How Tangible can Virtual Prototypes be? On the Limits and Potential of Going Virtual

What are Prototypes?

- **Communicate** and demonstrate **design ideas** to end users (Fig. 2)
- Design ideas are externalized so that the "*world can speak back to us*" [Sch87]
- Transformation of an idea which *filters* (emphasizes or diminishes) aspects (Fig. 5)
- **Experiencing a prototype** enables end users to judge, evaluate and comment on it and its suitability for the task it was envisioned for
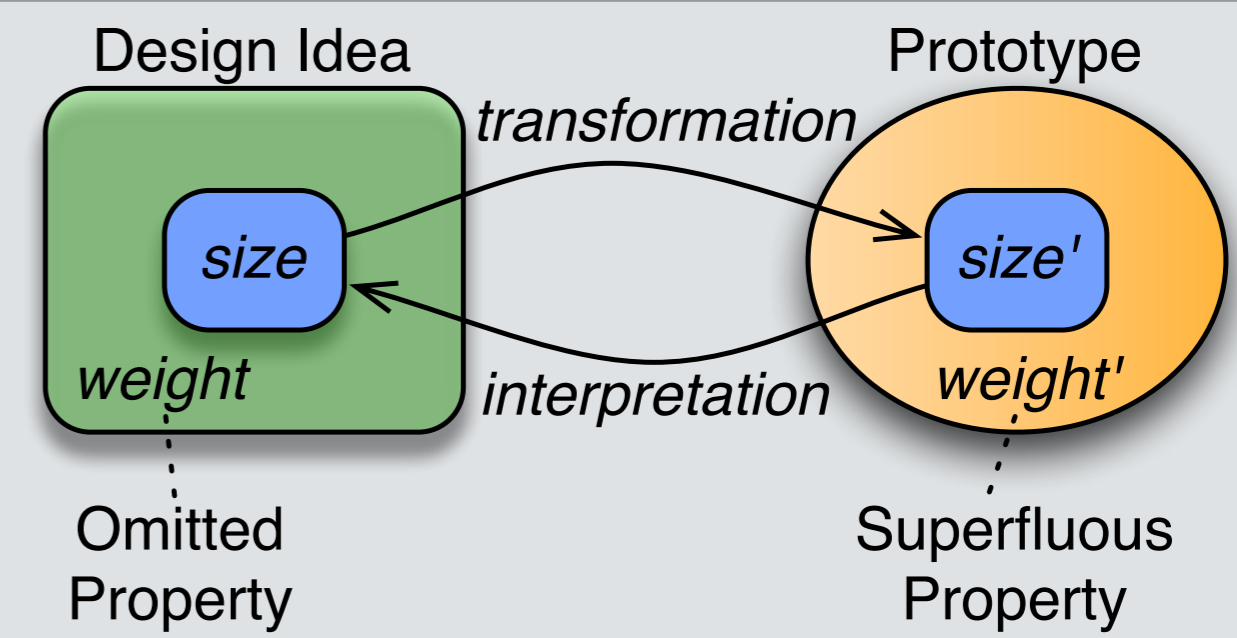- Consequently, end user feedback can be collected to evaluate design ideas and alternatives

Figure 1: Design ideas are externalized in the form of prototypes thereby filtering relevant properties
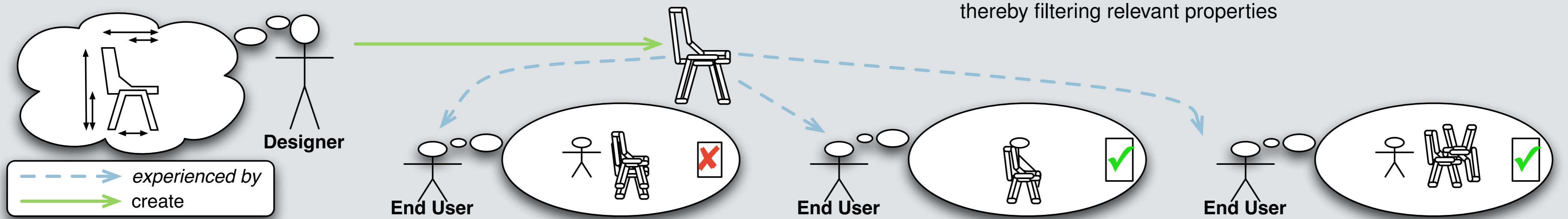

Figure 2: A concept is embodied in a prototype which can be evaluated by end users to judge whether they can see themselves use it

Types of Prototypes

Physical vs. Intangible

Physical

- End users perceive transformed design ideas by touching, using, and **experiencing prototypes**
- Affordances can be expressed by creating similarities end users intuitively recognize, e.g.:

  We can perceive the affordances of doorhandles because the attributes relevant for grasping are available for perception [Gav91]

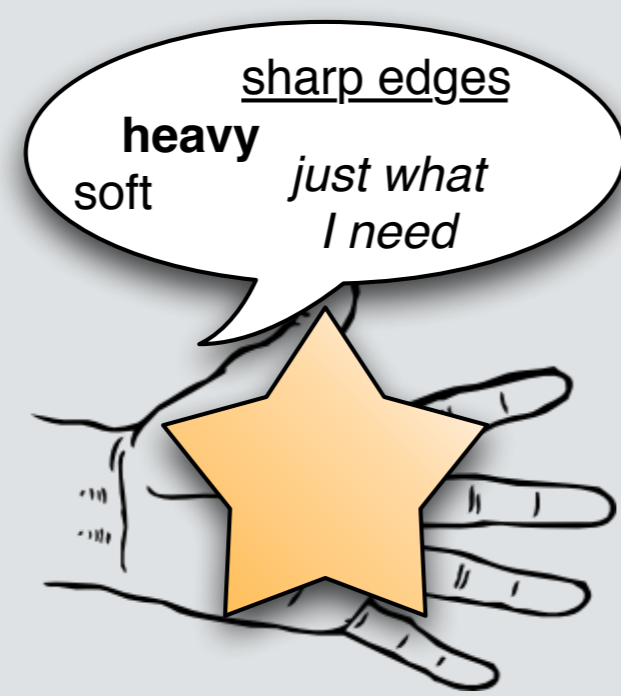- **Affordances should be obvious to end users**, thus, without any prerequisites

Figure 3: Physical prototypes can be experienced first hand

Intangible

- How to externalize & communicate design ideas that are intangible by nature?
- In certain domains, **models exist that can externalize concepts of the domain**
  - Unified Modeling Language for modeling *Software Systems*
  - Molecular Models used in *Computational Chemistry*
- As externalization of design ideas, **models can be considered as prototypes** since...
  - Models abstract from an original and thereby allow to filter relevant properties
  - Models can *manifest* a design idea
  - Models provide affordances as defined in their corresponding meta model
- However, **affordances of models cannot be perceived intuitively**

* Due to an enormous body of HCI research, this problem can be considered as solved for GUI prototyping
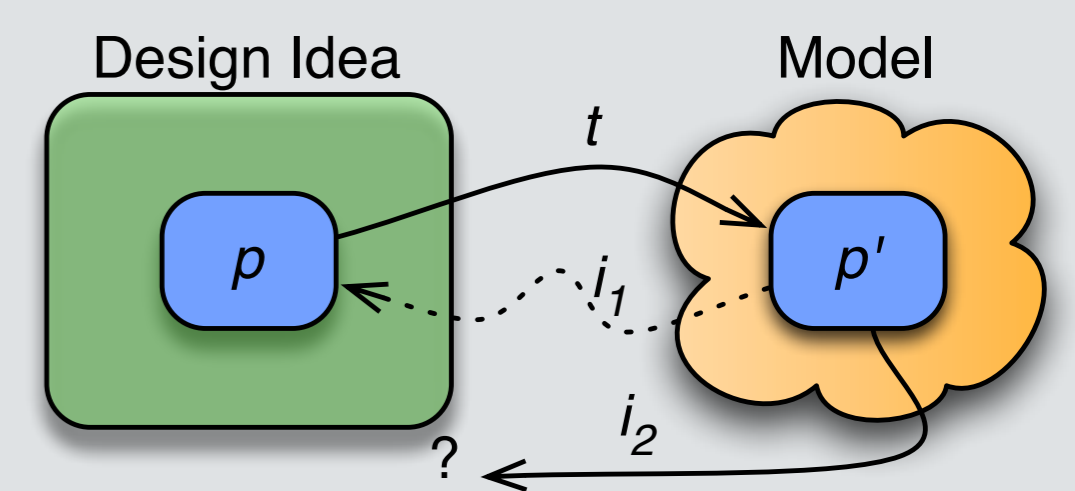

Figure 4: A property (p) manifested in a model (p') needs to be interpreted correctly which might require a certain understanding of the modeling notation's semantics. Without this knowledge, end users can hardly interpret p' correctly (i_2).

Virtual Prototypes: Creating Intuitive Interpretations

- **End users must understand what is presented to them** to provide feedback
- Models externalizing intangible design ideas refer to the end users' domain...
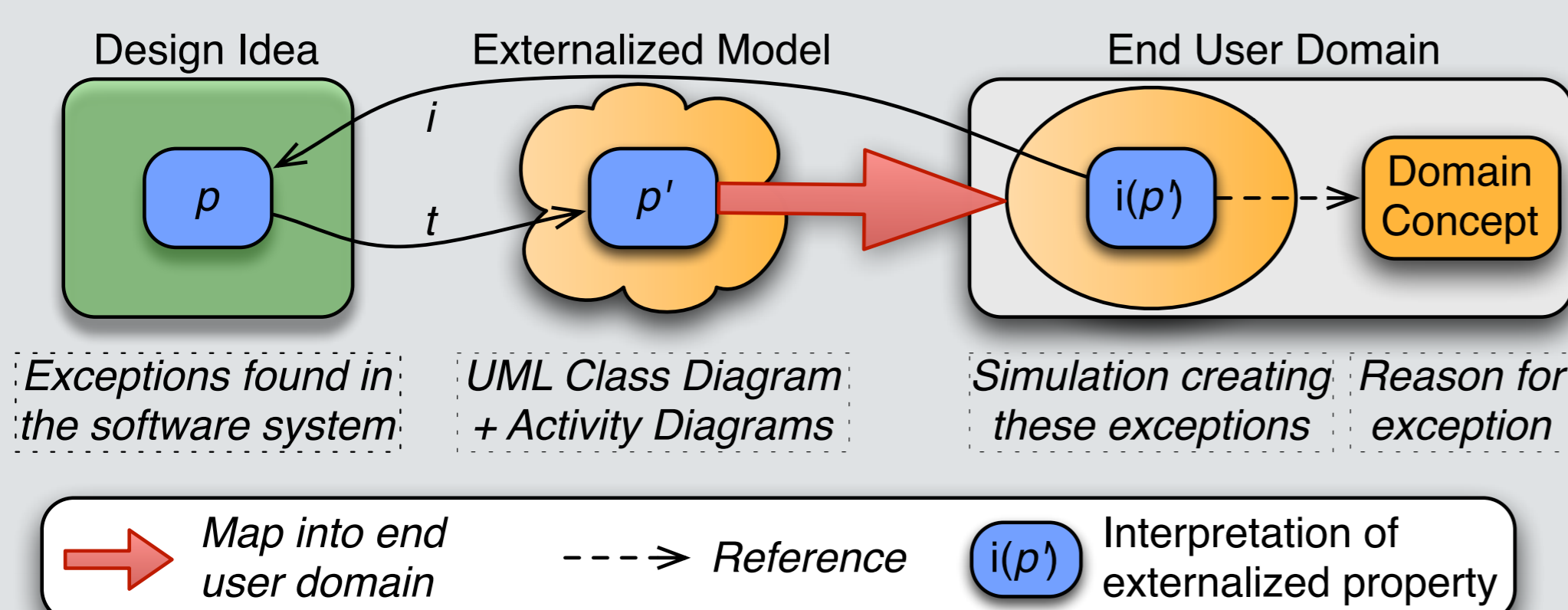- ... a domain the end users are usually experts in and recognize affordances of

Figure 5: Externalized design ideas (models) are mapped to be intuitive
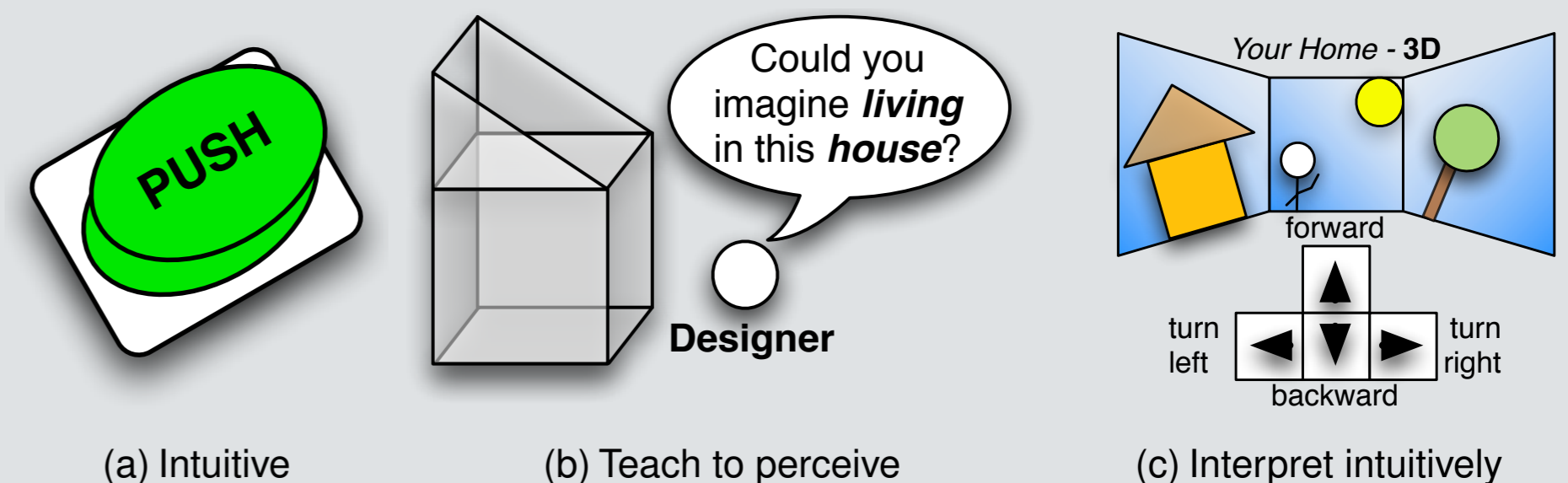

Figure 6: End users and the perception of affordances - either create them as intuitive as possible (*a*), teach end users to perceive affordances which are hidden or implicit (*b*), or offer intuitive interpretations within the end users domain of expertise (*c*)

An Example: Validating Insights of Multi-User Business Processes

- Elicit workflow & rationale behind interactions from all participants
- Present findings & implications to end users not as externalized (formal) model, but as **animated visualization** in the end users' domain
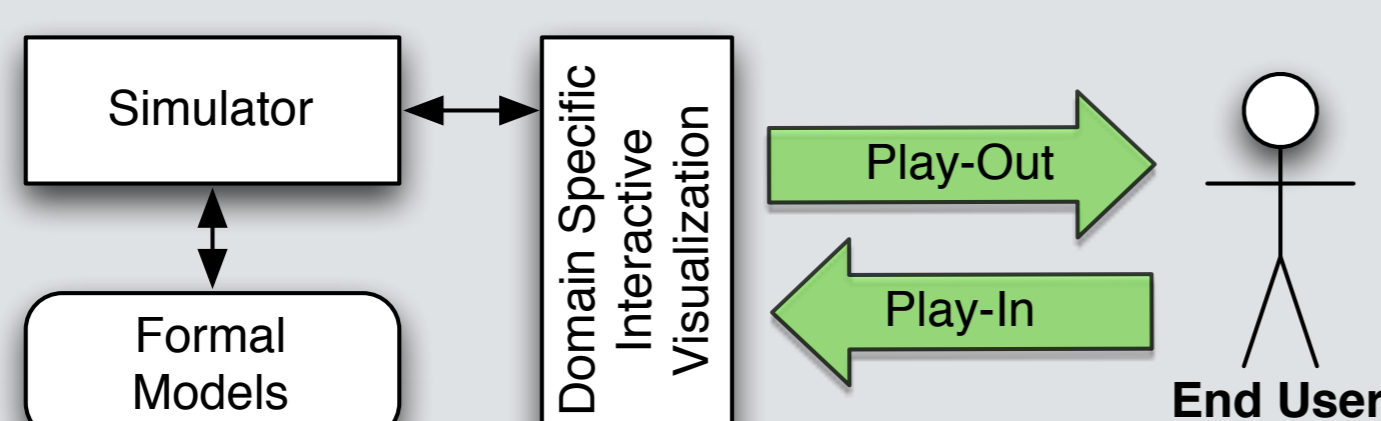

Figure 7: Affordances of models are provided intuitively for end users
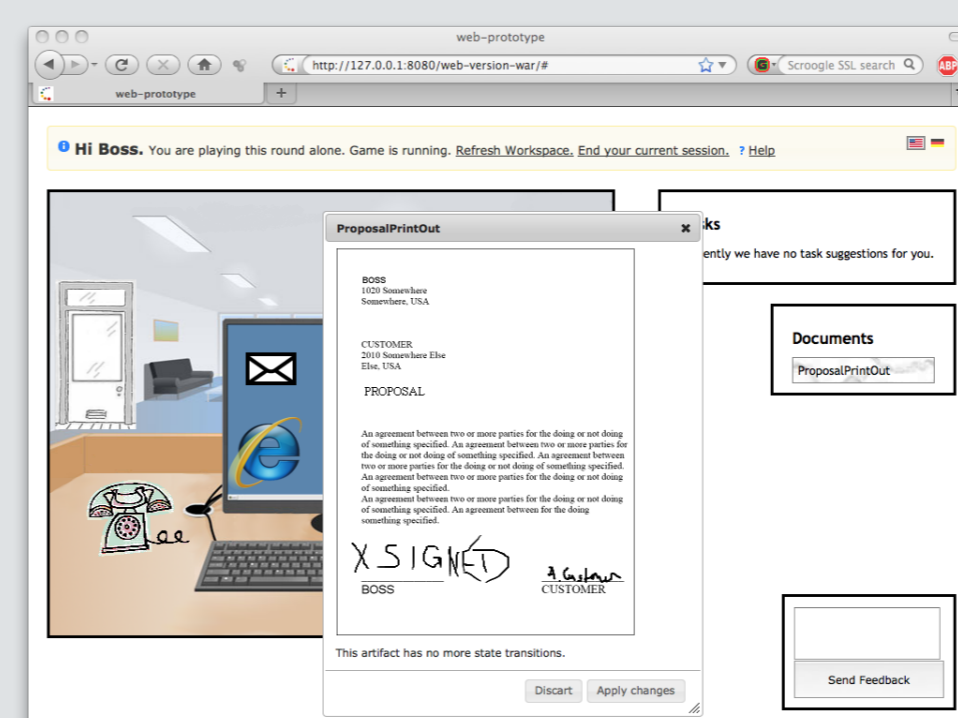

Figure 8: Documents afford to be signed

William W. Gaver: Technology affordances. In *CHI '91: Proceedings of the SIGCHI conference on Human factors in computing systems*, pages 79–84, New York, NY, USA, 1991. ACM.

Donald Schön: *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions.* Jossey-Bass, San Francisco, 1987.