Sketching Designs for Information Visualization
the five design-sheet (FdS) approach[1]

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Aims:

- To learn about the five design-sheet[1] methodology
- To start to understand how to interact with a client
- To carry out a group-based brain-storm
- To carry out creative sketching - develop new design-ideas around a scenario
- To assess the validity and usefulness of the designs under competing factors

Learning Outcomes:

Intellectual Skills: Demonstrate capability for innovation and disciplined creativity, identify and analyse requirements and form a technical specification. Assess the impact of uncertainty, such as technical risk and development time-scales, and trade-off competing factors such as costs and benefits.
Practical Skills: Use sketches as a method of planning and communication
Transferable Skills: Communicate effectively – using sketches, graphical and oral
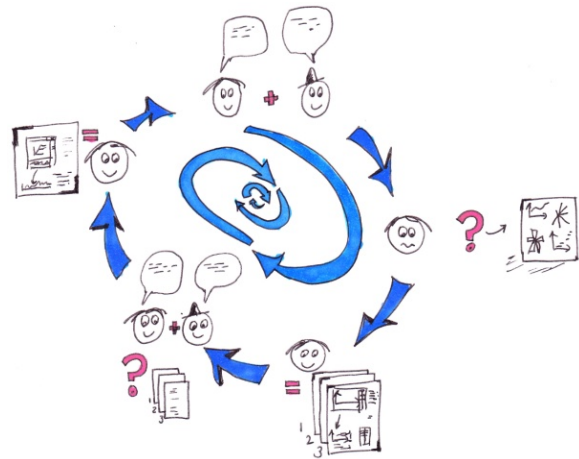
The methodology

- Using sketching and designs to ideate novel information visualization solutions.
- **Five stages**: Meet, Brainstorm, create Design-sheets, Discuss with client, Generate Realization Design
- **Five outcomes**: 1 brainstorm sheet; 3 design sheets; 1 realization sheet
- **Five parts to brainstorm**: ideate, filter, categorize, combine & refine, question
- **Five parts to each sheet**: Layout, meta-Information, Focus, Operations, Discussion or Detail (LIFOD)

By sketching on pieces of paper, the process forces you to think about what you are doing. It is too easy to get distracted by the interface of a modern drawing tool; you get bogged down in how to create a specific effect. So, creative juices flow more readily with pen and paper.

The designs you create are good 'discussion points' with the client. They give the idea that nothing is set-in-stone and that concepts and ideas can change. It is good that these concepts change – your interaction with the client is important. Not only to gain an understanding of their challenges, but to share with them your knowledge of design in visualization, your understanding of perception and your experience of information visualization.

There is also persistence in the artifacts you create. They can be put on the wall, scanned in to a computer and shared remotely.

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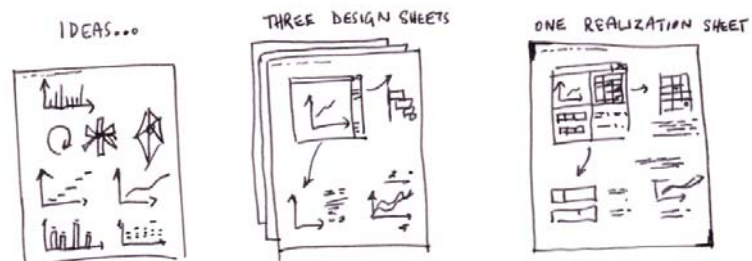
[1] The 5-stage approach has been developed by Jonathan Roberts.   ©J.C.Roberts, Sept/2010

The design-sheets content

What is the content of the design sketches?

Sheet 1 – brain storm

The idea of brain-storming is to enlarge the design space of possibilities. There should be a focus on quantity – to generate all the possible designs. This may, or may not, be a group activity. Brain-storming on one's own can be likewise rewarding. Also, software can be used to help in the process (such as the use use of mind-map software can help users order their thoughts and ideas around a topic). But in this work we advocate sketching as the principle design tool.

There are five stages in this task.

1. **Generate Ideas**. Sketch and draw as many ideas as you can think of. In reality these are *mini-ideas*. They are short concepts that could be part of a whole. E.g. use a scatter plot, or line graph, or need some Dynamic query task to filter the results. These may be comprehensive and complete ideas, or half-baked ideas, simple concepts or merely wacky suggestions.
2. **Filter the ideas**. Take the ideas and start to remove any duplication. Remove any ideas that seem too similar to another idea.
3. **Categorize the sketches**. Start to order and categorize the sketches, the *mini-ideas.* Concepts that are similar should be located together. If you are using sticky-notes then these can be easily moved and categorized on a wall, for instance. There may be different and alternative categorizations; just choose one and move on. The categorization and the ideas will probably change and develop anyhow.
4. **Combine & Refine**. Start to organize the mini-ideas into bigger solutions. Perhaps have multiple views: this could be two *visualizations* that demonstrate different aspects of the same information.
5. **Question**. The final stage is to question what has been generated. Does this provide a solution that the client wants? Does it answer the original research questions?

This process can be run as a group activity. It is important to consider that participants must not initially criticize or evaluate the worth of particular designs. Keep the ideas flowing by getting participants to sketch their individual ideas down on their own sheets of paper (sticky notes are useful in this exercise). Invite and record any ideas that they participants create. Try to make sure that the whole design space of possible designs is covered. Unusual or wacky ideas should be tabled.

Rules of Brainstorming

1. **Don't criticize**
2. **Don't evaluate.**
3. **Generate-generate-generate.**
4. **Ideate the whole design space.**

The process as a group participation exercise:
All participants listen to the challenge/task

1. Individually write down on sticky-notes their own thoughts   (IDEAS)
2. Collate all sticky-notes (the ideas) in the group
3. Stack the sticky-notes of similar ideas on top of each other   (FILTER)
4. In the group organize the sticky-notes   (CATEGORIZE)
5. Categorize the idea space by moving the stick-notes into groups of like-ideas
6. Combine and refine the ideas   (COMBINE, REFINE)
   Use sketching and start to prepare the three main design-sheets
7. Start to discuss the benefits/challenges
   or advantages/disadvantages of the categorized ideas   (QUESTION)

Sheet 2, 3, 4 – initial designs

The three individual design sheets are to record three ideas from the initial brain-storming exercise. The use of the number *three* is for guidance only. But, it is recommended that three design sheets are created.

Too few designs mean that it is difficult to have a discussion with the client. Too many and it would waste the clients time. It may be that there are only two sensible designs, but it would be better to create a third design, however unusual or unfeasible it seems, because the client may be able to see or extend the ideas through discussion. They may be able to see an application of the idea further than you can.

These design sheets should represent three completely *different* designs. Consider the hyperspace of possible designs, the three that you should propose should cover this design space well.

The Content of the three design sheets should be similar. They should contain

1. the **Layout** of the design. This is the vision of what the final visualization would look like. Commonly this would appear as a sketched screen-shot of the typical visualization application.
2. **Focus.** There may be a few key visualization techniques, or in particular, novel visualizations that are being created for this tool. These should be described in the Focus section.
3. Sketches and some brief descriptions of how the user **operates** the visualization, or controls the user interface should also be included.
4. A **discussion** of the advantages and disadvantages of this technique should be included somewhere on the design sheet.
5. Finally **meta-information** should be included: including title, authors, date, sheet number and task.
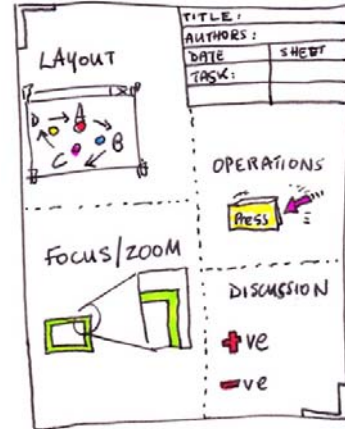
The **three design sheets** aid you in your discussion with the client. The sketches give the appearance that the ideas could change. Also, the designs give the client an understanding of the breadth of possible outcomes.

There are different approaches to designing the Layout and Focus/Zoom sections of the design sheet. One method is to follow Dan Roam's suggestions of sketching designs that are Portrait, Chart, Map, Timeline, Flowchart and plot. Each of these represent who/what, how much, where, when, how and why, respectively. Dan Roam also suggests that the designer should think whether they are simple vs elaborate diagrams, quantity or quality, visionary or execution, individual or comparative, represent change or 'as-is'.

Sheet 5 – realization design

This is the realization design. This is what you think (at this stage of development) the visualization tool may look like, what specific visualization technique it principally uses and how users operate it (what functions it provides). The differences with Sheet 5 and sheets 2,3,4 is that the Discussion is exchanged for some Detail.

The detail should include more detailed information of how the information visualization artifact will work or will be created. This could include many details, such as

1. Description of what algorithms are being used (perhaps citations of those algorithms or some critical maths used by the algorithm)
2. Any dependencies. E.g. this could be software libraries that the tool would be built upon, or aspects such as that it must be compatible with a current tool.
3. Estimates of cost or time to build, or man-months of effort
4. Specific requirements such as details of any materials and quantities required. E.g. hardware requirements, amount of pixels on a screen.

Related Work

Gayle Curtis (Palo Alto), Laurie Vertelney (Apple Computer, Inc.)Tutorial 33, "Storyboards and Sketch Prototypes for Rapid Interface Visualization", CHI '90, April 2, 1990, Seattle, Washington. http://ecologylab.net/courses/hcsi/hostedMaterials/curtisVertelneyChi90Storyboards.pdf

Mark Baskinger, Ki-Chol Nam, Visual Narratives: The Essential Role of Imagination in the Visualization Process", Asia Pacific Symposium on Information Visualization 2006 (APVIS 2006), Tokyo, Japan, February 2006. http://crpit.com/confpapers/CRPITV60Baskinger.pdf

Craft, B. and Cairns, P. 2009. "Sketching sketching: outlines of a collaborative design method". In *Proceedings of the 23rd British HCI Group Annual Conference on People and Computers: Celebrating People and Technology* (Cambridge, United Kingdom, September 01 - 05, 2009). British Computer Society Conference on Human-Computer Interaction. British Computer Society, Swinton, UK, 65-72. http://portal.acm.org/citation.cfm?id=1671019#

Contero, M.; Naya, F.; Company, P.; Saorin, J.L.; Conesa, J.; , "Improving visualization skills in engineering education," *Computer Graphics and Applications, IEEE* , vol.25, no.5, pp. 24- 31, Sept.-Oct. 2005 doi: 10.1109/MCG.2005.107
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1510535&isnumber=32338

Sarah Dennis-Shaw, "Guided Comprehension: Visualizing Using the Sketch-to-Stretch Strategy",
http://www.readwritethink.org/classroom-resources/lesson-plans/guided-comprehension-visualizing-using-229.html

Tamara Munzner "A Nested Model for Visualization Design and Validation", *InfoVis Conference, Atlantic City NJ, 10/09* http://www.cs.ubc.ca/~tmm/talks.html#iv09
http://www.cs.ubc.ca/labs/imager/tr/2009/NestedModel/NestedModel.pdf

Tamara Munzner "Research Cycles, Collaboration, and Visualization", VIEW workshop, UBC. 2007. http://www.cs.ubc.ca/~tmm/talks/leiden07/collab.pdf

Dan Roam, "The back of the napkin, The: Solving Problems and Selling Ideas with Pictures", Portfolio, Sept 2008., ISBN 978-1591841999

Stress in the Workplace – biometrics case-study mockup exercise

All together

14.15 - 14:45 | Preparation (30 mins)

Explain the Five-design-sheet approach.
Explain the problem domain

Rules of Brainstorming

1.	**Don't criticize**
2.	**Don't evaluate.**
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4.	**Ideate the whole design space.**

In groups

14: 45 -15.15 | Sheet 1 – brainstorm (30 mins)

Separate into the groups and into the allocated rooms

1. Individually sketch on sticky-notes your own designs	5 minutes
2. Collate & Sort:	10 minutes
• Collate all sticky-notes	
• Organize the sticky-notes	
• Stack similar ideas on top of each other	
• Categorize the ideas by moving them into groups of like-ideas	
3. Combine and refine the ideas	15 minutes
• Through sketching as a group start to prepare the three main design-sheets	
• Start to prepare design sheets 1,2,3	

All together

15:15 – 15:35 | Coffee

Back in groups

15:35 – 16:00 | Finish Sheets 2,3,4. (25 mins)

4. Finish off design sketches 2,3,4	10 minutes
• don't linger these should be done <u>very</u> quickly	
• They are sketches – not meant to be works of art!	
5. If you can discuss your ideas with the client – then do so, but don't wait around if you cannot! MOVE ON>>>	5 minutes
6. In group discuss the benefits/challenges or advantages/disadvantages of the categorized ideas	10 minutes

16:00 – 16:20 | Make sheet 5 (20 mins)

7. Make sheet 5. The design realization This is the one you will present in the plenary session.	20 minutes

16:20 – 16:30 Prepare (10 minutes) to get ready for the plenary session

8. Move to plenary room	10 minutes
9. Stick (with blue-tack) posters to wall in plenary room	

All Together = PLENARY SESSION

16:30 – 17:00 | Plenary 30 mins (Plenary)

10. Each Group presents their designs This is meant to be a fast feedback. Only 3 minutes per group. So be FAST and CLEAR	3 minutes each

17:00 | END