



Visualizing Information Graphics

How to design effective charts and graphs





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Mariana C. Mora Cano | Master of Fine Arts in Integrated Design | Thesis Project, Fall 2011

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Overview

The increasing use of information graphics as a communication tool presents serious problems. Data can be presented without a clear context, using isolated facts and without proper citations. Professionals lacking an understanding of information design principles use software that provides inadequate templates and guidelines. Misrepresented information adds further to a loss in understanding.

Technical barriers also impose problems in today's digital information visualization pieces. This topic is tested in-depth in essays by Elisabeth Bumiller, *We Have Met the Enemy and He Is Powerpoint* (2010) and Edward R. Tufte, *The Cognitive Style of PowerPoint: Pitching Out Corrupts Within* (2006). These essays explain how an over-dependency on presentation software with rigid slide templates can result in a failure to communicate ideas accurately and completely.

In his book *The Visual Display of Quantitative Information* (1983), Edward Tufte coined the term "chart junk" to describe unnecessary or distracting design elements in infographics. Other information theorists include William Cleveland (*The Elements of Graphing Data*, 1994), Robert E. Horn (*Visual Language*, 1998), Robert Jacobson (*Information Design*, 2000), and John Maeda (*Design by Numbers*, 2001).

Prominent designers working in the field include Massimo and Lela Vignelli, the partners of Pentagram (*Ideas on Design*, 1987), Nigel Holmes (*Designer's Guide to Creating Charts and Diagrams*, 1991), Erik Spiekermann, and Gerlinde Schuller (*Designing Universal Knowledge*, 2008).

These two groups direct their research at two specific populations: the first composed of data analysts and scientists and the other composed of graphic designers.

This study explores the population that falls into the gap between these two user groups: those charged with creating financial, corporate, scientific, and academic presentations. They will find the guidance in this project to be exceptionally helpful. The end result will help raise the level of graphic language, and improve their literacy skills in information graphics in order to communicate more clearly and more effectively with their audiences.

Visual information tools are needed to help improve the transmission and understanding of information. It is important at a time when information and communication work within the scope of a global world that we consider the potential and limitations that the majority of the population currently has in order to transmit visual information successfully.

Objectives

Anyone who prepares a presentation must realize how difficult it can be to overcome an audience's short attention span, distraction, and information overload. Ineffective or haphazard use of information graphics can actually make these obstacles greater.

The lack of mastery in how to communicate knowledge rather than to just display information, along with the problem of not having formal education on the creation of visualization displays and how to interpret their content, are some of the challenges that might prevent the development of proper information visualization projects. This is especially evident in the presentation of financial data, as well as business, scientific, and academic research.

Visualizing Information Graphics (VIG), will enable users to create more meaningful and engaging presentations that incorporate the theory and principles of information graphics by using interactive tools on the Web site. Users of this Web site will increase their knowledge about graphic design literacy and gain the ability to evaluate the effectiveness and integrity of an information graphic.

This thesis project examines the impact of graphic design choices in creating information graphs with integrity, where design remains consistent to data. The purpose of a graph is to fairly convey the story in the data. Every element in the graph should support that objective. Special effects, text boxes, and decorations detract from integrity if they interfere with the accurate perception of the data.

This project will integrate a wide range of interrelated research about information, design and users.

1. I have created a Web site on the topic of Visualizing Information Graphics (<http://www.designofvig.com>), in order to show how design principles can be shaped to fit specific contexts. Leading research findings are distilled, interpreted, and integrated for easier comprehension and application.
2. Users of this Web site will increase their knowledge about graphic design literacy and gain the ability to evaluate the effectiveness and integrity of an information graphic.
3. Final project elements include an interactive Web site (www.designofvig.com), videos and pdf downloadable tutorials, and a motion graphic video for social media.
4. Presenters in the worlds of business, finance, healthcare and education can use the content in this project to communicate more effectively across multiple platforms.
5. The project serves as a valuable resource for students, professionals, and academics.

In addition, I created a Web-based survey of professionals in a variety of disciplines to assess levels of user knowledge and understanding of information graphics. Research results and analysis can be found at (<http://www.designofvig.com/survey.pdf>)

Audience

The primary audience for this project consists of students, professionals from the financial and business fields, and people who make presentations about their academic and scientific research.

In order to better adapt the thesis project for this target audience, an online survey was distributed during the spring of 2011. The results gave a clearer picture of what information was needed in the Web site and the main area of interest.

The secondary audience comprises teachers and students in graphic design, visual communication, and image theory fields, who can use the site as a reference for analysis and practice.

Resources

The research sources used for this project are:

Critical readings of academic papers and articles in the areas of graphic design, visual literacy, visual intelligence, communication, computer graphics, scientific visualization, cartography, statistical representation, visual perception of cognitive science, and information visualization.

Web-based survey where participants answer information retrieval questions based on a series of visualizations characterized by varying levels of aesthetic attractiveness. This online survey (<http://www.designofvig.com/survey.pdf>) allowed one to investigate and measure both perceived aesthetics as well as the efficiency of retrieval tasks across a set of three different data visualization techniques: line, bar and pie charts.

Attendance at courses on data and visualization of information. Interviews with members of the University of Baltimore School of Design and Communications, and the School of Information Arts and Technology.

Professional works, blogs, essays and research web sites, where information and documents on the subject are published.

Market

Two groups create existing Web sites about information design.

The first group consists of information theorists and specialists in data visualization with a high academic level of information. These sites have little interactivity; they feature long texts and few images that may be unnoticed by the reader.

The second group consists of interaction designers that provides either great examples of visual depiction techniques and methods or shows conceptual uniqueness and originality in the choice of a subject.

VIG appeals to a wide range of users who share a common interest, visualization. Their specific knowledge on information visualization can't be guaranteed but the aim of this project is to help them create a broader and more comprehensive perspective on the subject. In this way, they may advance toward a better design of visual graphics and improve their communication of information.

In this Web site, the content is transformed into visual information after being subjected to statistical processing and organization, should be interesting (significant, relevant) and should have integrity (accuracy, consistency). Graphics serve as an analytical tool for the reader to use to acquire a better understanding of the information.

Process

In the spring of 2010 I attended the course “Presenting Data and Information” with Edward Tufte, the expert in the presentation of informational graphics and pioneer in the field of data visualization. The course is an intensive one-day and includes all four of Tufte’s books, which he uses as high-resolution handouts. It had the entire atmosphere and protocol of a lecture.

The course was a fantastic experience, but the information can be dry at times, especially since the person attending the course spends all day reading through about a half dozen sections in his books. Another part of the course was focused only on how to avoid PowerPoint. Again, everything was presented directly from the books. During the break and at the end of the course I talked with the people sitting next to me who were not designers and had attended the course to learn how to improve their presentations. They were confused; they felt that the solutions to solve the problems they have at hand were not presented in this course or the books they got. I came to the conclusion that the approach that Tufte offers is perfect for people with knowledge on the subject. I wondered how many of the four hundred attendees benefited from the seminar and learned how to apply the principles presented to the problems they have at work.

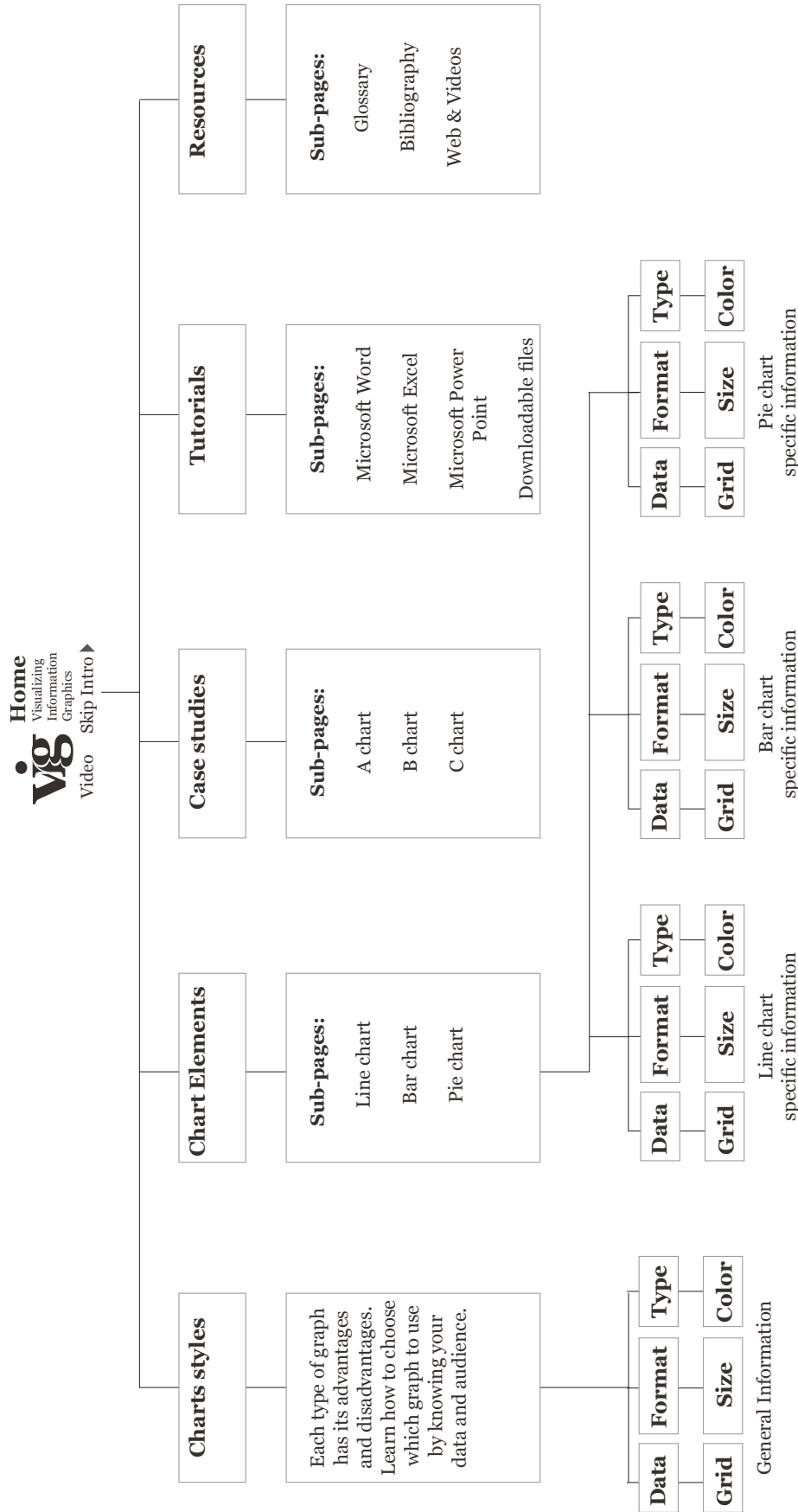
I started reading many books on data visualization, statistics, information graphics and information design. Visiting as many Web sites and reading as much as I could find on the subject, I started to develop the idea of creating a place where the pros and cons of any standard graphic technique—bar graphs, line graphs, area graphs, pie charts, scatter plots, etc.—would be presented. Specifically important for the development of the project was *The Wall Street Journal Guide to Information Graphics* by Dona M. Wong, an essential reference for designers of charts and graphs. An additional important resource is the book *Universal Principles of Design* by William Lidwell, Kritina Holden and Jill Butler, an extensive explanation of 100 important design principles.

In the spring of 2011, I developed and distributed an online survey where participants answered questions based on a series of visualizations characterized by varying levels of aesthetic attractiveness. The results of the survey (<http://www.designofvig.com/survey.pdf>) guided my research and helped to define the project. The survey results showed that users wanted more information on choosing the appropriate format for visualizing their data plus tips on how to improve the look of their infographics.

During the summer and fall of 2011, I designed an interactive Web site intended to be used as a reference or starting point for research on the application of graphic design elements to information graphics. During the summer and fall of 2011, I designed an interactive Web site intended as a reference or starting point for learning about the application of graphic design principles to information graphics. I wrote the site content and created a motion graphic to promote the project (a short .mov file that can be viewed on the Web site and also sent as a viral video through social media tools). I also created short video tutorials on how to use Word, Excel, and Powerpoint software to create infographics.

Project components

Site map



Footer

Privacy policy

Any errors or omissions are solely the fault of the author. Please write to info@moracano.com if you find information that should be changed or added to this Web site.

About

Mariana Mora Cano created the Visualizing Information Graphics Web site for her Master of Fine Arts thesis, Fall 2011.

Click for downloadable book.

Design elements

Name and logo



The name of the project had to connect the three main aspects of the project. “Visualizing” is an active word, a variant of visualize that describes the action to form an image. “Information graphics” refers to the graphic representations of information, data or knowledge. A subtitle was added in order to describe the goal of the Web site. From a literal integration of these three words came the idea for the logo which interlocks and merges the letterforms of the three initials into one design.

Color palette

Chart styles				Case studies	Tutorials	Resources
	Line chart	Bar chart	Pie chart	A chart B chart C chart	Word Excel PowerPoint	Glossary Bibliography Web & Videos

In this project color is used to visually identify the separate sections of the Web site and support easy navigation. The project color palette was also applied to the introductory video.

Typefaces

Georgia

Regular

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

Bold

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

Verdana

Regular

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

Bold

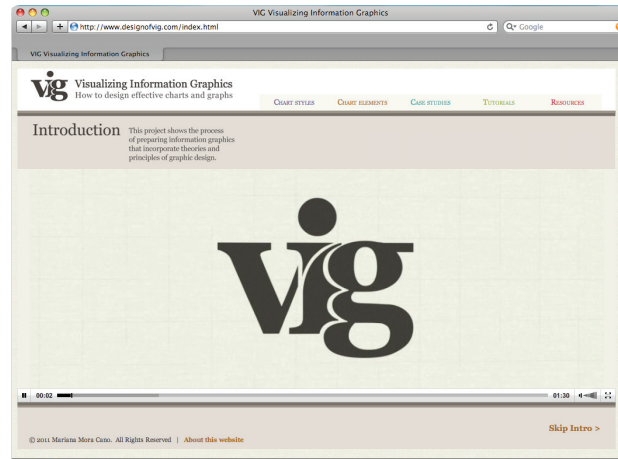
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890

The choice of typefaces for the Web site is restricted to what is installed on a user’s machine. Georgia was chosen for titles and subtitles. It is a serif typeface designed for clarity on a computer monitor, even at small sizes. Georgia is part of Microsoft’s core fonts for the Web and is preinstalled by default on Mac OS and Windows-based computers. Verdana was chosen for body text and chart labels. This sans-serif typeface is also designed to be readable at small sizes and is available on practically all Windows and Mac OS computers. If the user should not have these fonts available, the Web site will substitute a default type face.

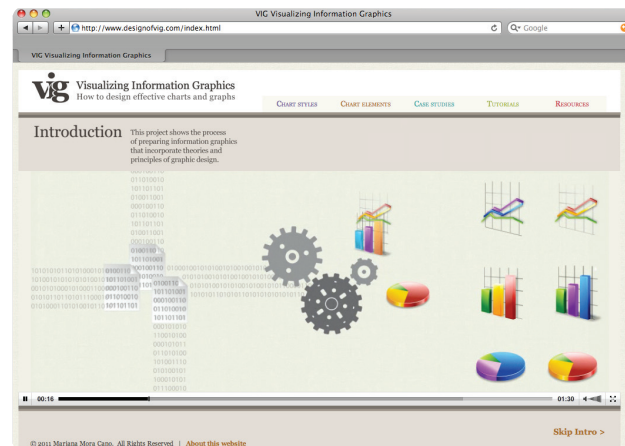
Web site Features

Introductory Video

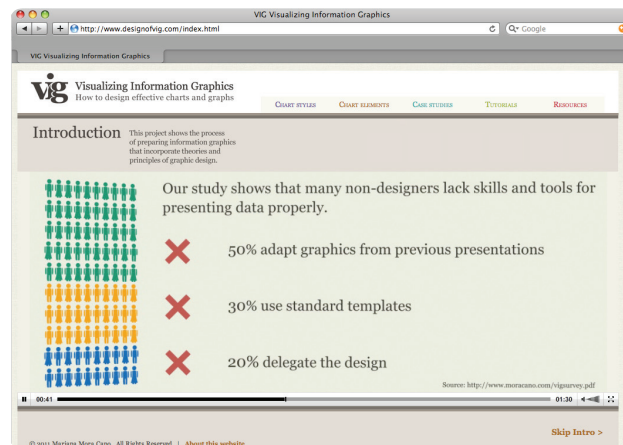
This project (www.designofvig.com) shows the process of preparing information graphics that incorporate theories and principles of graphic design. The introductory video gives a summary of what the Web site is about and how to use it.



Visualizing Information Graphics. How to design effective charts and graphs.

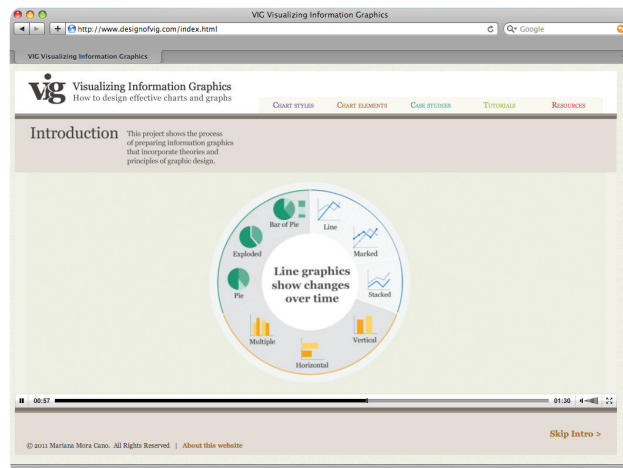


The visual presentation of data through spreadsheet software appears easy to produce, but without an understanding of design principles important information may be lost or misrepresented.

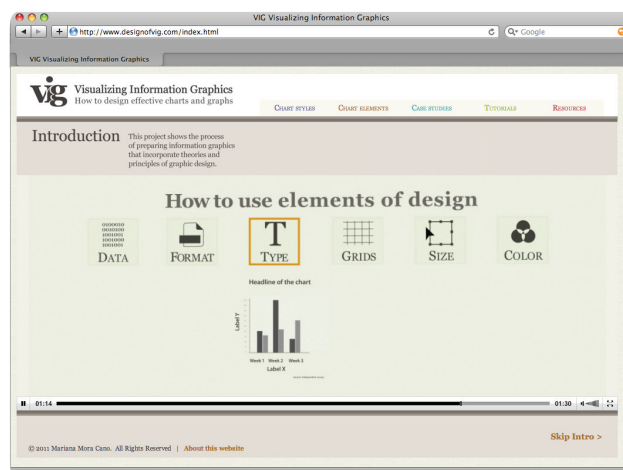


Our study shows that many non-designers lack skills and tools for presenting data properly. 50% adapt graphics from previous presentations. 30% use standard templates, creating default presentations even when the information is different. While the other 20% delegate the design and are unable to evaluate the results.

None of these methods create the best relationship between the information and the chart design.



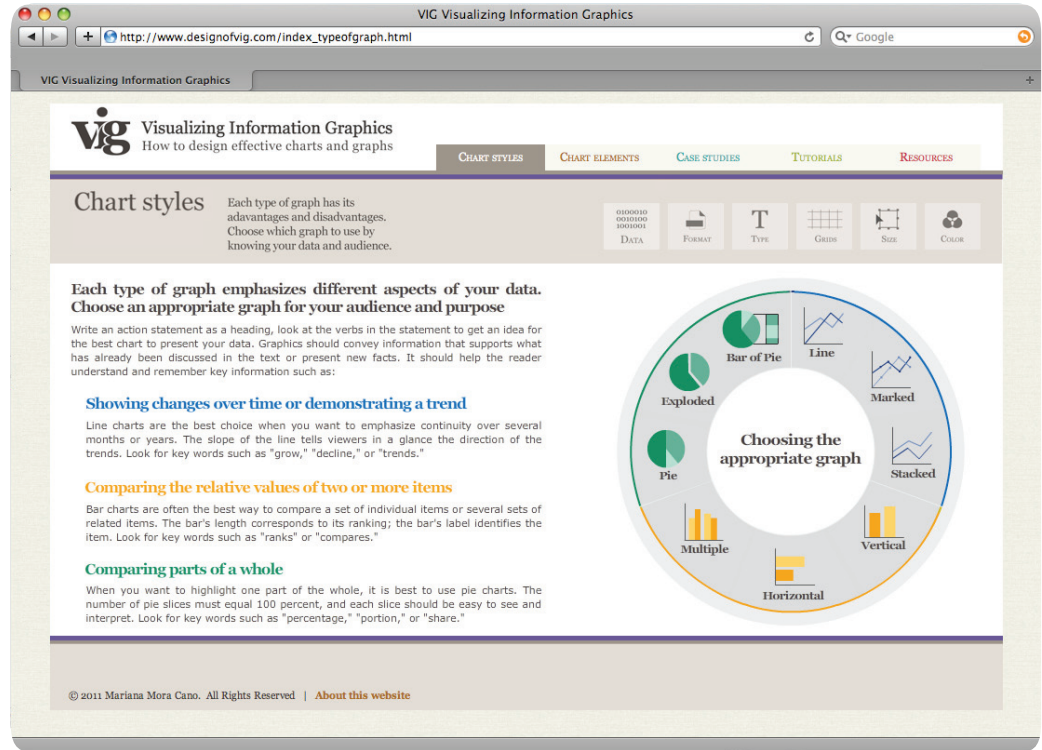
This project, allows users to learn how to properly incorporate theories and principles of design in the creation of information graphics. We will help you select the appropriate graph to use by understanding their strengths and weaknesses.



Once you have chosen the type of graph to use we will help you understand how each design element can be used to improve the presentation of you data.

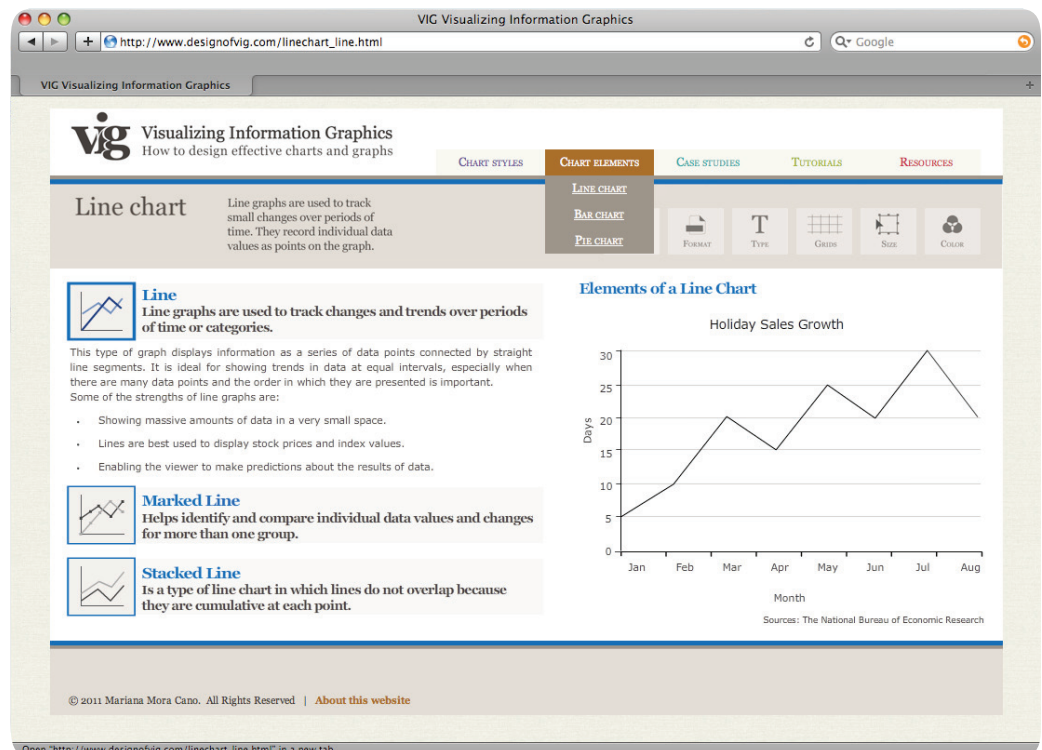
Interested in learning more? Continue exploring Visualizing Information Graphics.

Chart styles



Each type of graph has its advantages and disadvantages. In this page the user can choose which graph to use depending on the data and audience. The wheel is an interactive element of the page that guides the user and links to other pages of the site.

Chart elements

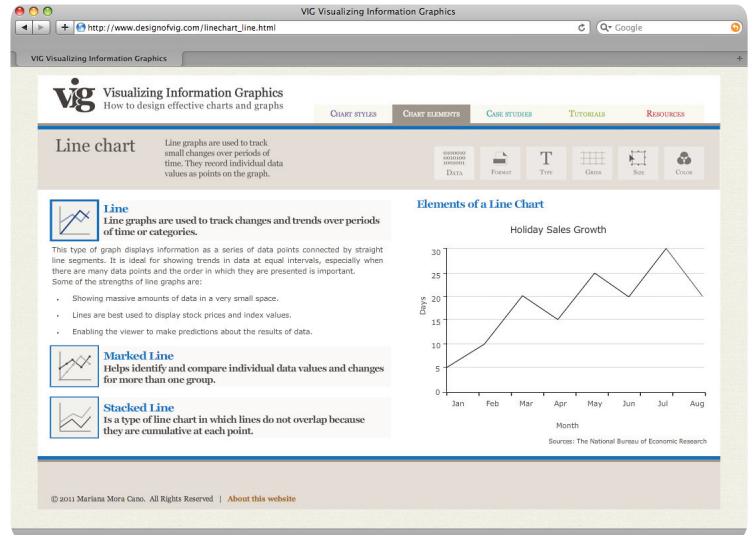


This section presents the three graph types discussed on this project: line, bar and pie charts.

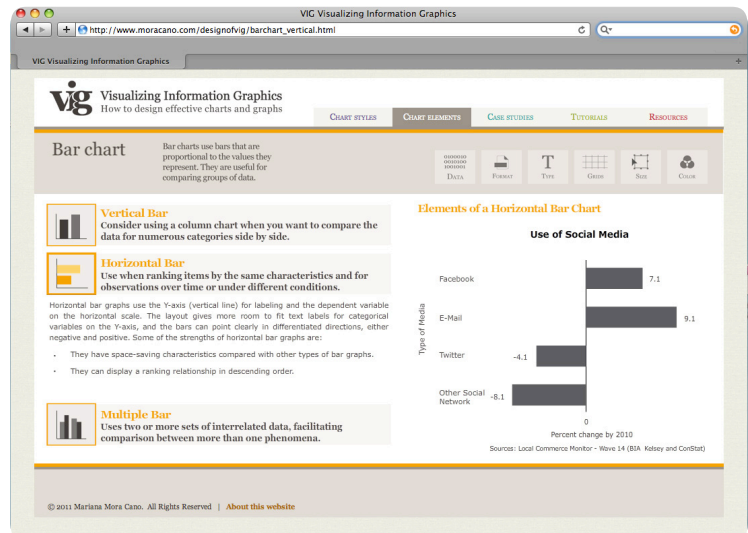
Chart elements

In this section, the left side menu has an interactive horizontal, accordion effect. For every type of chart a different graph shows on the right side of the screen. A roll over effect explains each element of the chart. The same behavior applies to all other pages in each type of chart.

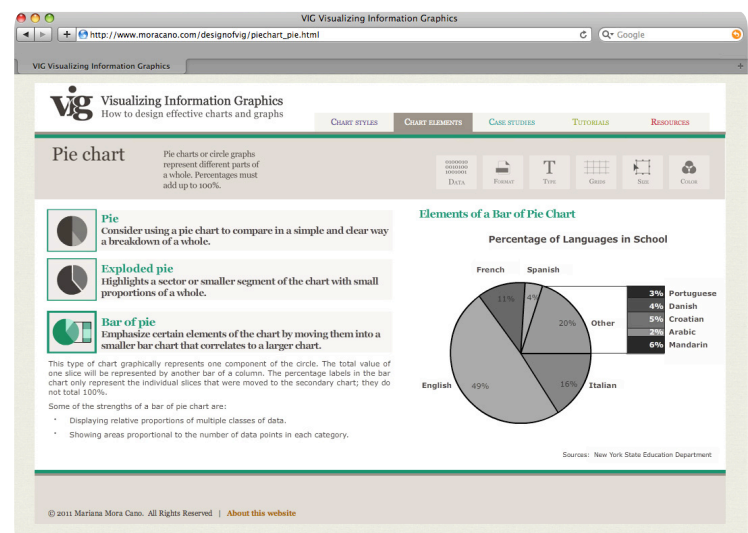
Line graphs are used to track small changes over periods of time. They record individual data values as points on the graph.



Bar charts use bars that are proportional to the values they represent. They are useful for comparing groups of data.



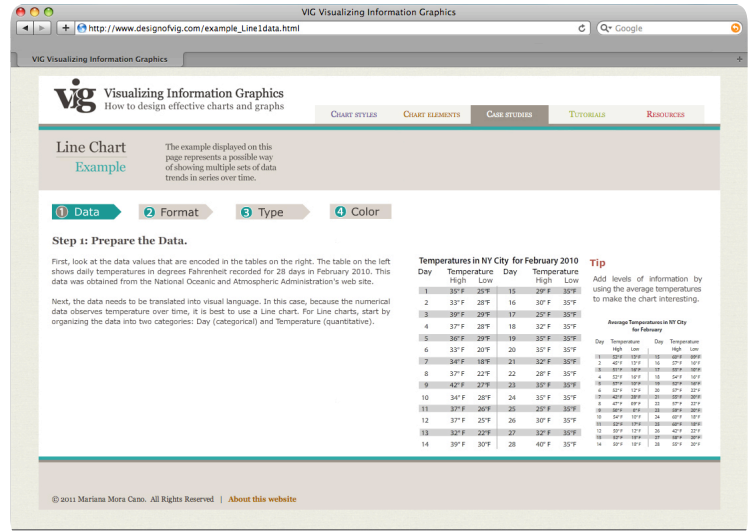
Pie charts or circles graphs represent different parts of a whole. Percentages must add up 100%.



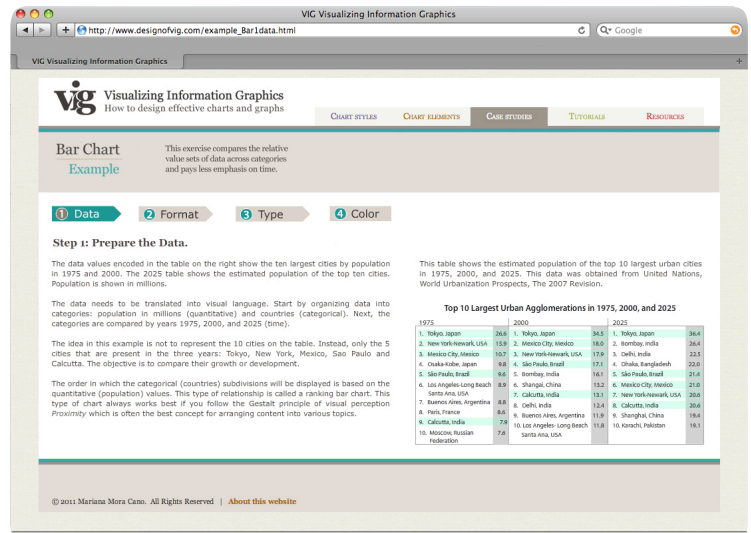
Case studies

For each type of chart a case study was developed. The process was organized in four sections: Prepare the Data, Format, Type and Color.

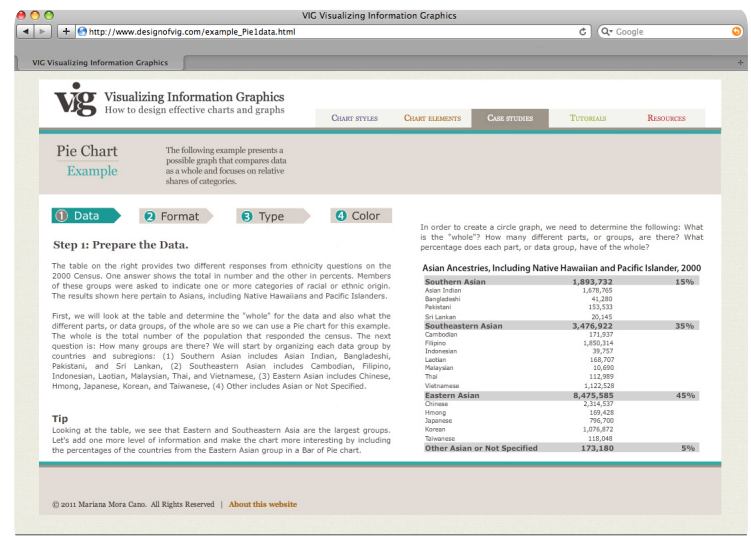
The Line chart example displayed on this page represents a possible way of showing multiple sets of data trends in series over time.



Bar chart exercise compares the relative value sets of data across categories and pays less emphasis on time.



The Pie chart example presents a possible graph that compares data as a whole and focuses on relative shares of categories.



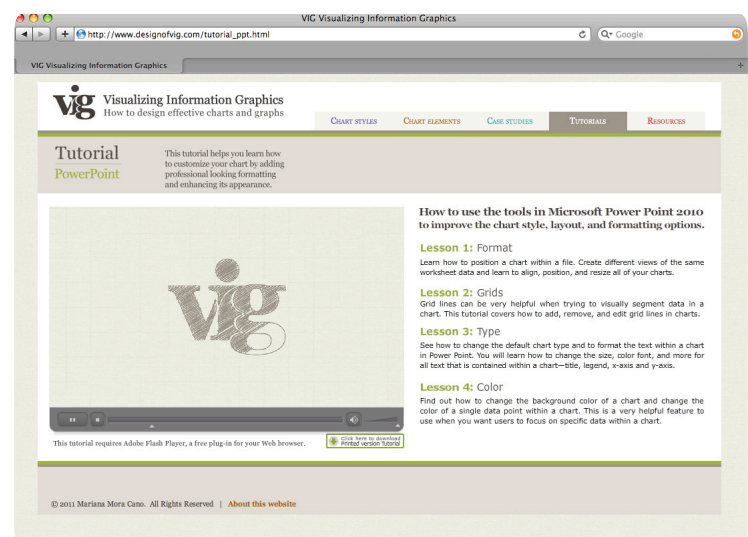
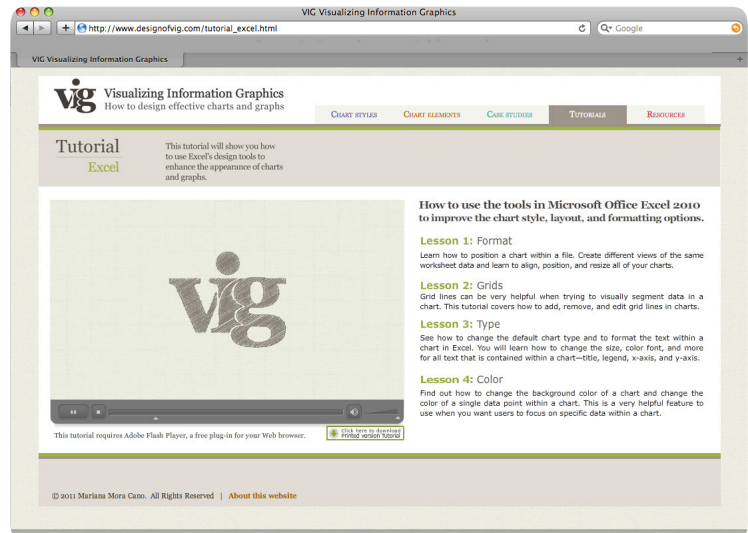
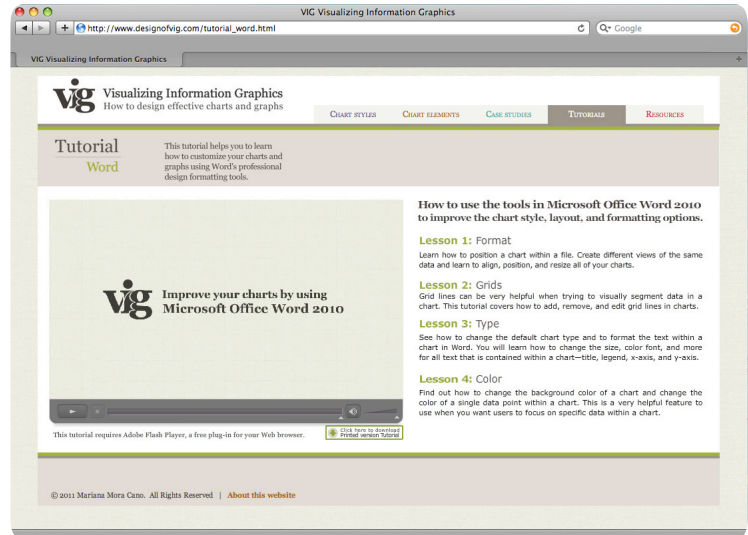
Tutorials

In these tutorials, users can learn how to customize their charts and graphs using the tools provided in the software: Word, Excel and Power Point. These programs were the most selected in the survey when asked which software do you use for creating graphs.

Each tutorial has four lessons: Format, Grids, Type and Color. Each video is no longer than 2 minutes.

In the video (toolbar) the user can handle the volume, stop, rewind and continue the video for easy handling of time and information.

All tutorials have the option to download the information for later use and keep it as a print guide in case they need it again.

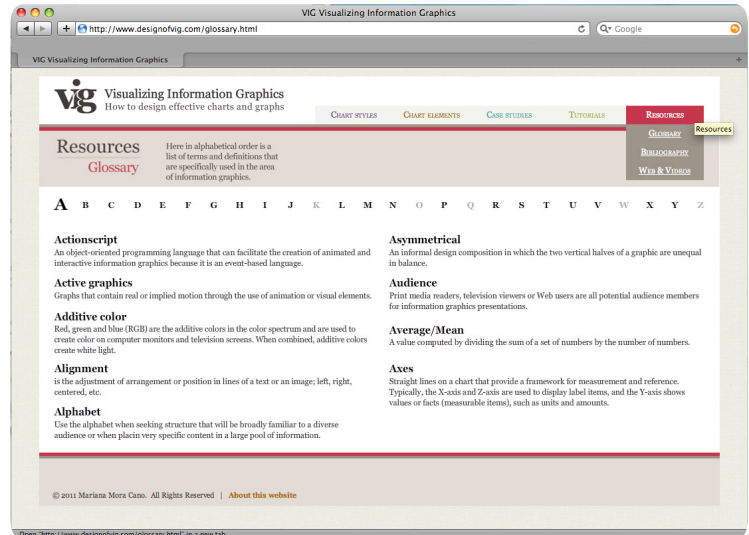


Resources

This section organizes resources for users who desire more information. Here the user can find a glossary, bibliography, and links to Web sites and videos on the subject of information graphics.

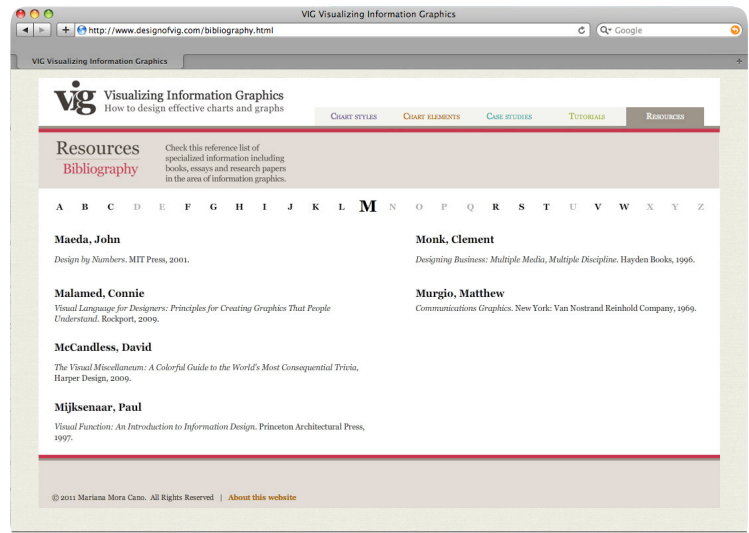
Glossary

Here in alphabetical order is a list of terms and definitions that are specifically used in the area of information graphics.



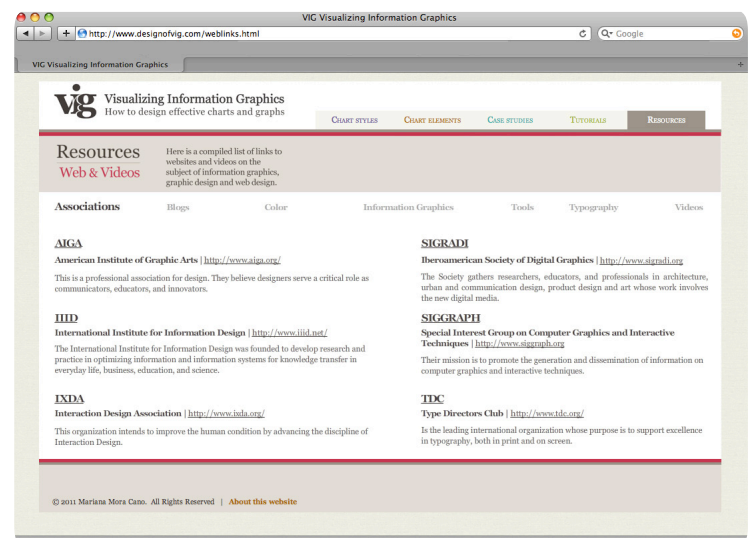
Bibliography

Reference list of specialized information including books, essays and research papers in the area of information graphics.



Web & Videos

Compiled list of links to web sites and videos on the subject of information graphics, graphic design and web design.



Distribution

Events

- SIGGRAPH 2012 (Special Interest Group on Computer Graphics and Interactive Techniques). Premier international conference on computer graphics and interactive techniques.
- IEEE Visualization 2012 (IEEE Vis). Premier forum for visualization advances in science and engineering for academia, government, and industry. The Web site will be submitted as a design study that focuses on the success of visualization evaluation based on the theory of visualization.
- AIGA Design Educators Conferences. December 2012.
- The International Conference on Design Principles and Practices, AIGA (American Institute of Graphic Arts) Design Conference, and ICOGRADA (the International Council of Graphic Design Associations), as part of many of the events that call for papers on a number of themes, including Visualization.

Design contests

- AIGA competitions.
- HOW magazine design competition.
- Communication Arts Interactive Design Competition.
- GOOD magazine regional design annual.

Digital Distribution

- Submission of project description for inclusion in the Palgrave Macmillan Journals Web site. This journal is essential reading for researchers and practitioners of information visualization and is of interest to computer scientists and data analysts working on related specializations. <http://www.palgrave-journals.com/ivs/index.html>
- Google analytics and search engine optimization techniques to assure first-page placement in Google search results for selected keywords/phrases (infographics, computer graphics, visual graphics, visual knowledge).
- Facebook group promoting and linking to the Web site.

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- Wong, Dona M. *The Wall Street Journal. Guide to Information Graphics: The Dos and Don'ts of Presenting Data, Facts and Figures*. W.W. Norton & Company, 2010.

Courses and Seminars

- Tufte, Edward. *Presenting Data and Information*. A one-day course. Arlington, Virginia. April 12, 2010.

Essays

- AIGA: *Defining the Designer of 2015*.
<http://www.aiga.org/content.cfm/designer%2Dof%2D2015>
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<http://www.xs4all.nl/~maxb/ftf2000.htm>
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Wilkinson, Leland. *The Grammar of Graphics*. Springer ISBN 0-387-24544-8.

Videos

The New York Times – *All the News that's fit to Post*.
<http://www.gestalten.com/motion/new-york-times>

The New York Times – *Visual Reduction*.
<http://www.gestalten.com/motion/christoph-niemann>

TED Talk: *David McCandless on the beauty of data visualization*.
http://www.ted.com/talks/david_mccandless_the_beauty_of_data_visualization.html

Tangible Actions in Motion by Jarvis, Jonathan.
<http://vimeo.com/1345841>

How Gasoline is made from Oil: Type in Motion by Pasternack, Matthew.
<http://vimeo.com/12465823>

Web sites

AIGA: Information Design
<http://www.aiga.org/content.cfm/clear>

Edward Tufte.
<http://www.edwardtufte.com/tufte/>

Fast Company Magazine Infographics
<http://www.fastcodesign.com/tag/infographic>

Feltron Annual Reports by Nicolas Felton
www.feltron.com

Flowing Data
<http://flowingdata.com/>

Good Magazine Infographics
<http://www.good.is/infographics>

Information Aesthetics. Where form follows data. <http://infosthetics.com>

Information is Beautiful. Ideas, Issues, Knowledge, Data – Visualized! By McCandless, David. <http://www.informationisbeautiful.net/>

Many Eyes (IBM Research Site)
<http://www-958.ibm.com/software/data/cognos/manyeyes/page/About.html>

Simple Complexity. Making simple sense from complex data.
<http://simplecomplexity.net>

Small Labs Inc: New York Times Infographics
<http://www.smallmeans.com/new-york-times-infographics/>

Visual Complexity
<http://www.visualcomplexity.com/vc/>

Appendix

Survey Results

The primary audience for this project consists of students, professionals from the financial and business fields, and people who make presentations about their academic and scientific research. In order to better adapt the Web site for this target audience an online survey was distributed during the spring semester of 2011 across a variety of different demographic targets: oilfield corporation staff, researchers at a health institute, and graduate students in business programs.

Two hundred and twenty-five responses to the survey provided a clear picture of what information and features needed to be presented in a Web site about the design of visual information graphics. Each participant received a unique ID, which tracked the order of answers to each section; the data was emailed to a specific email account and then processed in a spreadsheet program.

The survey responses give a picture of what level of information to present on the Web site Visualizing Information Graphics and help to identify areas that needed special consideration. The results confirmed that for the primary audience, aesthetics are often seen as an add-on, implemented at the very end of the development process. This group relies heavily on the accuracy and speed of statistical programs that process data, but they are uncertain when evaluating the choice of colors, fonts, and formats, which are often imposed by software templates. They are quite interested in learning more about the elements of graphic design and how can they improve their charts and presentations.

Section One: General information

Collected personal information regarding gender, age, computer usage, preferred platform and software, professional experience, and level of knowledge about information graphics provided useful insight about demographic and psychosocial factors of the survey participants.

The responses defined the audience as 65 percent male and 35 percent female. The majority were age 36 to 40 years (54 percent of respondents) and have a weekly computer usage of more than 40 hours (68 percent of respondents). The computer platform most respondents use is Windows (75 percent) and the software programs most use to present information graphics are Power Point (45 percent), Excel (39 percent), and Word (16 percent). According to the survey, 65 percent of the respondents prefer to use bar, line and pie charts to communicate their information. The remaining 35 percent use other types of graphics due to specific requirements of their profession. These results guided the selection of computer platform and software for the tutorial section of the project.

The level of knowledge about information graphics was defined by 60 percent as more than basic. The users were able to name at least three different types of graphics and understood how to develop data and create graphs. These results define the need for an intermediate to advanced level of training focusing on information design theories and concepts to enrich user knowledge.

The following percentages show the variety of demographic targets that were surveyed:

15% Human Resources	14% Finance
35% Engineering	10% Education
6% Project Managers	20% Scientific Research

In order to create the graphics: 50 percent of respondents refers to other presentations, 30 percent use standard templates as reference and 20 percent depend on the software and are unable to evaluate the results. 42 percent of those surveyed prefer to learn from examples with easy steps to follow, 30 percent prefer tutorials or online classes with instructors, 20 percent prefer a downloadable PDF-format guide and only 8 percent prefer a site where information graphics are created, discussed, and tested—ruling out for now the creation of a discussion Blog.

After completing section one of the survey, three different types of visualization were presented for analysis: line, bar, and pie charts. These graphics were selected because they are used most commonly in daily presentations and software.

For each example, the first few seconds were used to reflect on the visualization. After the first few seconds the user started to answer questions separated in sections; Section two presented questions to the user in order to assess whether they understood the content and the highlights of the information presented and Section three which assessed whether the graphic elements enhanced or distracted the viewer from the information.

Section Two: Content

This is the first and most important element in chart preparation. The examples cited during the survey presented information that varied in its precision, reliability and value. It was the users job to evaluate and determine if the content appeared to offer facts and well-argued opinions, or just unsupported claims.

85 percent of the responses showed interest in knowing more about the source and the information they were reading. This result supports the idea of developing a Web site section that talks about source selection tips. It also reinforces the importance of text fields in charts: Title, Subtitles, Labels, Legends and Source—elements that give the audience the first guidance on the data presented.

45 percent of the respondents stated that the use of only text was sufficient in order to understand the information, 60 percent required text and images (referring to the use of color and shapes.) They did not like to make calculations to understand the message of the graph. This is where shapes and colors became important as a second tool.

In conclusion 83 percent of the people surveyed found most interesting those graphs that combine the individual satisfaction of words with the emotional power of visual and graphic design elements.

Section Three: Graphics

The results of the survey show that 78 percent of the users did not interpret the graph information as intended by the publication. This is due to the common mistake of creating charts that include unintentional distortions or ineffective approaches to presenting numerical evidence with the use of graphic design elements.

Therefore it is important to guide the user of this Web site project to not use chart types that are decorative, or that distort relations between data. For 65 percent of respondents, the lack of a focal point and the use of too many colors made the reading of the information difficult. When asking the user about how color, shapes and typography helped explain the meaning of the data, 46 percent answered that they did not like it and 54 percent answered that it was aesthetically pleasing and functional.

When analyzing a 3D pie chart example, only 15 percent of the surveyed agreed that 3D charts are interesting, 85 percent answered that such charts misinterpret the information. For 65 percent the lack of a focal point and the use of too many colors made the reading of the information difficult. 44 percent of users responded that color, shapes and typography did not help them understand the information more clearly. 56 percent gave a positive response.

Conclusion

The original purpose of this research was to test how people feel and think about the use of graphic design choices in information graphs. People like to see graphs for a quick way to evaluate a set of numbers. However, often times the misuse of graphic design elements can mislead people and fail to communicate meaningful information.

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