

USING VIDEO FOR ANALYZING DAYLIGHT SIMULATION TOOLS

Dr. Dan C. Glaser
Department of Language, Literature, and Communication


Mr. F. Whitney Smith
School of Information Technology

Dr. Barb Cutler
Computer Science Department

Rensselaer Polytechnic Institute, Troy, NY

Motivation

- Are simulation tools unmediated sources of information?
- Tools get combined with people, workflow + organizations
- People, workflow + organizations are highly variable
- Video of use can capture performance (tool + people)



Heliodon as described to the public, Pacific Energy Center, San Francisco

Related Work

- Surveys are good places to start understanding what people want from tools

Austria

Non-Users

U.S.

Users

Figure 2 USA Survey: Ease of use of Simulation Program
Mahdavi, Feurer, Redlein, Suter 2003 Donn 1997

Related Work

- Cooperative work between industry + IBPSA Scotland
 - Different organizations need different solutions
 - E.g ad-hoc versus highly structured

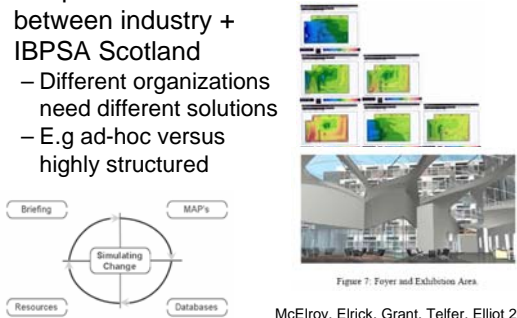



Figure 7: Foyer and Exhibition Area
McElroy, Eirick, Grant, Telfer, Elliot 2003

This Paper: Study Tools *In Situ*


- Potential gulf between tool specs + use
- Examine micro-interactions of people working with tools

"Dated?" heliodon



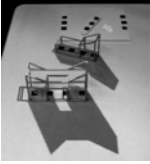
Physical

Software (Glaser 2001)



Software

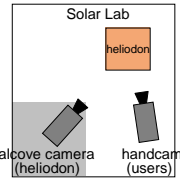
Future?



Hybrid (Underkoffler + Ishii 1999)

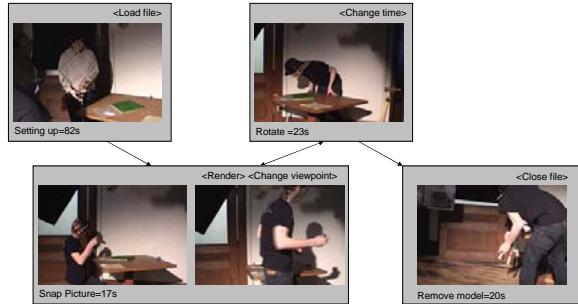
Physical Model: Setting

- Undergraduate Building Science Class
 - ½ hour training session
 - Sun study exercise- take at least 12 pictures of your model
 - Instructors and TA work with student
 - Heliodon needed sun path diagram
- Method
 - 2-4 observers taking notes
 - 2 video-cameras
 - Alcove for timing
 - Handcam for users
 - 5 hours of data
 - 7 users analyzed



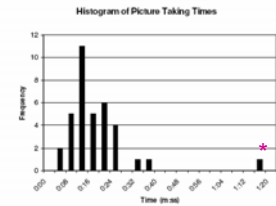
Physical Models: Basic Usability

- Time operations + tasks



Physical Models: Basic Usability

- These #'s can be used for benchmarking
- Caution has to be taken since not all operations and functionality are comparable
- Are today's computer programs as good as the heliodon at taking pictures?



* Outlier when teaching assistant discussed problem with student

Basic Usability- Errors

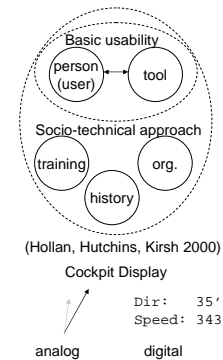
- Table falls to floor
 - Every other user!
 - Hazard to feet & model
 - 17 seconds to recover (avg)
- Accidental movement
 - 5 of 7
 - many unnoticed
- Just making things computerized does not automatically solve problem:



Enter latitude: +95N

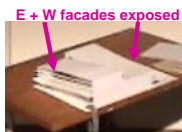
Socio-technical systems

- Usability metrics focus on person/tool
- Socio-technical systems examine larger networks
- Method: Observe Constructive interaction
- Conclusions are not automatic, they depend on context and interpretation

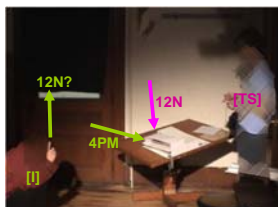


Socio-technical system: Instructor [I] + Student [TS]

- [TS]'s model has exposed facades
- [TS] thinks 12N is critical time
- [I] Suggests exploring other times



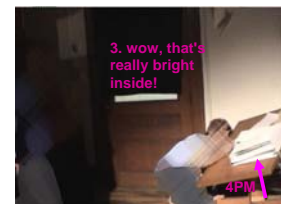
2. think about the east and west exposure, which is going to be 3-4 o'clock in the afternoon for the west, and for the east its going to be about 10 o'clock



1. actually [the sun does not] goes east and west as much as I thought it would go... because now it is at noon on June 21st

Socio-technical system: Instructor [I] + Student [TS]

- Instructor leaves TS to investigate himself
- TS finds problem
- TS returns to solar lab multiple times on his own initiative
- TS's design significantly improves



Socio-technical system: Teaching Assistant [TA] + Student [JP]

[TA] The professor wants you to be doing four different times of year and three different times of day-- morning, noon, evening, **but not too evening.**

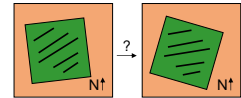
[TA] **So why are you doing October?** Think about what times are **most useful for you**

[JP] <inaudible> [hurriedly gets tape with new month on it, changes table position]



Result

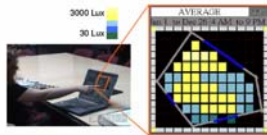
- JP is trained to use canonical times to investigate his non-standard ribbon-like design
- He did not investigate orientation!
- In later interview JP said that he put in too much work into heliodon for what he received
- No iterative design with solar tool



Did not reposition model to investigate other orientations

New Setting: Software

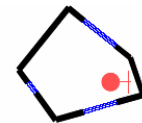
- Test with "Brina" and Dan.
- Hypothetical pentagonal room with 3 windows
- 'Average' daylight plot discussed
- How to incorporate this information into electric light planning
- Single camera on tripod recording session



Initial Use of Daylight Plot

- Brina starts a design with sconces

- 1 [B] =uhm, there we are always trying to get a balance with
- 2 that type of lighting, so even though you get a lot of
- 3 daylight, in this pattern, and we are looking kind of
- 4 dim over here so we want to get a **wall sconce** or
- 5 something happening.



Points to location of wall sconce
In hypothetical design

Organizational Breakdown and Individual Recovery

- 6 [B] uh- there, we are always trying to design for a good
- 7 balance, uhm and good work light, no matter what's
- 8 happening with daylight, because **we are assuming** a
- 9 **cloudy day** or
- 10 ok, [aha]
- 11 [or **bad**] **circumstances** (short laughter)
- 12 =ok [great]
- 13 or **evening circumstances**- so there is this
- 14 sort of general **assumption** that which is probably not a
- 15 very good idea, that, you know, **lighting is for when it is**
- 16 **dark** and=
- 17 [D] =aha
- 18 [B] when you don't have a lot of daylight,

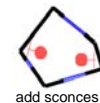


Integrated Design

- 19 [B] so, uhm but I think, I think it would be a useful tool to
- 20 know where the daylight is coming in,
- 21 so that maybe, maybe there is a **general lighting system that can be turned off** and we **add wall sconce**
- 22 **over here and wall sconce over here**
- 23 **then we have the person at the desk, be willing to get up, which is [the whole problem]**
- 24 [D] [Right]
- 25 [B] with those sensors, so that people don't have to get up
- 26 from their desks to change the light,
- 27 [D] aha



General lighting system



add sconces



how to switch?

Final Refinement

108 [B] [like] I now understand that this side of this room
109 could be the wall sconce and this side of the room.=

110 [D] =ok.

111 [uh huh.]

112 [B] [ok] and that, you know, if I put a fixture in
113 the middle, and I give the daylight
114 sensor here and there, near the, you know,
115 ok, I've [got it]


116 [D] [uh huh]

117 [B] sort of solved in my mind, and


118 [D] [aha]

119 [B] [so I] can move onto the next [thing].


120 [D] [aha]



Add sconces



More precise specification of
daylight system



Sensor Specification

Video

- (show video)
- Feel free to propose alternative interpretations during Q/A session

Software Summary

- Brina identifies an organizational norm that interferes with using information from a daylight simulation tool
- Brina increased her design capacity through iterations
 - Brina refines a “general” lighting system that can be switched with daylight
 - Brina talks about occupant control
- Chart just showed “average daylight”, yet informed sensor placement

Conclusions

- Video can provide practical benchmarking metrics for how people use tools
- Training greatly affects tool use
- Users can use tools to extrapolate on relevant issues outside their scope of work
- Understanding socio-technical systems can improve tool training, adoption, and use

Future Work

- Finish task and operational analysis for daylight tools
- Longitudinal studies, questionnaires, interviews
- Test other tools
- Looking for collaborators to investigate other contexts (e.g. design practice)

Acknowledgements

- Fantastic help with filming, observation, and interviewing:
 - Edward Davis Jr. (IT, undergrad student)
 - Matthew Fickett (Architecture, graduate)
 - Mark Cabrinha (Architecture, PhD student)
- Alastair Iles (Energy Resources, UCB) for substantial discussions on early versions of this work



Acknowledgements

- The Web for presentation images

- <http://i6.photobucket.com/albums/y245/Pennsuedo/SunnyDay.jpg>
- <http://www.pitt.edu/~ciddeweb/PICS/taping.gif>
- <http://melrosemirror.media.mit.edu/servlet/pluto?state=3030347061676530303757656250616765303032696430303438383738>
- http://azores.free.fr/Sao_Jorge-4.htm
- <http://www.mech.pku.edu.cn/robot/teacher/wanglong/photo/always%20cloudy.jpg>
- <http://static.wiredfool.com/wiredfool/twilight.jpg>
- <http://216.119.109.157/content/index.cfm?fuseaction=image&startrow=30&category=>

