PRACTICAL APPLICATIONS OF 2D AND 3D INFORMATION VISUALIZATION FOR INFORMATION ORGANIZATIONS

Chapter 2 presented a sample of the vast resources available in 2D and 3D information visualization. Librarians also need to examine the practical applications of information visualization. They need to begin the process of exploring, experimenting, and eventually offering up their information to their users in 2D or 3D.

Almost any type of data, whether financial, statistical, desktop, or scientific, just to name a few, can benefit from 2D or 3D presentation. Here is a quick list:[1]

Networks:	Electronic circuits, organizational relationships, computer systems, telecommunications
Classifications:	Desktop data directories, tables of contents, genealogical information, library collections, thesauri and subject headings, animal species
Histories:	Financial information (stocks, economic trends), medical patient histories, sales and employment, project management
Complex documents:	Annual reports, library collections and inventories, contents of information containers (book, video, audio, multimedia, and so on)
Personal services:	MyInfo online (travel, news, favorite websites, and so on), computer desktop, hard disk file folders
Digital libraries:	Presentation and navigation of multiple sources and collections of information, which users can then manipulate, search, and view any way they wish
Statistical data:	Drug and chemical attributes, sales, financial, census, demographic, labor, economic

Information visualization stresses three goals: discovery, decision making, and exploration.[2] In this spirit information organizations should begin to explore offering their content/information to their users in 2D and 3D.

Economics of exploring 2D and 3D applications

2D and 3D applications in information visualization are great because many of them can be explored and experimented with by one person. This person usually does not have to have extensive technical experience, although downloading and opening many of these open-source and trial packages can be tricky. Having some technical expertise is helpful; however, having a systems person or systems department in your organization to assist and troubleshoot problems and questions is even better.

To start experimenting with these technologies, the user needs only have access to a personal computer, albeit one with extensive storage and byte capacity. This computer also should be state-of-the-art, as many 2D and 3D programs require not only storage and display capabilities, but also other programs such as Flash, Realplayer, and other Web plug-ins and programs to be downloaded.

If this computer can be set aside in some type of separate secured room, in which more than one person can be allowed to have access to play with and experiment with these programs, that situation is even better.

Sometimes, however, only one person and one computer is needed to begin the process, and if all that an information organization has is yourself and your current computer, then at least you have the basics needed to begin.

Some information organizations may have a department that focuses on Web, digitization, or digital projects. If so, contact the head of that department to see whether he or she has interest in exploring 2D and 3D information visualization software applications for the organization. This group of people usually has the latest equipment available, as well as the technical expertise necessary to explore and experiment in 2D and 3D technologies.

Whether one person alone or many people in a department begin the process of experimentation, try to identify a few of the 2D and 3D open-source and trial software versions to begin with. The only expenditure from the organization's perspective will be staff time and expertise.

Although Chapter 2 lists dozens of websites and software programs for experimentation, the following 2D and 3D software applications look as if they are the most valuable.

They also have proven to be viable in the current and future marketplace (for those that must be bought), or are so interesting that they will immediately attract the attention of those within the organization as well as the users (for those that are open source).

Journals of interest

These journal websites do not necessarily provide access to content. Subscription may be required.

- *Inf@Vis!*: the digital magazine of InfoVis.Net, www.infovis.net/MainPage.htm
- *Information Visualization* from Palgrave

Conferences of interest

IEEE Visualization Conference (also known as Vis[year])

International Conference on Information Visualization (also known as IV[year])

Websites and articles

Martin Graham's Information Visualization Links, www.dcs.napier.ac.uk/~marting/linksFrame.html#infvis

Olive: On-line Library of Information Visualization Environments, www.otal.umd.edu/Olive/

An Atlas of Cyberspaces, www.geog.ucl.ac.uk/casa/martin/atlas/atlas.html

"New Age Navigation: Innovative Information Interfaces for Electronic Journals" by Gerry McKiernan. PowerPoint presentation, www.public.iastate.edu/~gerrymck/NewAge.ppt

"Virtual Browsing the Electronic Bookshelves: Overview and Demonstration of Graphical Browsing Applications from Around the World" by John Wanserski and Michael Sorensen. PowerPoint presentation, www.wils.wisc.edu/events/wworld03/present/72403/vbrowsing.ppt

Katy Borner's research in 3D information visualization, http://ella.slis.indiana.edu/~katy/research/

Antarctica Systems, Inc. (MapNet and VisualNet softwares), www.antarctica.net

The Geography of Cyberspaces Directory—Visualizing Information Spaces, www.cybergeography.org/vis_infospaces.html

Nooface: In Search of the Post-PC Interface, www.cs.uvic.ca/~mstorey/teaching/infovis/notes.html

Belmont Abbey College Library, North Carolina 2D visualization of library catalog, www.dlib.org/dlib/june03/beagle/06beagle.html and http://beta.belmont.antarcti.ca:8080/start

HighWire Press TopicMap, http://highwire.stanford.edu

KartOO Technologies, www.kartoo.net/e/en

Touchgraph.LLC, www.touchgraph.com

Vivisimo, http://vivisimo.com and http://clusty.com

"Visualizing Bibliographic Metadata – A Virtual (Book) Spine Viewer" by Naomi Dushay, http://dlib.anu.edu.au/dlib/october04/dushay/10dushay.html

Software products (open source)

Worlds.com, www.worlds.net

IHMC concept-mapping software, http://cmap.ihmc.us

Visual Understanding Environments (VUEs), http://vue.tccs.tufts.edu

Open Knowledge Initiative (OKI) at MIT, www.okiproject.org

SourceForge, http://sourceforge.net

Fedora Project, www.fedora.info

Touchgraph products (Dynamic Graph Layout, Planet-Wissen Navigator, GoogleBrowser, Wiki Browser), www.touchgraph.com

3D virtual reality worlds, http://vw.indiana.edu

i-Palace, http://vw.indiana.edu/i-Palace

i-Garden, http://vw.indiana.edu/i-Garden

i-Uni, http://ella.slis.indiana.edu/~katy/iUni (download the free iUni 3D browser)

iScape, http://ella.slis.indiana.edu/~katy/iscape

Visualization Toolkit (VTK), www.vtk.org

MusicMaps, http://fusion.sims.berkeley.edu/MusicMaps

OpenDX, http://opendx.org

FSN, www.sgi.com/fun/freeware/3d_navigator.html

Xcruiser, http://xcruiser.sourceforge.net/

CubicEye, www.2ce.com

Croquet Project, http://croquetproject.org

3DTop, www.3dtop.com/what.htm

3DNA, http://3dna.net

X3D—Example applications, viewers, and utilities for experimentation, www.web3d.org/x3d

Software products—commercial

ActiveWorlds ($6.95 per month), www.activeworlds.com/#

Grokker (free 30-day trial), www.groxis.com/service/grok

VisualNet, www.antarctica.net/products/visualnet.shtml

Pacific Northwest National Laboratory (PNNL), www.pnl.gov/infoviz, Galaxies, ThemeView™, Starlight, OmniViz Pro™, and IN-SPIRE™

Anacubis (free 10-day trial), www.anacubis.com

Aquabrowser, www.medialab.nl

Inxight, www.inxight.com/about, SmartDiscovery™, VizServer™, Categorizer™, LinguistX®, Star Tree™, Summarizer™, Table Lens®, and Thing Finder™

Vivisimo, http://vivisimo.com and http://clusty.com

Visual Thesaurus and ThinkMap (free five-click demo), www.visualthesaurus.com and www.thinkmap.com

xrefer Research Mapper (free 30-day trial), www.xrefer.com/research

Advanced Visual Systems (AVS), www.avs.com/index_wf.html, OpenViz, AVS/PowerViz, AVS/Express, Gsharp, and Toolmaster

ADVIZOR Solutions, www.advizorsolutions.com

ILOG Discovery, www2.ilog.com/preview/Discovery

MAYA Viz, www.mayaviz.com/web

Miner3D, http://miner3d.com

SemTalk™, www.semtalk.com

Webbook and Web Forager, www.parc.com/research/default.html

Webbrain 2.0, www.webbrain.com/html/default_win.html

DataDescription, Inc., www.datadesk.com, Data Desk, Data Desk XL, Viz!on

Research Systems, Inc. (RSI), www.rsinc.com, IDL and ENVI

Mercury Computer Systems, Inc., www.tgs.com, Open Inventor, amira, GPHIGS+, and Opale

VisualLinks™, www.visualanalytics.com/Products/Visualinks.cfm

VisualMine, www.visualmine.com

Rooms, http://rooms3d.com

The next step is to have the people selected to do the experimentation become familiar with the topic and the marketplace. Pick a few of the open-source software products to experiment with, and perhaps experiment with a few of the free trial commercial products.

For websites, make sure to take a look at Olive, An Atlas of Cyberspaces, the "New Age Navigation" and "Virtual Browsing" PowerPoint demonstrations, Katy Borner's research, The Geography of Cyberspaces Directory, Nooface, and the Belmont Abbey Library project.

With the open-source software, the most interesting are the Visual Understanding Environment (VUE) projects, the 3D virtual reality worlds (especially iUni), the Visualization Toolkit (VTK), the MusicMaps project, OpenDX, the various desktop 2D and 3D softwares (FSN, Xcruiser, 3DTop and 3DNA), the various applications and utilities available using X3D from the World Wide Web (W3) Consortium, and especially CubicEye.

With the commercial software products, the most successful and visible so far (and probably the ones to try to access free trial versions of for experimentation) are Grokker, VisualNet, Anacubis, Inxight (especially Star Tree™), Visual Thesaurus and ThinkMap, xrefer Research Mapper, Webbrain, and Rooms.

Once librarians have taken some time to experiment and play with some of the products and services available in 2D and 3D, they should give some type of presentation to the organization's staff.

The presentation should provide an easy-to-understand introduction to 2D and 3D information visualization, and it showcases some of the more interesting and viable software products available (keeping in mind the current economics and focus of the organization).

A PowerPoint presentation might be helpful, but some people might want to specifically focus on showing one to three product examples and how the organization might proceed with implementing one of them, depending on the interest and enthusiasm of the staff and administration.

This presentation, or future additional presentations, could proceed in many ways. The focus could be on 2D and 3D desktop applications, showing staff some of the open-source software that allow them to visually display the contents of their desktop or their hard files.

Alternatively, the focus could be on implementing one or more open-source or commercial software for users to visually explore the information available in the organization's online public catalog (OPAC), or to visually display a smaller, more specialized collection of information.

The focus also could be toward Systems staff and some of the more specialized 2D and 3D visualization software to help them to manage and detect network and architecture structures and problems visually.

In any case, the important points are to:

- Identify people in the organization to lead the experimentation and exploration.
- Set aside a high-end computer or computers for these people to conduct their experimentation on.
- Begin learning about 2D and 3D information visualization and begin experimentation with a few of the open-source and trial versions of the commercial products available.
- Give a presentation to the staff and administration of the organization, providing a simple introduction to the topic, and showcasing one to three software products by illustrating how they work and why this topic is important within the organization.

From that point, the organizational culture should be more interested in exploring ways to incorporate 2D and 3D visualization into its daily environments, either personal or user-related.

This topic is already a daily activity for many library users, who often play in virtual 3D worlds already commercially available, such as Playstation or Xbox, or by logging onto a virtual collaborative game or environment from their home PC.

Information organizations need to be ready to move their information into 2D and 3D environments, because its users are already accessing and are familiar with information presented in these formats.

Challenges for the 2D and 3D visualization community

Even though 2D and 3D visualization is an exciting, interesting development in the history of information organization, description, and presentation, many questions and issues still challenge librarians and remain unanswered.

Here are the top 10 problems in information visualization in 1999:[3]

1. Realistic visual displays
2. Integrated virtual reality and physical reality
3. Integration of visualization with networking, voice, artificial vision, computation, and data storage
4. Optimal visual interactions
5. Visualization of high-dimensional numerical information
6. Visualization of nonnumerical information
7. Direct manipulation with visualizations
8. Visual idioms for collaborative interactions
9. Abstractions for visualization and user interaction processes
10. Reconciliation of expressiveness and easy of use

Hibbard grouped these problems into interactions, abstractions, visual quality, information, and integration.

These challenges (now five years old) also were placed in front of participants at two Visual Interfaces to Digital Libraries workshops in 2001 and 2002. Participants were asked to discuss their top 10 problems/challenges in visual interfaces to digital libraries.

Here is a synopsis of what they came up with:[4]

1. Theoretical foundations

   Current research lacks foundation in theory. Although principles for computer graphics, human-computer interaction, perception, and cognition do exist, they do not assist software and database designers in the formation of design principles. Some areas that should be included in setting the foundations are scientometrics and bibliometrics (now widely known as informetrics), knowledge discovery, and knowledge tracking.

2. Empirical foundations

   The basic issue here is: Where are we now? What is now successful in the marketplace? What do the gaming and scientific communities have to offer in terms of successful interfaces, features, designs, and environments, given that they have had years of experience in this area? Other areas to look at are empirical studies of information visualization, visual information exploration, and visual information retrieval studies and research.

3. Scalability

   The various sizes, complexities, and contents of digital libraries means that experimentation needs to take place, not only on small-scale digital libraries, but on large-scale ones as well. Visual scalability is essential, no matter the size, volume, and number of data elements contained in any one digital library. Being able to work with small sets of historical and unchanged data, as well as super-large datasets that are changing every minute, will need to be examined and researched in terms of algorithms and database solutions.

4. Labeling

   This area involves the process of selecting meaningful labels, and displaying readable labels. Prominence of visual display on a computer screen is important for user interaction, as is the challenge of choosing labels that make sense to the user.

   Natural language processing, information retrieval research, and automated indexing may help with some of these challenges, but ultimately usability testing on specific and particular digital libraries may raise different and variable opinions and options for designers to consider.

5. Individual differences

   This topic enters the area of allowing users to manipulate the information visually for their preferences. Research in human-computer interaction has shown this topic to be the most significant factor in using information and performance issues for users.

6. Supporting collaborative work

   Many challenges face collaborative work efforts, even given if the problems in item #5 can be addressed. How to represent constituencies through a visual interface, how to integrate social structures, and how to know when a particular visual interface is useful in collaborative settings are only a few issues in this area.

7. Benchmarking and standardization

   Standardization and making use of a test collection to study the problems and challenges involved with visual interfaces to digital libraries and information is a vital step forward for the information visualization community. The test collection must be both complex in its size and content, yet simple enough for experimentation and usability analysis by a variety of researchers around the world.

8. Evaluation

   Usability testing and evaluation must be integrated into any design and development of visual interfaces. Previous human-computer interaction research can assist in establishing and jump-starting any development in this area.

9. Personalization

   Given the current trend and interest in the personalization of information interfaces from both the commercial and the user side, this issue also is important for information visualization. Being able to customize and personalize delivery and visual presentation of information is an important topic for research and usability study.

10. Standardization

    Finding a way to modularize or standardize the services of information visualization for library organizations must be incorporated—not only find ways to save money and staff time, but also for interoperability and cross-platform performance issues.

The biggest concern and challenge for 2D and 3D information visualization is the basis of the whole field itself: information visualization is for people who can see. The whole issue of presenting information in exciting visual ways leaves out and isolates a substantial portion of any population that has limited or no vision (such as visually disabled or blind people). Color-blindness and depth perception problems also challenge this field.

One solution is the parallel movement in the sonification or audiolization of information, which tries to provide audio equivalents of visualization tools. Some librarians say that both audio and visual capabilities are important for information visualization, and that research indicates that there is more information capacity available and usable when both auditory and visual abilities are accessed.

Another concern is that some users are not visually oriented but prefer numerical or textual information presented one-dimensionally rather than in multiple dimensions. In addition, nonstandardized visual displays such as handheld devices, cell phones, and both overly large and overly small devices will challenge how the field will market itself in the future.

The need for 2D versus 3D information visualization also comes to the fore. The majority of information visualization centers on two-dimensional presentation of information. Developing software for 2D presentation is easier, simpler, and ultimately cheaper. Users are accustomed to viewing information in 2D. The majority of current information visualization software are really 2D information landscapes or posters set up in a 3D environment.

In addition, the storage and display capabilities of the current average computer (even some state-of-the-art ones) cannot handle the demands the actual 3D information visualization places upon them.

Those people who feel that true 3D presentations are the future, point out that the real world is three-dimensional and that our experience and information-seeking behavior is based on that.

Proponents of 2D indicate that the field can move forward into the marketplace much faster if researchers and companies focused on presenting the information in 3D, but making the software products work and manipulate the original data in 2D, thereby sidestepping the storage capacity and display issue.

Those who try to moderate these discussions and arguments try to steer research toward identifying the features or components of both 2D and 3D infor-mation visualization designs that emphasize predictability, standardization, interoperability, and comprehensibility.

Another popular debate within the information visualization community has to do with strategies for address large and complex information spaces such as computer networks, maps, and timelines. There are two major approaches to this type of information:

- The overview + detail strategy, which allows users to maintain an overview of the data, yet simultaneously examine details
- The focus + context strategy, which shows details at a focus point chosen by the user while still keeping the context or overall overview.

The overview + detail strategy usually involves two or more windows open at the same time on the desktop, letting the user see levels of detail at the same time. The focus + context strategy usually incorporates zooming capabilities, allowing the user to zoom into selected areas to examine details and infor-mation, and then zooming back out again into the broader information environment.

The focus + context strategy has received more attention and research than overview + detail, given that current technology can incorporate zooming user interfaces (ZUIs) into many software programs. Some software programs that use ZUIs include the newest version of CONTENTdm, and the DjVU software from LizardTech, Inc.

As information organizations experiment in 2D and 3D presentation of information, they will come to a better understanding of how users play with and use information served up in this format.

The ability to not only view information, but to manipulate and rearrange it to illustrate new ways of discovering and using that information, is part of the power of multidimensional information visualization.

Users in the future will be able to wake up in the morning, and work with databases and systems in their homes and workplaces that interactively allow them to move seamlessly among personal, professional, and everyday activi-ties, using 3D and eventually virtual and holographic real-time technologies.

This future is not that far away; after all, human flight with the airplane happened just 100 years ago. In another 100 years, life will be just as drasti-cally different from today, as today is from 100 years ago.

3D information visualization will be a part of this future, and it behooves information professionals and organizations to begin to plan and indeed become part of the catalyst for its development and implementation.

Notes

[1]Inspiration for this list is taken from Table 8.1 "Applications of Information Visualization" in Card et al. (1999), p. 626. Each of these topics is examined more thoroughly in this chapter.

[2]Ibid, p. 625.

[3]Hibbard, B. "Top Ten Visualization Problems." *SIGGRAPH Newsletter*, 1999. 33(2). Available at www.siggraph.org/publications/newsletter/v33n2/columns/hibbard.html. Also mentioned in Chaomei Chen and Katy Borner, "Top Ten Problems in Visual Interfaces to Digital Libraries." *Visual Interfaces to Digital Libraries*. Katy Borner and Chaomei Chen, eds. Berlin: Springer-Verlag, 2002. p. 229.

[4]Chaomei Chen and Katy Borner, "Top Ten Problems in Visual Interfaces to Digital Libraries." *Visual Interfaces to Digital Libraries*. Katy Borner and Chaomei Chen, eds. Berlin: Springer-Verlag, 2002. p. 227-232.