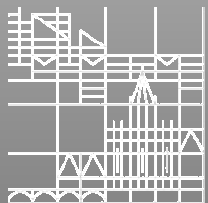




Model-based Design and Prototyping of Interactive Spaces for Information Interaction

Hans-Christian Jetter, Jens Gerken, Michael Zöllner, Harald Reiterer

*3rd Conference on Human-Centred Software
Engineering (HCSE 2010). October 14-15, 2010,
Reykjavik, Iceland*



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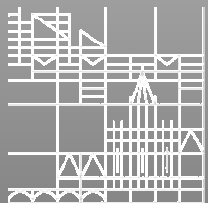


Model-based Design and Prototyping of Interactive Spaces for Information Interaction

Hans-Christian Jetter

3rd
Engin

Not a software engineer.
Researcher & designer of *(natural)*
interaction & visualization techniques.
→ for this reason: *I'm also a developer.*



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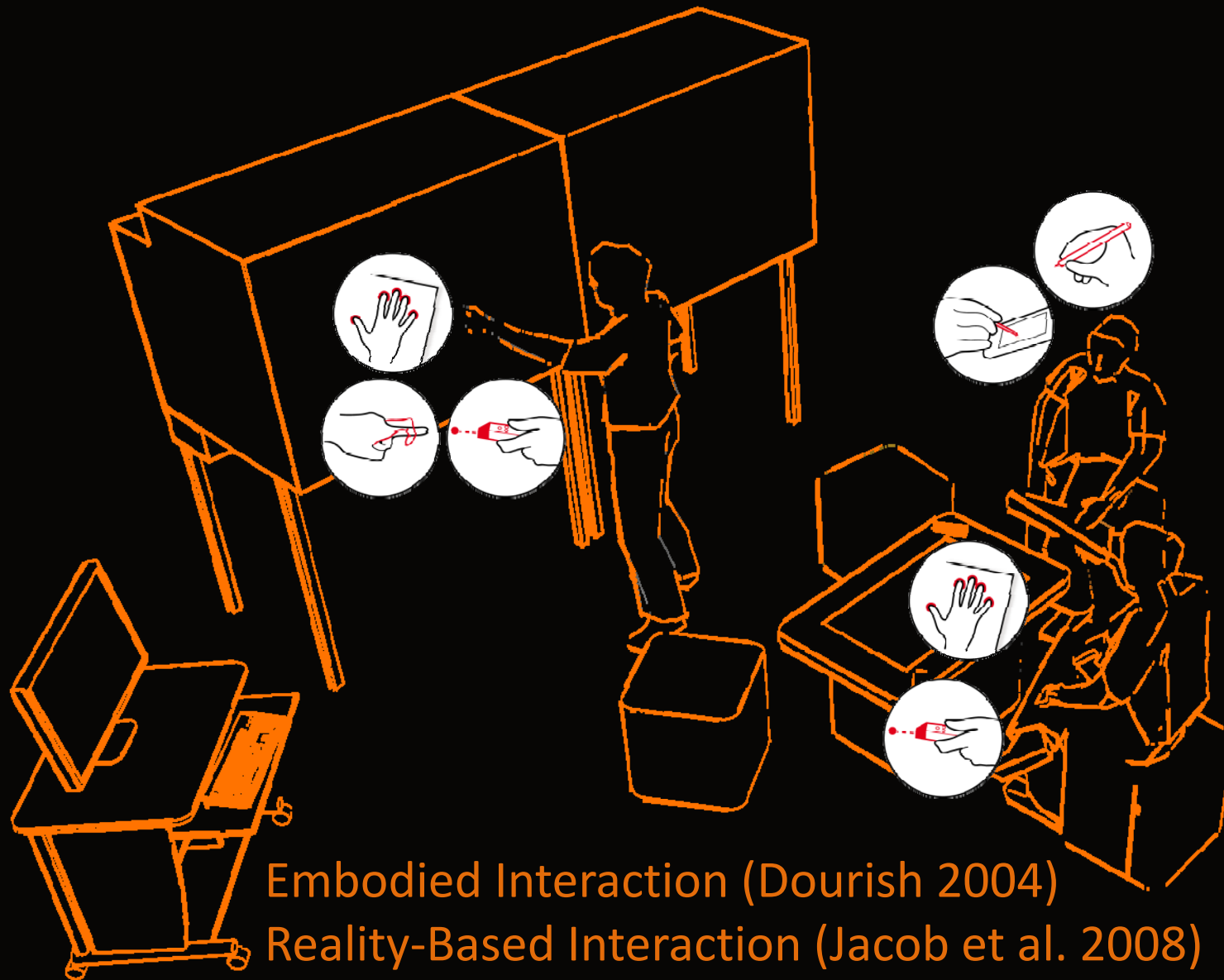


Model-based Design and Prototyping of Interactive Spaces for Information Interaction

1. Interactive Spaces: Tangible and Social Work Environments
2. Modeling & Designing for Information Interaction
3. Object-Oriented User Interfaces (OOUI)
4. Case Study
5. Discussion & Outlook

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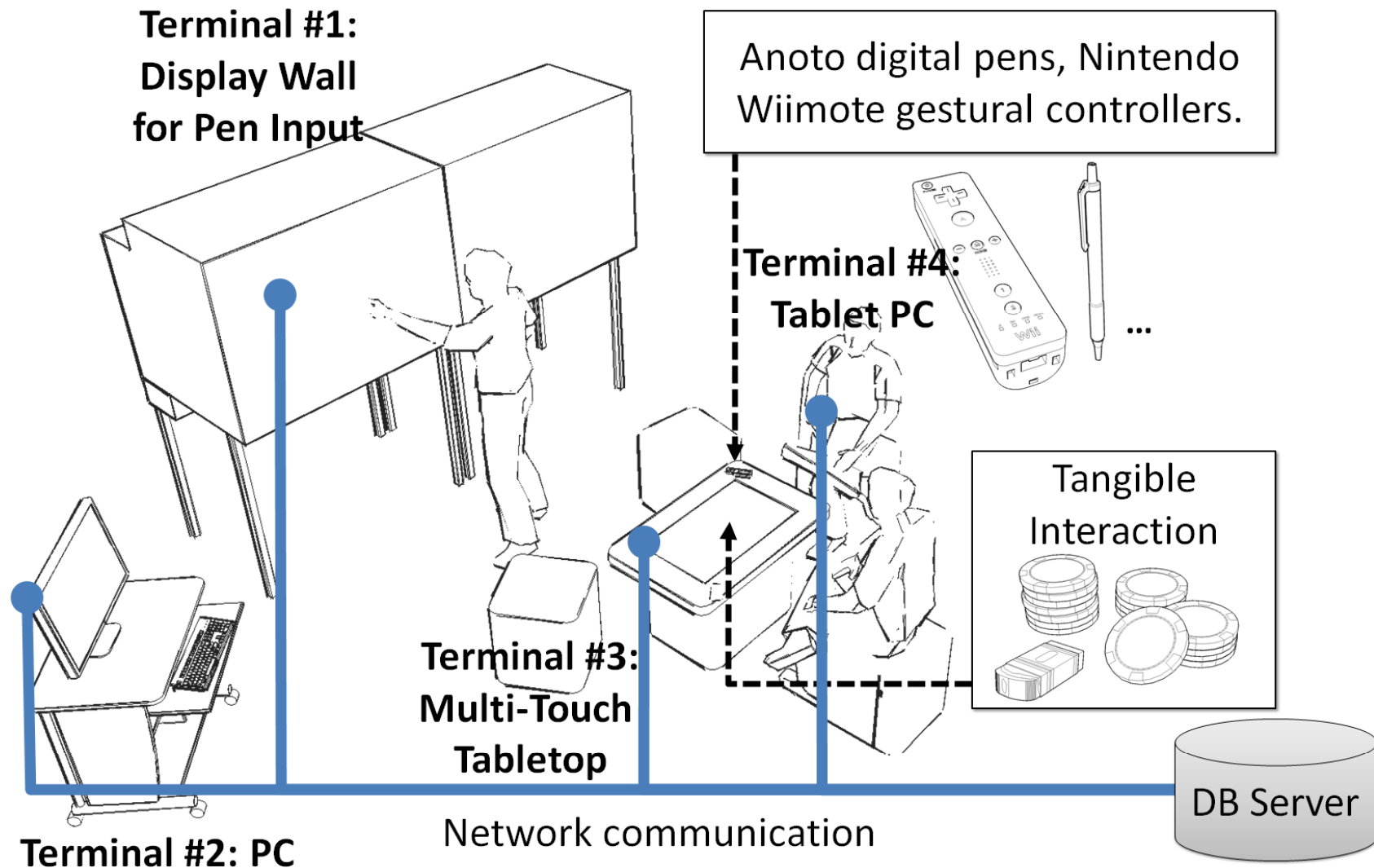
Embodied Interaction (Dourish 2004)

Reality-Based Interaction (Jacob et al. 2008)

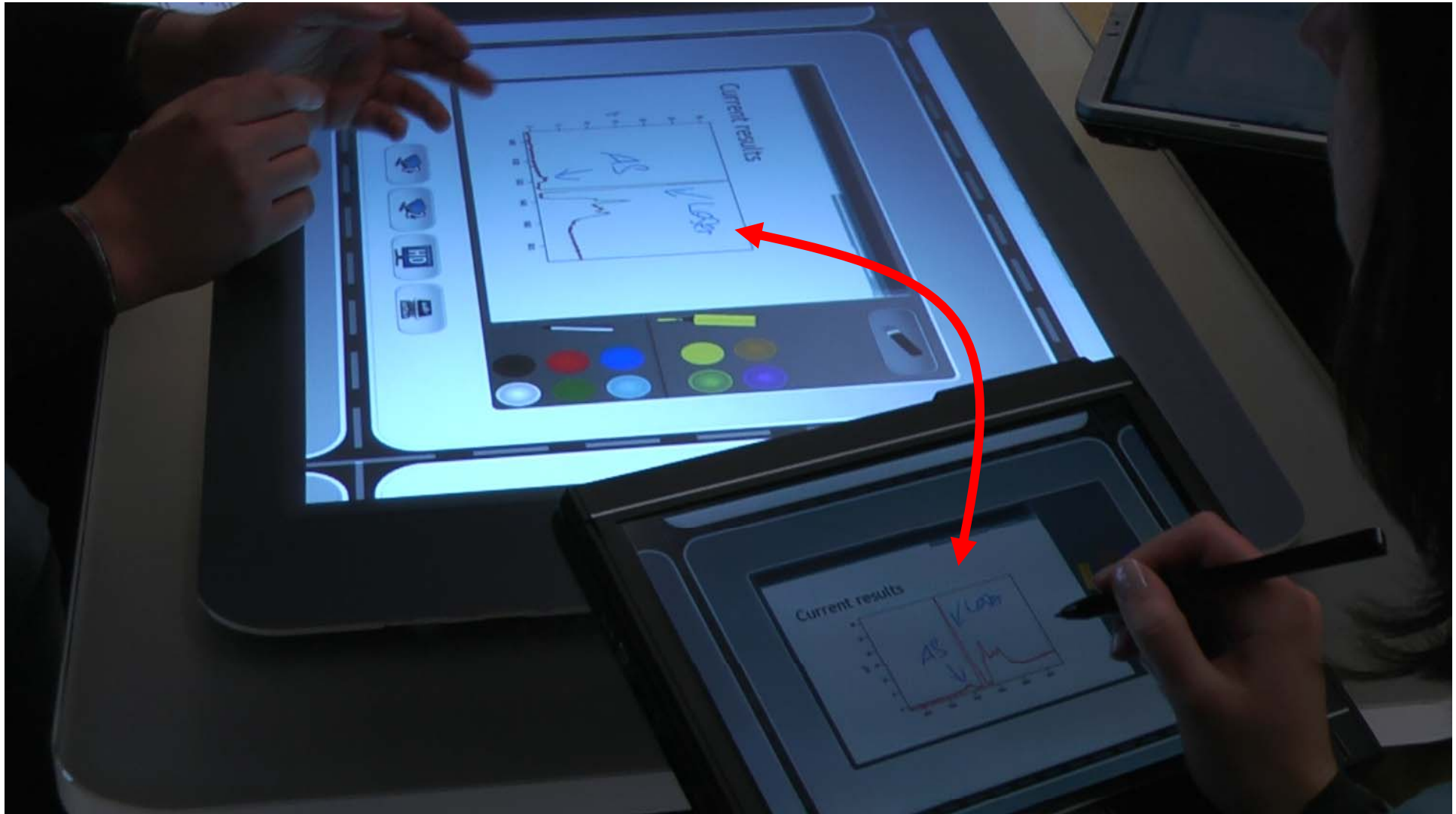
Making computing more tangible and social.

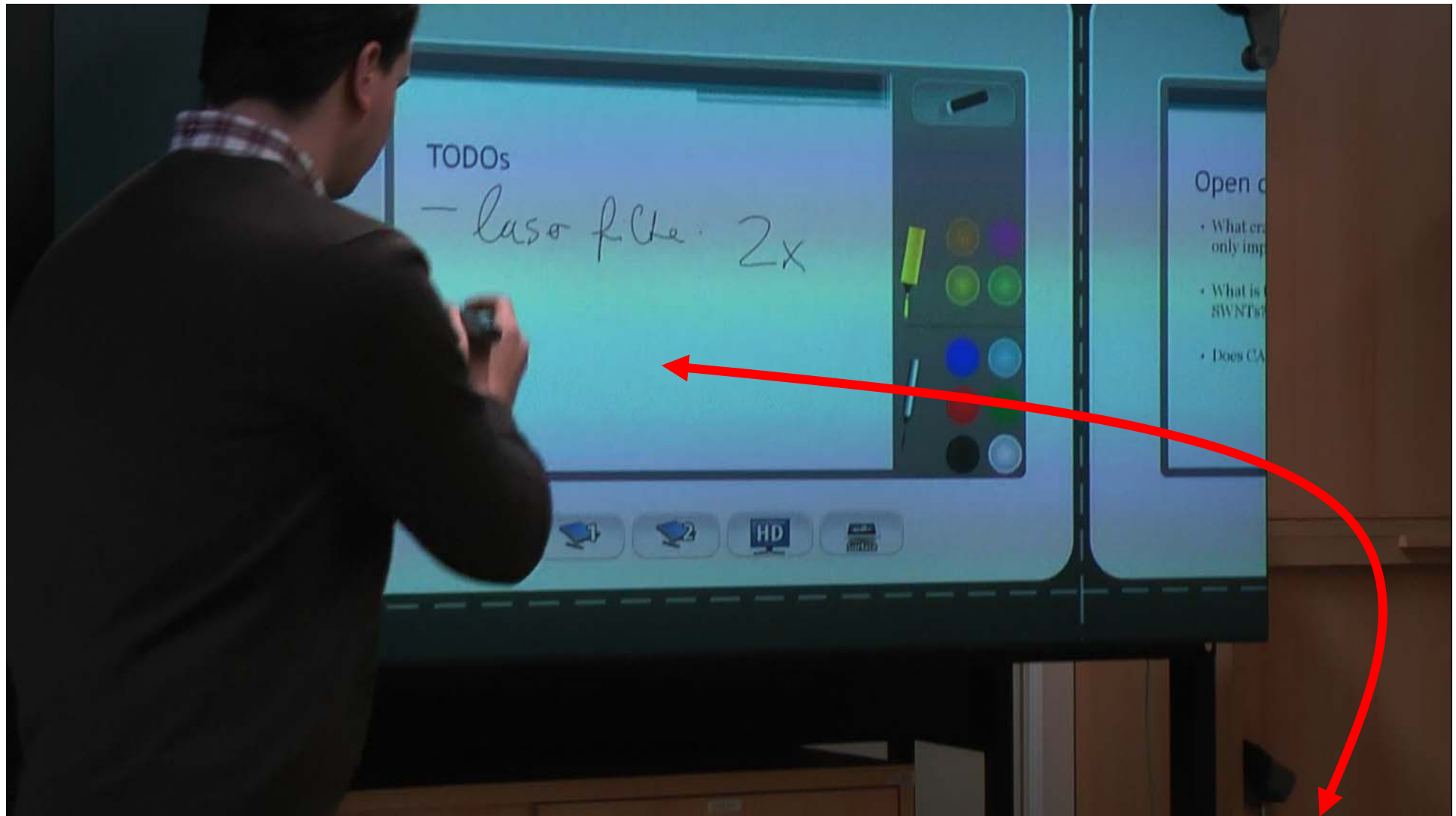


Interactive Spaces: Examples for Collaborative Information Interaction



Interactive Spaces: Examples for Collaborative Information Interaction





Interactive Spaces: Examples for Collaborative Information Interaction



Problems with Post-WIMP interfaces, e.g. tangible user interfaces:

- lack of appropriate interaction abstractions (*e.g. lack of modeling techniques*)
- shortcomings of current user interface toolkits to address continuous and parallel interactions (*e.g. too biased towards sequences of GUI pages & dialogs*)
- excessive effort required to integrate novel input and output technologies (*e.g. difficult to integrate multi-touch & tangible input and provide collaboration between multiple I/O-surfaces*)

[Shaer & Jacob 2009] (*and our interpretation/examples*)

Possible direction of future research:

How to create a tool chain for model-based design and prototyping of such interactive spaces for information interaction?

What I present today is a pilot study and first steps towards this...

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Frameworks for “Information Interaction” as starting points

Blandford et al.’s “Information Journey” (Context: Digital Libraries, 2010)

- 1. recognizing an information need*
- 2. acquiring information*
- 3. interpreting information*
- 4. using information*

Card’s “Knowledge Crystallization Operators” (Context: InfoVis, 2003)

- 1. acquire information*
- 2. make sense of it*
- 3. create something new*
- 4. act on it*

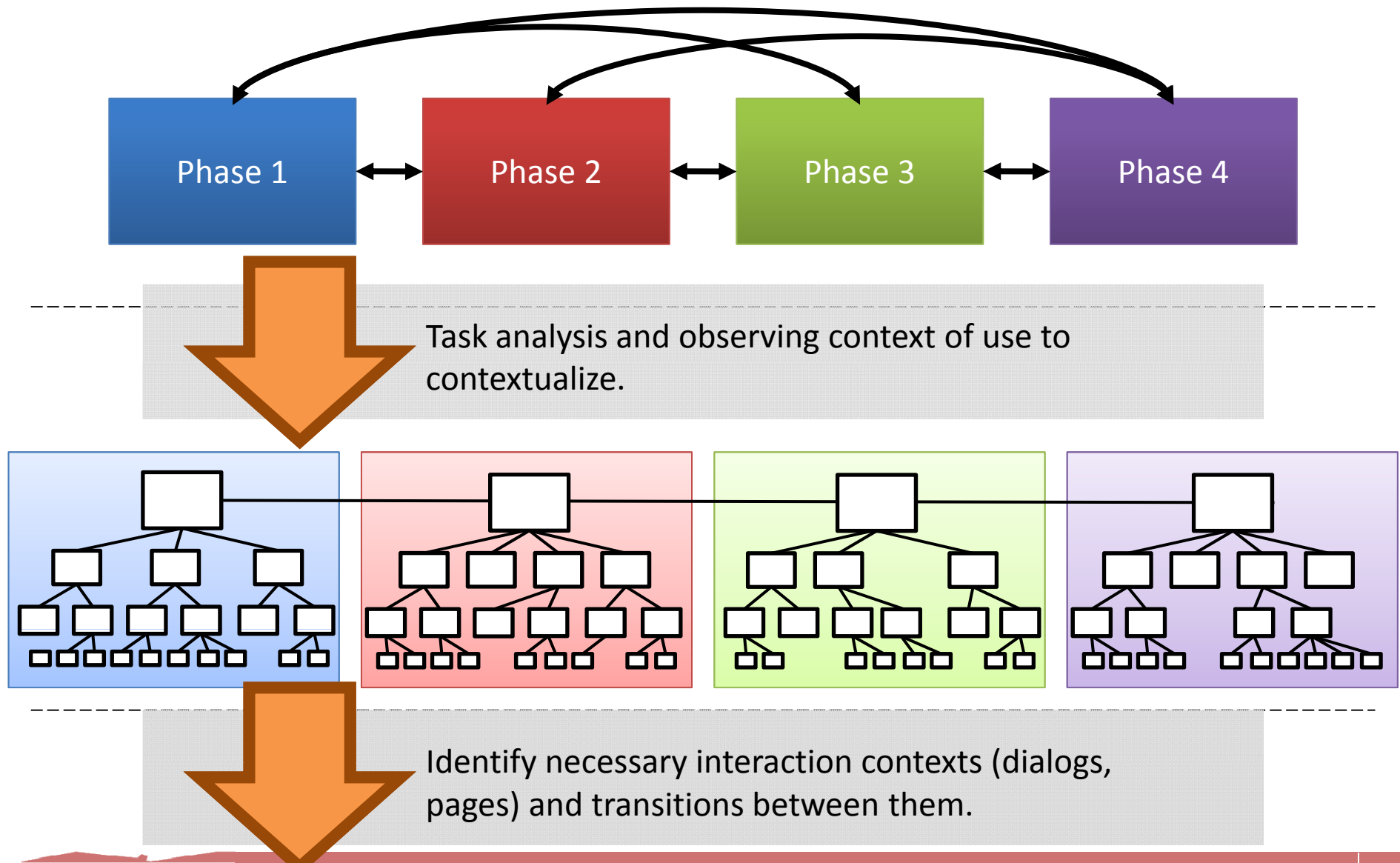
Shneiderman’s “Mega-Creativity Framework” (Context: Digital Creativity, 2002)

- 1. collect*
- 2. relate*
- 3. create*
- 4. donate*

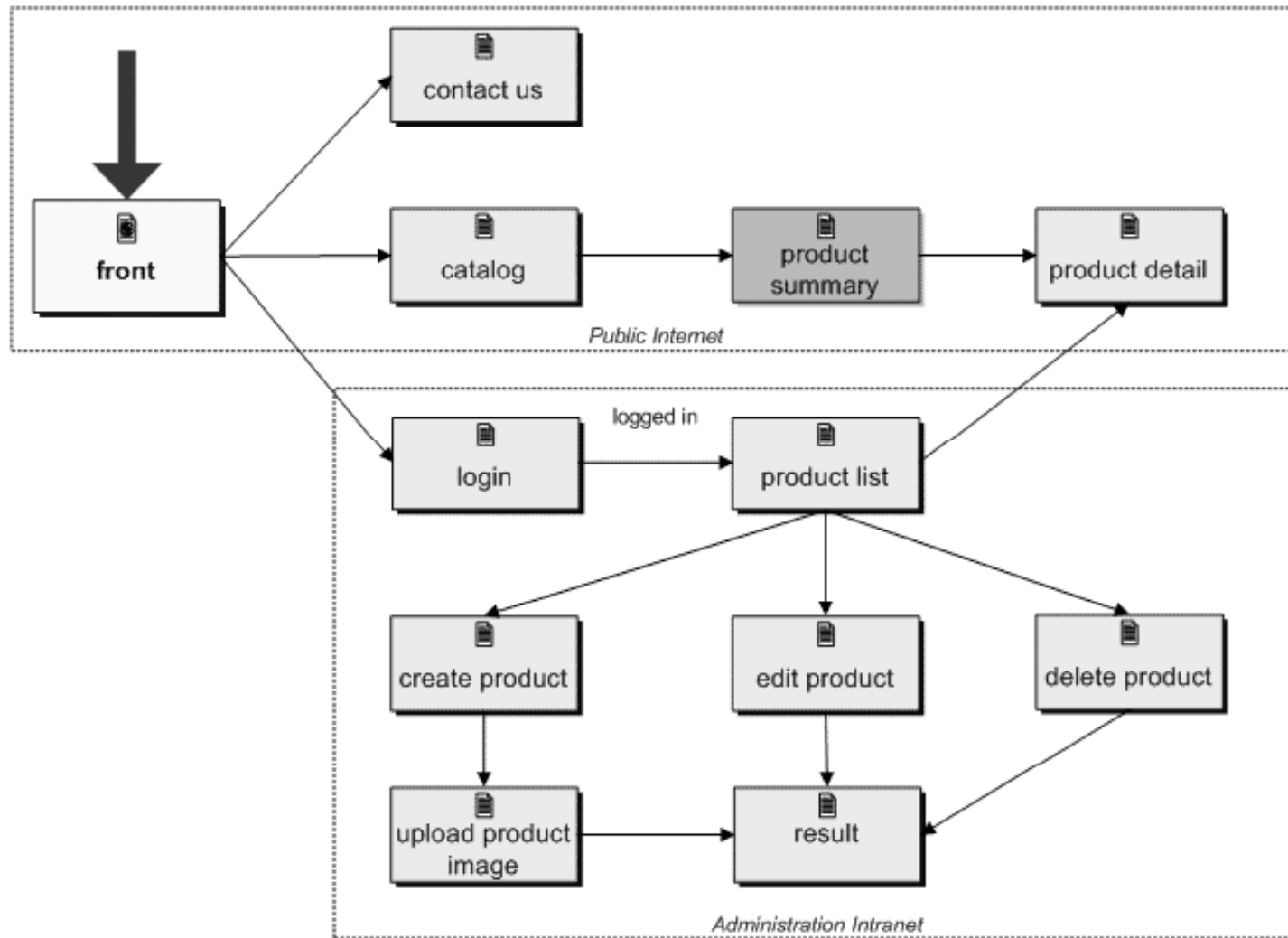
Lehikonen et al.’s “GEMS Model” (Context: Personal Content Experience, 2007)

- 1. get*
- 2. enjoy*
- 3. maintain*
- 4. share*

Generic Frameworks of Information Interaction

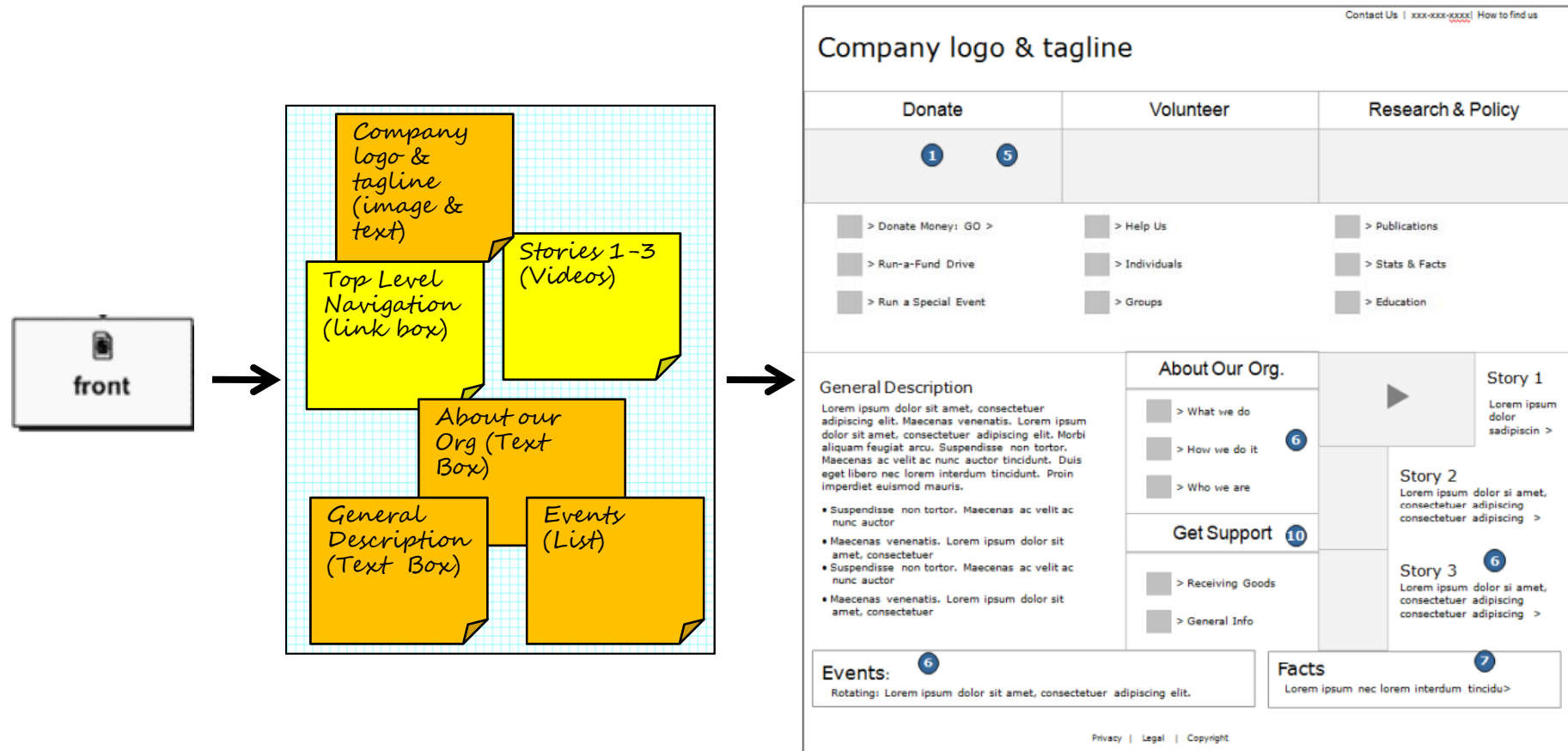


Navigation maps or page flows connecting the interaction contexts



Source: <http://www.javaworld.com/javaworld/jw-07-2004/images/jw-0719-jsf2.gif>

Detailed design of an interaction context (wireframes to HTML)



Source: http://www.akendi.com/assets/wireframe_example4.png

Problems when applying this to post-WIMP interactive spaces for information interaction:

- Reality-Based and Embodied Interaction is not discrete but continuous, e.g. navigating with multi-touch in a zoomable user interface with semantic zooming, sliding a physical token on a tabletop.
- Functionality in interactive spaces is attached to content and domain objects (*“the content is the interface”*, Edward Tufte, Dennis Wixon) and not to pages, windows, dialogs, or pulldown menus or other *“administrative debris”*
- Multiple points of action in an interactive space, e.g. multiple fingers, hands, devices, or users (e.g., bi-manual interaction with a multi-touch widget)
- An interactive space does not have one current state or interaction context but many (if not infinite)
- Sensible sequential “step-by-step” workflows are very difficult (if not impossible) to identify . Flexibility is key. (see Embodied Interaction [Dourish 2004], Situated Action [Suchman 1987])

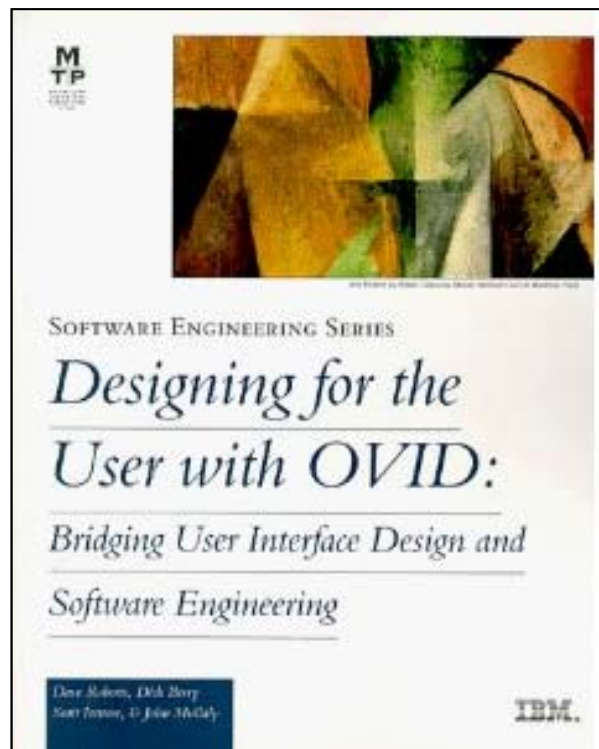
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Can the “Object-Oriented User Interfaces” of the 1990s be of any help?

(e.g. by [Mandel 1994], [Collins 1995], [Beck et al. 1995], [Roberts et al. 1998])

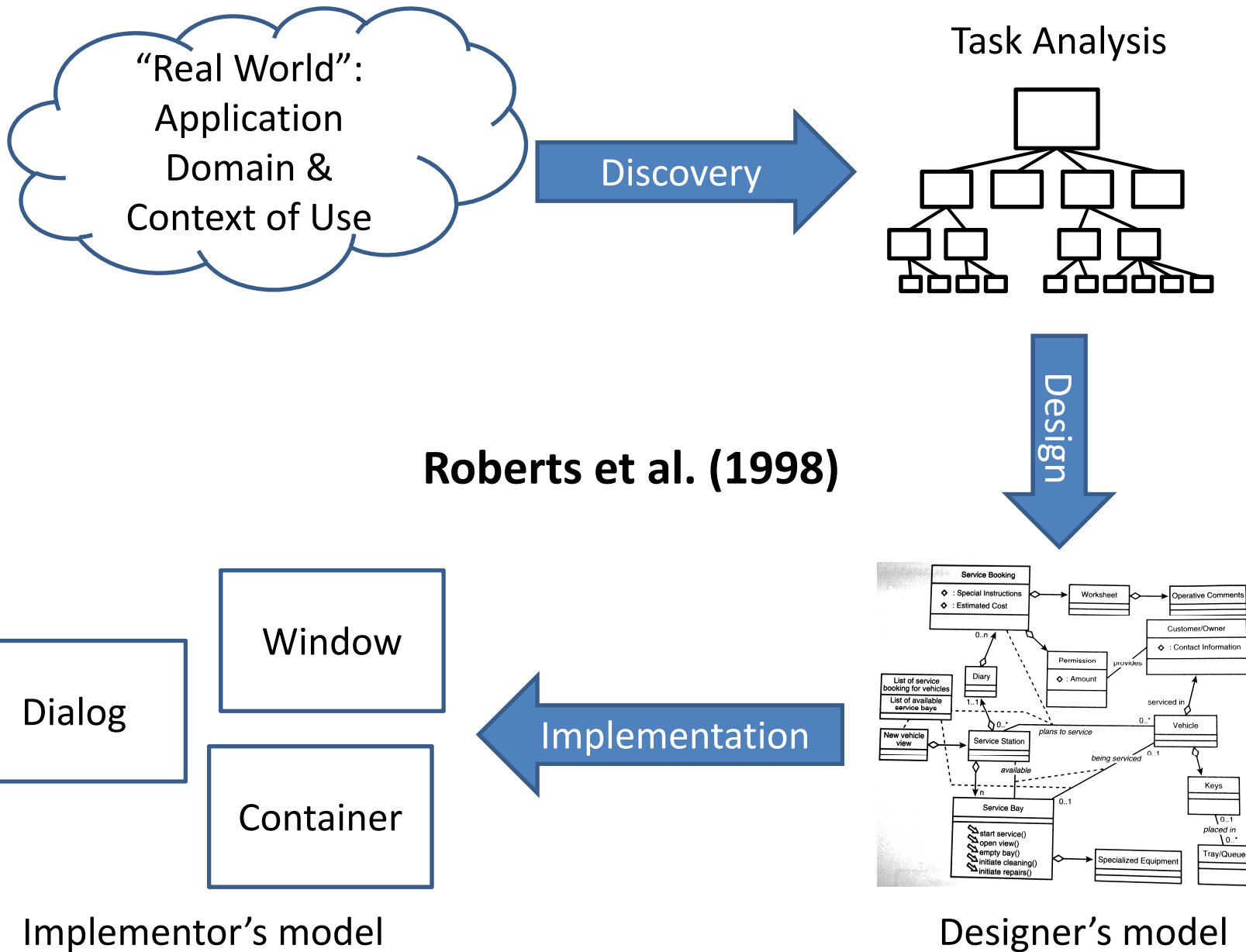
- In an OOUI, the user interacts explicitly with objects that represent entities in the domain that the application is concerned with by direct manipulation.
- Comprehensive methodology: IBM’s OVID (**O**bject, **V**iew and **I**nteraction **D**esign)



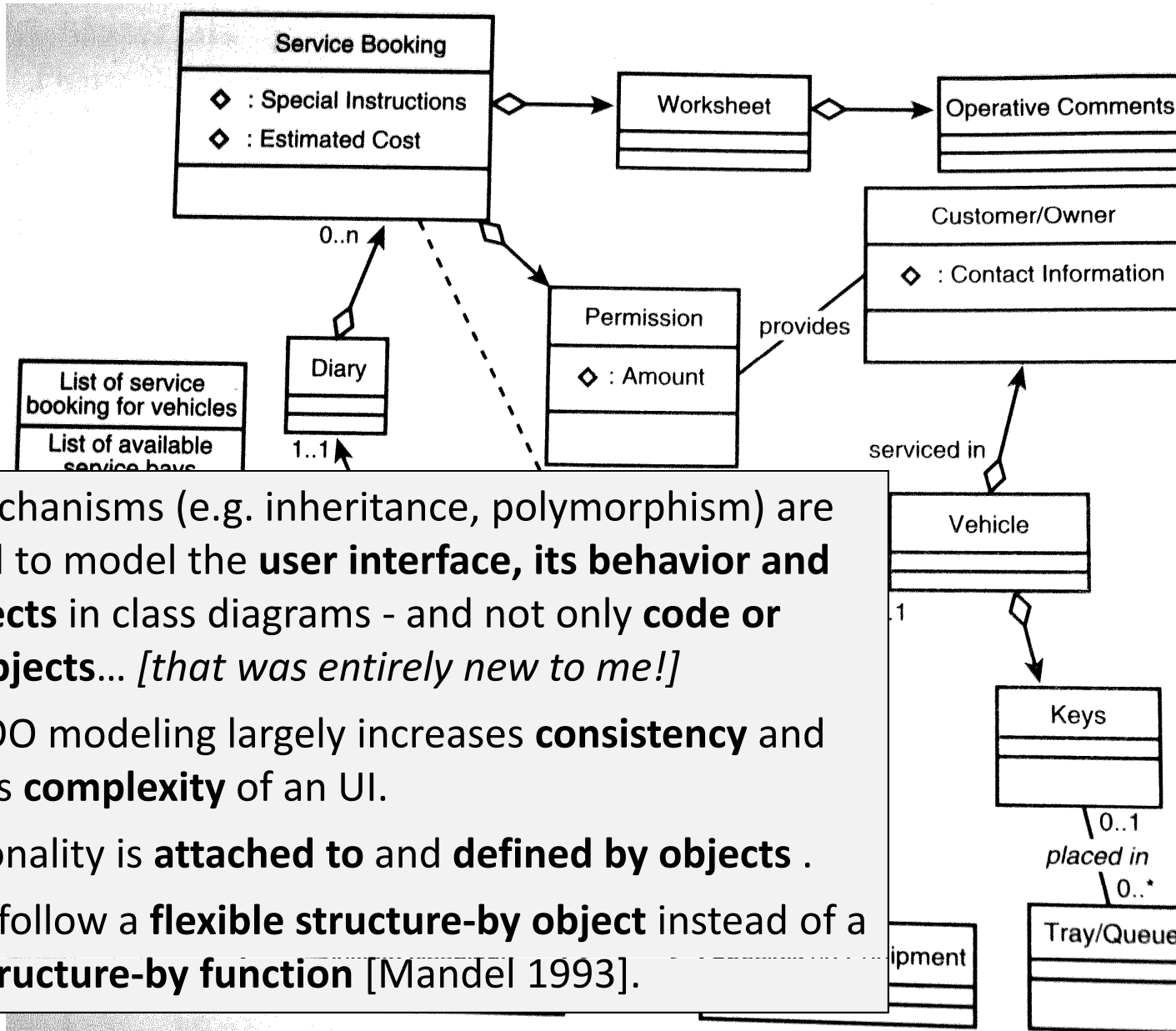
Roberts et al. (1998)

“An object-oriented user interface focuses the user on objects - the things people use to accomplish their work. Users see and manipulate object representations of their information. Each different kind of object supports actions appropriate for the information it represents.”

“At the heart of OVID is the *designer's model*, a conceptual model that includes descriptions of the objects users will employ to perform their tasks, the properties of those objects, and the interrelationships between them.”



Revisiting Object-Oriented User Interfaces: Designer's Model



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Let's try it out: Does object-oriented modeling and design of an user interface work for our students?

Task: "Model, design, and implement a zoomable user interface for direct manipulation. The interface shall enable users to search for hotels and to manage and annotate results."

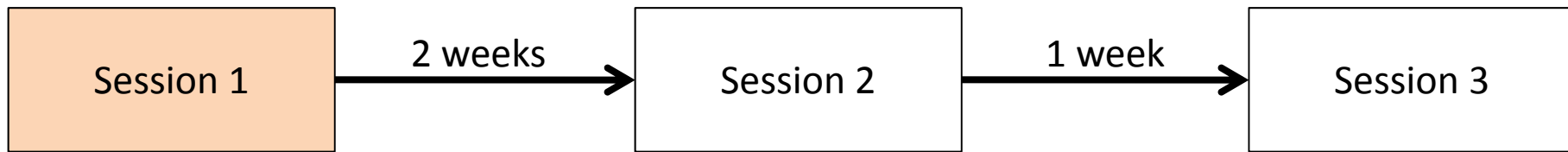
In this first case study: no multi-display and no multi-user scenario!

Input A

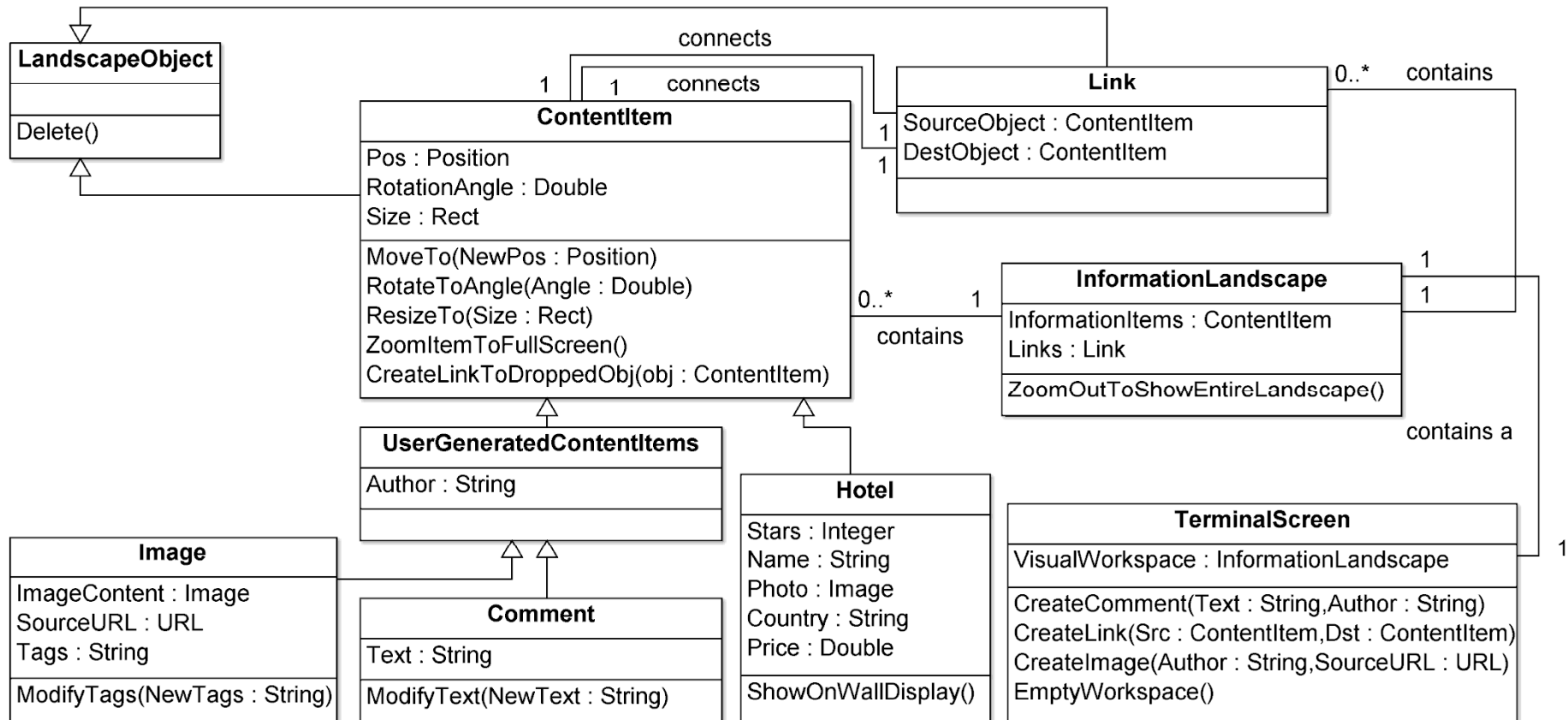
8 informal functional requirements
(e.g., "user must be able to add a textual comment to the workspace", "user must be able to zoom into all relevant details")

Input B

22 required object properties / metadata
(e.g., "each *Hotel* has a *Price* ",
"each *Comment* has an *Author*",
"each *Image* carries *Tags*")



- 11 participants (9 graduate-level and 2 undergraduates of computer science)
- Participants formed 5 teams (4x teams of 2, 1x team of 3)
- **Session 1 (Briefing – all teams together):**
 - 1 hour introduction into object-oriented modeling of user interfaces
 - Introduction based on creating an example model for an user interface for an image database
 - Assignment for next session: create own model for an user interface for searching hotels and managing and annotating results (based Input A and B)



Our model of the interface for hotel search



- **Session 2 (Study session – each team individually):**
 - Task 1: team presents and explains their prepared model
 - Task 2: team checks validity of the model (checking for the 8 functional requirements in a walkthrough)
 - Task 3: team checks validity of our previously unknown example model (checking by walkthrough again)
- Team members fill out questionnaire about difficulty of task 1-3
- Assignment for next session: design and prototype an interactive user interface based on the team's model (using our ZOIL software framework)

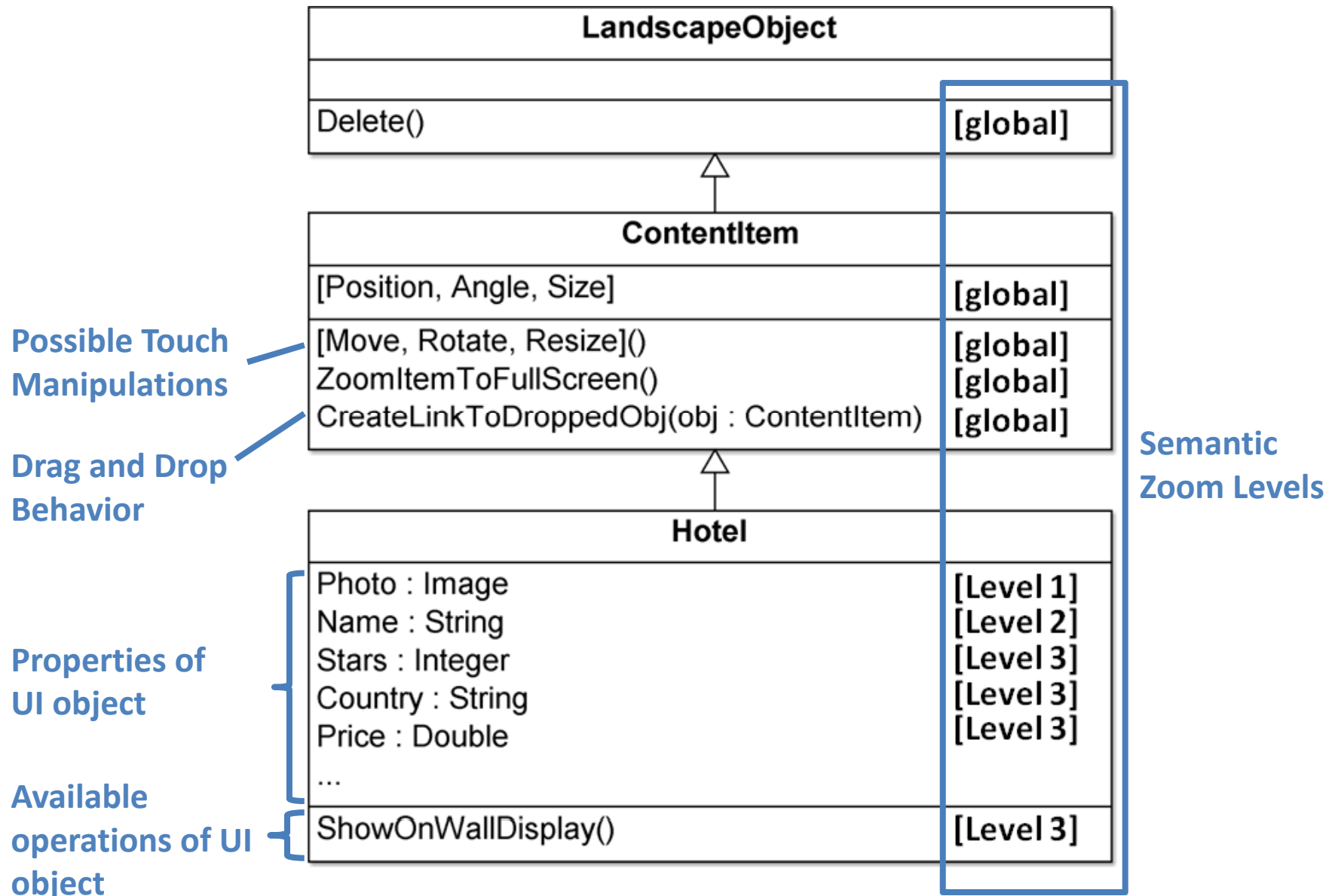
Case Study – ZOIL (Distributed Zoomable, Multi-Touch and Tangible User Interfaces)

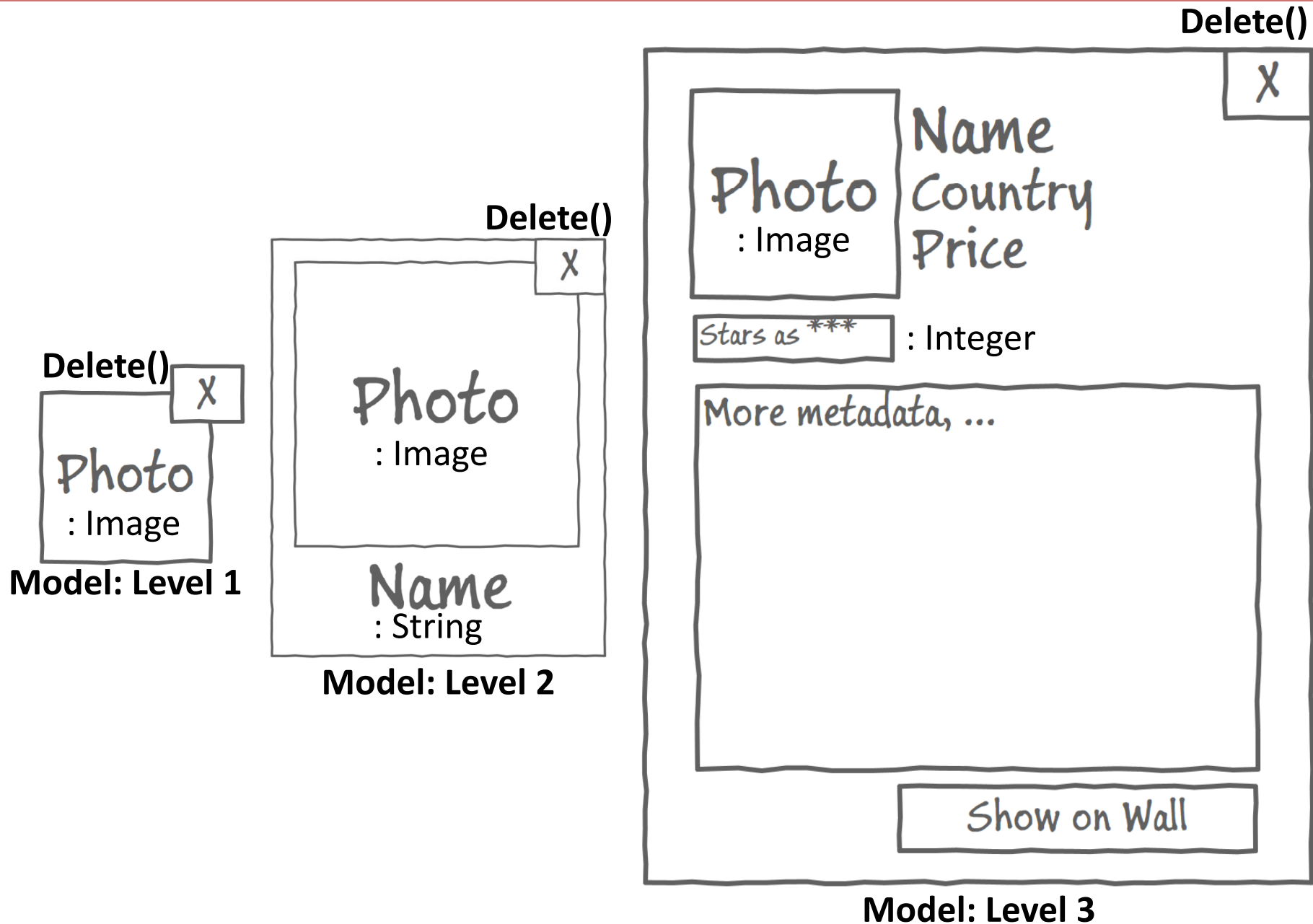


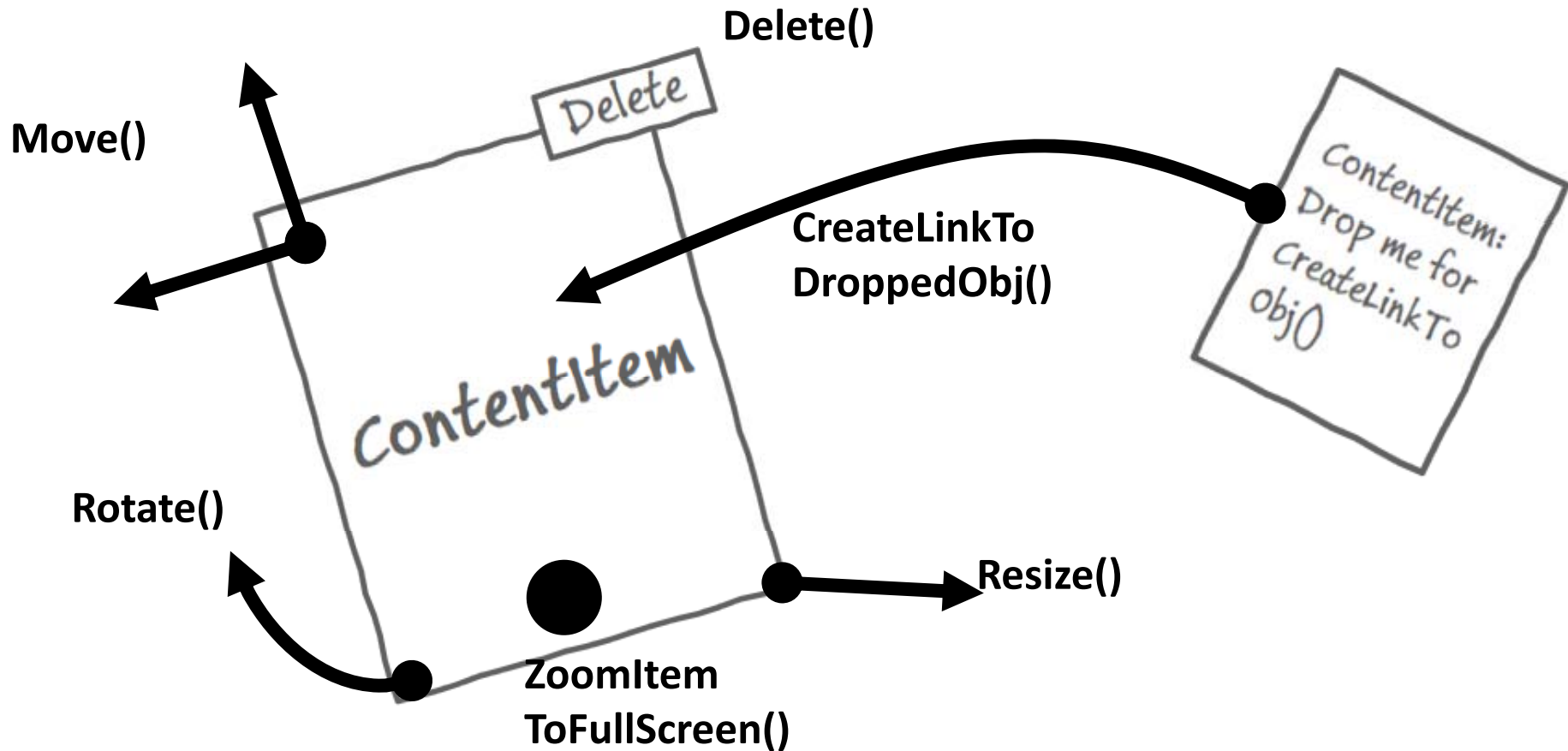
ZOIL = **Z**oomable **O**bject-Oriented
Information **L**andscape.

Software framework for implementing
distributed zoomable, multi-touch and
tangible user interfaces.

Will soon be released as Open Source:
<http://zoil.codeplex.org>



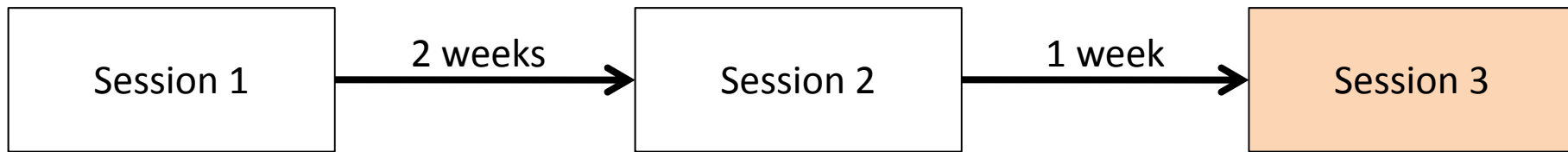




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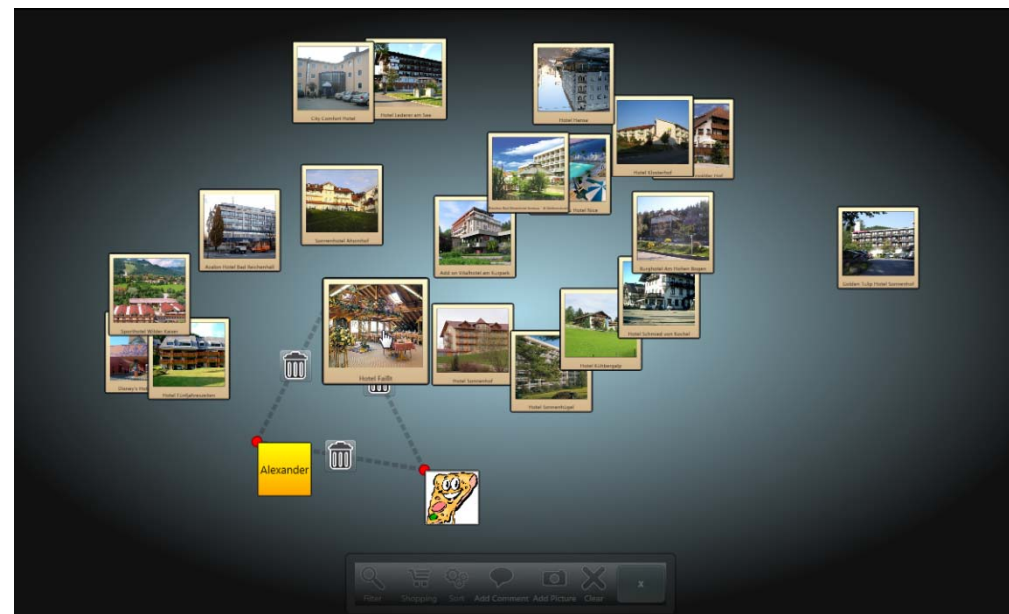
<ZComponent x:Class="Hotel"
  ZObjectDragDropBehavior.IsDraggable="True"           Move()
  ZObjectResizeBehavior.IsResizable="True"             Resize()
  ZObjectRotateBehavior.IsRotatable="True"            Rotate()
  ZInformationLandscape.ZoomTarget="True"> ...         ZoomItemToFullScreen()
  <ZObjectDropBehavior Type="{x:Type ContentItem}"
    Command="{Binding CreateLinkToDroppedObj}"/> ...   CreateLinkToDroppedObj()
  <ZComponentFrames>
    <ZComponentFrame WidthNeeded="0"> ... Level 1 ... </ZComponentFrame>   Model: Level 1
    <ZComponentFrame WidthNeeded="100"> ... Level 2 ... </ZComponentFrame> Model: Level 2
    <ZComponentFrame WidthNeeded="500"> ...                               Model: Level 3
      <Image Source="{Binding Photo}" Grid.Row="0" Grid.Column="0"/> ...   Photo: Image
      <TextBlock Text="{Binding Name}"/> ...                               Name: String
      <TextBlock Text="{Binding Country}"/> ...                           Country: String
      <TextBlock Text="{Binding Price}"/> ...                             Price: Double
      <StarRating CurrentValue="{Binding Stars}"/> ...                   Stars: Integer
      <Button Content="Show on Wall" Command="{Binding ShowOnWallDisplay}"/> ... ShowOnWallDisplay()
    </ZComponentFrame>
  </ZComponentFrames> ...
  <Button Command="{Binding Delete}" HorizontalAlignment="Right"
    VerticalAlignment="Top"> ...                                         Delete()
</ZComponent>

```



- **Session 3 (Study session – each team individually):**

- Team presents and explains their interactive prototype
- Each team member fill out questionnaire to rate the overall usefulness of the modeling approach and the difficulty to apply it

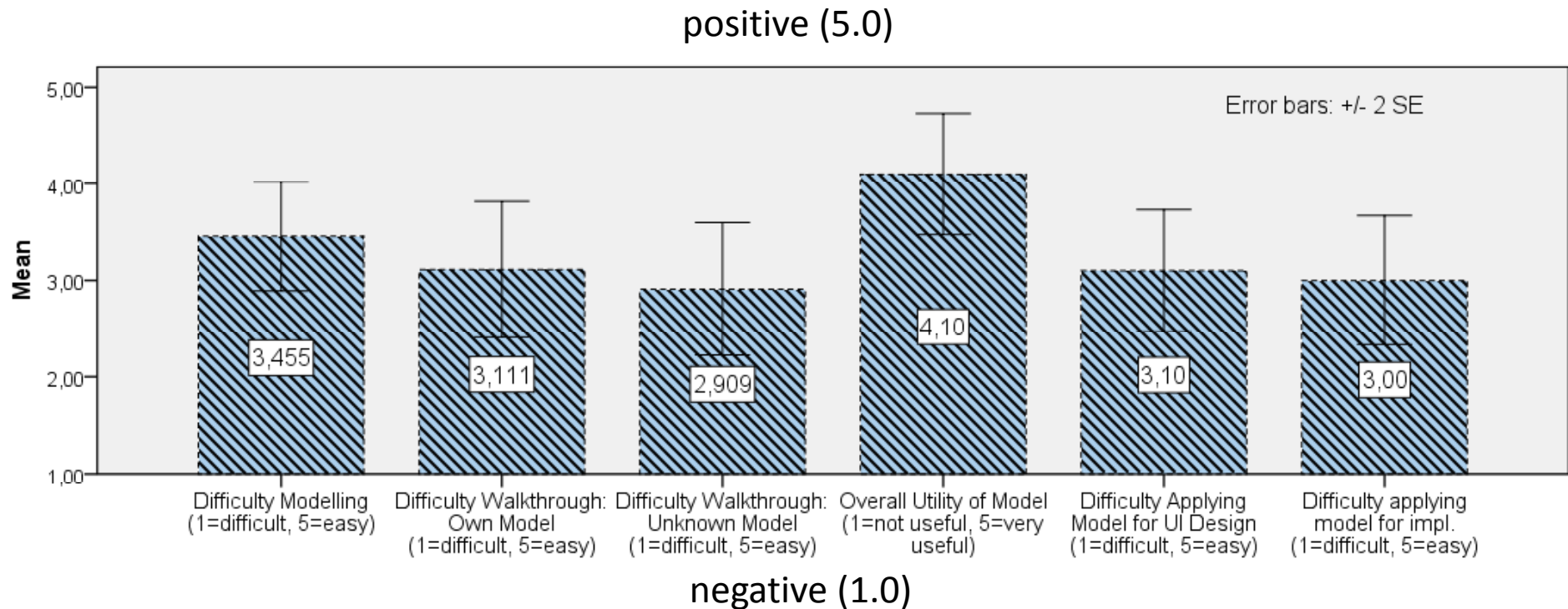


Results:

- All teams presented formally correct models that covered all functional requirements.
- All teams successfully carried out walkthroughs to validate own and unknown models.
- All teams presented interactive prototypes that covered the requested functionality.

- Participants initially struggled with modeling a user interface in a UML like notation (e.g. initially confused modeling data models with modeling user interface objects)

- Side note: Teams had a hard time getting away from WIMP designs (see prototypes)
→ *Students are “spoiled” by the Web and prefer to think in pages and pop-ups.*



- Overall utility of the modeling technique was considered as useful (mean=4.1, sd=0.99)
- All aspects (e.g. difficulty of modeling, difficulty of applying model for implementation) was not considered particularly difficult nor easy (neutral)
- **Promising results (but far from being clear!)**

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- Interactive spaces pose new challenges to model-based design and prototyping → Traditional design approaches based on discrete input and task-oriented sequences of dialogs or pages fail.
- Revisiting the Object-Oriented User Interfaces of the 1990s is a worthwhile undertaking. They support continuous interaction, provide more flexibility and achieve a feeling of directness
- In a case study participants have successfully employed OO modeling techniques to the design of a zoomable user interfaces for information interaction.

However: study was only a first step!

- Study has only covered a very small part of modeling entire interactive spaces.
- In future, the key aspects of collaboration, concurrency, different states of objects and physical objects have to be investigated.