Usability Considerations in Designing Tools for the Grid

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Tools for the Grid Are the Hardest Yet

- Like predecessors (parallel tools), must deal with
  - Extreme variations in scale
  - Rapidly evolving hardware/software environment
  - Competing demands of OS and middleware
- Grid tools add new challenges as well
  - Heterogeneous resources
  - Extremely dynamic resource availability
  - Lack of central management
And Then Consider the Users...

- "Grid users" are much more diverse than parallel users
- Direct (primary) users
  - Grid application developers
  - Resource providers
  - Resource managers
- Indirect (secondary) users
  - End-users of applications
  - End-users of data
  - End-users of second-order products (analyses/visualization)

NEES Example: Resource/User Diversity

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Usability Is More Important Than Ever

Back to the public utilities analogy…

1. The resources consumers want – when they want
2. Consumers don’t care how it really works
3. Consumers pay for what they use

<table>
<thead>
<tr>
<th>Electrical Power</th>
<th>Telephones</th>
<th>Grids</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or 2 choices</td>
<td>10-20 options</td>
<td>100s-millions</td>
</tr>
<tr>
<td>Plug it in</td>
<td>Dial 7 or 10 or 11 or ~15 or (N+14) digits</td>
<td>Few clicks to total rewrite</td>
</tr>
<tr>
<td>Charged for usage</td>
<td>Charged fee + (fee + usage) + (fee+usage+premium)</td>
<td>Open issue (but will be complex)</td>
</tr>
</tbody>
</table>

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Grid Tools – Where We Stand Now

- Tools describing system availability
  - Some focus on bandwidth/latency (e.g., NASA Grid Mgt System)
  - Some on load (e.g., PACI Hotpage)

[W. Smith, NASA]
Grid Tools – Where We Stand Now (2)

- Environments for launching/monitoring applications
  - Some specifically for parameter studies (e.g., Nimrod/G) – no special code needed
  - Some are programming/execution environments (Legion, GrADS)

  [Abramson/Buwaya/Giddy, Monash U]

Grid Tools – Where We Stand Now (3)

- Environments for particular tasks or communities
  - Rendering (RenderGrid)
  - Distributed information (DISCworld)
  - Molecular chemistry (Amber Portal)

  [Hawick/James/Patten/Vaughan]
Do They Look Familiar?

- Initial grid tools simply extend parallel tools
  - No significant new conventions or techniques
    ... although we know the challenges are tougher

  - No notable improvements in usability
    ... although users have never liked parallel tools

What Grid Users Are Expecting ...

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Usability Goals for Grid Infrastructures

If our intention is

1. The resources consumers want – when they want

2. Consumers don’t care how it really works

3. Consumers pay for what they use

Our immediate goal should be

• Make complex, multi-dimensional environments intelligible

• Encourage users to "let the system do it"

• Make cost-effective alternatives clear

Portraying Grid Info Effectively

• Grid = complex, dynamic resource landscape

• Requires multidimensional representations
  • Identifying needed resources (e.g., data, specialized equipment)
  • Mapping application components to resources
  • Understanding state of application and resources
  • Studying performance (now or post-mortem)
  • Maintenance (adding resources, assigning costs, analyzing system performance, etc.)

• Graphical techniques that help improve usability
Navigation in Large Landscapes

- Portray distinct levels of detail (not just magnifications)

- Zooming in provides more detail over smaller data space
- Zooming out reduces detail

Navigation in Large Landscapes (2)

- Large data spaces (even 2-D) require special navigational aids

- Thumbnail images
  - Give user sense of context
  - Support fast movement through large data space

[xprofiler, IBM]
Navigation in Large Landscapes (3)

- Caveat: “Thumbnail” may end up much larger than “main” image

![Image](xprofiler, IBM)

Navigation in Large Landscapes (4)

- Navigation through time-series info can be similar
  - **Strip mural images**
    - Provide context
    - Support movement
    - Can be extended to support comparison

![Image](Jerding & Stasko, Ga Tech)
Navigation in Complex Landscapes

- Nesting or belongs-to relationships can be complex
- **Tree maps** clarify hierarchies
  - Can be clearer than graph representations
  - Combine well with thumbnail and/or zooming techniques

**Graphical synopses**
- Quick recognition or summary
- Can be basis of filtering or selection

**DEEP/mpi, Pacific Sierra**
Integrating Multidimensional Data

- Can also use thumbnails/murals to integrate distinct types of data

- Synchronized summaries
  - Selection in one data space triggers corresponding movement in another

[Integration of multidimensional data using thumbnails and synchronized summaries.]

Integrating Multidimensional Data (2)

- N-dimensional data require the ability to move through multiple data spaces

- 3-D graph viewers
  - Can support movement across spaces
  - Could be combined w/ individual strip murals

[Integration of 3-D graph viewers for multidimensional data visualization.]
Focusing the User’s Attention

- Visually highlight important (or urgent) features

- Fisheye magnification
  - Less important info subsumed into background or mural view
  - Multiple areas can be highlighted

[Greenberg / Gutwin / Cockburn, U Calgary]

Focusing the User’s Attention (2)

- Highlighting can be more than a binary property

- Weighting-based fisheye views
  - Prominence of element scaled to its calculated “importance” or “cost”

[Koike & Yoshihara]
Conclusions

- Grid tools face more & harder challenges than parallel tools
  - We can’t continue basing tool strategies on parallel solutions
- Meanwhile, many new techniques have emerged
  - How to represent large, multidimensional data spaces
  - How users like to navigate through information
- Need to leverage that work – to ensure that grid tools meet key usability goals

Grid User of the Future???

“Think back ... which keys did you press?”