for us to understand the data that we had collected while interviewing IT administrators at Citrix. Because our interviews focused on processes done over time, we used a method of visualization sometimes called a “swim lane” flowchart (see Figures 1 and 2). This type of flowchart has a separate row, or “lane”, for each person involved. Activities are noted on the chart; the lane in which each activity appears shows which person is responsible for the activity. Because the chart is read from left to right, the activities occur in the same order as they happen in the real world, giving the viewer a sense of time as well.

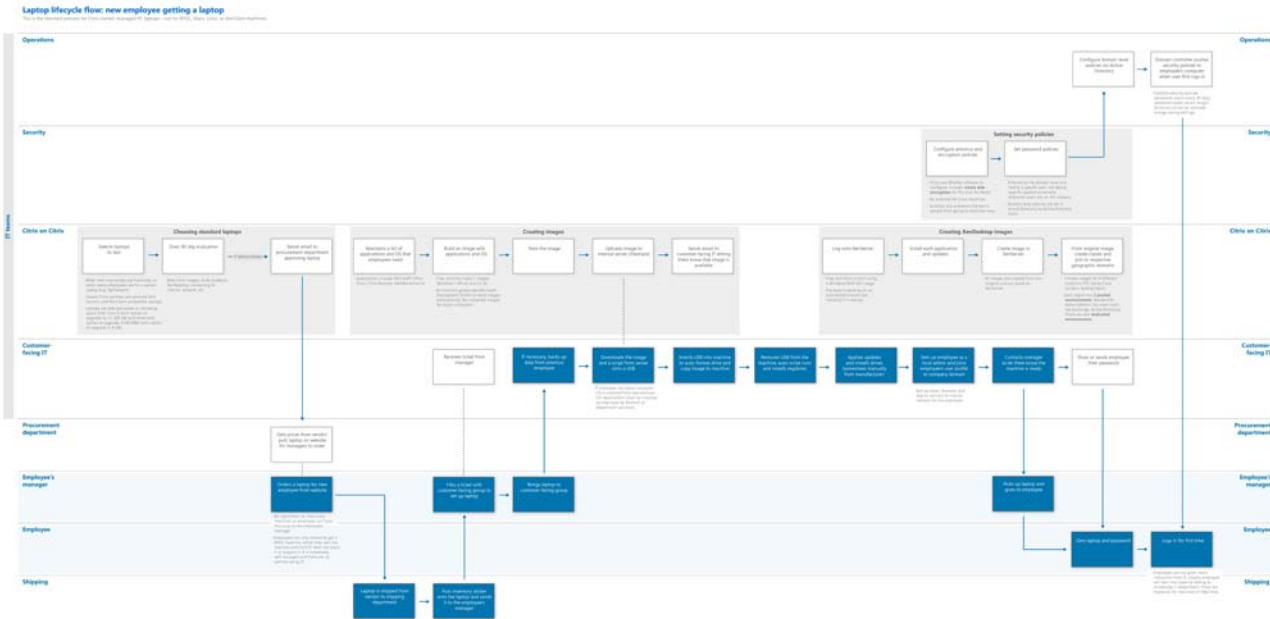


Figure 1. Swim Lane Flowchart

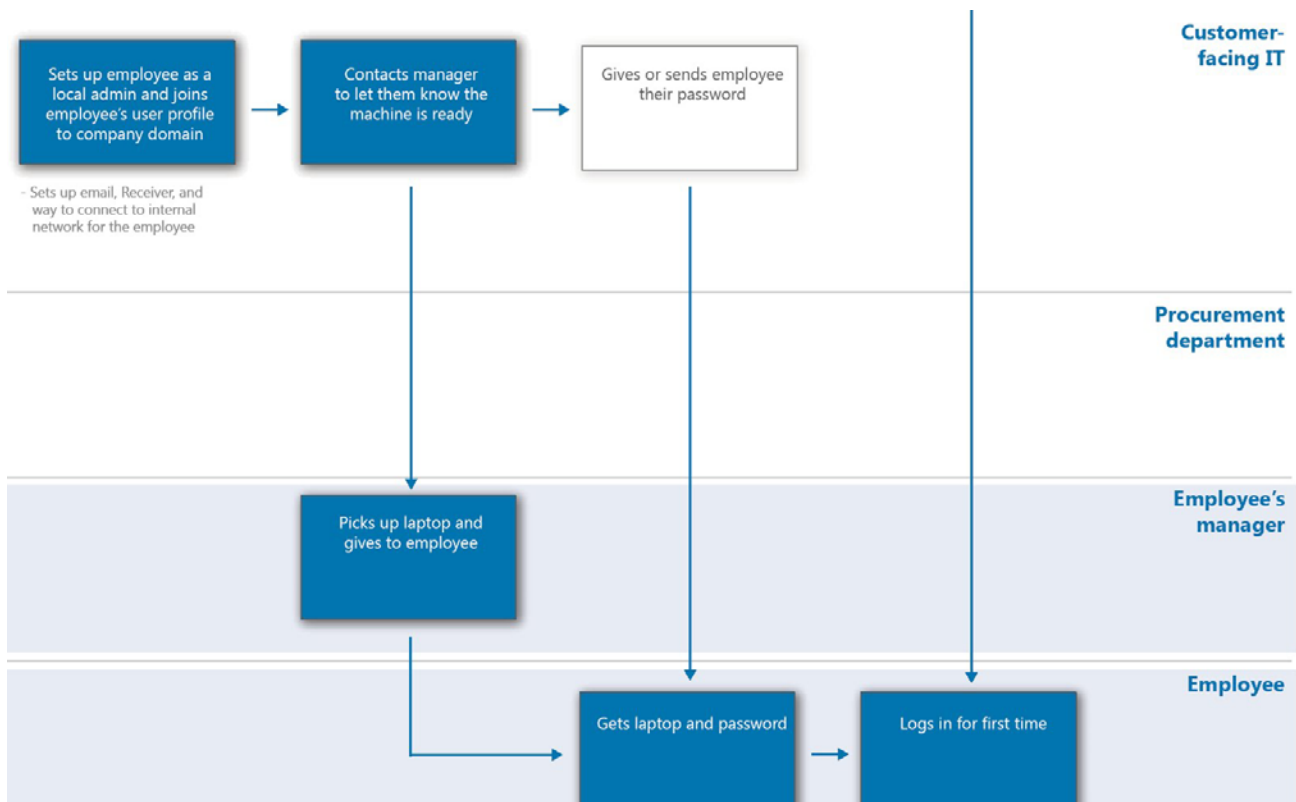


Figure 2. Detailed View of Swim Lane Flowchart

In our case, we wanted to map the sequence of events that occur when a new employee joins Citrix and is issued a laptop. This chart has eight lanes, each belonging to a particular group or individual. Each box represents an action. The journey of the laptop is shown in the dark shaded boxes, while the white boxes depict the auxiliary activities that must occur in order to request, prepare, and install appropriate software on the laptop before it is given to the employee. Finally, the shaded backgrounds around several boxes show discrete processes that take place within the larger flow.

The workflows, teams involved, and tools depicted in this detailed view clearly demonstrate the complexity of creating and deploying images to employees' computers. When printed at full size (4.5 feet wide by 2 feet tall), the flowchart allows viewers to absorb the information as a whole and also to move closer physically in order to inspect the details. As data visualization expert Tufte writes: "Confusion and clutter are failures of design, not attributes of information. And so the point is to find design strategies that reveal detail and complexity—rather than to fault the data for an excess of complication" [5]. Our strategy was to allow viewers to switch between macro and micro viewpoints.

While presenting the flowchart to our stakeholders, we printed out a copy for those located on-site and sent a digital copy to teammates in other geographical regions. Supplementing our slides with these visuals helped our audience to understand our rich data in a more meaningful way than slides alone.

During our second set of interviews, we focused less on the flow of physical equipment and more on the workflows of IT administrators who prepare, manage, and update images. Because each company has different tools, processes, and pain points, we found that a reference chart was a useful way to organize the resulting data in order to see patterns and insights (see Figure 3).

For this chart, we developed a matrix to organize our findings. The processes, tools, and pain points were taken directly from our interviews. In addition, we added ideas for opportunities that our team could explore in order to act on the information received. In this way, the reference chart begins to suggest future steps, unlike the swim line flowchart, which focused on the details of an existing process.

Finally, we created a simple diagram to contrast with the information-dense reference chart. This resulted in the image map, which shows how companies' team structures and interaction models would change for the better if they use XenClient to handle image management (see Figure 4). The purpose of this visualization is to quickly convey the point that our product is an all-in-one, holistic solution. Unlike the flowchart or reference chart, which require a certain level of domain expertise in order to fully understand the information, the image map is simple enough to be used in marketing or sales presentations to viewers unfamiliar with the material.

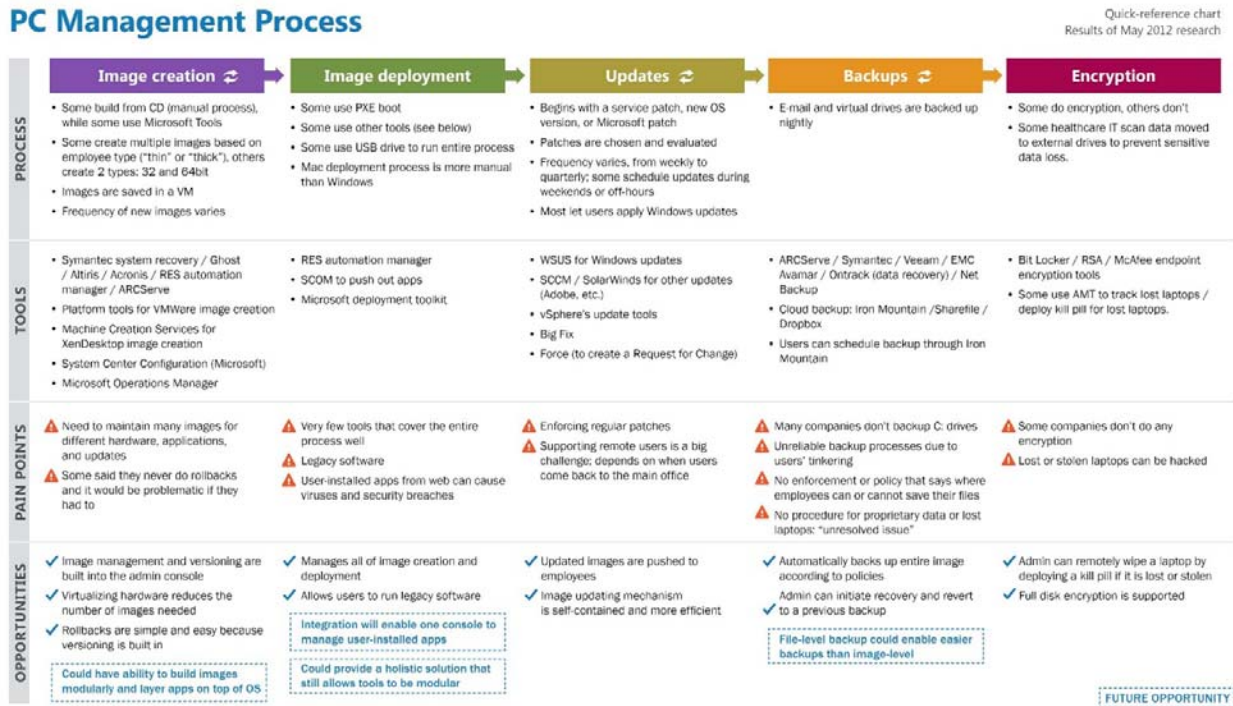
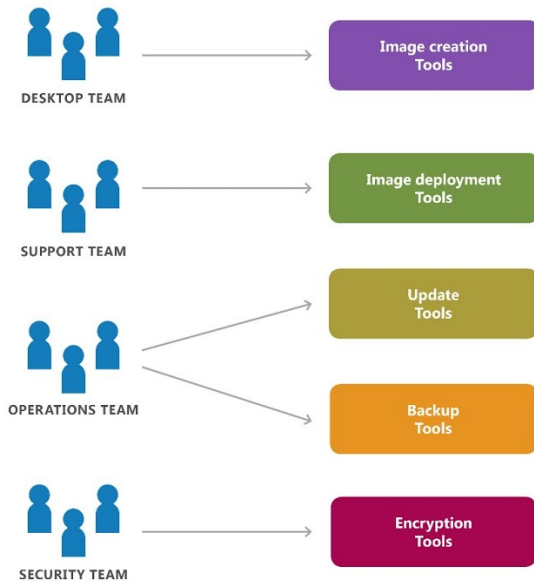


Figure 3. Reference Chart

Without our product



With our product

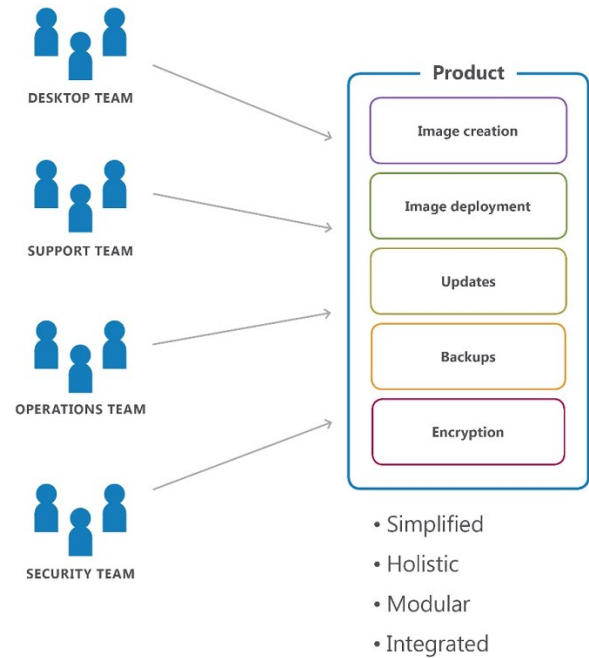


Figure 4. Image Map

In summary, we found that the various visuals complemented our research activities and helped to further our stakeholders' understanding during presentations. Throughout the process, we evolved our visual approaches to fit the data and the needs of our audience. For similarly complex research projects, we recommend including an information designer in the process. Creating these types of information visualizations can serve as a way to understand and synthesize the data internally, as well as to present the findings to others in an engaging and tangible manner.

5. RESULTS

To understand the impact of our research, we interviewed several stakeholders and team members to discover how our research findings and visuals have benefited the team. During our stakeholder interviews, we gathered general feedback and learned several ways that our research had been used.

First, we discovered that the product team had posted a physical copy of the swim lane flowchart on the wall as a reminder of the complex process. According to the product VP, this was not only a "great pictorial overview of the process" but also a "holistic view of the lifecycle". Our research was also beneficial for the XenClient team because "having data to show the complexity really helped [the team] tell the story around how XenClient solves that major pain point [of image management] for customers."

In addition, we also discovered that the swim lane flowchart was used in a sales training presentation at Citrix to depict the complexity of the image management process. This was a pleasant surprise as we came about the presentation inadvertently and discovered the graphic inside a slide deck. We

realized that although the graphic looked small in size as an image on a slide, it still effectively conveyed the complex process and the many different components and individuals involved in IT image management.

As many software companies have experienced, Citrix had come to a pivotal point in the growth of the product. This research study offered support that allowed the team to pivot much more quickly and provided a platform to help the team set priorities. In addition, we learned that as Citrix is exploring ways to integrate XenClient with other products, our research provided a common understanding of image management process flows that would help smooth the integration process.

Overall, this research has stirred conversations among the team about new ideas and business that can come out of it. Our ability to analyze and visualize complex information was key to this research project and the product team's success in understanding and acting on the research findings.

6. REFLECTIONS

The research and visuals that resulted from the adaptive interviewing method proved to be a successful way to explain and depict the image management process. However, like any project or new process, there were aspects that could have been done differently.

For example, we considered making our presentations more interactive by printing out the visualizations and gathering stakeholders in a room to discuss the details and ramifications. This might have led to richer discussions with the team. However, because our team members were distributed across the country, travel costs prohibited bringing the entire team together into one

physical location. In addition, we felt that it would be more effective to present the data immediately rather than wait for a future in-person meeting. For this reason, we opted to use Citrix's online meeting tool in order to allow everyone to participate in a cost-effective and timely manner.

These types of compromises will occur with any research project and must be considered as part of the research plan. Despite these tradeoffs, we felt that our presentation to the stakeholders was successful and well-received.

7. CONCLUSION

Overall, we accomplished our research objectives of learning about and mapping out the complex image management processes used by IT professionals. While interviewing users, we prototyped and improved on our research methodology in order to accommodate the diversity of IT organizations and how they approached image management. During the synthesis process, we innovated in our approach of communicating information by displaying and explaining the data we collected through three main visuals: the swim lane flowchart, the reference guide, and the one-page image map. These information visualizations aided our team in consuming the rich, complex research data and inspired new conversations about product development opportunities.

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Visual communication in Environmental Health: Methodological Questions and Compromises

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ABSTRACT

Disciplinary differences cause multiple problems with trying to create a research study that gauges readers' comprehension of complex scientific information. This paper provides a case study of some of the issues associated with research methods and methodologies on an interdisciplinary team.

Categories and Subject Descriptors

H.0 Information Systems: General

General Terms

Design, Human Factors,

Keywords

Research methods, data visualization, information design

1. INTRODUCTION

For the last four years, I have had been part of several interdisciplinary research teams in environmental health and family and community medicine. While the collaborations have been successful in a variety of ways, they have also been extremely frustrating. In the early years of the collaborations, I thought that most of my frustration was born out of my inexperience in explaining to academics the value that a technical communicator could bring to the projects. But, as weeks, and months, and years past, I realized that the problem was not me and my ability to explain my value; the problem was also not my generous and smart collaborators. The problem was, and is, fundamentally tied to disciplinary training, and more specifically, to training in research methods and methodology.

In this paper, I discuss the root of the research methodological impasse our team encountered and then provide a narrative history of how we worked through some of these methodological problems.

In doing so, I provide a literature review of the work on data visualization and information design and conclude with sketching

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out the research study design for a multi-site participant comprehension study.

2. THE ROOT OF METHODOLOGICAL IMPASSE

While bordering on an over generalization, one of the fundamental causes of the methodological impasse is the primacy of science and the continuation of the positivist view of world. How academics write vary from discipline to discipline each discipline appeals to their own background knowledge and their own ways of establishing truth [1]. For scientists, the truth-making proposition is the scientific method and the gold standard of clinical trials or large-scale cohort studies. This view is further constructed through the knowledge making enterprise as seen in the publication in peer-reviewed journals.

For technical communicators, the idea that a discipline has its own set of conventions and its own language is not surprising. Rather, our understanding of this fact makes it possible for us to do the jobs we need to do. However, it was not long within the process that I realized I was the only one who understood that different disciplinary communities had different methods and that each research method afforded the research team important insights and should be valued for those contributions. Somewhere along the way in the training of the scientists, any method outside of the scientific method was conceived as less and as something that distracted from the science. Hyland explains this problem through his term the adequacy condition, which means that that claims must be plausible based on the discipline's epistemological framework. Scientists routinely reject statements and claims because those claims fail to meet the minimum level of acceptance within the community. Research methods, particularly qualitative research methods, do not consistently meet the adequacy condition. Searching "qualitative research methods" in *Environmental Health Perspectives*—one of the top journals in environmental health—will generate eight hits.

Admittedly, boiling down the research methods conundrum to the adequacy condition oversimplifies the situation, but at the same time, it does highlight the fundamental impasse between disciplines. Thus, the big question then is how to overcome this condition and find suitable research methods to answer questions that different disciplines agree are important? In my case study two movements (of sorts) within the broader field of environmental health helped move us forward.

3. POSSIBLE WAY THROUGH THE IMPASSE

Within environmental health, two movements have gained traction over the last several years that seem to indicate a shift in disciplinary thinking: community-based participatory research (CBPR) and an awareness of the ethical role of “reporting back” information to research participants. Similar to Blythe and Grabill’s description of participatory action research [2], CBPR is a research framework that emphasizes a bi-directional relationship with the community and research participants where information is shared between the community and academic institution in a mutually beneficial way [3].

Increasingly being used in fields such as public health, health promotion, social work, and environmental health, CBPR allows researchers and community members to have equitable roles in the research process and helps to blur the lines between the researcher and those being researched [4]. The primary benefit of the CBPR orientation is that the research is *with* the community rather than *on* the community. In their landmark environmental health article, O’Fallon and Deary provided six guiding principles for CBPR that are endorsed by the National Institute of Environmental Health Sciences (NIEHS): prompts active collaboration and participation at every stage of research; fosters co-learning with both researchers and the community contributing expertise; ensures projects are community-driven; disseminates results in useful terms; ensures research and intervention strategies are culturally appropriate; defines community as a unit of identity [5]. In environmental health, scientists and researchers incorporating CBPR in their work are careful to focus solely on the science and the research process rather than on any potential political and cultural issues associated with the research project. By focusing on the science and trying to find scientific answers, this orientation seems to enable long-term participation and often offsets the fears about economic loss for the community. This research orientation is particularly useful when dealing with complicated environmental health problems that require ongoing community participation and buy-in.

Incorporated within the bi-directional relationship of CBPR is the need to provide information to the community, which is often centered on “reporting back” scientific information. Objective facts and scientific results create no “social resonance” as long as they are not communicated back to the participants [6]. In CBPR the need to close the communication circuit with research participants and other community members mandates that scientific information must be and should be reported back to community members, who generally have little background in science. Within the last several years, scientists and researchers in environmental health have been faced with the dilemma of how to report back complex information to research study participants. Thus, the need to be able to communicate complex scientific information clearly becomes a paramount challenge. To help solve the communication problem, environmental health researchers have begun to team up with technical communicators to create informational materials and to research the best methods for reporting back information.

4. DETERMING METHODS

Fundamentally, scientists want their methods to discover and depict reality, while technical communicators understand that the methods chosen enact a certain reality [7]. So how do we bridge the gap? How do we craft a research study design that satisfies the scientists and everyone else?

As we began to approach the study design for reporting back complex information, we knew that there were multiple factors at play. We needed to find the best way to visualize data so that participants could understand it, which we called the data visualization. We also knew that the way that information was presented could potentially effect how well participants understood it, which we called the information design. In this sense, we are using “visualization” to mean how to effectively translate data into visual representations such as bar graphs, scatterplot graphs, bubble charts, or information graphics. We are using “information design” to mean the overall appearance of the page that includes the data visualization, accompanying explanatory text, headings, and other page layout features (in both print and online delivery).

As we began to find out what had been done previously on this topic, we were surprised at the dearth of empirical studies and we were also surprised at the wide range of fields that attempted to study this issue. The research on data visualization and information design is dispersed across a wide range of fields and disciplines, which makes it difficult to build a coherent body of research that could lead to best practices. For example, current studies include psychologists studying the comprehension of bar graphs [8], public health researchers examining cultural data representations [9], and physicians studying how to explain cardiac risk [10,11]. One multidisciplinary review essay [12] attempted to bring together this diverse research, but the authors relied solely on searching two databases, which eliminated the work in the humanities, engineering, and much of the social sciences.

When we narrowed the scope to our two specific fields, the results were not surprising and unfortunately, not helpful. Even though environmental health researchers are concerned with reporting back information, they have yet to generate any substantial work on how best to do it. Adams, et.al produced the first substantial attempt [13], but since they are not trained in technical communication, data visualizations, or usability, their results are limited in application because of the costs involved in producing the information to the levels of “scientific objectivity.” Moreover, a member of the research team hand delivered and explained the material to each participant (95), which is cost prohibitive in most studies.

But technical communication has the opposite problem in that much work in technical communication is based on myth, or rather, long standing theories that have rarely been empirically tested with potential audiences [14,15]. A small corpus of work looks at the organization of documents [16, 17], the layout of documents [18], and typography [19, 20, 21].

Two recent examples attempt to design research studies that incorporate testing with potential users. Cain et al.’ study began as a test of a finished document and focused on reader reactions to a four-page informational pamphlet about hurricane safety procedures and asked to use the “plus-minus method” to evaluate the text, which involved placing a “+” next to parts that they reacted positively to, and a “-” next to those that elicited negative reactions. The results of this activity and follow-up interviews were then used to recommend changes to the document [22].

Ganier tested users’ comprehension and use of instruction manuals in his study, which videotaped 30 participants as they learned to boil potatoes using a prototype pressure-cooker with one of three different manuals (text only, picture only, and text + picture). Participants’ use of the instructions and the time it took for them to locate the needed information were tracked. The study

showed that users with the picture + text manual were able to locate the information faster than those with the other manuals, and suggested that procedural documents are not read linearly but selectively, based on the task at hand [23].

The small corpus of work and the fact that none of these studies were similar in research design or findings makes it difficult to argue to those outside of the field and outside of the bounds of disciplinary knowledge that our methods are sound. Pushing against the qualitative bias of scientists, these studies only seemed to support their position that our research methods were not as viable as theirs. It is only when one sees these studies through the eyes of an outsider do one begin to understand the method problems the field of technical communication faces.

So what started out as my attempt to prove that the field of technical communication had something to offer ended up as a quest to understand the ideologies that underscore out current research methods. Perhaps, broad research studies seeking to prove or disprove design principles are not the cure; rather, as Brumberger argues, technical communication needs to abandon such a “formulaic” approach to design [19]. What we need instead, then, is a methodology that is valid and easily replicable and that can be used to test the efficacy of our design decisions, including specific elements of design such as chart and graphs, in the many varied situations in which we must produce texts. Further, that methodology needs, as Zender, et al., point out, meaningful measurements are to determine the success or failure of a particular design or element [24]. But what might this method look like and will this method be something that scientists recognize as rigorous and valid and trustworthy?

5. WHERE DO WE GO FROM HERE?

So with research that was not acceptable to either side, the team was faced with trying to design a research study that met the “standards” of both fields and could have the potential to be replicated in other sites and other projects. What I do know is that the final research study design for the data visualization study will have to be one based on methodological pluralism, which is no single approach is better than others and what is important is that the method be appropriate for the questions under investigation. This rather obvious orientation, however, is important because at its heart methodological pluralism is an attempt to show that no more method is inherently more valid or respectable than others [25].

Since I have been the one that has pushed and argued for this part of the research study to be completed, I determined that one of the most important issues for me has been the ethical impact of methodological decisions. An issue that has consistently concerned me, and one that Barton touches on [26], is the need for research participants to truly understand the research study and its findings. My reorienting my view on research methods to start with ethics first has enabled me to see the project in a much different way. For example, an ethical orientation means

going beyond the standard signing of informed consent, which is really a mechanism for protecting the university rather than the participants, and integrating into the research study design adequate information feedback loops.

One of the greatest strengths of qualitative work (and much of user experience is qualitative) is in its ability to characterize complex situations from multiple perspectives, and in doing so it gives not only a voice but a body to participants [27]. When environmental health scientists discount and/or are skeptical of methods other than scientific methods, research studies run the

risk of forgetting the users—the real people—involved in the research. Technical communication has long advocated for the users, and this is one the main reasons that I have continued to work on this project even for all of its frustrations and roadblocks. This ethical obligation to ensure that research participants understand the research and its findings are one of the biggest contributions technical communicators can make.

At this point, the research study design is still not finalized. What we do know is that the data visualization study will incorporate a number of methods that will most likely include eye-tracking, reader response, interviews, focus groups, and surveys. This multi-stage process is guided by St. Amant’s RAFT model for image design [28] and Wogalter, et.al, information processing model [29]. Moreover, as I considered the ethical stance that I decided to frame the project, we have expanded the study to include a number of other diverse audiences connected to a variety of research projects (such as Latino/a, urban and rural Appalachians, African-Americans). The aim of expansion was to counter potential critiques of the limitations of the study to one particular participant group and one type of data.

The expansion will allow us to recursively develop, test, and refine our findings, which will ultimately help to prove (or disprove) whether we can develop a best practices or a set of protocols that can be adapted by other environmental health scientists (and those working with complex scientific information). While this method/ology will take longer, it will provide for a large amount of data that can be correlated and should lead us to data saturation and/or having enough information that the majority of readers and participants will understand the information the majority of the time, which are better odds than most findings in scientific studies.

6. ACKNOWLEDGEMENTS

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Transforming Contracts from Legal Rules to User-centered Communication Tools: a Human-Information Interaction Challenge

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ABSTRACT

In this paper, we illustrate how merging contract design with information design, especially visualization, can help to transform contracts (and people's perceptions about contracts) from legal rules to communication tools. We argue that improved human-contract interaction can maximize the value of commercial relationships, minimize risk, and prevent workplace frustration. Viewing contracts as boundary objects and changing their design to overcome the current challenges offer unexplored opportunities for both research and practice.

Categories and Subject Descriptors

H.0 Information Systems: General

General Terms

Design, Documentation, Human Factors, Legal Aspects

Keywords

Contract Visualization, Information Design, Knowledge Visualization, Human-Contract Interaction, Boundary Objects

1. INTRODUCTION

Working through contracts has become central to virtually all modern organizations, a trend that will only intensify as supply networks broaden and globalize. No one can dispute the importance of contracts, but many could object to their language and format. In our careers we have never met anyone without a legal background who enjoys working with contracts. For non-lawyers, contracts are too long, confusing, and boring. However, commercial contracts belong to managers and to business at least as much as they belong to legal departments. Contracts can work as the foundation and framework for successful deals and relationships with suppliers, customers, and partners. Managers need to be able to understand contracts, and the association "contracts = stuff for lawyers" is unwarranted and counterproductive. We suggest that merging contract design with information design, especially visualization, can help to transform

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contracts (and people's perceptions about contracts) from legal rules to communication tools.

In this paper we create a link between information design and human-information interaction in the context of commercial contracts. We develop this link through the concept of boundary object [1] – an object that serves as a focal point in collaboration enabling parties to represent, transform and share knowledge. We argue that contracts can work as valuable boundary objects inside and between organizations, provided that contract design takes into account how different groups of users interact and work with contracts. In today's business, these aspects of contracts are not addressed properly, and user-centered contracts continue to be the norm. Communication and understanding are hindered, and so is collaboration. In this paper we introduce four dimensions (context, needs, information display, and content) that should be considered in the design of user-centered contracts that work well as boundary objects and enhance human-contract interaction.

2. CONTRACTS AS "IMPERFECT" BOUNDARY OBJECTS

Contracts are complex artifacts, reflecting the intricacies of the businesses they seek to describe. They are produced and used in varying social contexts, often at the boundaries between different communities of experts. Complex business processes and several professional groups are involved in the production, negotiation and implementation of contracts, both on the buy-side and on the sell-side of the relationship.

In addition to legal professionals, a number of domain experts participate in writing and reading contracts. At the writing stage, these often include technical experts who contribute to scope, specifications, requirements documents, testing and approval processes, as well as output and performance definitions. In addition to legal and technical terms, contracts often contain sophisticated financial terms and project-related timelines and procedures: hence finance and HR departments might also be involved. Contracts consist of layered information, each layer being relevant for different users. Additionally, information relevance changes over time, depending on what is required in different stages of the business relationship. The backbone of a contract is hardly ever made from scratch but compiled using forms, templates, or clause libraries. While these are typically designed by lawyers, deal-specific information is required from other professionals, mostly business managers and engineers [2]. During negotiations, meetings are arranged and changes made to

the contract, again activating lawyers, business managers, technical experts, and engineers on both sides. Once made and signed, contracts need to be implemented, and project managers and operational teams take over. The contents of the contract need to be translated into action. In order for businesses to reach their goals, contract-related communication must be effective. Merely translating “legalese” into plain language cannot help if the implementation teams do not read the contract or if they inherit misunderstandings from the previous phases.

Existing both as artifacts that memorialize consensus and as the outcome of a communicative process of interest matching, contracts can be seen as boundary objects [1], focal points in collaboration reconciling the diverse worlds of the many groups involved. Boundary objects are flexible enough to be interpreted, contextualized and used in different ways, as well as robust enough to maintain shared meanings and bridge the cognitive gap across communities [1; 3; 4]. Contracts have a different role and mean different things across professional communities, but at the same time contracts allow the communities to coordinate their efforts around the specific deal at hand, by helping them to “translate, negotiate, debate, triangulate and simplify in order to work together.”[1].

Brown and Duguid [5] point out how contracts are a classic example of boundary objects; they “develop as different groups converge, through negotiation, on an agreed meaning that has significance for both.” However, Brown and Duguid seem overly optimistic regarding the outcomes of negotiations. They describe the best outcome possible, but often contracts do not live up to such expectations. Levina and Vaast [6] show how merely *designating* a boundary object does not mean that it will acquire a common boundary-spanning identity as well as satisfying local needs. Instead, true boundary objects need to be embedded in the situated practices of the actors who use them. While contracts are symbolically relevant for an organization, they often lack a deeper adaptation to non-legal and non-administrative contexts: for many, they remain “lawyers’ stuff”. This is exemplified by a sentence which we often heard from our interviewees with a business background in different firms: “first is the deal, then comes the contract.” In other words, contracts are just an official (lawyerly) seal of approval on the deal: contracts are not conceived as significant in achieving understanding and synchronization between the parties in the first place.

We thus need to ask ourselves what can be done to fully develop the potential of a tool which is currently underdeveloped. Following Levina and Vaast’s [6] pointer, we believe that contracts should be looked at from a new, more concrete and practical perspective. As regards their style and language, contracts constitute a very recognizable *genre*, where written text is the unchallenged ruler. Lawyers and non-lawyers alike tend to see contract drafting as a subset of legal writing. Most contracts actually resemble laws, with all their dense text, paragraphs, and internal references.

A characteristic of boundary objects recurrent in several studies is their capability of visualizing and clarifying insights and implicit knowledge. Sometimes such visualization is more a mental phenomenon, but often it corresponds to real visual representations in 2D (e.g. knowledge maps [7], scenarios [6]), 3D (e.g. physical models [8]) and even 4D (e.g. actors enacting through gestures the process they want to explicate [8]). Where is this visualization element in contracts? Neither their form nor their style provide visible structures which users can utilize to better explore, navigate and internalize the content [30]. Users are

left alone to create the causal or argument structures that are needed to make sense of complex and interrelated content. This certainly affects individual users who are not provided with visible patterns that can support analytical thinking. It also neglects groups of individuals trying to align their goals and understanding: they lack shareable, externalized objects for thought, as well as a way to articulate tacit assumptions and expectations in a more explicit, easier to understand format [9].

We argue that, in most cases, contracts are “imperfect” boundary objects: ideally, their role is extremely relevant, yet their implementation is suboptimal. As long as contracts are seen only from a legal perspective, their design and communication issues will not be noticed, and thus their full potential as boundary objects will not be harnessed. In order to overcome this management challenge, the perspective of legal writing must widen into the domains of design, and borrow the lessons learnt in the fields of information design and user-centered design about users, content and information display.

3. USER-UNCENTEREDNESS AND DESIGN ILLITERACY

The drafters of contracts seldom view themselves as working in the field of communication. While they produce documents with the intent of capturing and transferring information – work with text for an audience – they do not define their role in terms of communication. For lawyers, the focus is on producing legally sound and predictable content, rather than communicating messages effectively to the key persons in charge of implementation. Instead of focusing on the needs of implementation teams, they optimize contracts to be used in court, an event that marks a failure of the project and the relationship. So contracts are structured in a peculiar way and use language that non-experts often find overly complicated and hard to understand. Contracts seem to be written *by lawyers for lawyers* [10]. While they may help to win a battle in court, they do not help those who want to avoid such conflict. Current contracts do not engage their readers, nor are they easy to read, comprehend, or implement. If implementation fails, business and legal problems will follow.

Contract interpretation remains the largest single source of contract litigation between business firms [11], bringing us back to the issue of communication. Contracts do not normally fail for a lack of legal, technical or business expertise, but for a lack of communication. It is not considered to be part of the job of a contract drafter to think about contract users who lack legal background and try to achieve a specific task in a given context. So the focus remains on legal rules, with no attention to the access structures of the document [12] or to providing salience [13] to the information that non-lawyers are going to search for and use in day-to-day business. Considering that the majority of contract users in business-as-usual situations do not have a law degree and that their knowledge needs are mostly not taken into consideration makes us realize how user-*uncentered* contracts currently are [14].

The challenge of “user-*uncentered* contracts” resembles the issues raised by Human-Information Interaction (HII): the source of communication failures is not to be found in the specific technologies, repositories and interfaces utilized, but deeper in a lack of understanding of how information should be communicated, and how people interact and interpret information [15]. HII directs attention to the information itself rather than to a specific medium or technology [16]. In the case of contracts, the medium is typically a piece of paper or a digital document, but despite this apparent simplicity, contract writers are still unable to

get right the communicative dimension of contracts. One of the biggest issues is thus what Waller [17] calls “design illiteracy on the part of the writer”: a lack of models and grammar to obey when designing contract documents; a lack of understanding of affordance and gestalt; and a lack of empathy with the user.

The concept of affordance as used by Norman [18, p. 9] is particularly relevant to contracts. Affordance refers to the perceived properties of objects that cue how they should be used. When affordances are expressed through design, users know what to do just by looking at the object, because the actions it allows become intuitive and self-evident. Affordances are badly neglected in contract design: every contract looks the same as any other contract, even if their content and meaning are different. So, if, as Levina and Vaast [6], Bechky [8] and Brown and Duguid [19] point out, practice is the only site where knowledge transfer and learning truly happen, shouldn't contract drafters care more about the affordances of their documents that could be revealed through design? The interaction of people with content and, through such content, with others, is not something that can be left to chance. After all, contracts do not make things happen – *people* do. The ability to understand, share knowledge, align expectations, and ultimately do the right thing, should be strongly facilitated.

Contracts offer an interesting case to explore the different dimensions that need to be considered in the design of user-centered communication tools and to focus on the basics of human-information interaction without extra complexity from technology. Researching HII in this context is of great practical interest for both private and public organizations, since improved human-contract interaction can maximize the value of commercial relationships, minimize risk, and prevent frustrating working practices for employees.

In the next paragraph we present a framework that identifies essential dimensions for the design of user-centered contracts. These dimensions have emerged from our qualitative interviews and focus groups. Together, they provide a look into the complexity of contracts and negotiations as perceived by different professionals and ways to overcome that complexity.

4. DIMENSIONS FOR DESIGNING USER-CENTERED CONTRACTS

When designing truly user-centered contracts it is not enough to consider the “cognitive hardwiring” that each user is provided. Other constraints and factors at play might facilitate or hinder users trying to achieve their goals. Previous works like Albers' Model of Complex Situations [20] and the Cognitive Work Analysis framework utilized by Fidel and colleagues [21] highlight how the context, the social organization and division of work, the goals of the users and their information needs all play a role in determining the outcomes of interaction between humans and information. Users are influenced by many factors affecting their behavior, their motivation and their reactions, so the designers (or authors) of the information system need to get a richer understanding of the situation in order to produce useful and engaging information systems.

Such is the case with contracts, at least intuitively, if we wish to design them in a user-centered way. However, where a contract is a written document, it is not as dynamic as an information system. Furthermore, producing tailor-made information for different groups seems unlikely. To some degree, information for different users will coexist in the same document. This gives particular importance on how we organize and give an intuitive structure to

the content, how we express the linkages between different parts of the text, and how we give salience to key clauses through typography and visualizations. So the question remains: despite their differences, can we apply to contracts those frameworks initially developed in the HCI/HII field? Are the dimensions of the frameworks valid in this specific case?

4.1 Sampling and data collection

To answer this question, we looked at the qualitative data collected during three ongoing case studies. Two of the cases are carried out in cooperation with companies in the metal and engineering industry – one looking at the sourcing interface and the other at the sales interface – while the third case explores a research consortium jointly created by research institutes, universities and companies. The data source presented in this paper is comprised of eight individual, in-depth, semi-structured interviews, which aimed at getting a rich picture of the contracting process, its bottlenecks, and the different needs of different groups. Additionally, five focus groups (a total of 26 participants) were conducted after an experimental evaluation of visualized versus traditional contracts (described in [22]). Their purpose was to gain more information about the needs and challenges experienced by the participants, as well as discovering more about their mindset and their work environment. The sample was chosen purposefully rather than statistically [23], and the interviewees were chosen according to their professional background and experience, in order to collect perspectives from different points of view.

4.2 Analysis

As we collected the data, we analyzed it by continuously comparing it between informants and with findings from previous literature, following the tradition of grounded theory [24]. This helped to delineate and isolate themes, and create aggregate dimensions. We especially compared whether the dimensions emerging from the descriptions of the contracting process “as is” by interviewees who have never seen a visualized contract also emerged from the interviews of those who had a chance to work with a prototype of a visualized contract and to compare and contrast it to a traditional one.

4.3 The dimensions of the framework

As also illustrated in Figure 1, we identified four aggregated dimensions to be considered in the design of user-centered contracts:

- 1) **The context of use and practices**, which determine the users' tasks, goals, knowledge needs, social interactions, and how the communicative artifact is produced. In the case of contracts, this dimension identifies the organizational and contextual constraints of the space of action of the users, as they do what they are required by their job, and search for the information that will make them successful in such task. Additionally, departmental interests, common identities, and power relationships may also act as contextual constraints.
- 2) **The user needs**, which can be divided into two different subgroups:
 - a. **The cognitive needs**, depending on the inescapable physical and cognitive hardwiring that each user possesses, and that thus cannot be ignored. Users are not constantly aware of their cognitive architecture and their continuous workings (e.g. sensory memory, working memory, long term memory, schemas and automation

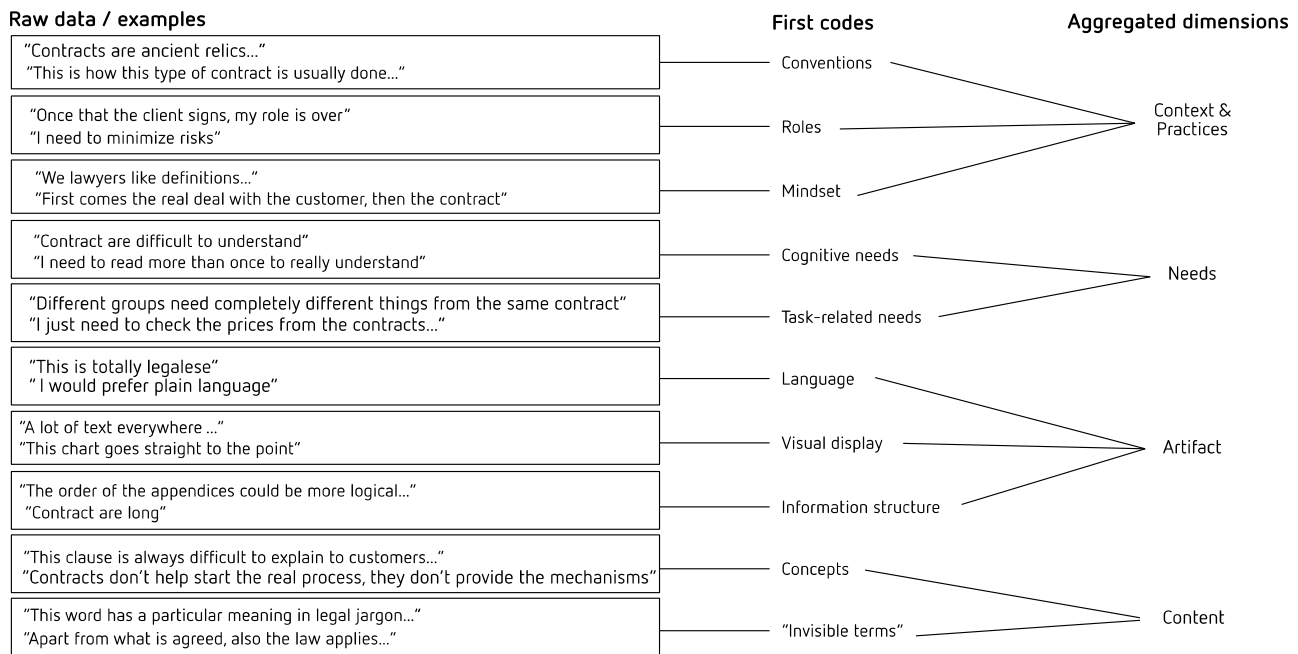


Figure 1. How the four dimensions affecting user-centeredness of documents were obtained from the case data.

[25]), but these ultimately result in whether they are able to correctly understand, learn and recall information.

- b. **The task-related information needs.** Each user, depending on her professional role, approaches information from a different perspective and with different goals and priorities in mind. In case of specialist information, the users' previous knowledge and skills will determine whether they can understand and purposefully utilize the information.
- 3) **The characteristics of the communicative artifact**, which has to be optimized both for cognitive processing and the achievement of contextual goals. The artifact works as a boundary object between different groups of individuals, and needs to bridge the culture, knowledge, and communication gap between them. In the case of contracts, the physical characteristics of the artifact include the contract's language, structure, and the visual display of the content.
- 4) **The content** at hand, which requires ad-hoc communicative solutions to better express its concepts and meaning. Some concepts or arguments might be inherently complex and difficult to understand. Additionally, the content can have a different importance, value and function for different users, affecting their perception of whether it is difficult or simple. In the case of contracts, content is impacted not only by what is expressed in the text, but also by what is left unsaid or implied as "invisible terms", determined by the default rules of the law and by legal interpretation [26, 27, 28].

If we compare these dimensions to those found in the models of Fidel et al. [21] and Albers [20], we can notice several similarities, but also some differences. Our dimensions appear more simplified and while several points still exist, they are aggregated under more general labels. These differences stem from our focus mainly on the contract as a boundary object and on what interventions can be done at the artifact level to improve its role. From this perspective, other factors can be seen either as characteristics of the users or as

contextual constraints that determine the space of action and reaction of the user. Additionally, the goal of our research is to enable contract drafters to become sensitized about their users. For this aim, the dimensions cannot be too complex – or they would not be used at all. We might not be able to overhaul completely what a contract is and how it is written, but we can start with the quick wins that can be gained through a better display of contract information. Figure 2 shows the relationships among the four dimensions and how they belong to the continuous interplay between context, users, and the artifacts.

4.4 How visualization can enhance user-centeredness

In this section of the paper we show how visualization can help users overcome much of the complexity inherent in contracts and gain better insights. We utilize the four design dimensions we introduced to compare visual contracts and traditional, text-only contracts, through the experiences and the perceptions of contract users. All the examples are taken from our interviews and focus groups.

Bob is a program manager of a large, long-term research project where private companies, research institutes, and universities – a total of over 20 organizations – are participating. Bob has had the responsibility to make the project operational and to establish the processes for collaboration among the participants, as well as making sure that the promised outcomes are achieved and all the reporting to the project funders is done in a timely and correct way. The participating organizations, before the project started, signed a Consortium Agreement, which provides rules about, for instance, how intellectual property, background information, and Bob feels that the agreement "has an importance as a hygiene factor, it puts some minds at rest through its existence", but it is not an effective "tool to start the real process". He does not feel that the contract helps him, as a program manager, to do his job, and wishes that contracts could "pay more attention to different people and different contexts and different needs. A frontline project person has completely different needs compared to a controller, compared to a work package leader, compared to a

programme manager. They all have different perspectives, and different stuff becomes important depending on the perspective". Additionally, Bob is not satisfied with the look and feel of the document. Even though he speaks English very fluently as a non-native speaker, he "would appreciate simpler, plain language. And I think everyone else would like that too, this is legalese on a high horse." He thinks that the document is "not inviting to read" and that "unless you really need to understand something, you would just have a look and put it away, because it doesn't invite you to explore the content." Bob also believes that the content could be changed, for example by "putting more energy on creating ways to enact the principles that these documents contain, rather than sticking to their formal aspects" or by reformulating them as "proactive statements about the work plan", rather than "negative statements" focusing on trouble, prohibitions, and what can go wrong.

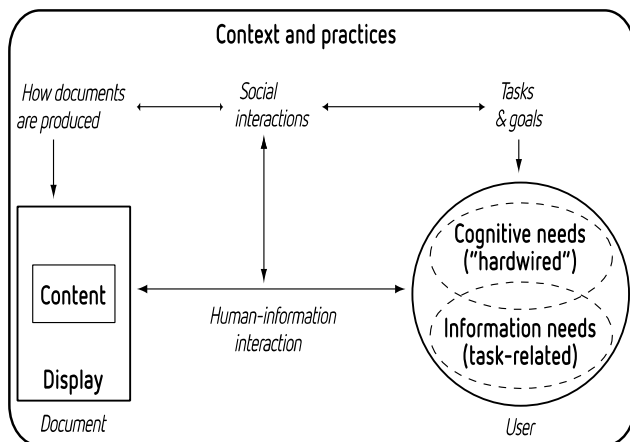


Figure 2. The four dimensions of the framework hold key positions in the relationship between user, document and context.

We can see how Bob addresses issues of content and information display, but he is also reflecting on the context he is working in, acknowledging the existence of different needs and perspectives and how, currently, they are not well taken care of. Bob is not alone in his opinions, as we noticed similar patterns in other interviews. Contextual constraints, for example, can be very strong for the drafters of the agreements, as the experience of this lawyer, Jane, who was appointed to draft a R&D Contract, reveals: "I was doubtful about these clauses, they felt funny, but it was said to me that this is a very normal type of clause in these kinds of agreements. That this is business as usual and so it should be included." Jane also provided a good explanation of why contract language is the way it is (even though she admits that it could be hard for non-lawyers) and how it is strongly related to lawyers' professional identity: "We like definitions so much. Everything should be defined - that's perhaps the handicap of lawyers in general. Everything should be defined and if it's not defined you ask yourself 'Why is it not defined? Is there something behind?' You should know what exactly is meant by the words that have been chosen [...] You can always take any viewpoint and you can argue about it. It's always possible. This way of thinking is what we learn in law school, and we all share it [...] That's why you need to try to be as defined as possible." In this case, language is both a characteristic of the artifact – the contract – but also an expression of professional identity, which signals a knowledge gap between the lawyers' community and the others. Such gaps characterize the context in which the contract users can act. Even though there is a motivation, from the lawyers'

perspective, for how contracts are currently designed, managers with a business or engineering background just perceive its format, and are frustrated by it. It was not uncommon to hear such comments as "they are long like hell", "it's such a pain when there are, like, 100 pages of appendices!" and "it's simply not inviting."

The same categories emerge from the descriptions provided by the focus group participants who had the possibility to utilize a visualized contract in an experimental, yet realistic, setting [22]. The most prominent aspect is how the participants, despite belonging to different departments and having different backgrounds (sales, sourcing, supply chain management and legal), all perceived cognitive and experiential benefits from the presence of visualization in the contract, highlighting how the display of information matters. It was not uncommon to hear that the visual contract "is inviting, and nicer to read", even though the textual content was exactly the same in both the visual and traditional version. They felt that is good "when you can understand at first sight where you can find what you're looking for" and "when you manage to get things quickly out of the contract". Two examples of the visualizations utilized in the experiment can be seen in Figure 3.

Visualization seems to have a positive impact on information finding ("if I use a text-only version [of the agreement], things don't pop up to my eyes as quickly as they pop up from this one"), understanding ("[Visualized contracts] are clearer than conventional contracts. There's a lot of texts, which is per se difficult to understand correctly, but when it's visualised it's more 'black on white', in some sense"; "Pictures help to understand the text a little better. First, I read the text, then I had a look at the picture, and then I got it. But if there's only the text, I need to read it carefully at least once more so that I can really understand what the text is about") and recalling ("Somehow I remember pictures better than text. It is like a screenshot"; "At first glance, I already noticed the pictures and what they were about, so, when I had to find something about those topics, I obviously remembered straight away where I saw it").

By comparing and contrasting the visualized and the traditional contracts, the participants also became sensitized to less immediately apparent aspects of the artifact, such as how the information was structured, and whether the proposed structure was good or not in aiding information retrieval and understanding. Referring to the traditional version of the contract, some lawyers pointed out how "the contract was quite long and the structure wasn't so good... it can be made clearer", and that "the order of the appendices was not very logical".

Visualization proved also beneficial to putting the content of the contract in relation to the processes where it needs to be deployed. The focus group participants, unprompted, started thinking about what it would mean to utilize such contracts in the real context, and were able to express their contextual and goal-related needs through these examples. For instance, some sales representatives felt that visualizations "would decrease the work of the lawyers. Somehow I feel it is clearer, we would need less help from them" and were able to express their contextual and goal-related needs through these examples. For instance, some sales representatives felt that visualizations "would decrease the work of the lawyers. Somehow I feel it is clearer, we would need less help from them" and would help increase trust and transparency during negotiations with customers: "Let's say that I need to make a framework agreement with a big company. And I have two options. One is based on plain text. The other is a visualised

centeredness not only misses a potential improvement, but it actually amplifies the difficulty of communicating specialist knowledge and insights across occupational boundaries.

However, visualization is not completely unproblematic, if we consider our own suggested dimensions for user-centeredness. While the cognitive, experiential and communicative benefits seem clear, the interviewees pointed out some possible difficulties that visualization could bring into practice. The first fear is related to personal skills and processes. Many interviewees, despite liking the visualizations, did not feel that they were the right person to produce visualizations. They did not feel confident in drawing and would prefer a designer to take care of these things. However, if a designer were to be involved, the production time of contracts would increase, and the complexity of the process would increase, as the designer would need to be involved every time there is a change. We feel that involving a designer is not the way forward. Increasing the basic visual skills and the confidence of those already involved in contract making and negotiation would maximize the benefits instead, because the experts would be enabled in better communicating their knowledge and insights.

The second fear is about the legal validity of visualizations. What if the text and the pictures contradict or do not exactly mirror each other? What happens in this case if a dispute arises? Even though some companies are willing to adopt visualizations in their contracts, this is not yet a mainstream practice and obviously we cannot predict how this would work in court – even though our main goal is to avoid going to court completely, by cultivating more transparent relationships. An easy solution would be to assign priority, in case of inconsistencies, to the text of the agreement. This approach is already used when a contract in more than one language exists: the parties agree which language version prevails.

A third fear is that visualization might be even too transparent. Some respondents were worried that their know-how about services or technology would leak to competitors, if too many details were to be fully opened up and explained through visualizations. Even though most contracts are confidential and most images are protected by copyright, a customer might utilize a supplier's visualizations to better explain their needs in negotiations with other suppliers. The solution could reside in making strategic choices in what to visualize, on what media, and when to make the visualizations available during negotiations.

6. CONCLUSIONS

In this paper we present how contracts, despite being conceptualized as boundary objects, are falling short in that role. They are not conceived or designed from a communication perspective, only from a legal one. We argue that visualization and user-centered strategies identify user needs and contexts of use that could be highly beneficial in understanding contracts and improving collaboration. We take a perspective similar to human-information interaction: successful communication, task completion, learning and collaboration is found in how humans interact with information, and not in technology – or, in our case, legal thinking or legal writing.

By gathering qualitative data, we identified four dimensions that affect the user-centeredness of documents, and were able to notice the similarities between this framework and others developed in the field of HII. Moreover, the analysis of our data led us to develop two further propositions clarifying the impact of information design and user-centeredness on successful cross-disciplinary communication:

1. Visualizations help in bridging the knowledge gap across different occupational communities, acting as a boundary object. Their deployment in contracts can transform contracts from merely “nominated boundary objects” into truly effective “boundary objects in practice” [6].
2. Disregarding the aspects that can increase user-centeredness in documents does not simply lead to a missed improvement, but it becomes itself a source of complexity that hinders successful communication across the boundaries of professional communities.

These results, despite providing some interesting points for discussion and reflection, have to be considered limited and preliminary. All the cases we considered in our datasets are ongoing, and further interviews and focus groups might contradict these initial findings. However, since we believe that discussion and reflection with peers are a key factor in improving research quality, we took the liberty of presenting a work-in-progress, with the intent of collecting useful feedback and constructive criticism. Without doubt, further research is needed in order to confirm these findings and generalize them across domains, as well as developing further prototypes of visual contracts. Our ongoing research work aims to further the theory and practice of contract visualization, while at the same time raising general awareness about the importance of user-centeredness and effective communication in the field of contracting.

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Visualizing Complexity and Uncertainty about Climate Change and Sea Level Rise

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ABSTRACT

In this paper, we discuss the use of visual representations to assist people in understanding complex information about sea level rise and climate change. We report on the results of a 2011 study in which we conducted plus-minus document usability evaluations of documents describing the mechanisms and consequences of sea-level rise in coastal areas. The protocol included 40 participant interviews and post interview quizzes. We tested with three documents, one that presented information for the U.S. southeastern coastal region and two that presented information “localized” for the two areas in which we conducted the research. Findings indicate that participants had difficulty with information presented in graphs and maps and that, while they indicated preferences for localized information, localized images did not improve understanding of complex information.

Categories and Subject Descriptors

H.0 Information Systems: General

General Terms

Documentation, Design, Experimentation, Theory.

Keywords

Visual information, graphic displays of information, document testing, sea-level rise, climate change, science communication, risk communication, images.

1. INTRODUCTION

Sea-level rise and a related probable cause—climate change—present a number of significant, far-reaching, and complex problems for government at all levels, for emergency management, for NGOs operating in the aftermath of serious events, and for populations living in at-risk areas including coastal regions and flood-prone areas. These pressing issues increasingly require that researchers, community leaders, and stakeholders create, access, and use complex information for planning and decision-making. For scientists, science educators, and technical writers who develop materials to inform and assist all these groups in decision-making, a related complex problem is

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communicating the issues. While recent past rates of sea-level rise can be measured, far-past rates are estimated and future rates are projected. In addition, how rates of sea-level rise translate to specific impacts vary by geographic location and are often considered speculative.

To assist in policy development that might foster any changes aimed at mitigating the impacts of sea-level rise, communicators need to convey information to publics, including residents in communities most at risk from sea level rise as well as people who might be affected by climate-change related weather effects and other impacts—broad segments of populations. However, climate change and sea-level rise pose particular problems for communication because conveying the causes, illustrating the rates of change, and projecting the impacts of both processes involve uncertainty. The potential consequences of sea-level rise entail projecting risks to environments, wildlife, agriculture, economies, infrastructures, and people’s health and well-being. The complexities involved in modeling and communicating these issues include that scientific projections are uncertain and that, in part because of uncertainty, scientific information faces challenges from other perspectives and agendas.

We focus here on the benefits and challenges of using visual representations to assist people in understanding complex information about sea level rise and climate change. Visual representation of climate change and sea level rise can be powerful tools for conveying information about risks, processes, change over time, and potential impacts. Visual representations of climate change and sea level rise will increasingly need to illustrate not only history and predictions, but relationships and interactions of natural and built environments, populations, and infrastructures, among other considerations.

For the public in particular, information about risk and science must be appropriately framed, and should incorporate compelling, clear visual images and accessible language. But even when such communication strategies are used, people have difficulty interpreting graphic information about science. We approach this work from the perspective that conveying information about a complex problem is in and of itself a complex problem—we need to understand why certain types of information are difficult for people to understand and how widespread the difficulties might be. We consider that scientists and communicators sometimes lack insight into how people process complex information presented in text and visuals.

Results of a small study we conducted in 2011 identify some problems that respondents had in understanding scientific information, including difficulty in interpreting graphs, charts, and maps and interpreting other types of images. Our research

was conducted in two coastal communities in North Carolina, areas at risk from sea level rise. Although scientists have promoted awareness of the danger of sea-level rise since the 1980s (Moser 2005), previous research in North Carolina indicates that residents and property owners in vulnerable regions have misconceptions about the causes, rates, and future of sea level rise and many deny that they will be affected (Perry 2008; Miller 2010). Though we tested both textual elements and visuals in three different documents, we are focused in this discussion on people's receptions of visuals information.

2. COMPLEXITY IN VISUAL REPRESENTATIONS OF SEA-LEVEL RISE

The science about the causes and consequences of sea-level rise and one of its possible underlying causes—climate-change—is complex. Many of the effects are perceived to be distant in both location and time (Moser 2010); the solutions involve issues of economics and infrastructure, culture and social justice as well as individual behaviors (see also Ockwell, Whitmarsh and O'Neill, 2009; Renn 2008). Many people view the problems of sea level rise and climate change as insoluble, unrelated to their lives, or they may deny the situation altogether (Hulme, 2009). Debates about the issues covered by media—such as the 2012 nationally reported efforts by North Carolina to legislate against the use of some types of scientific information in state planning decisions—also impact perceptions because of the ways the issues are framed (Dirikx & Gelders, 2010; Hulme, 2009; Durfee 2006). While researchers agree that the science of sea level rise and climate change is an important component of public education with the goal of facilitating change, the challenge is providing comprehensible and relevant information for decision makers and publics in a complex context.

2.1 Complexity and Communicating Risk

The history and future of sea level rise and climate change can be modeled in a variety of ways, as can the associated potential impacts and risks. However, illustrating the scientific projections of potential future climate change and sea level rise are particularly problematic for people because of the risks and uncertainty involved. Various aspects of risk, as opposed to realized hazards, are socially constructed and evaluated differently by scientists, experts on risk, policy makers, and individuals using different decision-making tools and strategies (Renn 2008; Taylor-Goolby and Zinn 2006; Sjöberg 2000; Luhmann 1993). Risks perception also tends to be context specific and place-based (Masuda & Garvin 2006), and decisions about risks and what to do about them are often based on experience and cost-benefit decision making.

Considerable research about risk analysis, risk perception, and risk communication indicate that in risk-related decision-making, people consider scientific information about risks but may be more influenced by the perceived impacts of risks to themselves or their actual experience with a particular hazard. Determinations about risk, whether by individuals or groups, involves considering tradeoffs and are influenced by the proximity of the risk; the level of uncertainty that the risk will become an actually reality; communication, including the level of media attention the risk receives, how the issues are framed by the media and other information sources, the trustworthiness of source of information; and the immediacy of any threat (Renn 2008; Masuda & Garvin 2006; Rosati & Saba 2004; Roepik & Slovic 2003; Sapp 2003;

Baron, Hershey, Kunreuther 2000; Slovic, 2000; Grabill and Simmons 1998). People perceive risks from sea level rise and climate change as far away in time and distance, which is a challenge for researchers and policy-makers attempting to convey that the actions should be taken now.

2.2 Complexity and Visual Representation

Communication researchers generally agree that visual representations of complex information offer possibilities for enhancing understanding of complex problems. However, they also agree that for visual representations to be effective, we need a better understanding and more information about visual literacy. Currently, no unified theory of visual literacy exists to explain how people process visual information (Avgerinou, 2011; Trumbo, 1999). The range of visual representations may mean such a unified understanding is not possible. Visuals such as graphs and charts are abstract representations that have no more direct correspondence to the reality they depict than a written word has to a thing it names (Galesic & Garcia-Retamero, 2011; Amare & Manning, 2008). These types of visuals rely on loosely agreed upon sets of conventions, the capabilities of systems to apply conventions to data, and designers and audiences' understanding of the ways data and conventions function together in a representation. The success of charts and graphs to convey information is also dependent on audiences' levels of numeracy. Diagrams and maps may have a higher correspondence to reality but depend on spatial reasoning as well as understanding of the conventions for those representations (Mennis, Peuquet, & Qian, 2000). Illustrations and photographs have the highest correspondence to reality but still require audiences to interpret their representational purpose.

Visual representations combine facts and judgments, which also means they are never value free. In fact, visuals can be representations of arguments (Northcut, 2006; Perini, 2005). With respect to representations of sea-level rise and climates change, these arguments are often politically charged. One example is the graph that has become known as the “hockey-stick” graph (Figure 1), which was first constructed by Dr. Michael Mann in 1998 as an “easy-to-understand” (Mann 2012, p. xiii) illustration designed to depict the temperatures changes on the Earth over the past

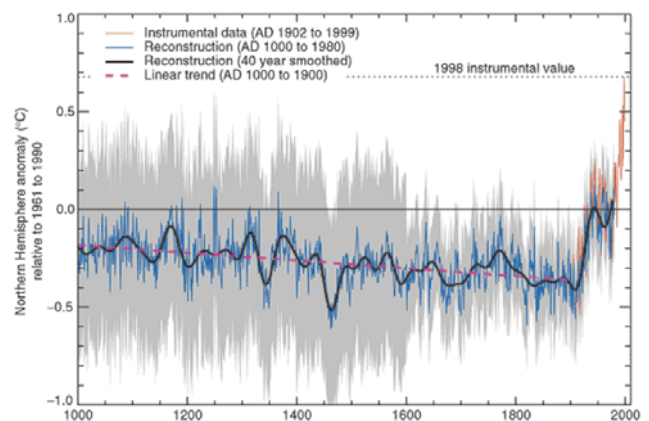


Figure 1. “Hockey-stick” graph.

millennium. The graph gained prominence because it was included in the IPCC Third Annual Assessment Report, Climate Change 2001’s high profile “Summary for Policy Makers.” The graph includes a statistical reconstruction of Northern Hemisphere

temperatures based on tree rings, ice cores, corals, historical records, and temperatures recorded on instruments starting in 1850. Proxy data methods—methods that are used to reconstruct or estimate data rather than data recorded by instruments—yield highly imprecise and uncertain data. In the graphic used in the climate report, uncertainty is indicated by a large shaded area. The trend line of temperatures is highly variable, so statistical methods are used to average and smooth the line. The phrase “hockey-stick” was coined to describe the shape of the curve, which is a relatively flat downward shape of the statistically smoothed trend line with a sharp rise within the last 100 years. To most scientists, the trend was dramatic evidence of exceptional global warming in the 20th century.

The graph was disputed by some scientists who criticized the methodology used to determine proxy temperatures and the statistical procedures. Although analyses in 2005 supported the findings of Mann, et al., uses of the graph by environmental interests and others that minimized the uncertainty surrounding the reconstruction of past temperatures was criticized (Brumfiel 2006).

The graphic became a lightning rod for controversy because it is very persuasive and therefore given a place of prominence by the IPCC and the media. It is more complex and illustrates more uncertainty than is commonly depicted, so some critics felt it was misleading. Criticisms were repeated by political opponents of climate change policy efforts and even used by some to claim that climate change science was a “hoax.”

Researchers and scholars have been concerned with developing theories of both visual representation and visual literacy and those efforts should be sensitive to the ways that graphics manage complexity such as uncertainty. Though outlining these theories in detail is beyond the scope of this discussion, our work contributes to continuing research into the ways that people assess, understand, and respond to visual representations that is essential to theory-building efforts.

3. METHODS

Most research on public perception of issues related to sea-level rise and climate change rely on data from mail-in, telephone or internet surveys (Leiserowitz 2010, Brody 2008, Maibach, et al. 2009, McCright 2010, Zia & Todd 2010) that focus on what participants’ know about sea-level rise and climate change, their concerns and attitudes about the both the problems, and possible responses. These methods gather data from large numbers of participants about attitudes, perceptions, and knowledge, but they don’t shed light on how people actually interpret information. Our research goal was to investigate how people processed, evaluated, and understood specific instances of information.

We conducted our study in two small coastal communities in North Carolina using document-based evaluations and semi-structured interviews to research people’s reception of information as well as their knowledge of and attitudes about sea-level rise. These methods have been used to analyze audience interpretation of hurricane risk and preparedness information as well as information on other environmental and health risks (Kain, deJong, & Smith, 2010; de Jong & Rijnks, 2006; de Jong & Schellens, 2000).

For this study, a document-based evaluation approach was used to assess residents’ issue awareness, reaction to texts and images, and possible adaptation responses. The primary purpose of the

document evaluation is to better understand how audiences attend to and interpret information about a topic rather than to critique a specific document, though information about specific documents can be a benefit of the process. Our goal in the current study was audience analysis, an important task for establishing an audience profile, identifying audience characteristics, and determining the ways that audiences read and use information about issues (Schriver 1997). We also knew from experience with this method that in discussing the information in the documents, our participants would tell us about their experiences and give us their opinions about the topics of sea-level rise and whether they see it affecting their area. Though the documents we tested mentioned climate change as a factor in rising sea levels, the focus in the documents and the discussions was sea-level rise.

In a preliminary test of our methodology, we conducted the document-based and semi-structured interviews with several North Carolina residents using a fact-sheet developed to inform residents of Maryland about sea-level rise risk and adaptation. We found that readers had positive reactions to the visual nature of the document, but that many did not understand why specific visuals were included or what they actually depicted. Though few of the pre-test participants were familiar with the topic of sea-level rise, all expressed concern and interest in North Carolina-relevant information. In addition, in a comparison of the Maryland fact-sheet and similar climate change fact sheets, we found that the reading levels needed to understand the texts exceeded that of most readers. Little to no audience analysis, testing, or feedback information was collected by risk communicators working at the state agencies or not-for-profits that produced these communications.

In our study, we tested with three documents. One document—developed for Sea Grant, a non-profit NOAA sponsored research and outreach organization—provides information about sea-level rise affects to the southeast region of the US. Two documents we developed specifically for the evaluations included locally specific information about sea-level rise designed for residents of Manteo/Roanoke Island, NC, and residents of Washington, NC. The documents we localized included local images and maps that depicted the impacts of sea-level rise in areas of the coast in which the participants lived as well as graphs depicting rates of sea-level rise.

3.1 Participant Selection

Study participants included 20 people in Washington, NC, and 20 people in the Manteo/Roanoke Island area. Participants were recruited by flyers that were located in strategic locations (including public libraries, post offices, an estuary, a local college, a local community center, and several local coffee shops in both target areas). We conducted the interviews in central, public locations in each area. Though we relied on a self-selecting convenience sample of participants, we found that the participant groups were demographically diverse and represented the populations of the areas in which the testing was conducted.

3.2 Document Testing

We used the method known as “plus-minus mark-up” in which participants read and marked-up one of the three samples texts to indicate where they had positive and negative reactions to the information (de Jong & Schellens 2000; de Jong & Rijnks 2006; Kain, et al. 2010). Participants were instructed to read the entire document and, as they were reading, to mark any content to

which they reacted positively with a plus symbol (+) and to mark any content to which they had a negative response with a minus symbol (-). We instructed participants to mark any type or level of content they wanted, from words and images to whole pages and for any reason. When participants finished reading and marking the documents, we interviewed the participants, asking them to explain the marks on the documents. We audio recorded the interviews for review and partial transcription and made notes about participants' comments on pre-prepared forms that included areas for the various feature and sections of the documents. Each participant session lasted approximately 60 to 90 minutes.

3.2.1 Participant Interview

We conducted extensive interviews to gather details about readers' comprehension of the documents as well as their attitudes about the issue and their perceptions of risks. The discussions with participants about their marks on the documents provided starting points for further discussion about their attitudes and general knowledge of the problem. Following Morgan et al's (2002) mental models approach, we asked open-ended questions to further elicit participant reactions to the documents they read and to the issues. Data about each participant's age, level of education, race, gender, income, and length of residency were also collected.

3.2.2 Post Test

To assess participants' understanding of information presented in the documents, we developed a post-interview "quiz" about concepts presented in words and/or graphical representations in the example document they read and discussed. Participants took the quiz the conclusion of each interview and were instructed that they could use the document as a reference to complete it. The purpose was to determine whether any particular information or presentation of information caused problems for audience understanding.

4. Results

We found in interviews with residents that many had heard of sea level rise (see Table 1), but did not understand the causes or know much about the projected rates or possible responses. Most participants (88%) reported that they learned new information from the documents, but they expressed substantial confusion about the causes of sea level rise and in making sense of graphical representations of information.

The inability to decipher and understand the visuals and some of the text in sample documents was exacerbated by attitudes and beliefs about environmental change and adaptation including fear, skepticism, fatalism, and loss.

Table 1. Familiarity with Sea-level Rise

	Participants	%
Yes	16	40
Somewhat or a little	11	27.5
No	11	27.5
Unclear	2	5
TTL	40	100

4.1 Reading Graphs

Each document tested included graphs representing rates of sea-level rise. The regional document developed by Sea Grant included two graphs, one (Figure 2) depicting past estimates, instrument- recorded data, and projected sea-level rise to the year 2100. The graph included an image of the outline of a person (5'10" male) to assist people in processing the projected sea-level

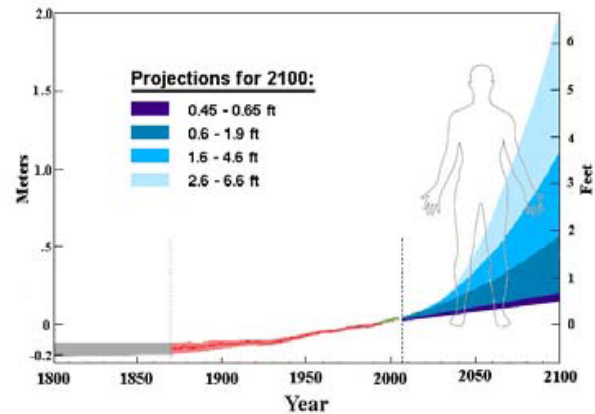


Figure 2. Projection of sea-level rise, regional document

rise in feet. The documents we localized included a different graph (Figure 3), one that did not include the human image but did include the most recent, instrument-measured data about sea-

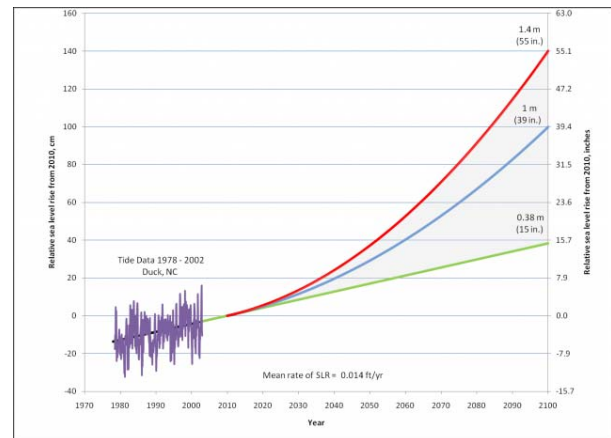


Figure 3. Projection of sea-level rise, local document

level rise (represented by the purple lines on the left side of the graph) collected from Duck, NC, a location close to both of our research sites. Both graphics depict three different scenarios based on different projections of sea-level rise and both included extensive captions explaining the rates.

Graphs are particularly difficult for many readers to understand. Almost half (43%) of the participants in our study could not correctly read the graphs and answer a simple multiple-choice question correctly (Table 2). Though a number of participants

commented favorably on the inclusion of graphs or did not comment specifically on problems with them, the results of the uiz indicate that people have more problems reading graphs than they are willing to admit.

Table 2. Survey (Quiz) to Evaluate Document Comprehensibility and Reader Retention--Graphs

Questions	Number Surveyed	% Correct Answers
<p>Regional. How much have global mean sea level increased since 1960 (according to Figure 1)? <input type="checkbox"/> 0 mm <input type="checkbox"/> 50 mm <input type="checkbox"/> 100 mm <input type="checkbox"/> 200mm</p> <p>Local. How much is sea level expected to rise by 2100 if the warming trend in the ocean over the last century is considered (according to the figure “Future Sea-level Rise)? <input type="checkbox"/> 0.38 ft <input type="checkbox"/> 1.25 ft <input type="checkbox"/> 3.25 ft <input type="checkbox"/> 4.6 ft</p>	20	50%
	20	65%

Comments about graphs during the document interviews reflect the discomfort that many readers have with graphs in general and with the graphs used in the documents specifically. A typical comment was:

I didn’t understand it. I am not a graph person. I like a basic bar graph. I am not saying it is bad it is just not for me. I read some of it—especially the bullets to try to better understand the graph and I said okay, not for me.

Some comments indicated that people had difficulty because of aspects such as size, color, or clarity of graphs or the information in captions. For example, one reader commenting on the size one of a graph (not shown here) and the colors used said, “The red on the graph is clear, but the blue and black you couldn’t tell. I did not understand the 90% confidence level part [in the caption].”

Observations of the participants, as well as the ways they discussed the graphics with us, indicate that some people didn’t take the time to review graphs carefully enough to interpret them effectively. One participant said,

when I first saw it, my first instinct was to say, what does each of these lines mean, but I didn’t read it at first. After reading it through I understand it, but.... there are pretty pictures, I don’t want to look at a graph.

On the other hand, a few people understood and appreciated the inclusion of graphs. One said, “I liked the graph here. It shows how high the level is going. I like the whole graph. I do understand some of it... in 2000 it’s up high.”

4.2 Reading Maps

Maps presenting information about sea-level rise were included in all three documents. The map included in the regional document (Figure 4) depicts sea-level rise at particular points along the coastal Carolinas and includes estimates of anticipated sea-level rise. The map included in each of the two localized documents focuses on the area of the North Carolina coast that included our research areas (Figure 5). The localized map also differs from the regional map in depicting different scenarios for inundation depending on sea-level rise amounts.

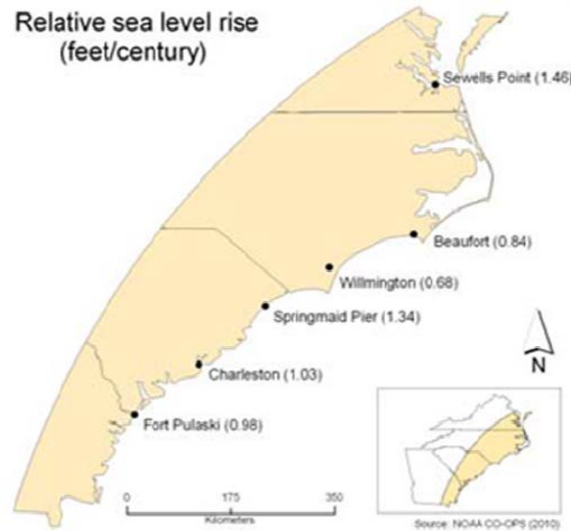


Figure 4. Sea Level rise map, regional

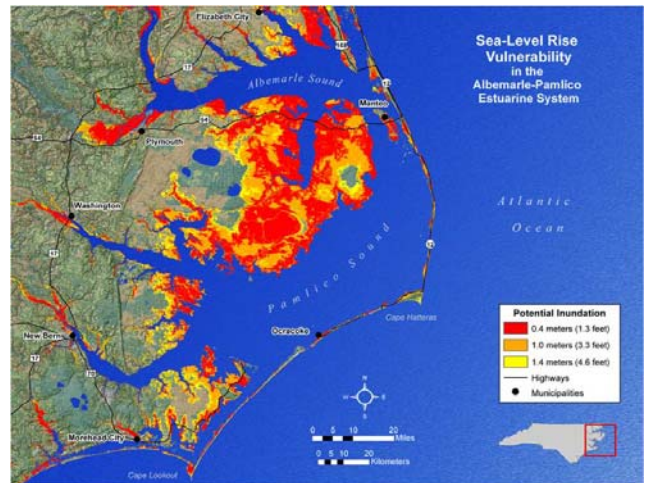


Figure 5. Sea Level rise map, localized

Though readers were more successful in reading maps than they were at reading graphs, only two-thirds (68%) of readers were able to answer a simple map question correctly (Table 3).

The results of the quiz indicate that participants fared somewhat better with the localized map. Although the information presented in that map is more complex, it graphically represents the effects of sea-level rise whereas the regional map only gives the numerical amount of potential sea-level rise at given points.

Some confusion about the map in the regional document may have been due to small print size, but several people did not understand the map or the information it was conveying. One person said, “I didn’t know what the bottom right chart [caption] was about at all. It says change in sea level rise along Carolina Coast but compared to what? Looks like a kind of ‘just kind of threw it in there’ as a filler.”

Table 3. Survey (Quiz) to Evaluate Document Comprehensibility and Reader Retention--Maps

Questions	Number Surveyed	% Correct Answers
<p>Regional. Where along the coast of the Carolinas is the sea level rising the most (see Figure 2)? <input type="checkbox"/> Wilmington <input type="checkbox"/> Beaufort <input type="checkbox"/> Georgia Border <input type="checkbox"/> Virginia Border</p>	20	60%
<p>Local. Areas on the map shown on the front page that are red may be under water when the sea level has risen <input type="checkbox"/> 0.38 ft <input type="checkbox"/> 1.25 ft <input type="checkbox"/> 1.64 ft <input type="checkbox"/> 3.28 ft</p>	20	75%

Other people liked the maps as visual references for the information, but felt more explanation was necessary in the local document. One person said, “The map needs to be one page with a commentary on it about what it is. Needs to be larger. The legend needs to be explained more. More explanation is needed and inundation doesn’t need to be put like that.”

4.3 Reading Images

The localized documents included illustrations of several concepts related to sea level rise and mitigation strategies, photographic images of recent, local storm-related flood events (Figure 6), and altered photographic images that depicted how local areas might change as a result of sea-level rise (Figure 7). The photographic images of flooding and the altered images were included not only to convey information about that potential impacts of sea-level rise but also to determine whether information about sea-level rise would be more interesting and relevant to people if it included recognizable content.



Figure 6. Local image of flooding
 Photo Credit: Dave Galley/FEMA News

Photographic representations may be the closest visual representations to reality and don’t require the same interpretive skill demanded from charts and graphs. Participants’ responses to

the photographs included comments such as the following about Figure 6:

I like the photo because it shows what horrible things happen. Although I have never seen this, I have pictures my parent, my dad went through Hazel in the 40s or 50s and he had lots of pictures. He used to talk about canoeing down main street. I think that was in the 40s, so I think that helps show how big a deal this is.

This picture is not shocking, because I have been in that boat. Rescuing people before in the city during a hurricane. It was not shocking to me as it might be to someone else. I have been here for every one of the storms for the last 17 years. I can’t remember the names of them. It is devastating the amount of damage a flood causes.

For the photo I put a plus, but then I didn’t believe it. I am sure I was here during Hurricane Floyd and there was no flooding like that here. I do not remember anything like that, nothing. I don’t know why a put a plus there. The problem was it went right around us- so we didn’t get it here.



Figure 7. Altered local image (Washington, NC waterfront)

Participants’ comments indicate that photographs link more directly to experiences than other types of visual representations our participants viewed. Most of the comments about photographic images such as Figure 6 accept or reject the “reality” represented by a photographic image based on the direct experience and recollection, or lack of these, of the participants or people they know.

Participants commented less on altered images of local landmarks such as the depiction of the waterfront of Washington, NC, in Figure 7. In the documents we tested, these images did not include the black line separating the current view of an area from the view depicting the effect of sea-level rise on the same area. For this reason—and because the difference doesn’t register as particularly significant in the images we used—some participants were confused about what the images illustrated, including what the change in the sea-level would mean in terms of effects. A complicating factor here is the tide. These areas are also susceptible to wind tides that can raise the water level to this height or higher. The comparison is difficult because wind tides are weather dependent. Several questioned the accuracy of these visuals and one participant was not sure that altering images was the right thing to do [ethically].

5. CONCLUSION

Our findings were consistent with research on public reception of information about risks from climate change and sea level rise that indicates people often fail to understand scientific, technical, and probabilistic information generated by experts (Mosher 2010; Hulme 2008; Handmer & Proudley 2007; Keller, Siegrist, & Gutscher 2006; Gigerenzer et al 2005).

Maps and graphs can be effective in conveying information that would be difficult to convey only in text and in illustrating relationships among data. However, reading maps and graphs accurately requires that people are comfortable enough with the genres and conventions to manage the cognitive tasks required to interpret them. Some audiences will simply ignore information in graphs, charts, and maps, as one participant's comment suggests:

Map is a negative. It is unclear what it means and why it is there. I don't see what its purpose is. The graph didn't mean that much to me. The charts didn't mean that much. If this was something that I was really interested in, I would pay attention to the charts, but you know sea level rise. I try to keep informed about things, but it is not on the top of my list. Or real gun ho about learning about. Some people may really get into these charts. I can't say it was a bad chart, but for me, it didn't really do much. The chart – you would have to be involved – charts are for the person in the business.

If people in part make decisions about risk based on proximity and experience, then, we hypothesized, people might pay more attention to risk information that was locally focused. Although we have not completed analysis of all of our data, preliminary analysis suggests an affective value in localization but not necessarily a cognitive one. Areas for further work on our study—and for additional work in the field—include determining what types of literacies people require to benefit from the information in different forms of visual representation and what the effects of including multiple types of representations in one communication might be. Much of the information provided to the public—in print and delivered electronically—includes various types of visual in the same document. Ours did as well. But people use different types of reasoning in approaching different types of visuals and we need more information about what types are most effective in conveying various kinds of information.

6. ACKNOWLEDGMENTS

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It's Not About Usability

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ABSTRACT

Traditional usability firms (or usability groups within large companies) tend to focus on evaluation, and their design process typically ends at the Discover phase. For organizations (or individuals) that tout themselves as “User Experience”, the goal is to have the research and data dictate design, going so far as to have the research person creating wireframes - defining screen layout, interaction models and information architecture. After all, isn't a research-based interface what we're after?

Categories and Subject Descriptors

D.3.3 [Human-centered Computing]: Interaction Design – *interaction design process and methods.*

General Terms

Design, Human Factors, Theory

Keywords

Design Process, User Experience, Design Research, Usability.

1. INTRODUCTION

Usability is not sufficient for the creation of an innovative, useful, complex system. There – I've said it. Let me explain.

Traditional usability firms (or usability groups within large companies) tend to focus on evaluation, and their design process typically ends at the Discover phase. For organizations (or individuals) that tout themselves as “User Experience”, the goal is to have the research and data dictate design, going so far as to have the research person creating wireframes - defining screen layout, interaction models and information architecture. After all, isn't a research-based interface what we're after?

While these firms (and the software development industry in general) have recognized the need for designers, it has typically been to create nice looking marketing materials or to make the designs created by researchers “look pretty.”

The reader can be forgiven if he or she has imagined me to be a (disgruntled) designer looking for a little respect. Not so. As a researcher with a classical background in experimental psychology (Ph.D. in Cognitive Psychology, 1991, The State University of New York at Buffalo) I have seen the field of ergonomics / human factors engineering / usability / design research / user experience architecture develop and mature.

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However, in the more than 20 years I've been doing usability research, I've seen (and been party to) a great many applications that, while usable, were not innovative, inspiring, beautiful, lasting, or useful. Why? Because we were following a research process (or, dare I say, a technology-driven process) rather than a design process. Plus, we're not designers.

2. THREE WAYS TO DESIGN SOFTWARE

There are a number of ways to approach the design of a new system. In the first, a list of new features, functional updates and component wish lists are collected from key stakeholders and representative users. This list is then handed to a talented development team who do their absolute best to coordinate the requirements and create a unified system that will make sense to users. This is how terrible software is created. Why? Because developers are not usability analysts or designers and they are being asked to do the jobs of both.

In the second, a researcher works with key stakeholders and representative users to determine the needs and requirements of both groups. This results in a more appropriate set of requirements. Researchers are trained to uncover not only what users say they want but also to infer, based on observation and questioning, what they need. This is incredibly powerful. Neither users nor stakeholders are typically able to see beyond their immediate wish list and the difference between incremental improvement (giving users what they want) and innovation (giving users what they need) lies in skilled requirements elicitation. While this new system will be based on an excellent set of requirements, issues such as screen layout, interaction models and data visualization (i.e., design issues) are still being determined by roles whose core competencies are not design.

In the third, research and design professionals collaborate, gathering requirements and creating innovative ways of supporting users to complete their work in ways they never dreamed. Sound a bit too utopic? It's true and when you can be part of such a “design process” as either a stakeholder, user or team member, it's a beautiful thing.

3. WHO IS DESIGNING?

Traditionally, the field of software development has looked to the contributions of three types of individuals to design applications that meet the needs of users. These are Business Analysts (BAs), Subject Matter Experts (SMEs) and Research professionals (Usability / Human Factors).

Neither BAs nor SMEs are trained or qualified to design a system that is usable, innovative and supportive, no matter how well intentioned they might be. In order to understand what is missing from this process, you need only look at what these two job roles are expected to bring to the design process.

Research professionals fare marginally better, I argue, given their expertise in eliciting user requirements. However, the ability to elicit requirements is a very different skill set than visualizing those requirements.

3.1 Business Analysts

The traditional role of the Business Analyst (BA) is to gather functional requirements from the point of the view of the business. In order to provide structure and guidance for the development team, these requirements are incorporated into “use cases.” A use case describes what the application needs to present to the user and what data the user needs to provide in order to accomplish a task. From these requirements, systems are designed (by the BA or the developers). This view of design ignores the needs of the user and the demands of the situation. Usability is questionable and usefulness is unlikely.

This is not to minimize the role of Business Analysts—it is extremely important to understand the needs of the business. However, accurate documentation of business requirements counts for little if users thumb their noses at the resulting application. Millions of dollars, years of development and crowds of dissatisfied users at companies all over the world are an unfortunate testament to this method of traditional software “design.”

3.2 Subject Matter Experts

As a way of addressing the *problem* of users and their stubborn refusal to use systems that do not support them, industry has inserted the role of Subject Matter Expert (SME) into the mix.

In the medical industry, for example, this means making sure that software development firms employ clinicians (MD, RN, etc.) whose role is to describe what the application needs to do, what data is required and how it should be presented. While this might be a step in the right direction, these individuals are fundamentally like any other user group—they are not skilled design professionals and their appointment to this role in the design process is flawed.

It is flawed because the job of the SME is specifically to act **in place of** users. Experts are, at best, providing what they believe to be user requirements or, at worst, their own requirements. The point is that they are not providing the user’s requirements. In addition, Subject Matter Experts are also asked to make decisions regarding design. I want to be clear; experts are not qualified to design any more than designers are qualified to be subject matter experts.

3.3 Research Professionals

What does Research do? Research informs design. We have the skills, taken from the fields of psychology, anthropology, sociology and human factors among others, to collect the appropriate user requirements. We uncover needs that users are able to verbalize as well as needs that users have but don’t realize they have. We understand what users need to be able to accomplish through their interaction with the system. That’s the key to innovation. We answer “what” and “why” and then support designers as they explore visual alternatives (“how”). When research professionals are forced into the role of creating different visual artifacts to satisfy those requirements, the ice starts getting thin. The training and aptitude necessary to excel in these two areas are very different and it is rare to find a single individual who is both embodies the qualities of both.

3.4 Designers

Designers should be designing. I am not a designer. I have no great natural aptitude for design. I am not an expert in the mechanics of design. I was never formally trained in the process of design (though I have a pretty good grasp of what that means now). I should not be designing nor should others of my profession. Great designers are skilled at creating visual artifacts that meet a set of requirements. There are a great many ways to design how a system will enable a user to accomplish their goals (our requirements) and the process of design requires that these alternatives be explored, refined and rejected. I will consult, provide advice and generally make sure that my requirements don’t get lost in the shuffle. I will collaborate with Design but I will not pretend to design (if I can help it).

4. SOFTWARE DEVELOPMENT

What if the design process I’ve described could also decrease the risk associated with software development? And since risk typically incurs cost, what if research and design could reduce the cost of software development?

The two main software design processes today are Waterfall and Agile. Each model begins with prose-based descriptions of the requirements that describe what the software should do. Each begins with a “Risk Potential” (my term) of zero. By this I mean that at the beginning of the development phase, everyone is confident and happy. Nothing bad has happened and everyone believes they share a common vision for the end-product. Then development begins and risk begins to increase. Why? Because decisions are being made that cause the final form of the product to veer away from the vision held by each member of the team. Is it the fault of the development team? Absolutely not. They’ve been put in the uncomfortable position of needing to make design decisions as they try and do what they love to do – code. And so, as time passes, risk goes up and up.

As demonstrated in Figures 1 and 2, this happens whether the project is following a Waterfall or Agile methodology. Waterfall is the more problematic of the two because the end result isn’t available until the build is complete. Agile attempts to address this issue by chunking the build into short sprints. However, this only allows views into isolated pieces of functionality, requiring the team to imagine how they will work as part of the larger whole.

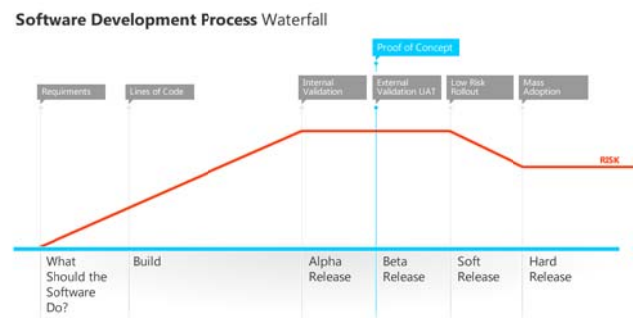


Figure 1. Risk associated with the Waterfall model

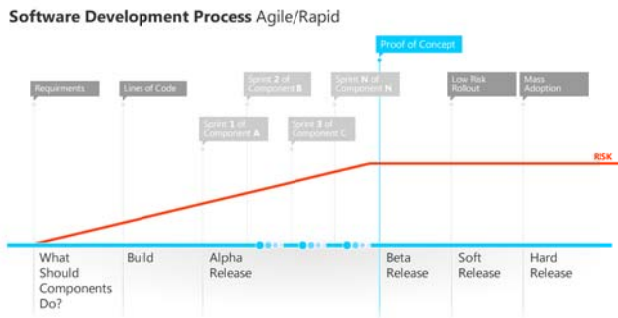


Figure 2. Risk associated with the Agile/Rapid model

Neither process allows the team to view what the final system will look like, how it will behave or how it will interact with other systems and other pieces of functionality until the development process is complete. In both, the initial development cost is high. Changing design decisions that have already been implemented in code is even more expensive. The likelihood of users accepting such a system is small.

The design process, as shown in Figure 3, coordinates the skills of research and design professionals and addresses this problem.

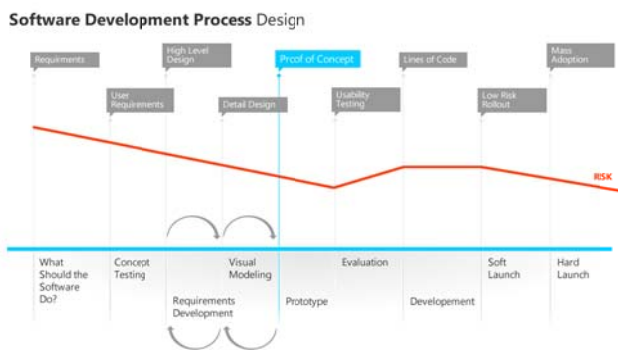


Figure 3. Design Process minimizes development risk

In addition to creating a better set of requirements (which, admittedly, could be the input to either Waterfall or Agile methods), the research and design professionals also create quick, inexpensive models of the final system. Through a rapid series of sketches, wireframes and screen mock-ups, the team is able to provide a view of the complete system that enables everyone to gather around, question and come to agreement. Since this process of rapid prototyping does not require code, it is as easy to modify as erasing a line. It also provides the opportunity to put the prototype in front of users and test both the conceptual ideas

generated during requirements gathering as well as screen-level usability. Once the bugs have been worked out and everyone shares a common understanding of the final product, the development team can begin working. And in addition to the requirements, they also have designs that concretely demonstrate the final visual form of those requirements. Development risk is therefore minimized before coding begins and held relatively constant throughout the development process.

5. WHAT IT MEANS

What a user needs becomes clear as you observe them work. It becomes clear as you ask them to explain why they took a certain action or why actions were taken in a certain order. *Innovation becomes possible once you understand what the user is trying to accomplish.* During one task, a user might be trying to decide whether to buy or sell a certain financial product. To do this, he or she may need to know how certain currencies are trading relative to one another, whether the rates of change between the currencies are trending in the desired direction over time and how this compares to historic rates of change between the currencies. *Rate of change, the rate of change of the rate of change, historical comparisons of rate of change.* There are many ways to represent this information. One way includes 6 monitors worth of spread sheets and line charts. Or a designer could create 3 novel ways of visualizing rate of change data at a glance (because it's what they're extraordinarily good at). Users cannot think in these terms. Frankly, neither can BAs, SMEs or most researchers. We have neither the proclivity nor the training. Designers have both. That's what happens when research and design collaborate. You get **User Experience** - accurate requirements presented in an innovative, beautiful and useful form.

Good design doesn't just happen. It is not a checklist of requirements, though it must certainly support the tasks that users need to accomplish. It is not a passing grade on a usability test; all the functionality in the world is meaningless if users can't or won't use the application. It is not a slick, natural-feeling interaction model. Most of all, good design is not "making it look pretty," though a well-designed application should certainly be expected to look the part.

So what is *good* design? Design is a research-based, highly iterative **process** with a focus on exploring different models of the user-system interaction. It consists of gathering requirements from end-users, business and technology stakeholders coupled with fast, early and iterative validation to determine the ultimate form of the design. Whatever the form, it must support a user's requirement to get something done.

6. ACKNOWLEDGMENTS

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Cargo Cults in Information Design

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ABSTRACT

There are a multitude of rules of writing and design. Cargo cult design occurs when designers rigidly apply a design rule without a clear understanding of why the rule exists or whether it applies to the situation. The rules moved into the status of being a rule for a reason. It is important for designers to understand those reasons so they can critically analyze the situation and make decisions about the applicability of the rule. Successful design requires deeply understanding and working within the situational context and not blindly applying generic rules.

Categories and Subject Descriptors

H.0 Information Systems: General

General Terms

Documentation, Design, Human Factors, Theory

Keywords

Information relationships, information design, human-centered design, technical communication, cargo cults

1. INTRODUCTION

Design is a skill, not something that anyone can do by following a recipe. Learning that skill amounts to learning not only what the design guidelines are but also how to recognize which rules to follow in each design situation.—
Jeff Johnson from *Designing with the Mind in Mind*, 2010

In the opening quote, Johnson makes the explicit statement that design requires knowing which rules to follow in which situation. It's the last part of the quote, the "how to recognize which rules to follow" that are our concern in this paper. Design is not a matter of learning a set of rules and blindly applying them. When we start to blindly follow rules because "it's a rule" then we are progressing into the realm of what I'm calling *cargo cult design*. There is a design rule and the design rule must be followed, period. Think back on all of the movies that contained parodies of corporate or government bureaucrats who insist that the rules must be followed exactly, with the comedic value arising from the main characters trying to follow confusing rules that don't apply to their situation. Unfortunately the design process shouldn't have a comedic value (regardless of whether the resulting design should), but with a cargo cult mentality to design, we can either

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either inadvertently introduce humor or end up with just plain bad design, even if it does follow the rules. Or perhaps the result is bad design because it does blindly follow the rules, but fails to conform to the situational needs.

Stepping back, let's define what I mean by cargo cult. The concepts of cargo cults come out of the Second World War where after the war ended or the front moved on, the island natives would make effigies of airplanes and worship them on the assumption (hope) that the military and their abundance of supplies would return. They knew airplanes brought the material, so they believed worshipping a model would make the real ones return. Of course, that didn't happen. What the natives lacked was an understanding of the real connections between the airplanes, why they had come to the island, and why they had left.

Translating that story into a basic definition for information design, we can consider cargo cult design as using practices with no real understanding of the underlying philosophy. The designer has learned the rules, but not why they are rules. As a result, they can't effectively apply the rule to a situation because they don't know how/why to bend, reshape, or simply ignore the rule. In the end, writing and designing a complex text is a constant decision-making process that requires more than black & white answers. Cargo cults may work for simple situations, but fail with the increasing complexity of the situation and the design decisions required to effectively communicate the information.

2. EXAMPLES OF CARGO CULT THINKING

Let's consider some examples of cargo cult thinking, both in the general world and in technical communication.

In all of these examples we can see instances of cargo cult design with no real understanding of the underlying philosophy. The person is blindly following a rule because they learned it was a rule. They also should have learned that after you know a rule, you can sometimes break it. However, to effectively break it, you need to understand why it was defined as a rule. It is within that lack of understanding where we start to develop a cargo cult mentality.

2.1 Example 1

Woodwright's Shop (a PBS show about old style woodworking) had a show that looked at an old tool chest. The host examined the dove tail joints on the drawers and mentioned how they were finely made, but were backwards. If we look at the image in figure 1A, it could be thought of as the end of a board shoved into the side of a board. The flat part wraps around the shoved part and forms the outside edge of the joint. In the old tool chest, the shoved part was on the outside (figure 1B). He then said it didn't really matter, but that it looked wrong to his eye trained for modern dove tail joints. If a design rule is simply stated as

right/wrong based on “how we do it” then we are moving into the cargo cult area. For the dove tail joint, he said that it was ok and could explain why. A person who was cargo culting would have said the joint was wrong and that there is only one way to do it. But, if that person was questioned about why, he would not have been able to justify that statement beyond citing the rule.

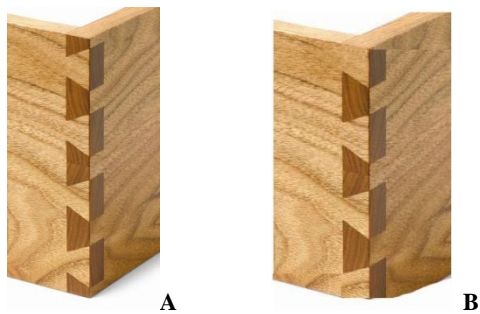


Figure 1. Dovetail joint. This image in A shows how the joint is typically laid out today.

2.2 Example 2

A simple, but telling example of cargo cults in design.

I’m creating a document where the age of the primary audience is 60–65. Guideline says to use larger fonts for older adults, thus I should use 14 point or maybe even 16 pt. Now, one additional piece of contextual information: these reports for the 64 year old CEO. The rules for older adults state to use a larger font, but when was the last time guidance on business reports said to use a larger font if the executive team is over 55? More interestingly, I’m willing to bet that if we did a survey, the same designers who would be aghast at a suggestion of using anything other than 12 point fonts for the CEO reports would also say that older adults need larger fonts. It’s not a contradiction; it’s cargo cult design—blindly following a design rule without considering the context.

2.3 Example 3

I was asked to review a TC program poster design. The designer did a good job, but the font they picked used old style numbers. Personally, I like variation shown by old style numbers, but they can also give the appearance that the font alignment has issues. The poster was similar to figure 2, with the phone number isolated from other text and that phone number was the only number on the poster. The vertical variation of the numbers looked overly pronounced. I made a comment that the font of the numbers should be changed to modern numbers. The response was a

good cargo cult answer: you should only have one or two fonts on a page so good design requires we don’t change it.

Ok, true, in general you shouldn’t use more than a couple of fonts per page. But the real rule is to have a solid reason for every font. A rule which gets simplified to a maximum of two fonts per page, to prevent novice designers and non-designers from creating ransom notes. We can discuss the nuances of this rule for a long time, but here we want to look at this instance of blindly following it. The oldstyle numbers did not look good; the vertical variation coupled with the isolated location of the number gave the appearance of alignment issues. Using an argument that changing the font would be bad because it violated a rule and, thus, shouldn’t be changed makes no sense. Especially when you consider that the phone number was the only numerals on the page, they were the only font change required, and modern numbers in a similar font would work just fine.

2.4 Example 4

A class assignment I use is to create a poster, designed for the workplace, that explains how to effectively use graphs. Your boss wants the poster to address the problem of too many people are creating graphics with Excel defaults and/or picking cool-looking graphs rather than thinking about how they are perceived. One student created a poster that did a good job of addressing the assignment, except that she put pictures of young kids in six of the nine panels of the poster. Pictures that had nothing to do with graph design. When I asked why, she responded:

I used pictures of 2 kids, my niece and nephew because ‘cute’ pictures of children are ‘eye-catching’ and most people enjoy seeing pictures of kids. I wanted to use this as my ‘hook’ and be creative like the assignment stated. [An assigned reading] article presented a winner that used cartoons to make her point, my intention was similar.

The reading she was referring to said:

“Rasheda Hatcher, a doctoral student at Baylor College of Medicine in Houston, Texas, and third-place winner in the graduate-student category of the ASCB Minority Affairs Committee poster contest, made the most of her prime, end-aisle location. It had cartoons instead of text to explain the methods and conclusions.”

“It is worth taking the time to come up with a creative hook”

“Judges say that a killer poster will have clean lines, white space, intriguing images and a clear visual flow that

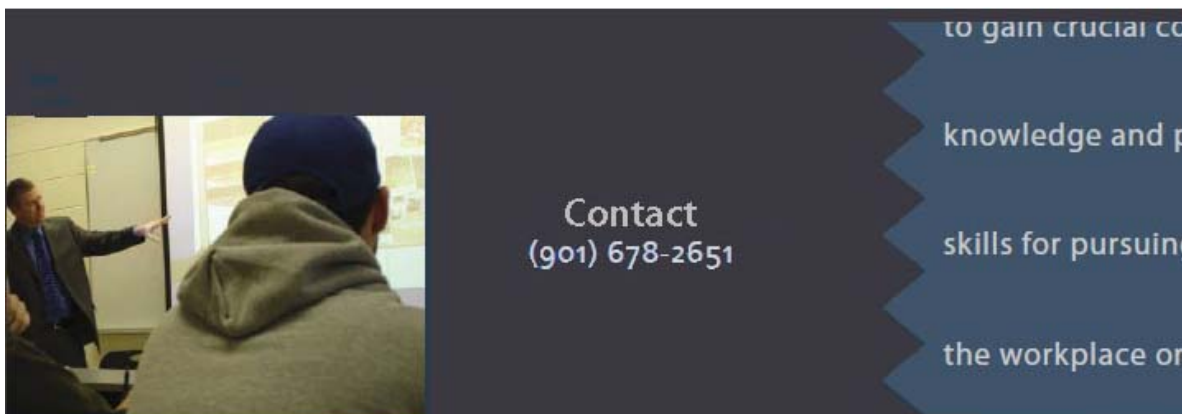


Figure 2. Poster with old style numbers. With the numbers sitting isolated on the page, they looked misaligned. This is an example since I don’t have the actual poster.

supports a well-told research story.” [10]

Essentially all “how to design a poster” articles say to use well-chosen images to replace the text and provide interest. That is good advice, but we have here a clear example of the student developing a cargo cult mentality. She had read that an award winning poster used cartoons. Those cartoons were the creative hook for the poster, thus using pictures on her poster would be a good creative hook. Missing was the understanding of how and why the cartoons and use of images in the poster helped communicate its message. Cute pictures of children may be eye-catching and people may enjoy looking at them, but they didn’t support communicating the information.

2.5 Example 5

Many “how to create a PowerPoint presentation” articles says to use short bullet points of 5-7 words. It’s simple, it’s easy to remember, and people accept it as a fixed rule. They rewrite their slides to have all short phrases and tell anyone who asks them for advice to use shorter bullets. But they could not justify why that rule exists. There are some people who create long paragraphs for each bullet. But most of the time what happens is that the person, in the act of shortening the content to 5-7 words, is left with no content. Instead, they are left with a note to themselves about what to talk about—they create speakers notes, not audience information. They followed the rule for short bullets, thus their PowerPoint slides are good. We could easily make an argument that the rule is to “make your point as succinctly as possible.” I agree, but “succinctly as possible” and “5-7 words” are worlds apart when it comes to focusing the author’s attention on communicating information. The former implies “determine what you need to communicate and say it using as few words as possible: if it takes a 2-line sentence, then it takes a 2-line sentence.” The latter implies “short phrase, meet word count;” communication goals don’t enter into the mental calculation.

2.6 Example 6

When we discuss comprehensive editing in my editing class, one of the tricks I teach students is to number the paragraphs. Then when they want to suggest rearranging them, they can write a comment such as “order the paragraphs 7, 4, 8, 6.” I had one student who remembered that I had said to number the paragraphs. Across multiple editing assignments, she never moved any paragraphs, but always carefully numbered them. If she would have been asked why, I’m sure her answer would have been I had told her to and that she could not have explained why it was worthwhile to number them.

2.7 Example 7

We bring part of this cargo cult mentality on ourselves. How many articles get published with titles of “5 tips for a ...” You find advice such as “A designer needs to understand the audience’s information needs and focus the design to address those needs.” All a person has to do is follow the advice, given in 150 words or less for each of these five points and they will achieve nirvana. Ok, I’m being a bit melodramatic, but the advice for each of those points is too high level and too light to actually let the person know what to do, how to apply it to their situation, and to determine if it does apply to their situation. At one level, the five-point articles are typically rather “duh” statements; true, but not actionable. In the example I gave, the designer still has no guidance on either how to understand the audience needs nor on how to create a design which addresses them. If I wanted to be snarky, I could justify it with something as people know how to

do the difficult part of understanding audience and designing for them, we just have to remind them to do it. Right. “But wait,” some people say, “this just tells them what to research to find the answer.” Unfortunately, the title promises to tell them all they need to know and a web search on the topic is likely to turn up the same high level information. With the preponderance of cut & paste on the web, it might even be the *same* information.

A person with more than a novice-level of design experience knows that an understanding of audience and designing to match that understanding is important. The problem is they may not know how to gain that understanding or how to translate that understanding into a design. The detailed answers are buried in multiple places which require real research acumen to uncover; places like conference proceedings and academic journals. In addition, the answer doesn’t exist as a single how-to, but as separate pieces that need to be assembled. Lacking the time or research skills to find and interpret these results, authors and designers proceed to create content based on what they already know.

If we take the second-to-the-last line of the previous paragraph, it mentions writing how-to texts; the procedural texts that once were the bulk of technical communication writing. Unfortunately, complex information doesn’t lend itself to how-to writing. The linear presentation fails to meet the reader’s needs, but too often, the writers will use the rules of simple how-to writing to construct texts for complex information. Here we have another example of a cargo cult mentality, the belief that the rules for writing for one genre apply to all. I’ll be fair here and qualify that statement by saying that many writers (typically the non-technical communicators) only know one set of rules, so they have no choice but to apply them to all genres.

3. WHY WE HAVE A CARGO CULT MENTALITY WITH COMPLEX INFORMATION

Social and environmental human-information interactions are inherently complex and nonlinear. The impact of seemingly inconsequential nuances of data can have serious effects as they ripple through the situation, causing it to suddenly shift from stable to unstable. Many decision failures occur because of assumptions that the initial conditions were not going to change, or were going to somehow suddenly jump from initial to final state.

People assume and project the future based on linear change or a step function once the new system enters operation, but a real system has a nonlinear change element that might overshoot or undershoot and requires time to settle to a new stable position. [5, p. 42].

Part of the issue I have with cargo cults in information design is that they reflect the overly prevalent attempt at reducing complex situations to simple situations. The inherently complex and nonlinear nature of the interactions gets discounted and an overly simplified mental version is used for making decisions. In addition, people try to minimize their cognitive effort by depending on rules and rubrics. However, these attempt to be applicable across many situations. The very nature of complex information negates the “applicable across many situations.”

Reducing complex situations to simple situations removes the contextual factors and tries to reduce the situation to fitting a black & white rule. Data can exist in a black & white world, but information cannot. By definition, information is data in context

and applied to a specific situation. Thus enters the multiple shades of gray mixed with the color spectrum as the information gets shaped by multiple audiences operating within a specific context and situation. As a result, the black & white rules fail to map onto the situation and fail to conform to the reader's situational needs.

Black and white rules fail because complex information systems are not simple systems with added twists, they are fundamentally different beasts. As Mirel points out [9, p. 233], "complex tasks and problem solving are different in kind not just degree from well-structured tasks." In its place a new approach has been called for [11], one that recognizes most users operate, or carry out their tasks, within complex systems that present multi-dimensional challenges—layers of changing depth that, unfortunately, do not lend themselves to rule-based design. As a result, we see too much cargo cult design as people try to blindly apply rules.

People come to understand a complex situation, not on just the information, but on the relationships between that information [2]. People build their mental information and relationship structure in a recursive manner, not in a single rise to full completeness [7, 8, 11]. A significant problem with much of information analysis for information systems is that it assumes an error-free execution and focuses on defining the optimal information a person needs to make a decision. Both error-free execution and optimal information lend themselves to the application of simple rules. If they were a justifiable approach to complex design, then my entire cargo cult argument fails apart. Unfortunately, effective complex design fails to conform to either of those assumptions.

When proceeding with those assumptions, the design decision-making process tends to get separated from the user goals and intentions which lead a person to perform it. Instead, it becomes an acontextual event viewed as a series of human-computer interactions with no outside influences [6]. But that is not how people read to decide, it is a much more complex and situational-based interaction [3]. When a person is seeking information or engaged in complex information interactions, their interactions and information needs are deeply imbedded in the environment and, thus, the analysis must consider the interactions of user, task, and environment.

A major complication is that a complex situation cannot be fully defined at design-time. Complex situations have six characteristics [1]:

- **Open-ended.** There is no specific answer, but rather the situation can be examined at multiple levels with more and more information applicable at each level. The reader decides at which level to stop.
- **Multiple paths.** The situation contains an abundance of information both relevant and irrelevant to achieving the user goals. This information can be combined in multiple ways to reach a valid conclusion. There is no single correct answer; multiple valid paths lead to multiple valid answers.
- **Multi-dimensional strategies.** The information in a complex situation must be simultaneously evaluated according to different (often opposing) factors.
- **History.** The history determines the situation's current state and the current state affects its future evolution.
- **Non-linear response.** The evolution is highly dependent on the initial conditions and can evolve in different ways from seemingly minor initial differences.

- **Dynamic.** The information that makes up the initial conditions becomes rapidly outdated. But the cargo cult rules are applied to the initial conditions and carried forward.

These six characteristics define the complex system and must be considered every time a design team makes design choices that influence how people will interact with the information. Rather than a simple rule, the design team must examine the rule within the situational constraints as driven by these six characteristics. Then the team can make an informed decision about how to proceed.

4. ARE WE TEACHING (OR REINFORCING) CARGO CULTS?

Many of the rules which designers cite are learned as part of their formal education. Even ones which they say they learned on the job—typically from a senior designer—if we follow the path back, we would find the senior designer learned it in their formal education. Which brings up the question of whether our teaching methods are contributing to a cargo cult mentality.

How guilty are we of producing students that have a cargo cult mentality? Do we even realize it exists? Catering to undergrads with their "just tell me what you want" or "what do I need to know for the test" attitude is one source. Rather than learning to analyze a situation, they want to learn a simple list of facts. Unfortunately, the simplistic situations posed within classroom assignments (yes, I understand keeping assignments scaled to fit a class require this), allows them to only consider simple situations and not have to work through the complexities they will face in complex real-world situations. In addition, textbook authors provide a single way to write each of the genres they discuss. Even when multiple approaches are discussed, they tend to focus on one. In turn, in-class discussion of the readings get narrowed down to a single way. All of which contribute to a student learning a rule of how to do it, but not understanding when, why, and how to apply that rule. All important concepts they must possess if they are going to apply the rule to situations other than the one they considered in the classroom.

4.1 A few class assignments

Here are a few potential ways that we can move students past simple rule memorization and to learn to think more critically about the design constraints of the situation.

- Have students explain why they use Times Roman or Calibri as their basic document font. If pressed, they typically have trouble explaining why they picked those two fonts. The reality, those were the defaults and it is easy to rationalize an explanation to match the default. Basically, they use cargo cult design for font choice: "Microsoft picked it and that's ok with me." For a variation that exposes their cargo cult design assumptions, have them design a basic business report, but require they pick something other than the standard fonts (Times Roman, Arial, Calibri) and explain their choice.
- Take a "5 points to a great ..." article and have the class research each of the points. Have them explore the nuances of what the point really means and in which situations it applies and, more importantly, doesn't apply. The rhetorical goal here is to get them to think critically about what any list of points or rules and what that list really is saying.
- Ask design questions about a specific genre, such as a business report. Many answers will shift to a genre that is mentally easier to process, such as procedures or to using

absurd design examples such as why to not use Chiller as a report font. Make the student think critically to put their answer in context and explain how it works within the genre under consideration and not just as a design rule.

There are a multitude of rules of writing and design. The rules moved into the status of being a rule for a reason. A blatant disregard for the rules is worse than blindly following them. But it is important to understand the underlying principles that support the rule so that we can make intelligent decisions about how and when to apply them.

5. CONCLUSION

Moving from a cargo cult mentality to an effective communication mentality involves understanding the human-information interaction and the contextual awareness in which the communication occurs [4]. There is a need for an awareness of the pitfalls of cargo cult design. No one wants to be accused of thinking that way. At some level, realizing that many ideas and concepts are blindly applied can help to inspire more critical thinking about the design and the decisions which go into it.

The idea of avoiding a cargo cult mentality requires us to critically examine each step of the design and writing process.

- How are we analyzing the audience and determining information needs?
- How are we constructing the content to meet those information needs?
- How are we creating the design and layout for that content?

In all of these three areas, we need to ensure we are engaged in critical thinking about the information needs of the complex situation and meeting those information needs rather than simply following rules.

Successful content creation and design requires understanding how people interact with information and how they will comprehend it. Defining the information needs in a complex system is about:

- Defining the communication required to communicate the information relationships, not individual information elements.
- Thinking about the complexity of the whole rather than the simplicity of the parts.
- Communicating non-linear, dynamic relationships.

Achieving those goals means understanding the people's goals and information needs within their situational context. A design goal which cannot be achieved by coming at the situation (or, worse, the data) with a cargo cult mentality. Success requires deeply understanding and working within the situational context and not blindly applying generic rules. If the justification for a design point is that "it's the rule" then the designer needs consider whether this is a rationalization or if the design decision truly fits the situational needs.

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