Design study methodology

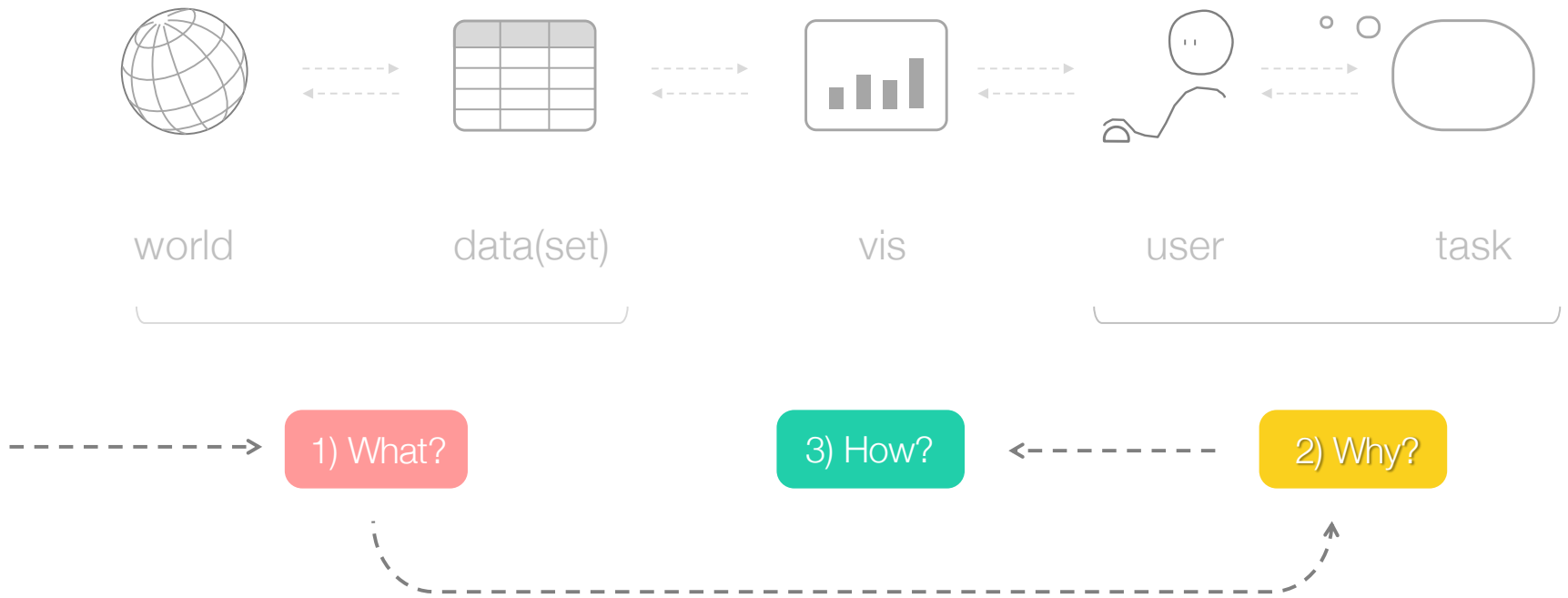
Torsten Möller

Acknowledgements

- Tamara's vis course slides

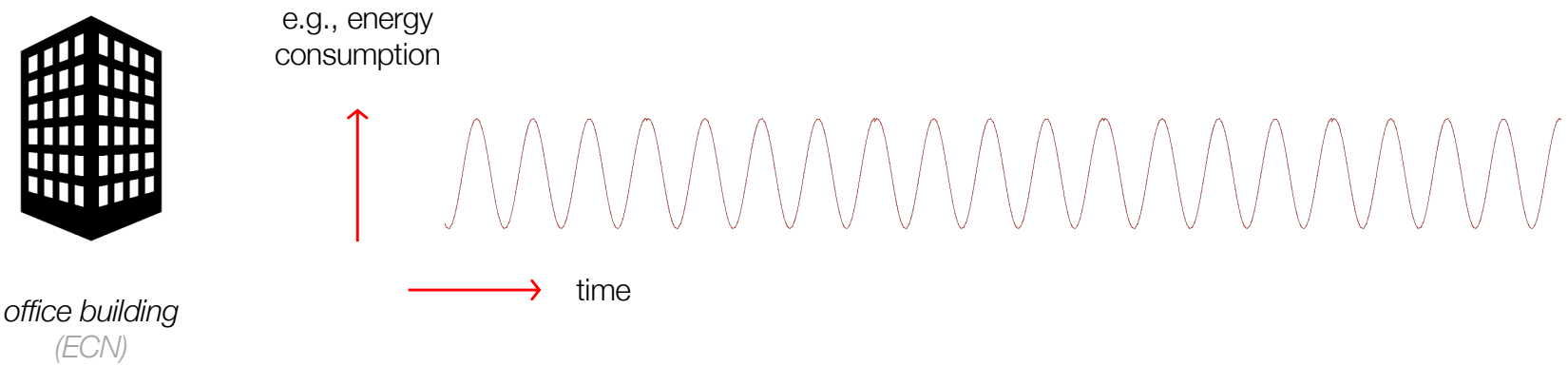
- Design study methodology: Reflections from the trenches and the stacks. Michael Sedlmair, Mariah Meyer, and Tamara Munzner. IEEE Trans. Visualization and Computer Graphics 18(12):2431-2440, 2012.

- Cluster and Calendar based Visualization of Time Series Data. Jarke J. van Wijk and Edward R. van Selow. Proc. InfoVis 1999, p 4-9.


world
data(set)
vis
user
task
1) What?
3) How?
2) Why?

Cluster and Calendar based Visualization of Time Series Data.
Jarke J. van Wijk and Edward R. van Selow. Proc. InfoVis 1999, p 4-9.

Research question:
How to create visual insights into univariante time series data?



office building
(ECN)

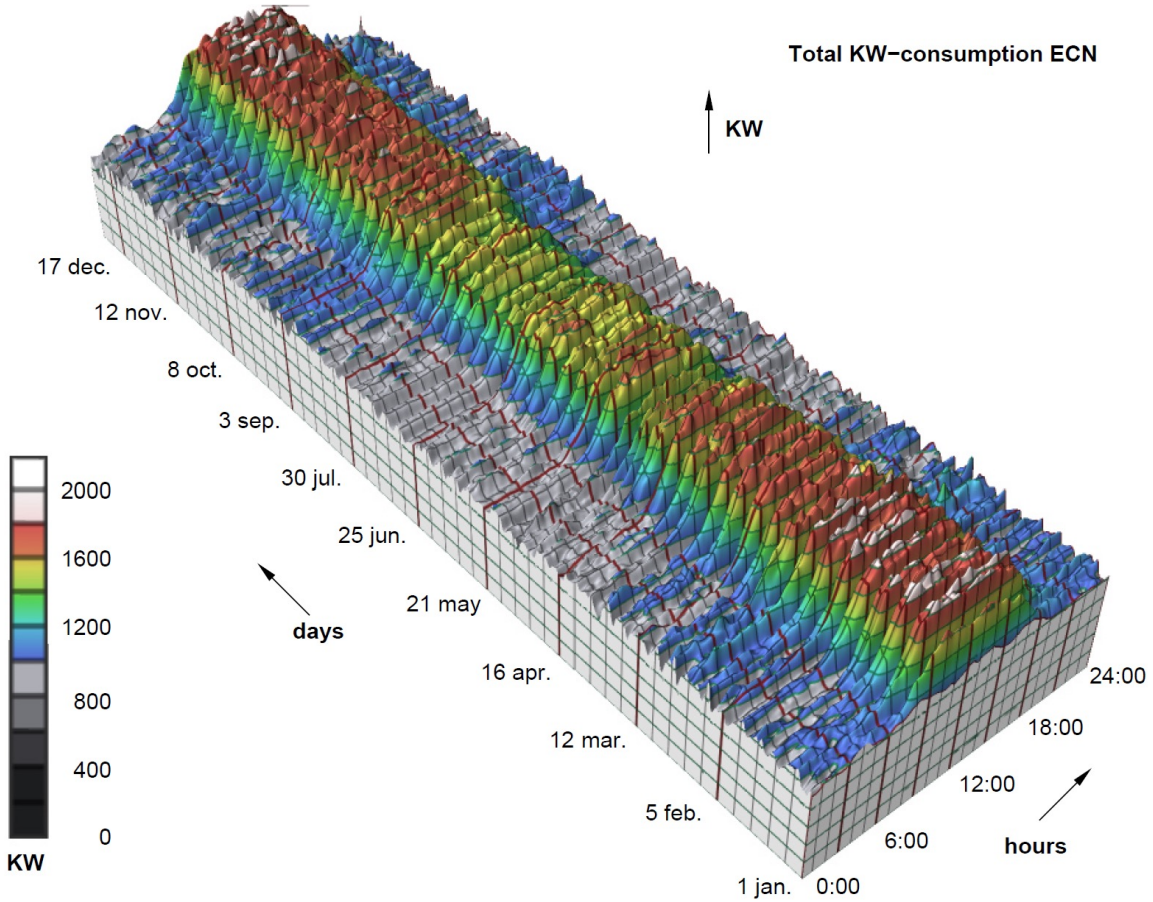


Figure 1: Power demand by ECN, displayed as a function of hours and days

Design No. 2

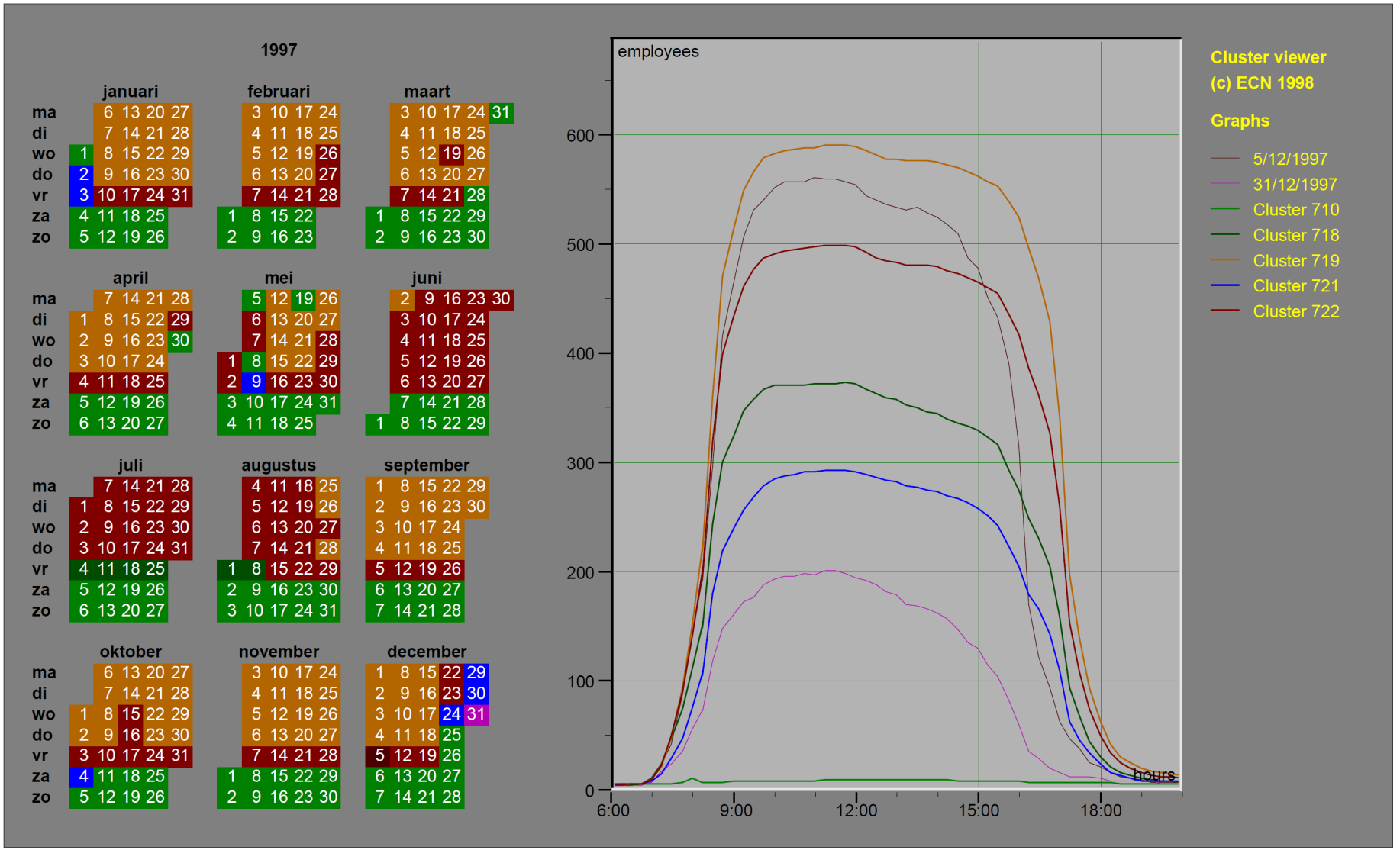
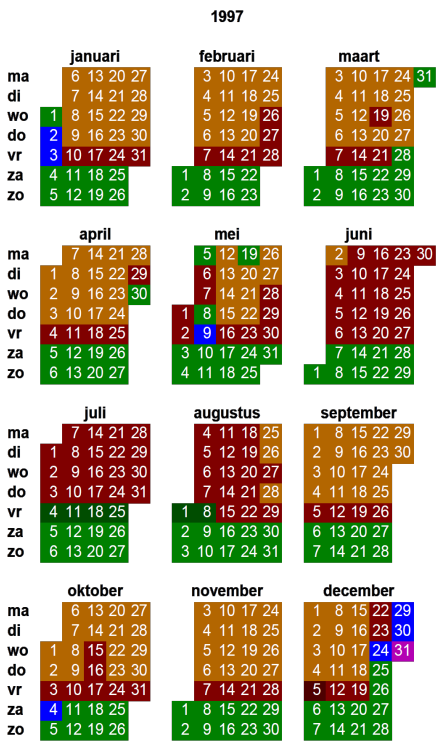
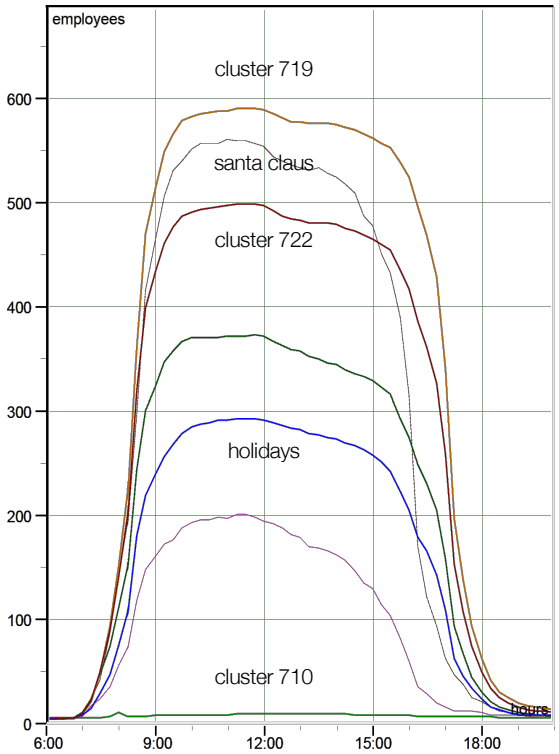


Figure 4: Calendar view of the number of employees

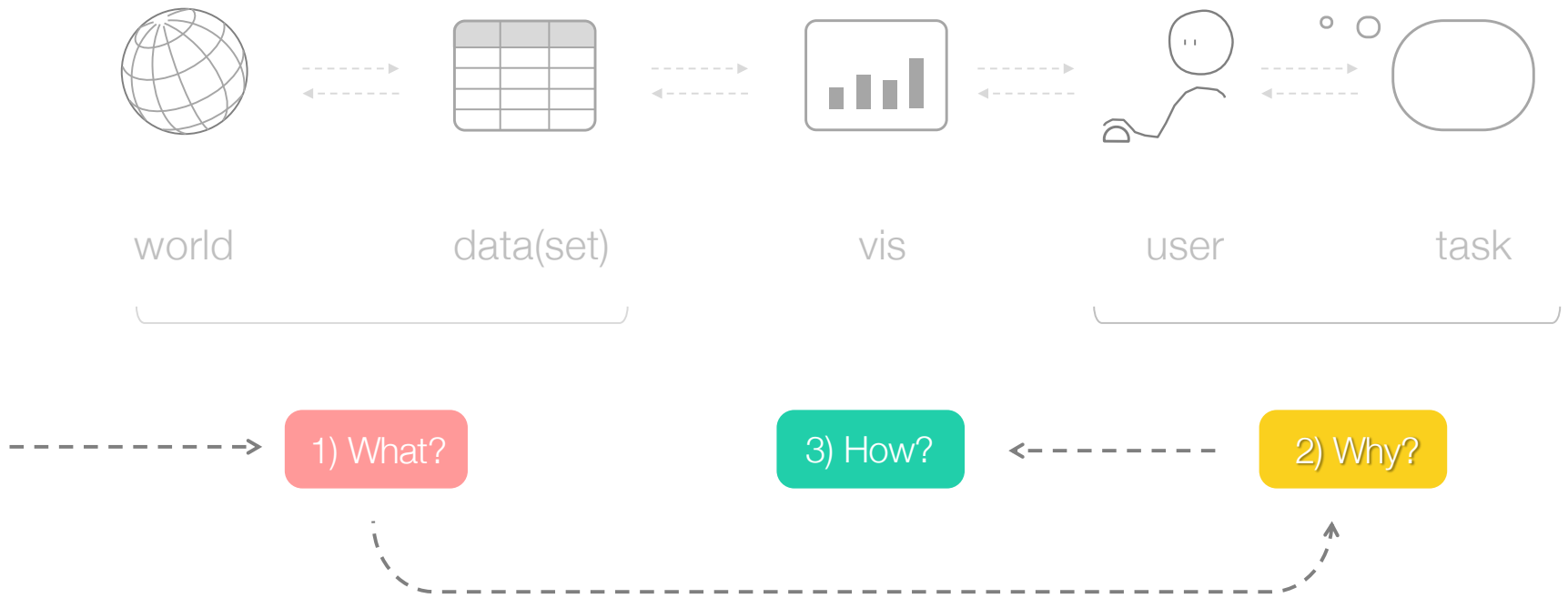




Several conclusions can be drawn from this image. We see that:

- Office hours are followed strictly. Most people arrive between 8:30 and 9:00 am, and leave between 4:00 and 5:00 pm. Furthermore, in the morning the number of employees present is slightly higher than in the afternoon.
- On Fridays and in the summer fewer people are present (cluster 722);
- On Fridays in the summer even fewer people are present (cluster 718);
- In the weekend and at holidays only very few people are working (cluster 710): security and fire brigade;
- Holidays in the Netherlands in 1997 were January 1st, March 28th, March 31st, April 30th, May 5th, May 8th, May 19th, December 25th and 26th.
- School vacations are visible in Spring (May 3rd to May 11th), in Autumn (October 11th to October 19th), and in Winter (December 21th to December 31st);
- Many people take a day off after a holiday (cluster 721);
- On December 5th many people left at 4:00 PM. Dutch people will immediately know the explanation: On this day we celebrate Santa Claus and are allowed to leave earlier!

Nested model for visualization design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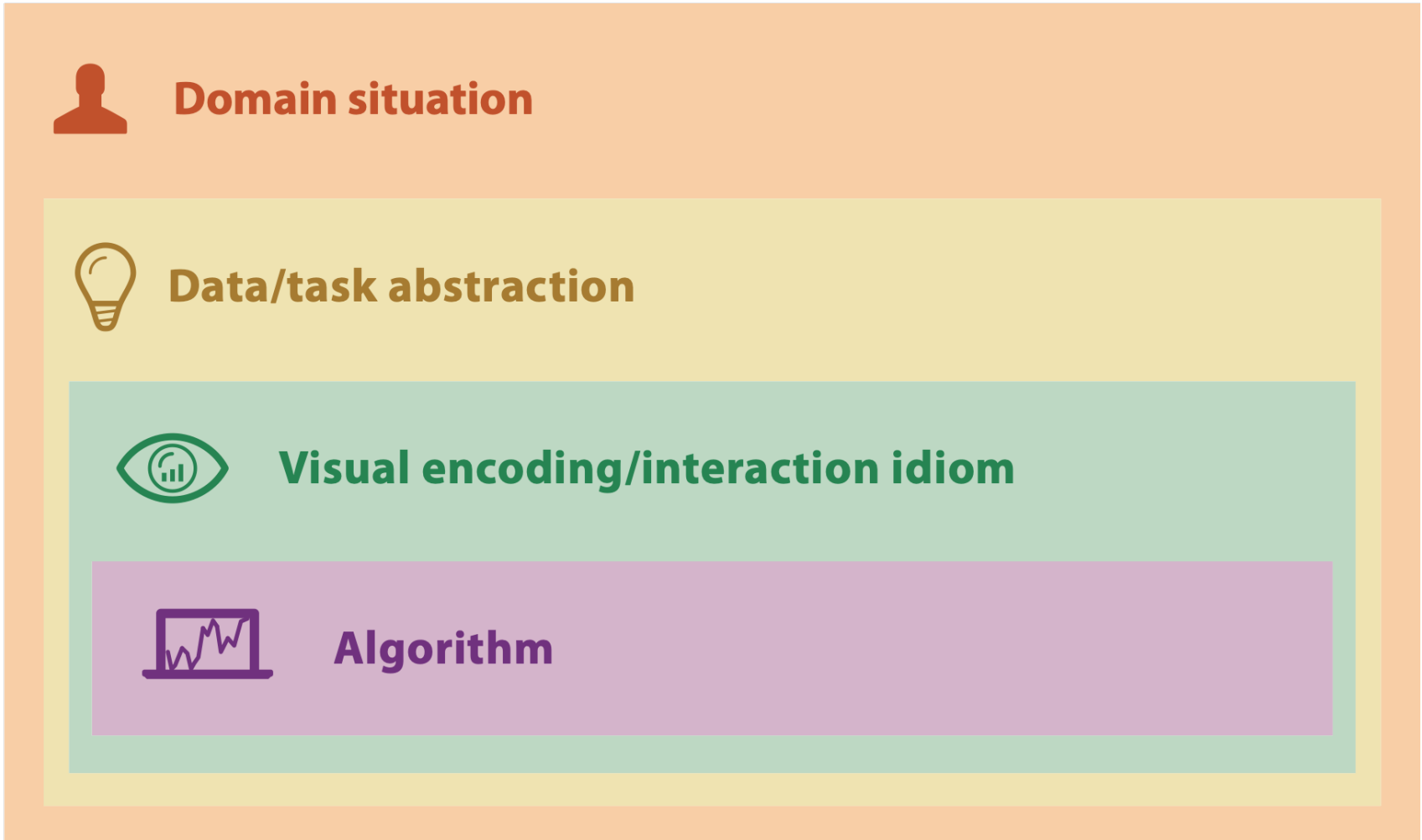
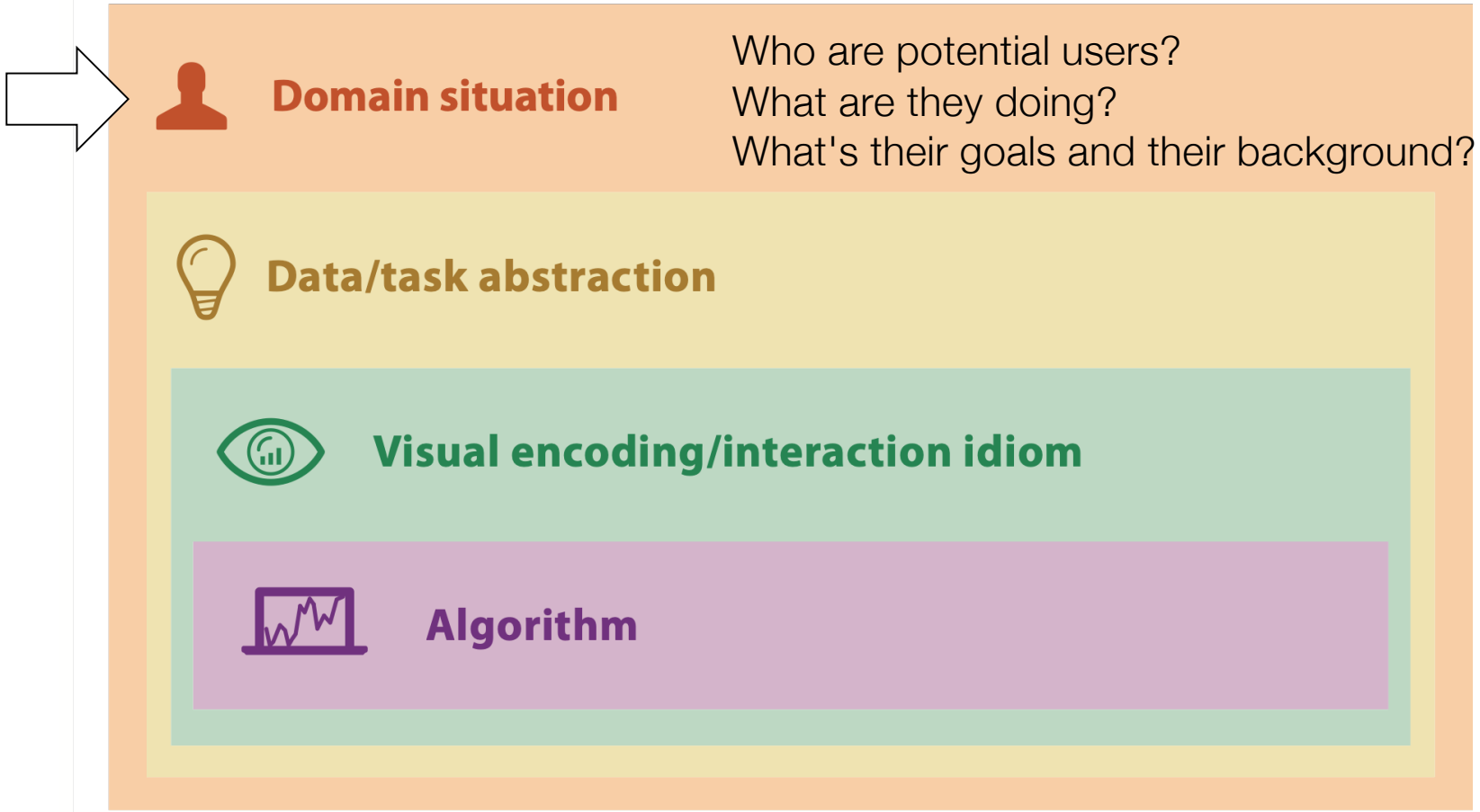
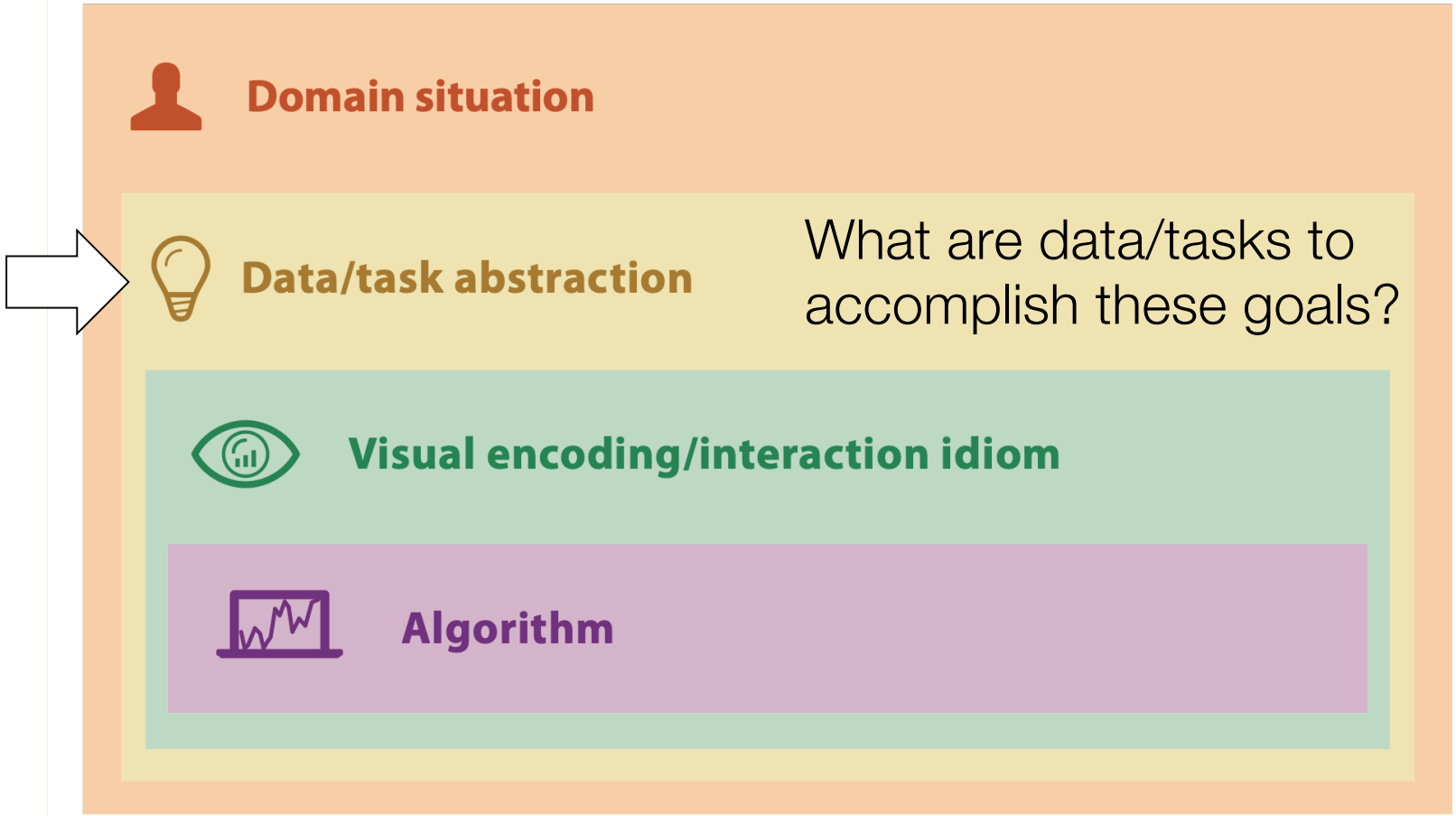
Nested model for vis design (Munzner 2009, 2014)



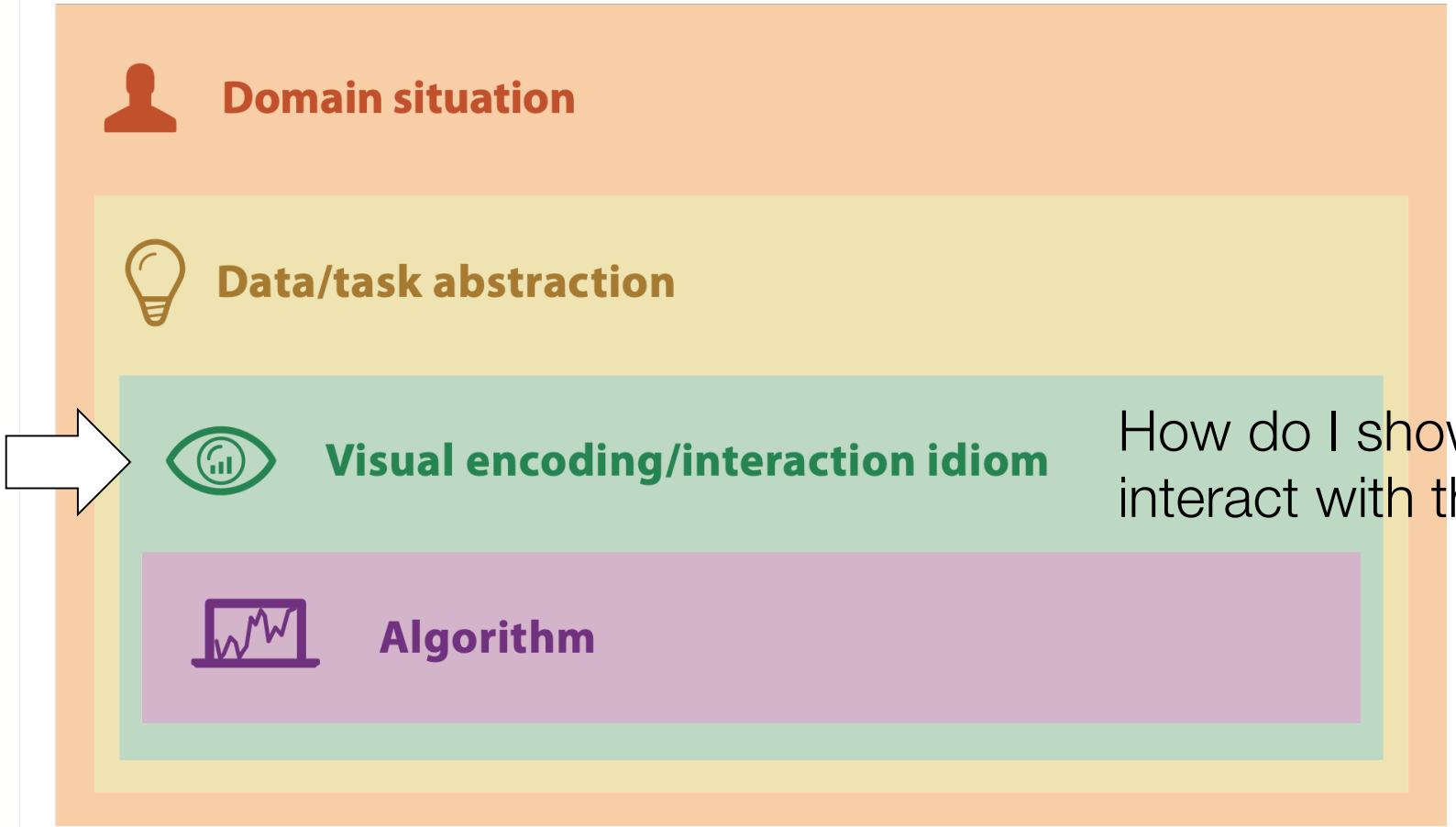
a) Analyzing the domain problem



b) Abstracting data & tasks

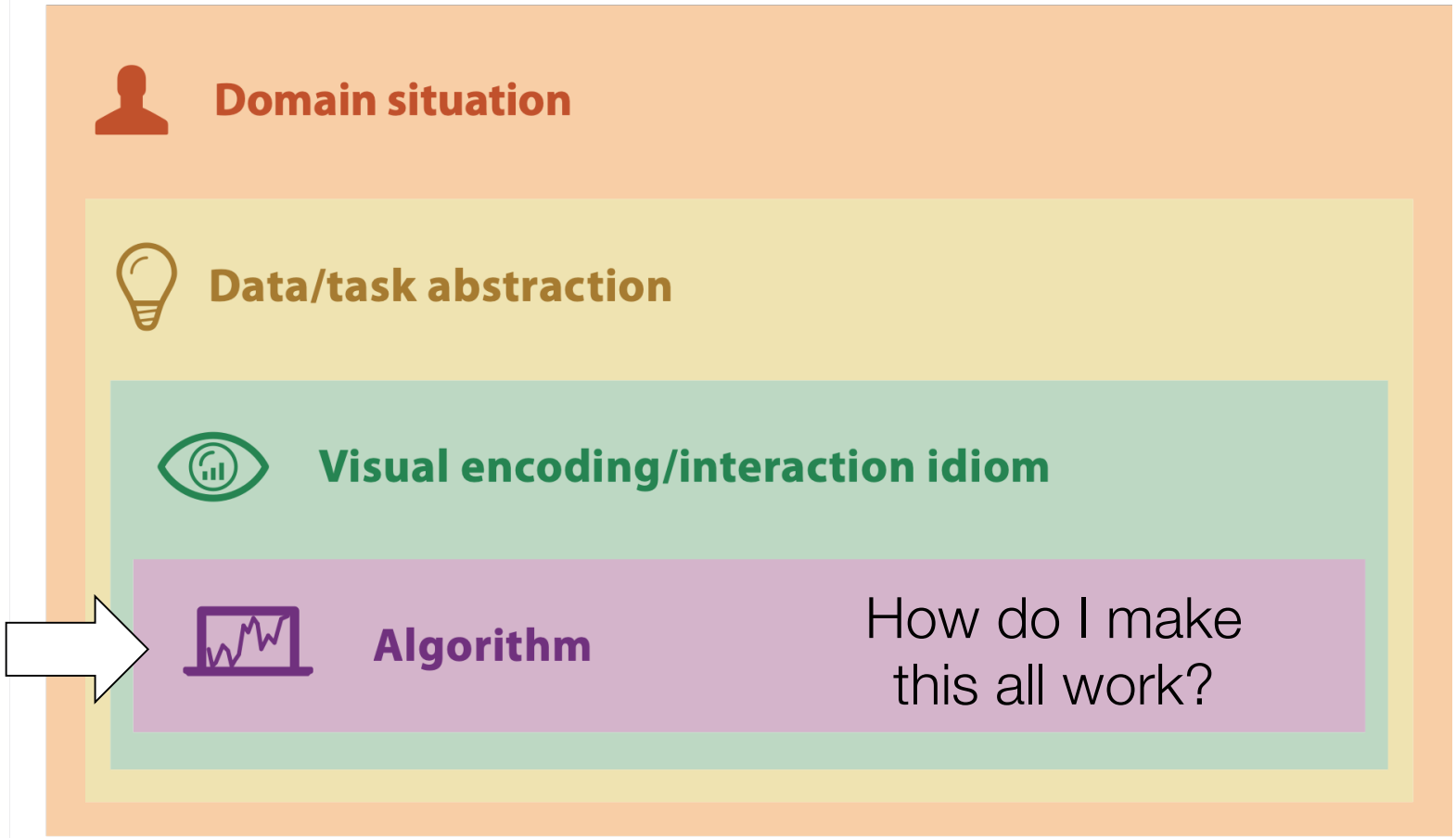


c) Desining visual encoding & interaction

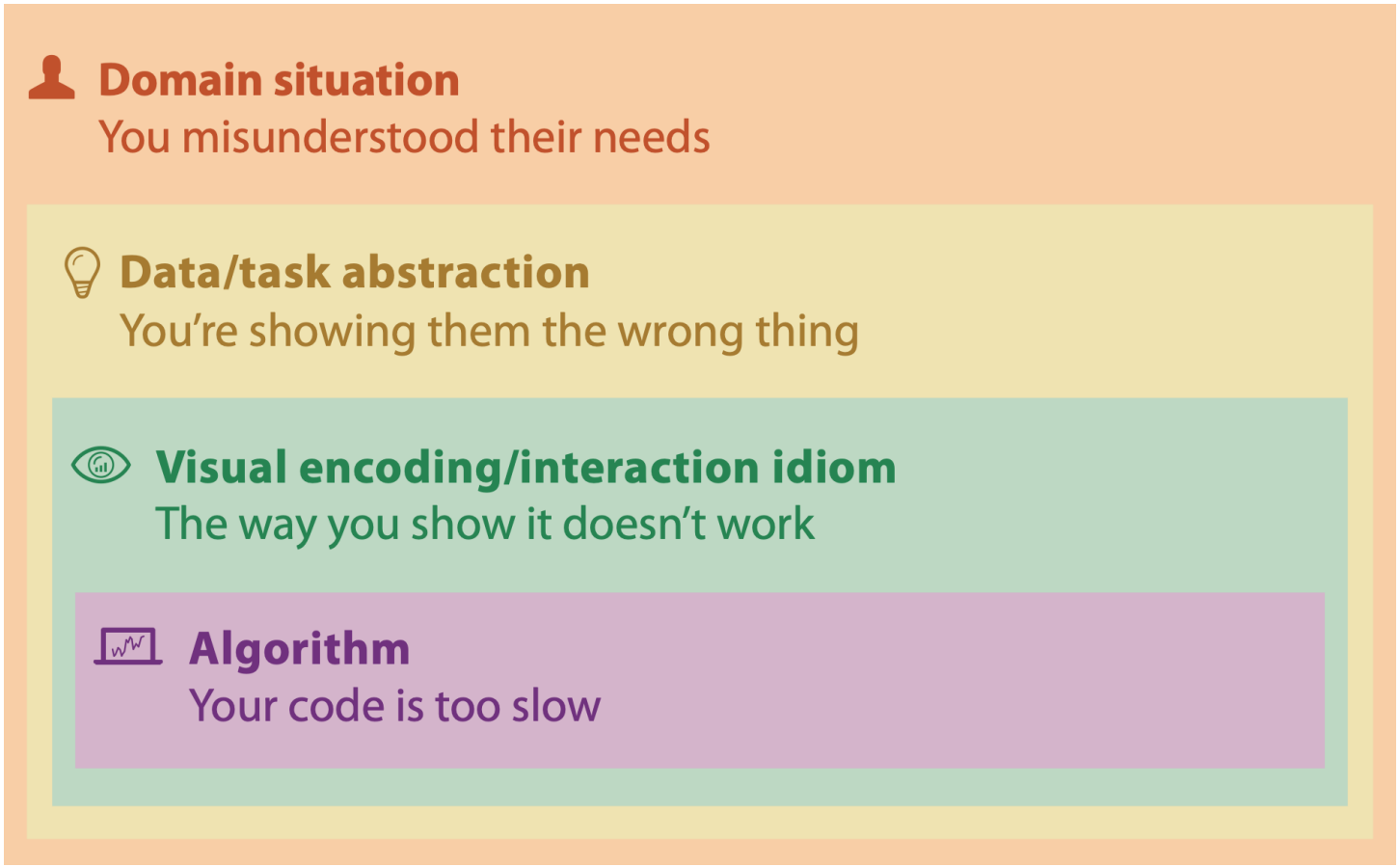


How do I show / interact with the data?

d) Creating algorithms

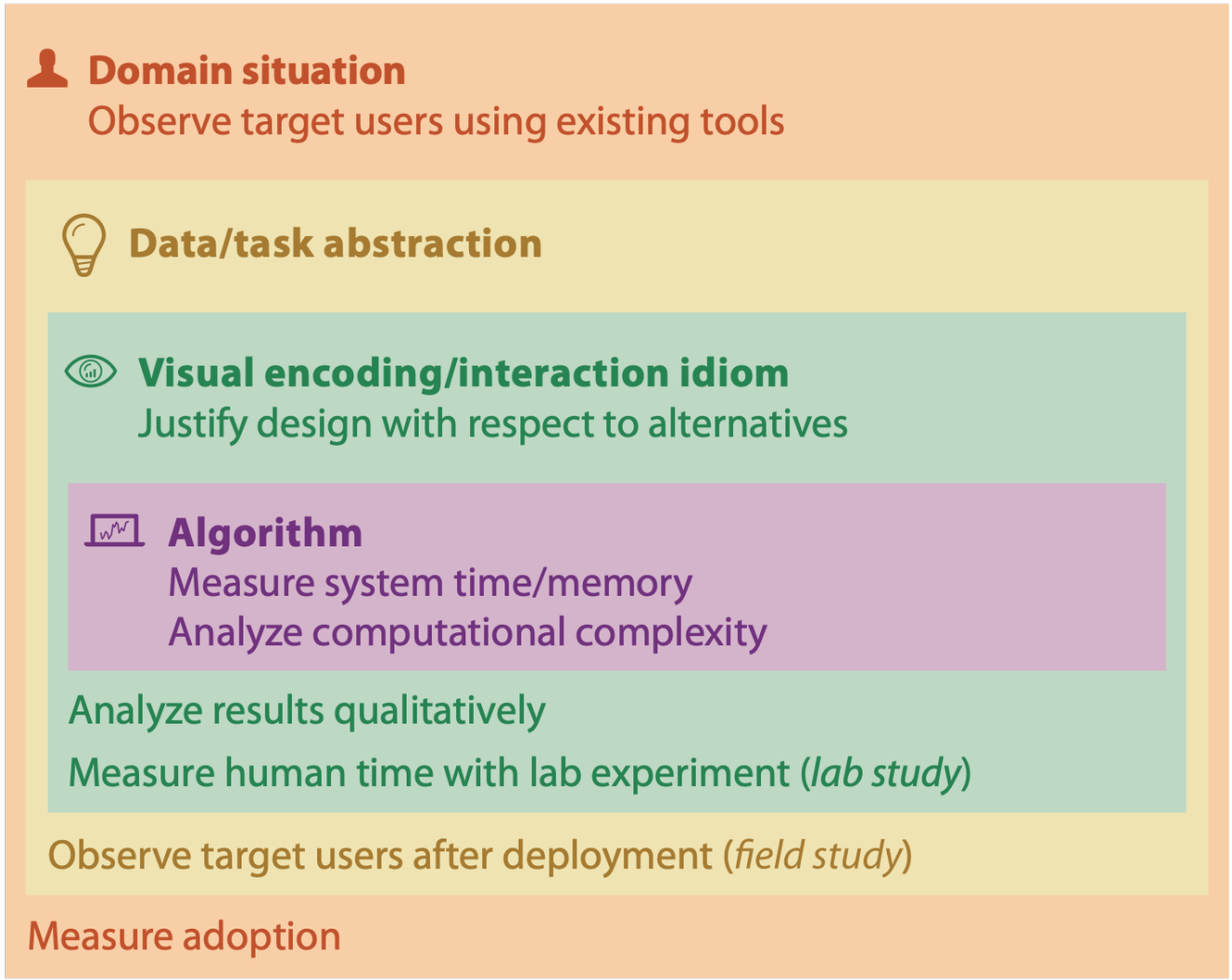


VIS design - What could go wrong?



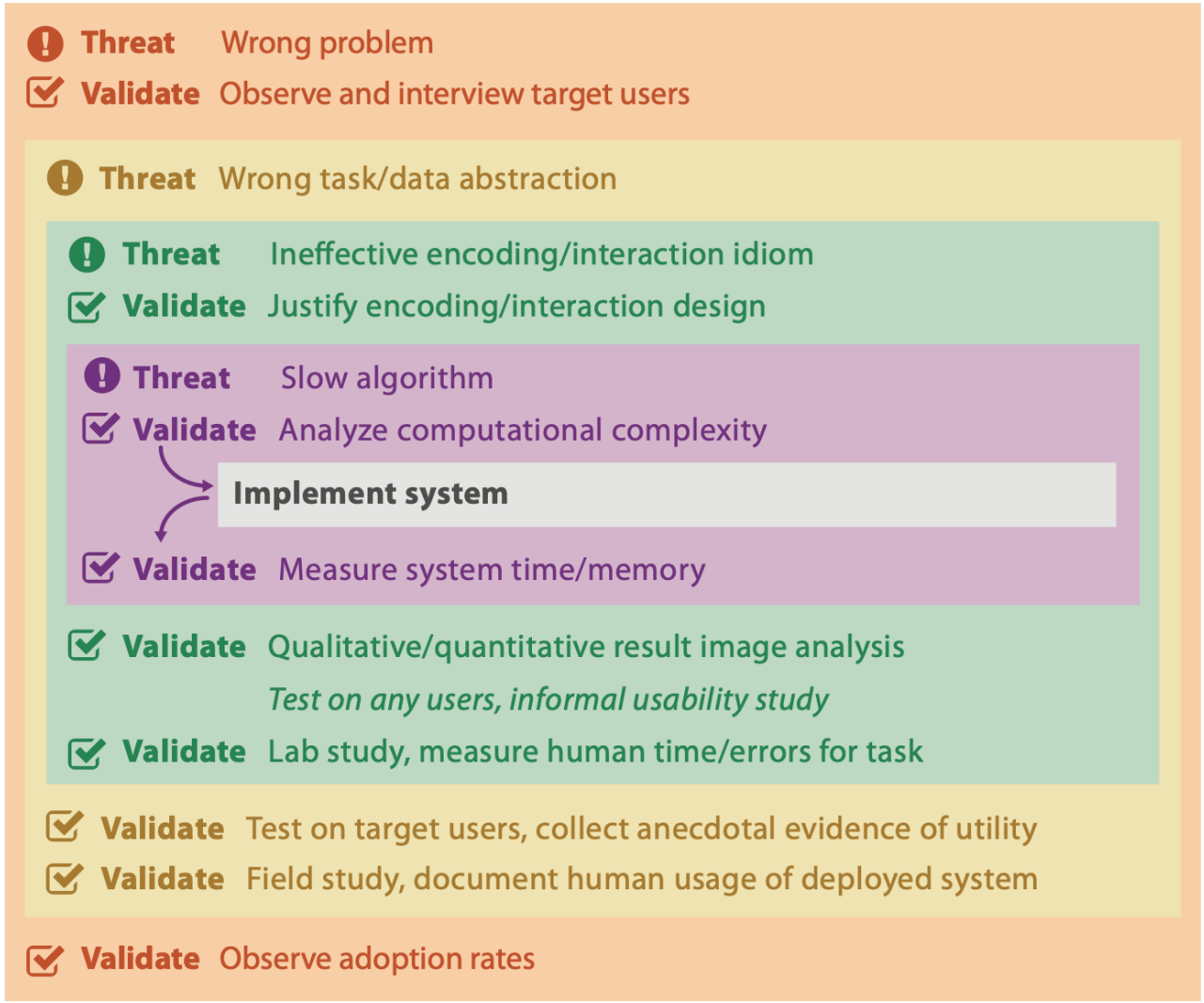
Munzner

Measures to validate VIS development



Munzner

Addressing threats at each level



Munzner

Workflow for designing a tool

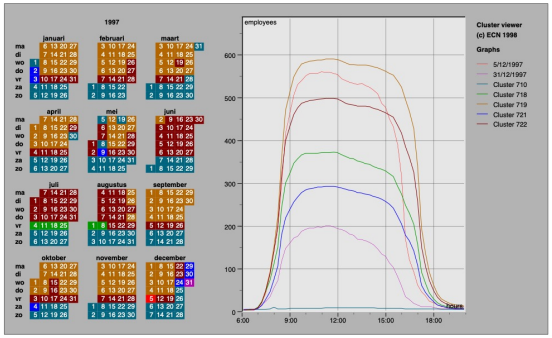
Making the right tool

Questions

Data

Tasks

Vis researcher



(van Wijk & Selow, 1999)

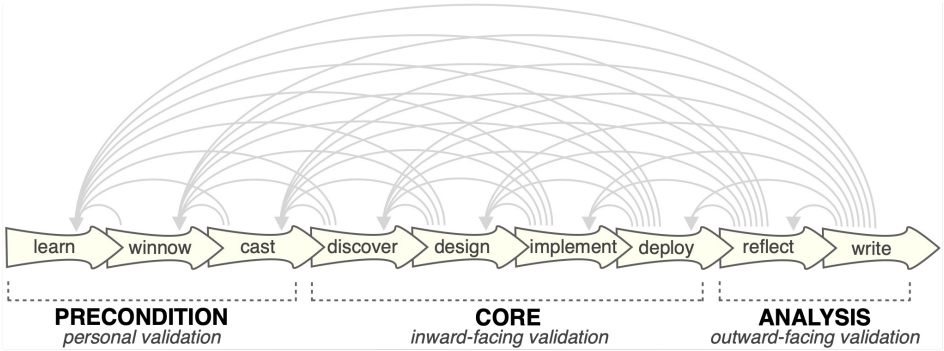
http://halalfocus.net/wp-content/uploads/2014/05/question-mark-nothing.jpg

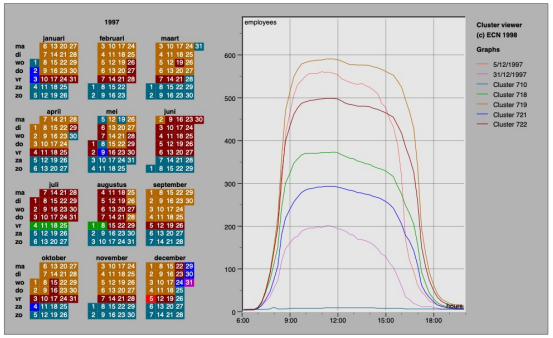
Making the right tool

Questions

Data

Tasks

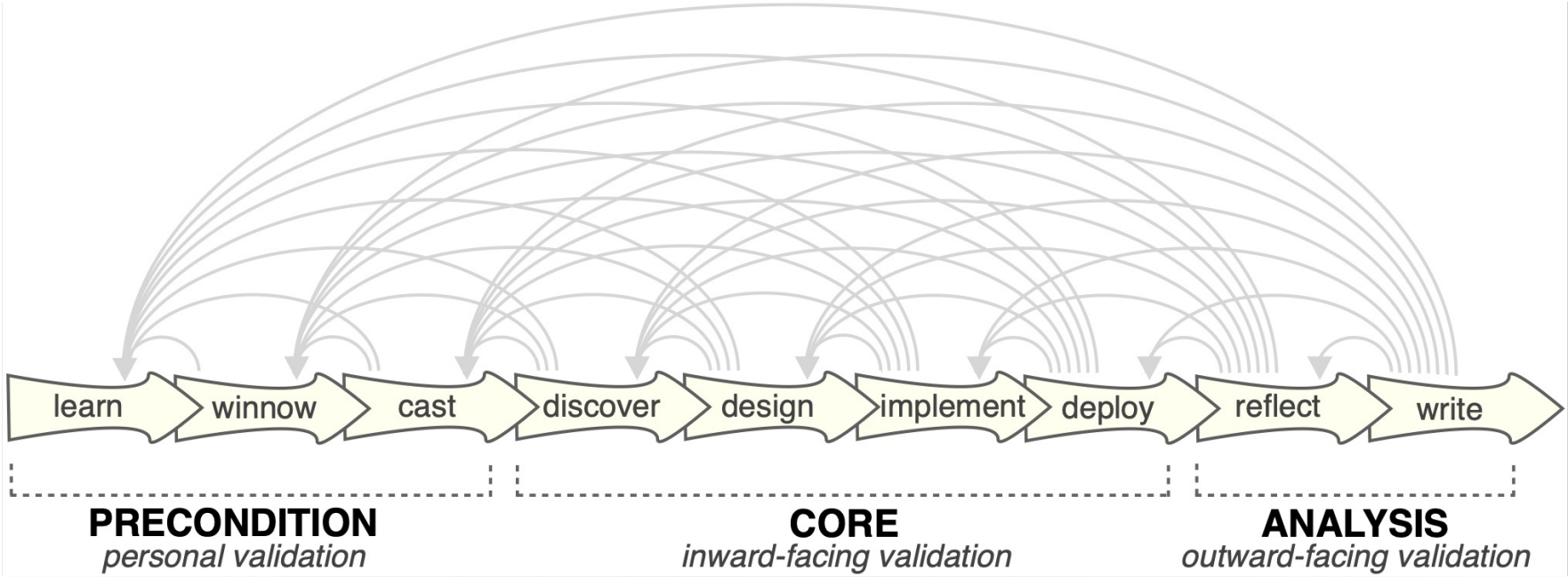




Design study methodology

(van Wijk, 1999)

Design study methodology



(Sedlmair et al., 2012)

Design study definition

Design study papers explore the choices made when applying infovis techniques in an application area, for example relating the visual encodings and interaction techniques to the requirements of the target task. Although a limited amount of application domain background information can be useful to provide a framing context in which to discuss the specifics of the target task, the primary focus of the case study must be the infovis content. Describing new techniques and algorithms developed to solve the target problem will strengthen a design study paper, but the requirements for novelty are less stringent than in a Technique paper.

[Munzner, InfoVis03 CFP, infovis.org/infovis2003/CFP]

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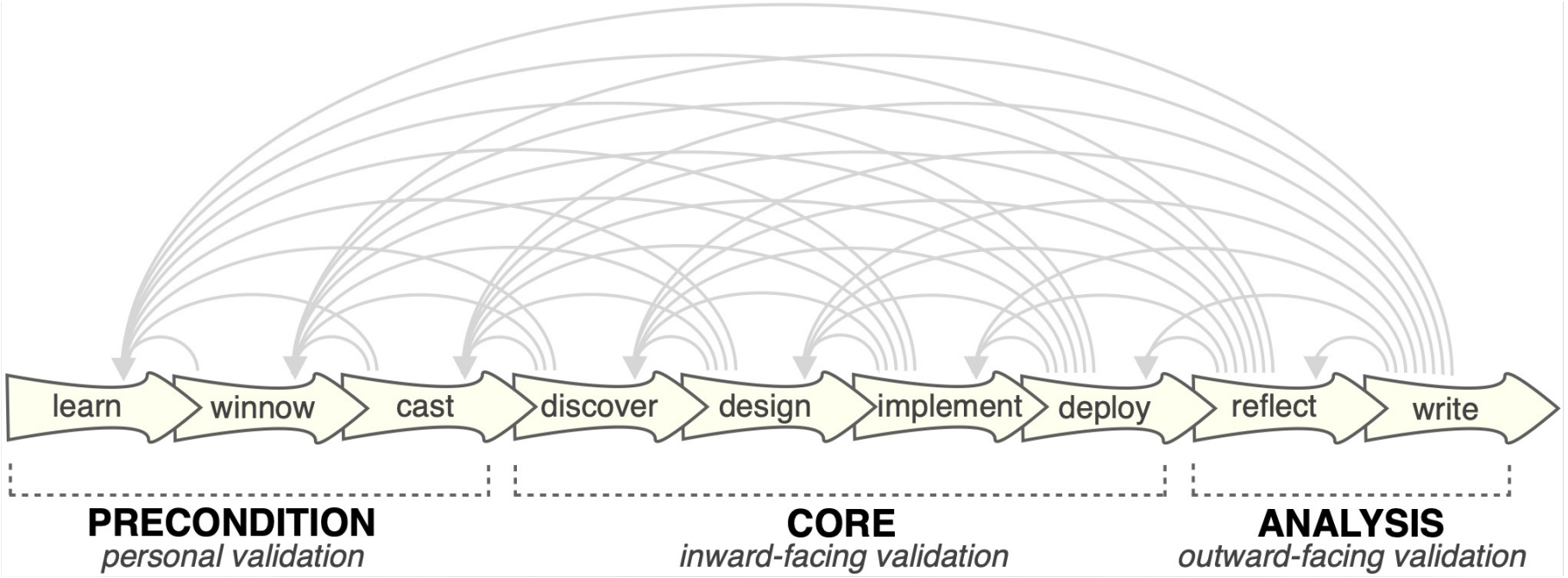
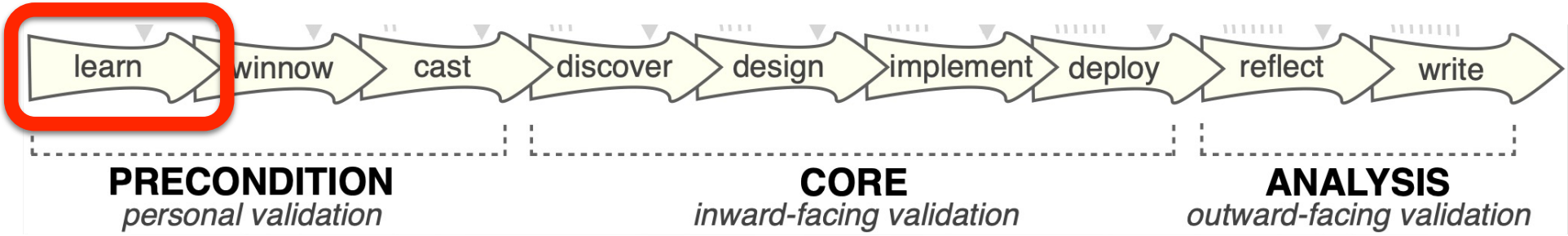
Design study methodology



1) What? 2) Why? 3) How?

(Sedlmair et al., 2012)

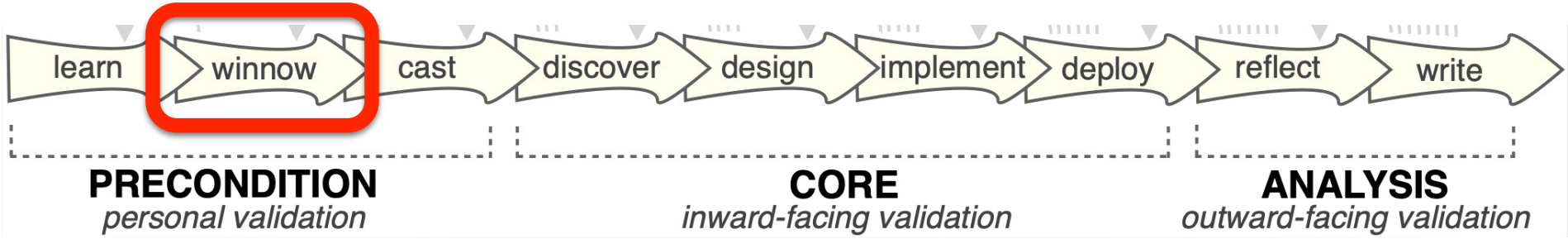
Design study methodology



What tools/techniques are available?

- Read vis papers
- Read vis books
- Talk to vis practitioners
- This course!

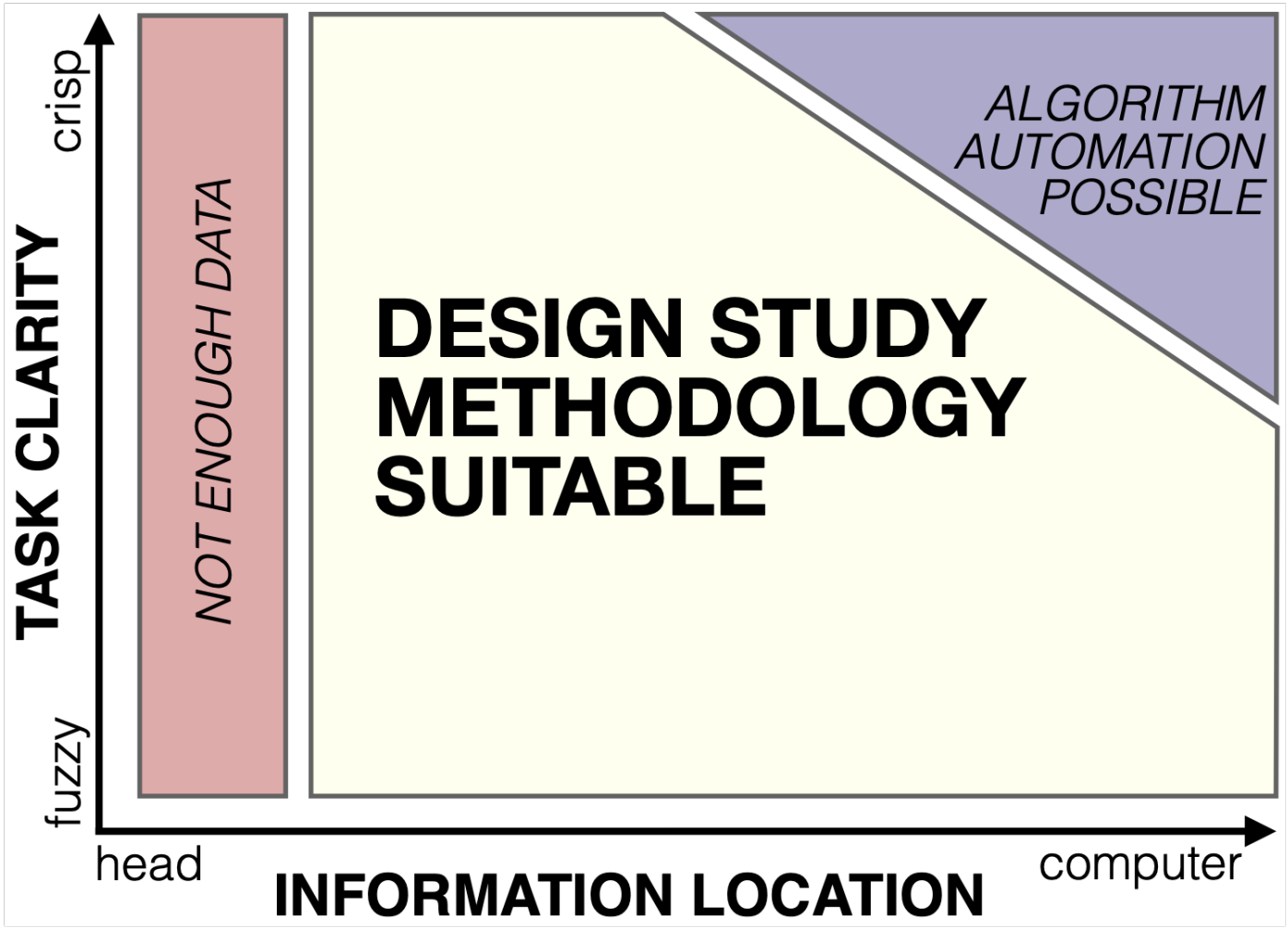
Design study methodology



Are these good collaborators?

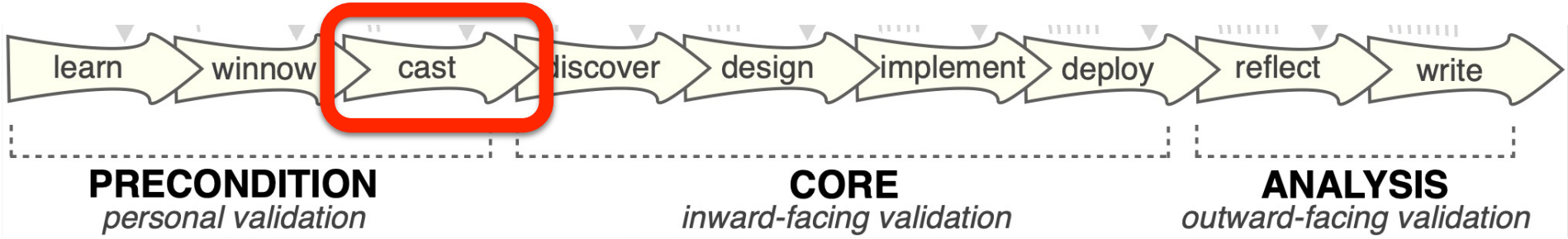
- Do they have interesting problems?
- Do they need novel solutions?
- Is there data?
- Can I work with these people?

When can you do a design study?



Sedlmair:2012

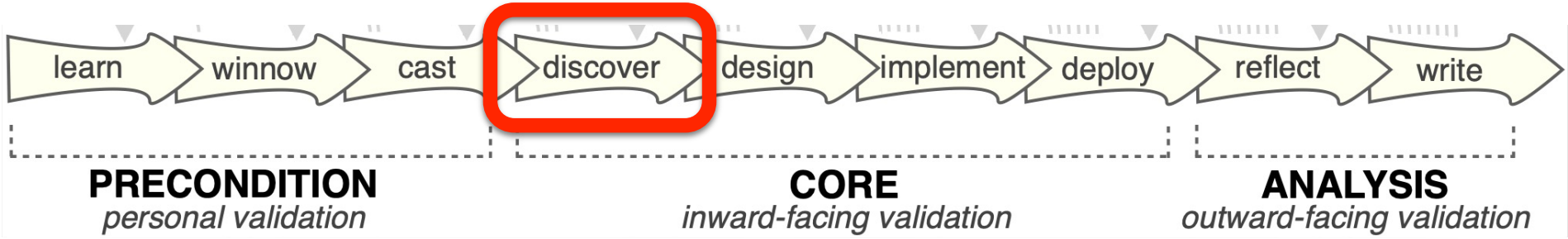
Design study methodology



Who's who?

- Do people have time for a new project?
- "Front-line analyst" is the domain expert
- Are there false "front-line analysts"?
- Do you need a "translator"?

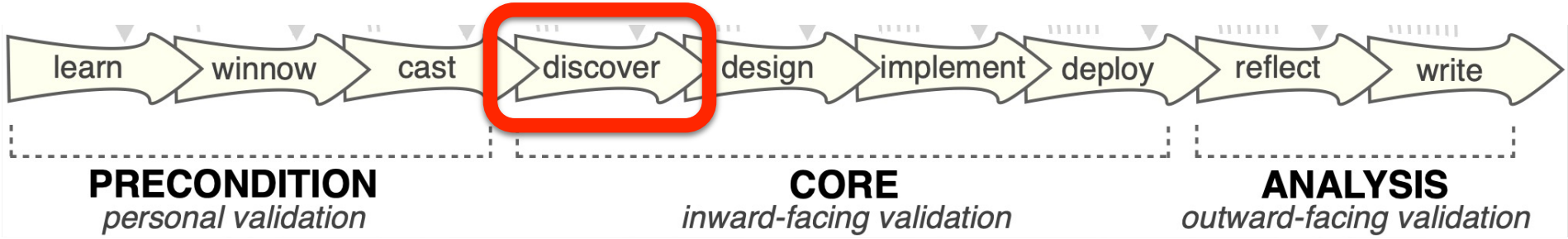
Design study methodology



Problem characterization and abstraction

- Requirements analysis
- Critical reflection on requirements!
- Abstraction is important for transferability
- Need some domain-expert knowledge

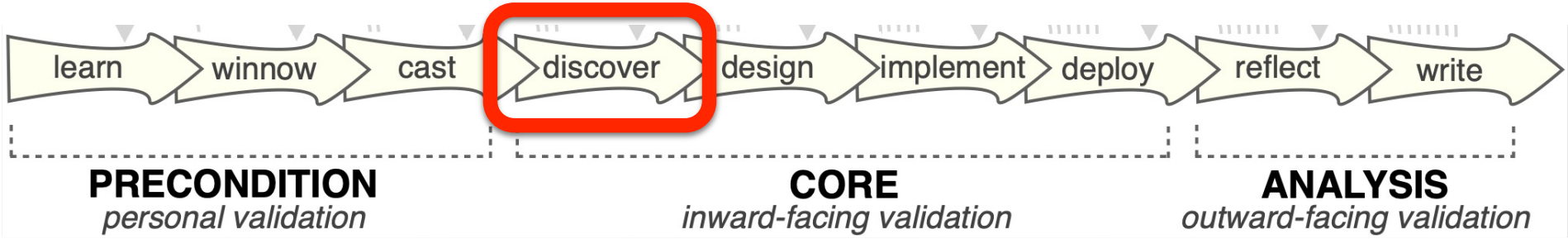
Design study methodology



example: Cluster-Calendar, van Wijk and van Selow

- Overall goal: are there temporal patterns in power consumption?

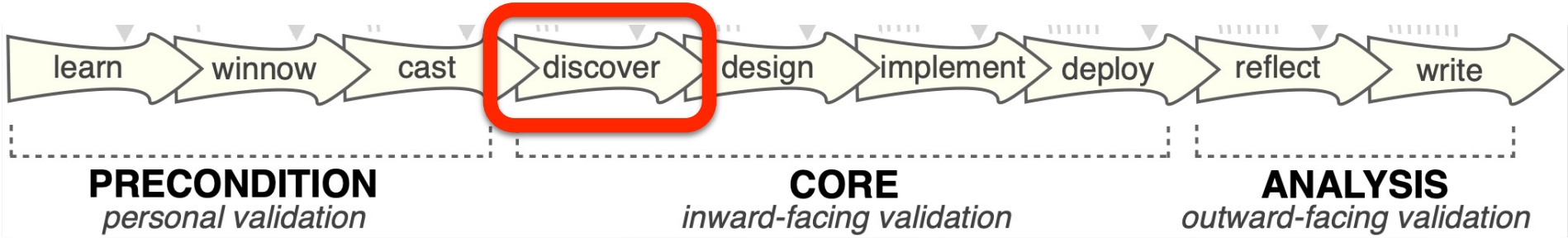
Design study methodology



example: Cluster-Calendar, van Wijk and van Selow

- Data: ~50K pairs of (value, time)
- Tasks
  - Find standard day patterns
  - Find out how patterns are distributed over year, week, season
  - Find outliers from standard daily patterns
  - Want overview first, details on demand

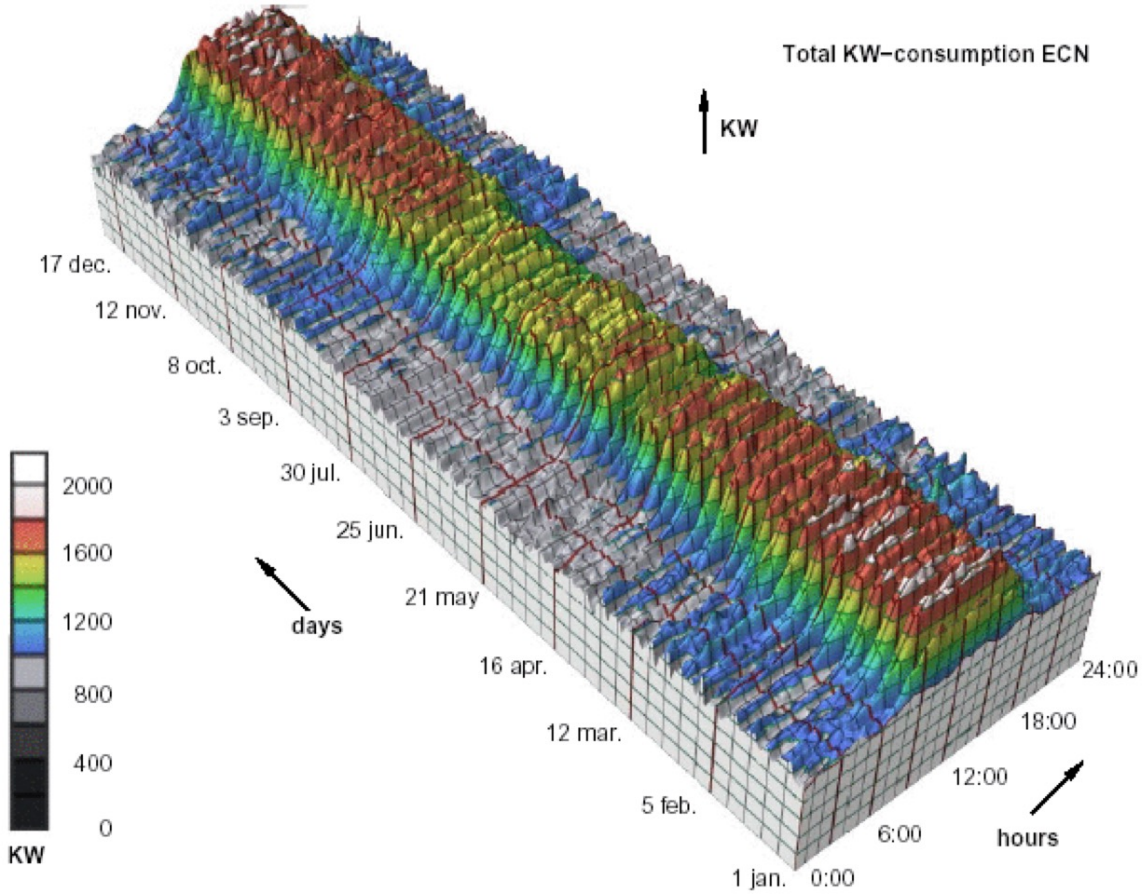
Design study methodology



example: Cluster-Calendar, van Wijk and van Selow

- Limitations of previous work:
  - predictive mathematical models: details lost
  - scale-space approaches (wavelet, fourier, fractal): hard to interpret, known scales lost
  - 3D mountain diagram (x: hours, y: value, z: days)

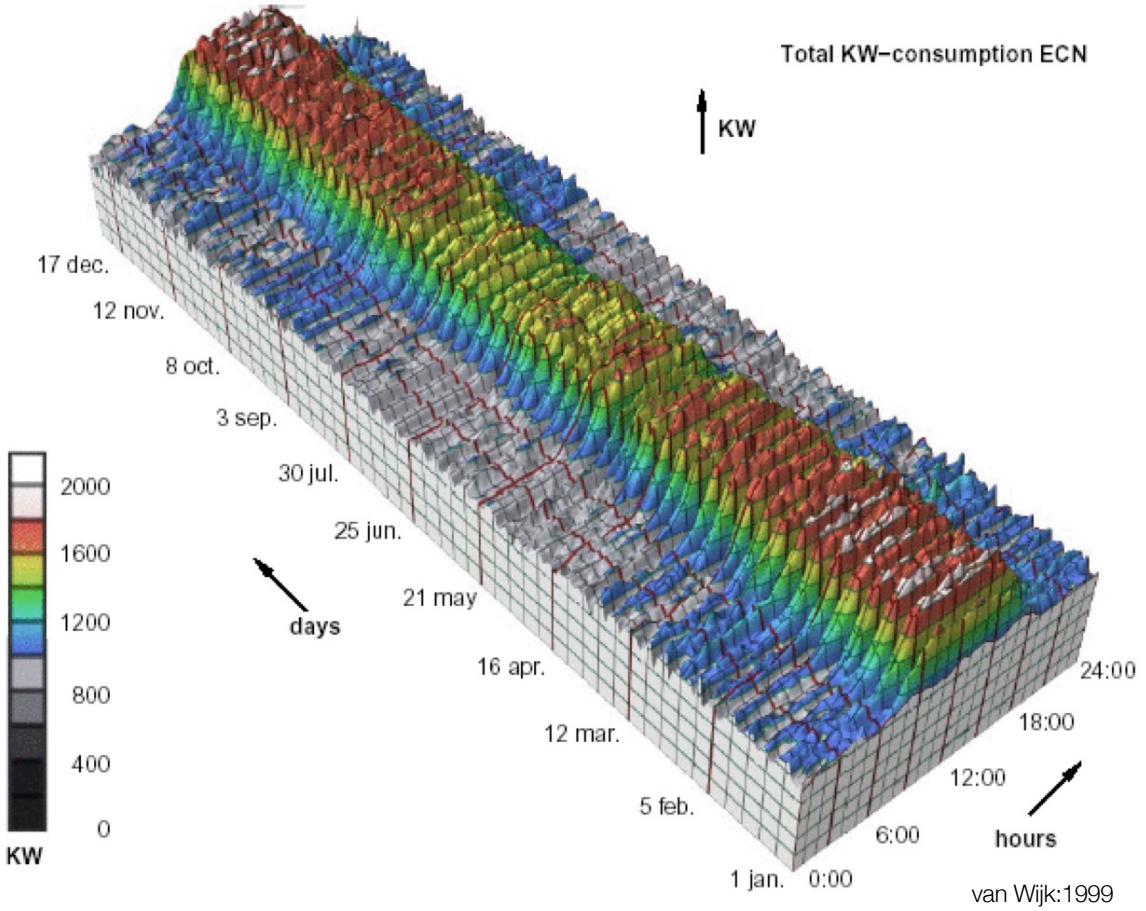
Design study methodology



van Wijk:1999

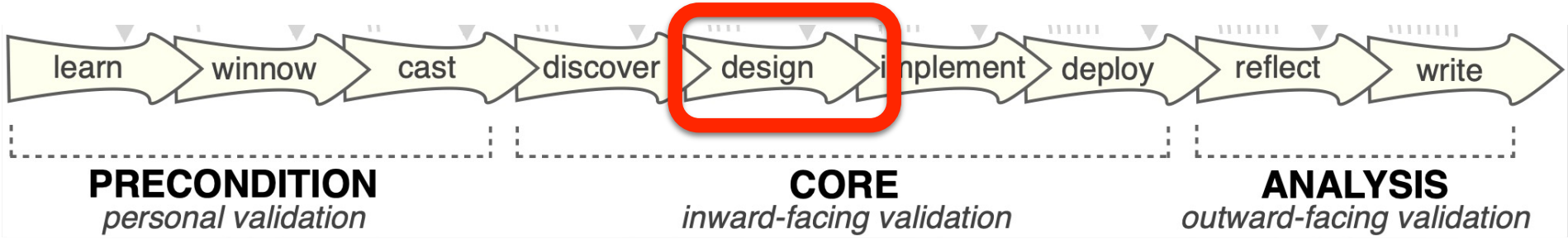
Design study methodology

- Pretty, not so useful
- Daily, weekly patterns are hard to see



van Wijk:1999

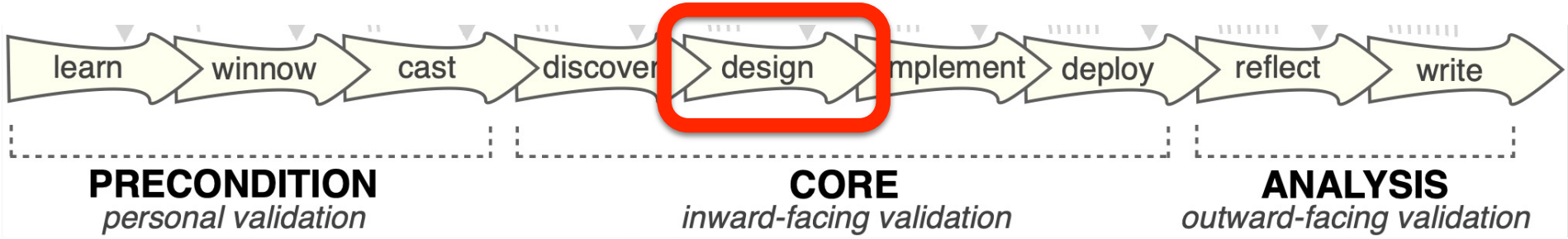
Design study methodology



Data abstraction, visual encoding, interaction

- What data transformations are needed?
- What visual designs to use?
- How to tie this together with interaction?
- Don’t code!

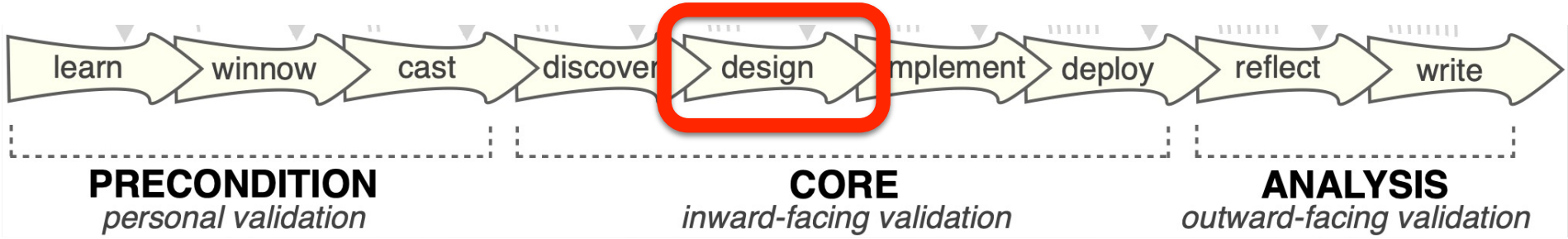
Design study methodology



example: Cluster-Calendar, van Wijk and van Selow

- Data transform: hierarchical clustering

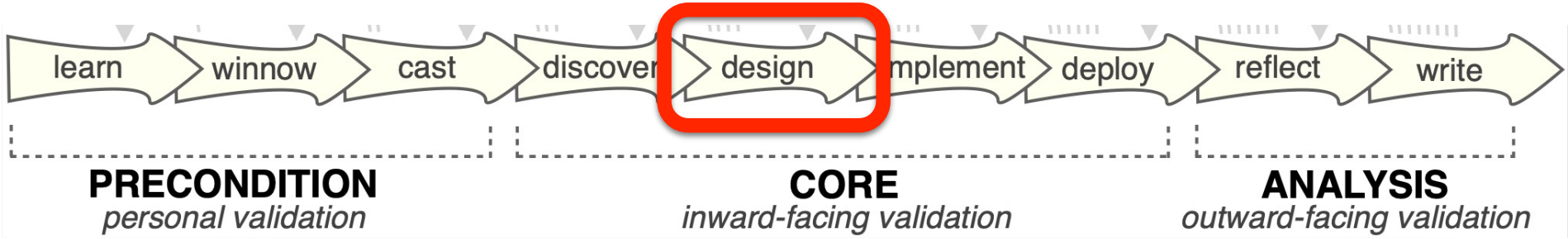
Design study methodology



example: Cluster-Calendar, van Wijk and van Selow

- Data transform: hierarchical clustering
- start with M day patterns
  - compute pair-wise differences, merge most similar
  - now we have M-1 patterns
  - repeat until we have 1 root cluster
- result: binary hierarchy of clusters

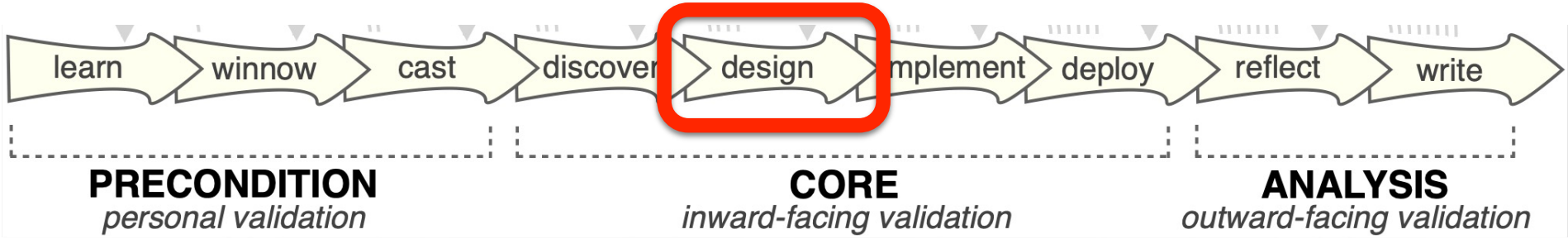
Design study methodology



example: Cluster-Calendar, van Wijk and van Selow

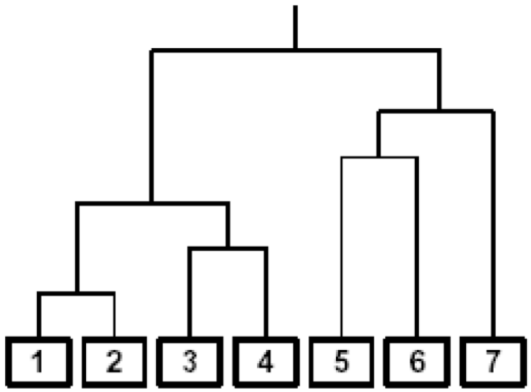
- Data transform: hierarchical clustering
- issues:
  - distance metric to use?
  - how to display the cluster?

Design study methodology

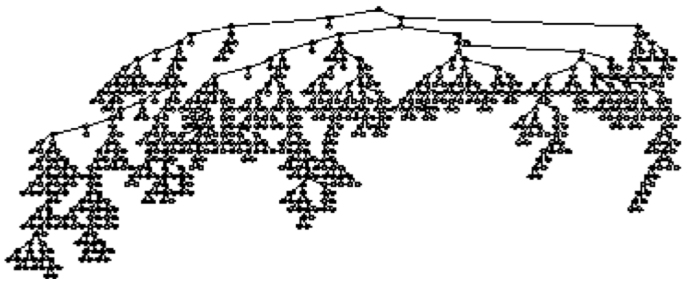


example: Cluster-Calendar, van Wijk and van Selow

- dendrogram

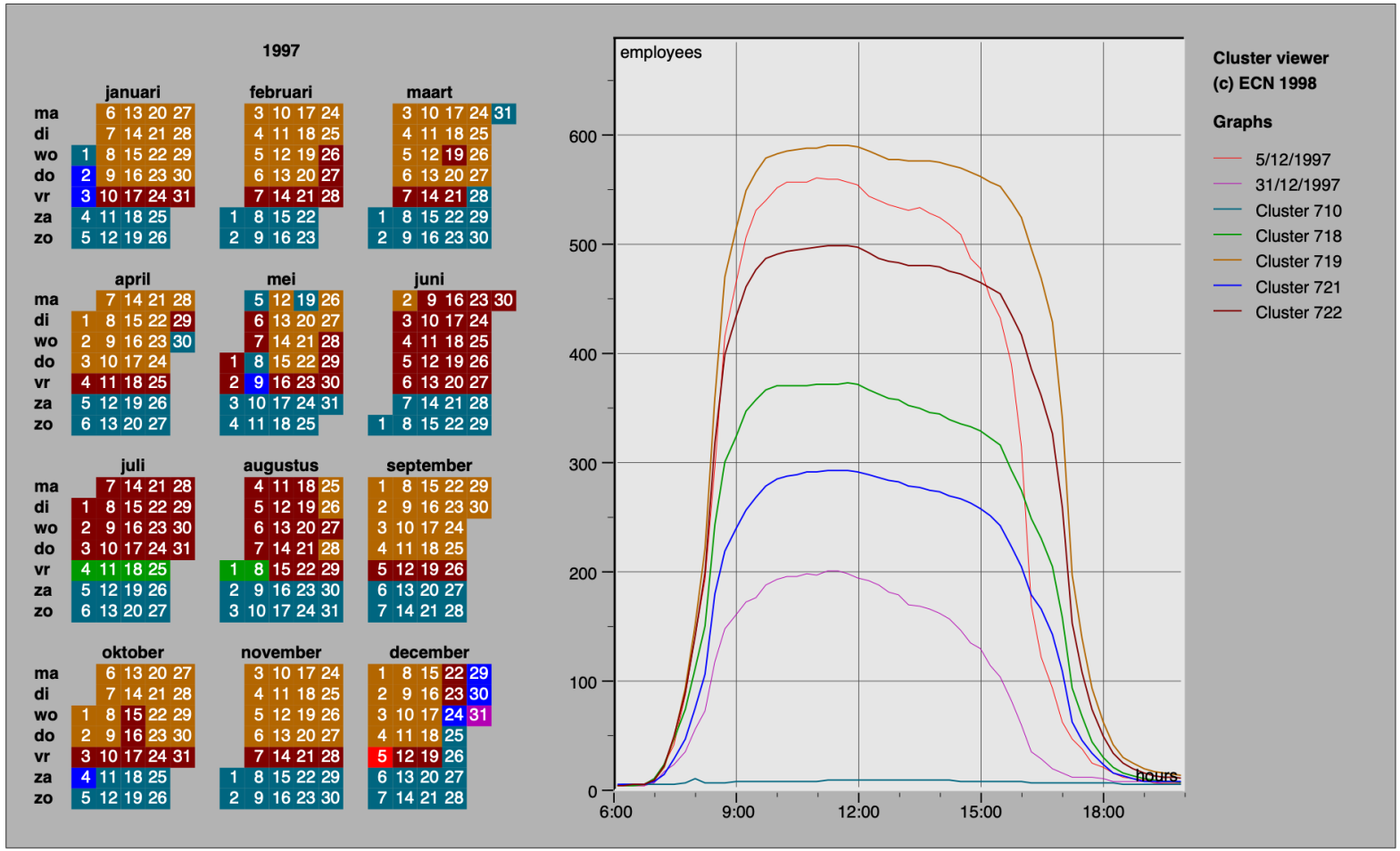


Shows hierarchical structure
but not time distribution!



van Wijk:1999

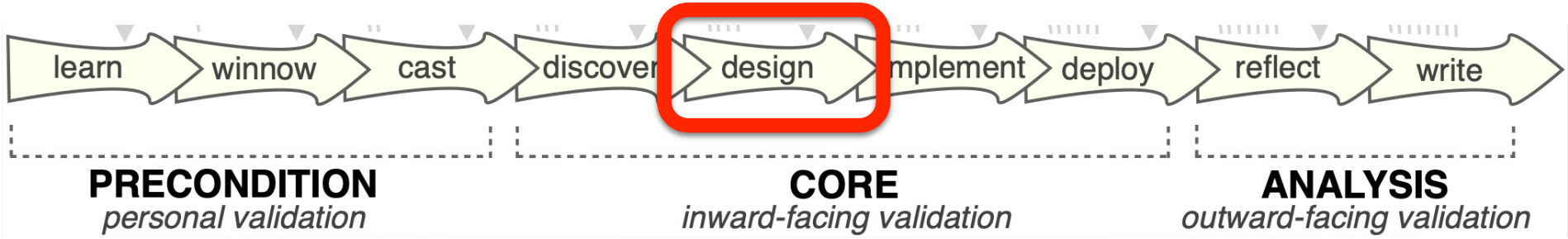
Design study methodology



Overview

Detail

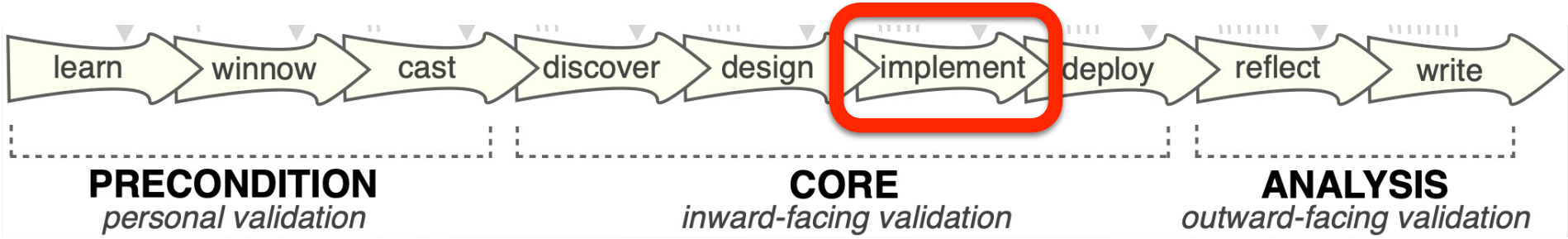
Design study methodology



example: Cluster-Calendar, van Wijk and van Selow

- clusters: data transformation to aggregate data
- calendar: familiar visual representation for time
- linking: interactive exploration of the data
- task analysis guided choices: 3D extrusion and dendrogram don't work

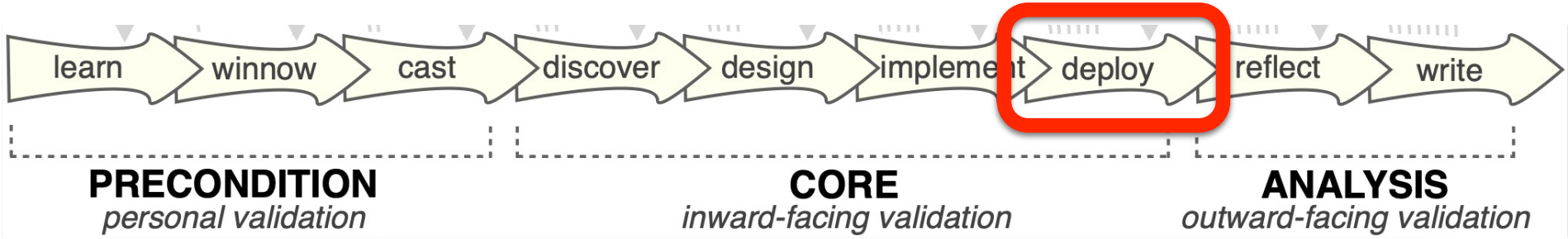
Design study methodology



Yay coding!

- Need to test design hypotheses
- Rapid prototyping (will probably throw away alot of code)
- Breaking bugs vs annoying bugs
- Fast usability testing

Design study methodology

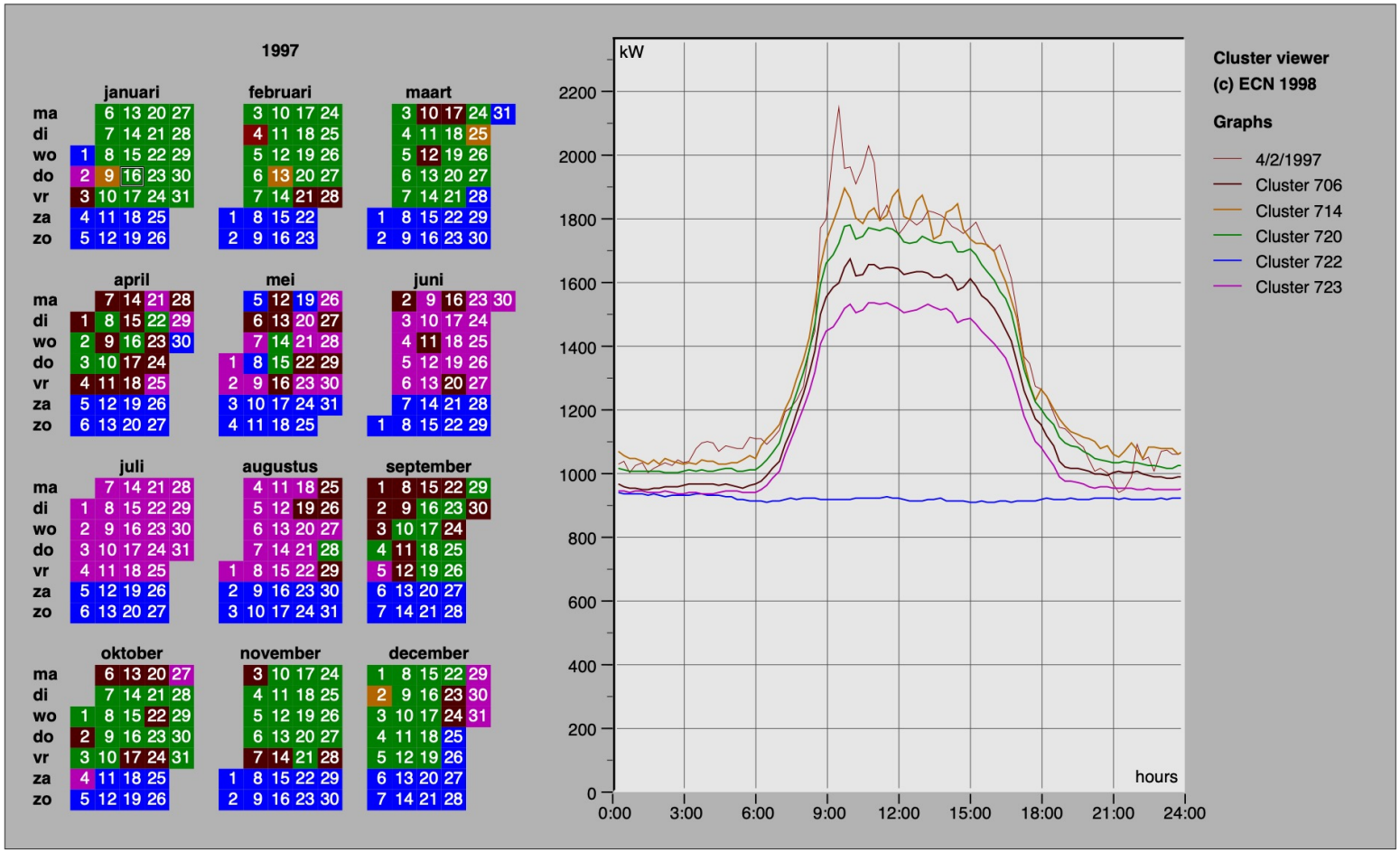


Hand-off to the users

- Domain experts need to play with software
- What works, what doesn't?
- How to evaluate?
- May need to redesign/reimplement a lot

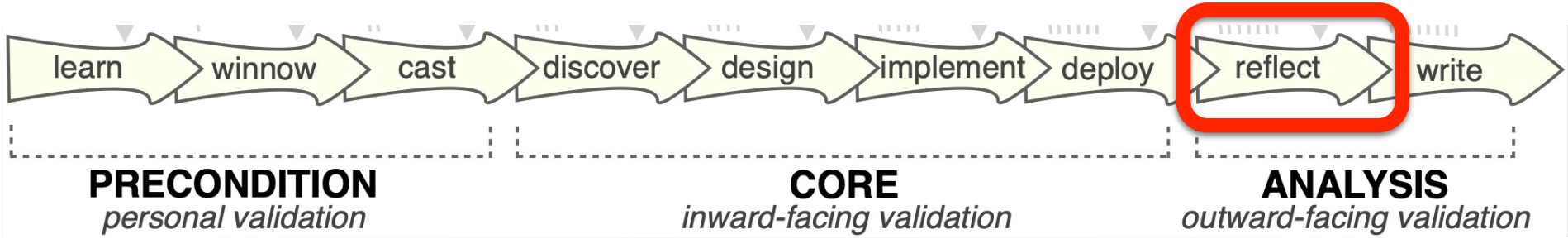
Design study methodology

Critique?



van Wijk:1999

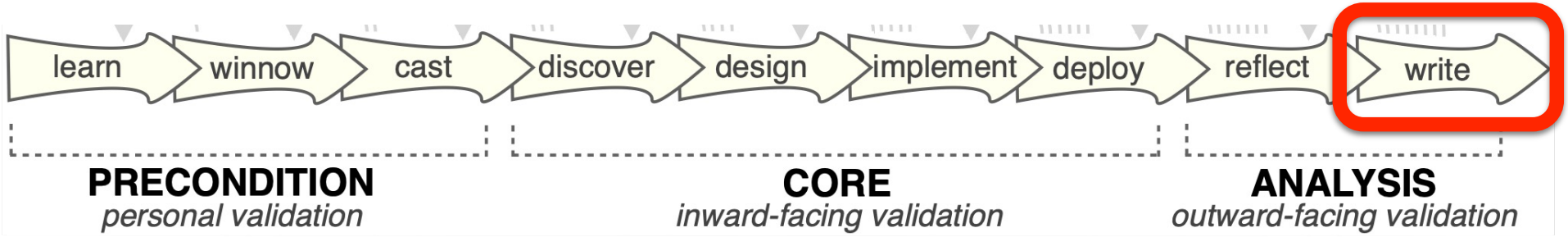
Design study methodology



Refine, reject, propose guidelines

- Compare to existing design guidelines
- Confirm which ones worked
- Reject which ones didn't work
- Come up with new guidelines

Design study methodology



Yay words!

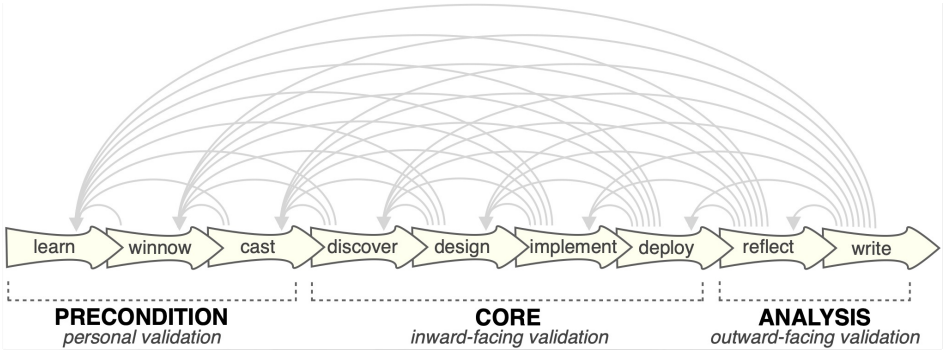
- Forces clear articulation of problem, tasks, solution
- Who else does my study help? - transferability!
- Think carefully about what readers will care about
- This takes time to do well!

Making the right tool

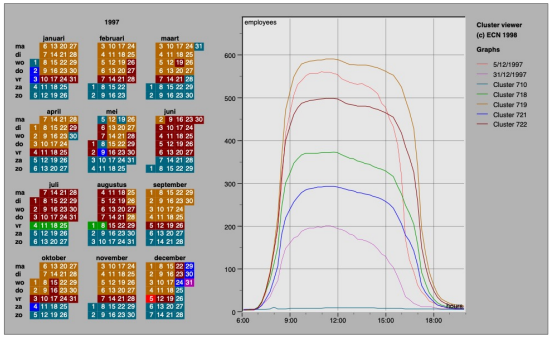
Questions

Data

Tasks



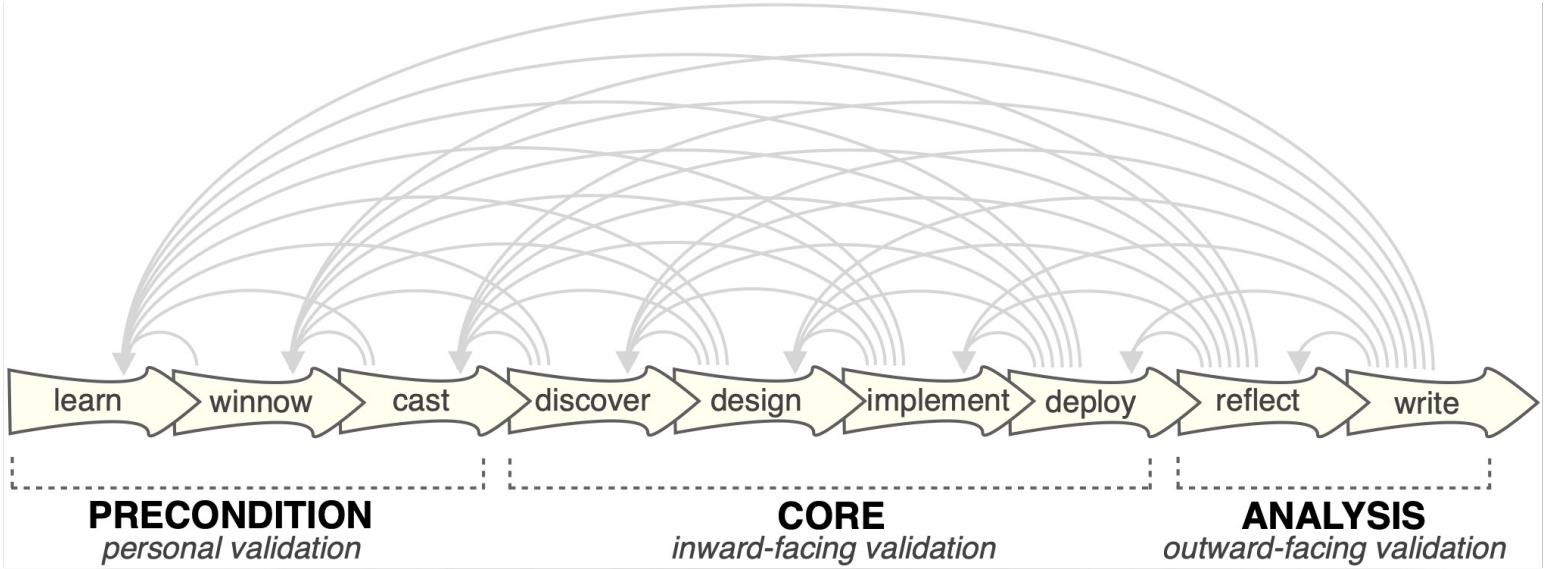
Design study methodology



van Wijk:1999

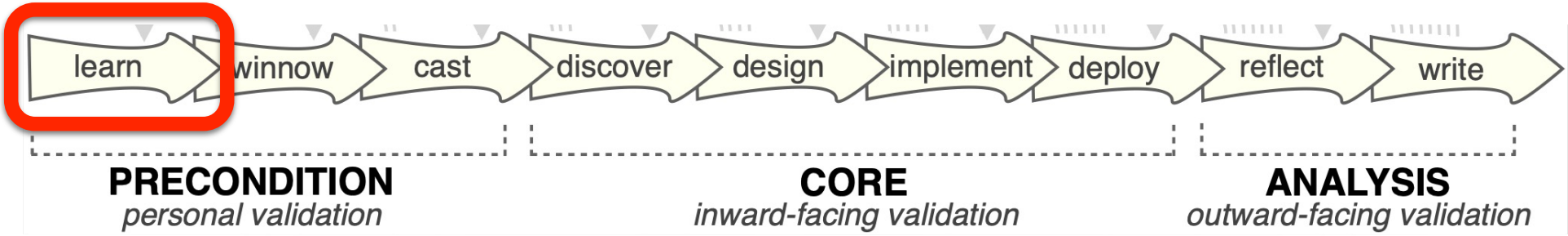
Pitfalls

Pitfalls



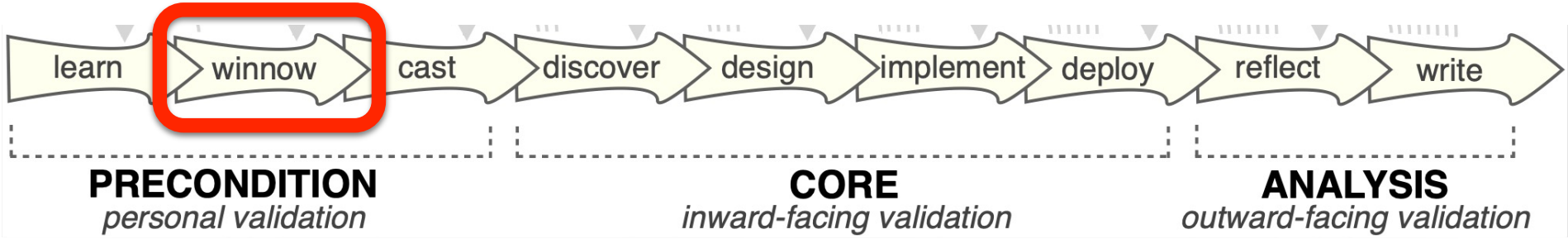
#1: Don’t skip steps!

Pitfalls of learning & researching



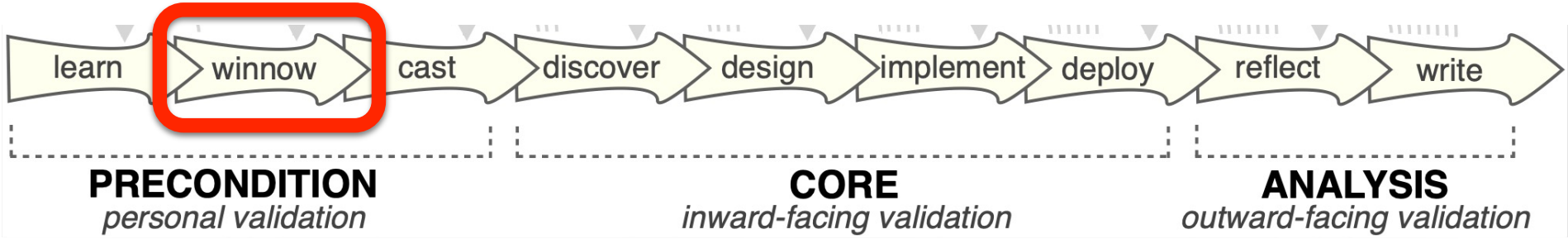
- insufficient knowledge of literature

Pitfalls of winnowing (I)



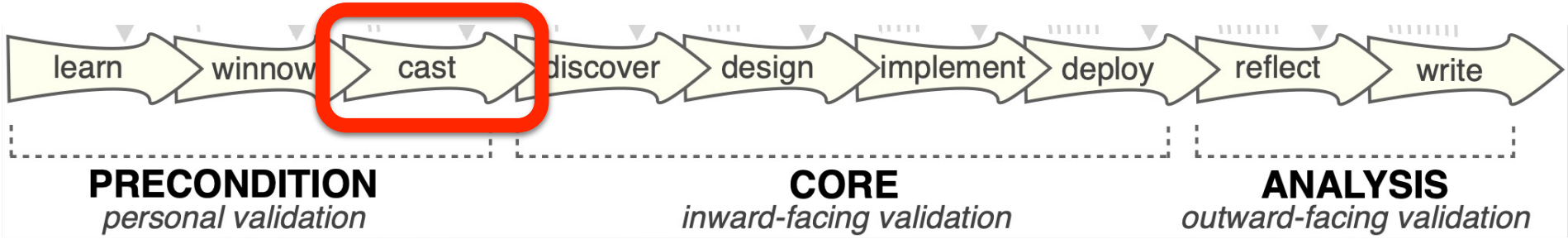
- collaboration with the wrong people
- **no real data available**
- insufficient time available from collaborators
- **no need for visualization: automate**
- no need for research: engineering project

Pitfalls of winnowing (II)



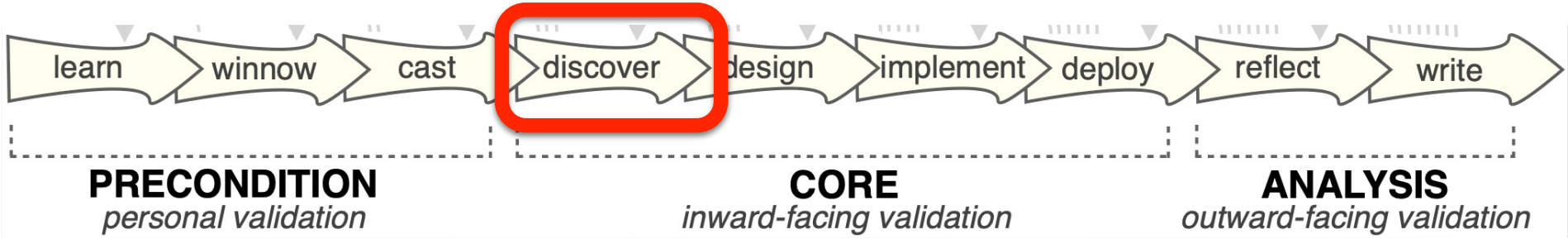
- **is this interesting to me?**
- existing tools are good enough
- **not an important/recurring task**
- no rapport with collaborators

Pitfalls of casting & enrolling



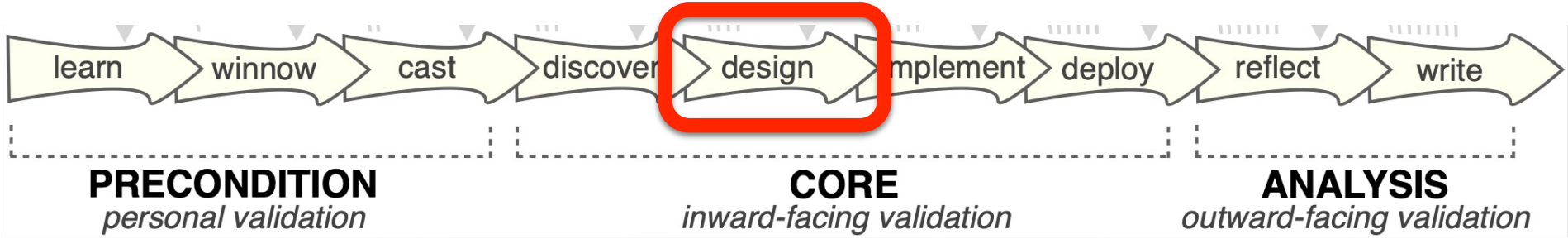
- not identifying front-line analyst and gatekeeper
- assuming same role distribution across projects
- mistaking tool-builders for real end users

Pitfalls of discovering



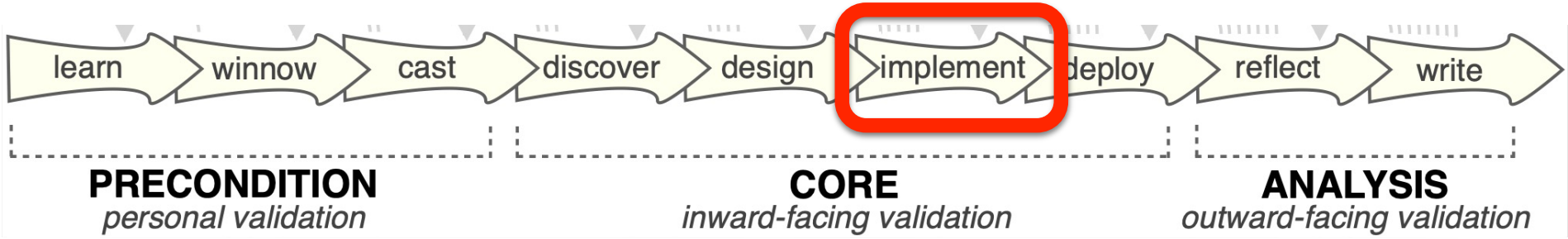
- **ignoring practices that currently work well**
- **expecting *just talking* or *fly on the wall* to work**
- **domain experts design the visualizations**
- too much/too little domain knowledge

Pitfalls of designing



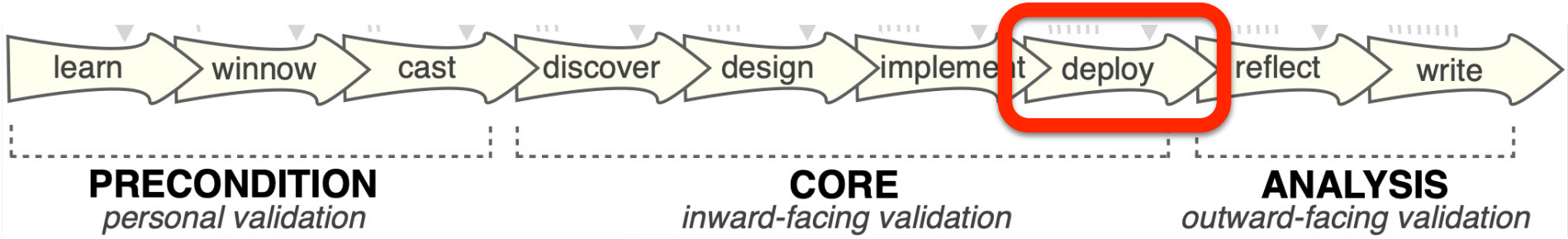
- too little abstraction
- **design consideration space too small**
- mistaking technique-driven and problem-driven work

Pitfalls of implementing



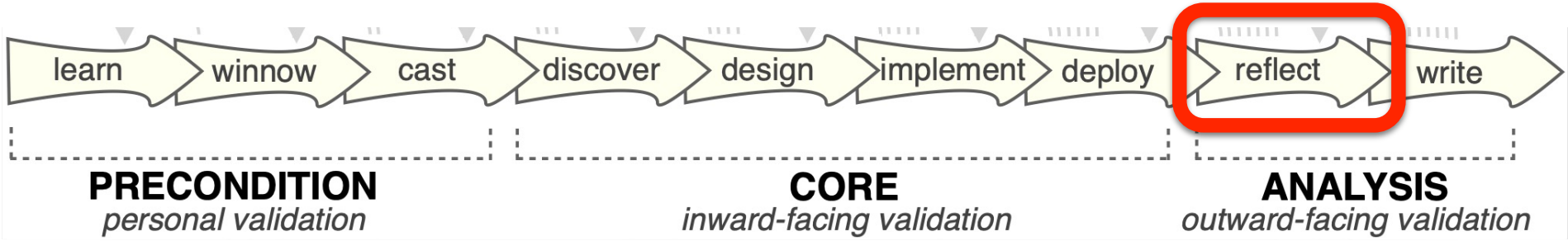
- **non-rapid prototyping**
- **usability: too little / too much**

Pitfalls of deploying



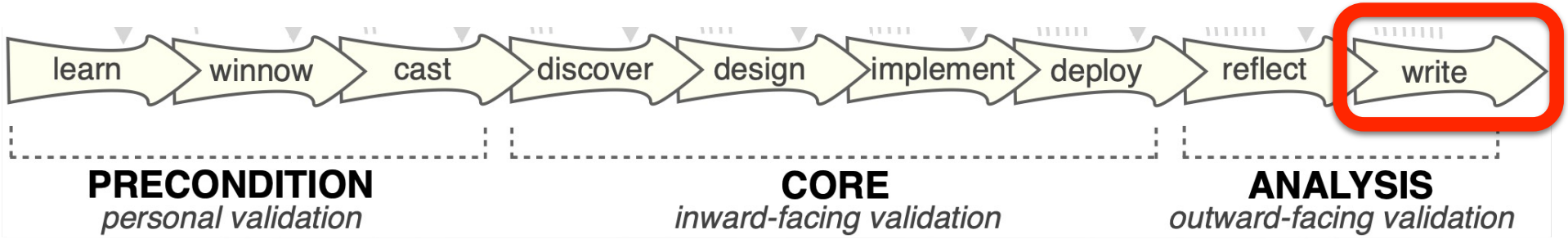
- **insufficient deploy time**
- non-real task / data / user
- *liking* a tool is not validation!

Pitfalls of reflecting



- failing to improve guidelines

Pitfalls of writing



- **not enough writing time**
- no technique contribution ≠ write a design study
- too much domain background
- chronological story vs concentrating on results
- **premature end to the project**

Additional reading

- Design study methodology: Reflections from the trenches and the stacks. Michael Sedlmair, Mariah Meyer, and Tamara Munzner. IEEE Trans. Visualization and Computer Graphics 18(12):2431-2440, 2012.

- Cluster and Calendar based Visualization of Time Series Data. Jarke J. van Wijk and Edward R. van Selow. Proc. InfoVis 1999, p 4-9.

- MizBee: A Multiscale Synteny Browser. Miriah Meyer, Tamara Munzner, and Hanspeter Pfister. IEEE Trans. Visualization and Computer Graphics 15(6):897-904 (Proc. InfoVis 09), 2009.