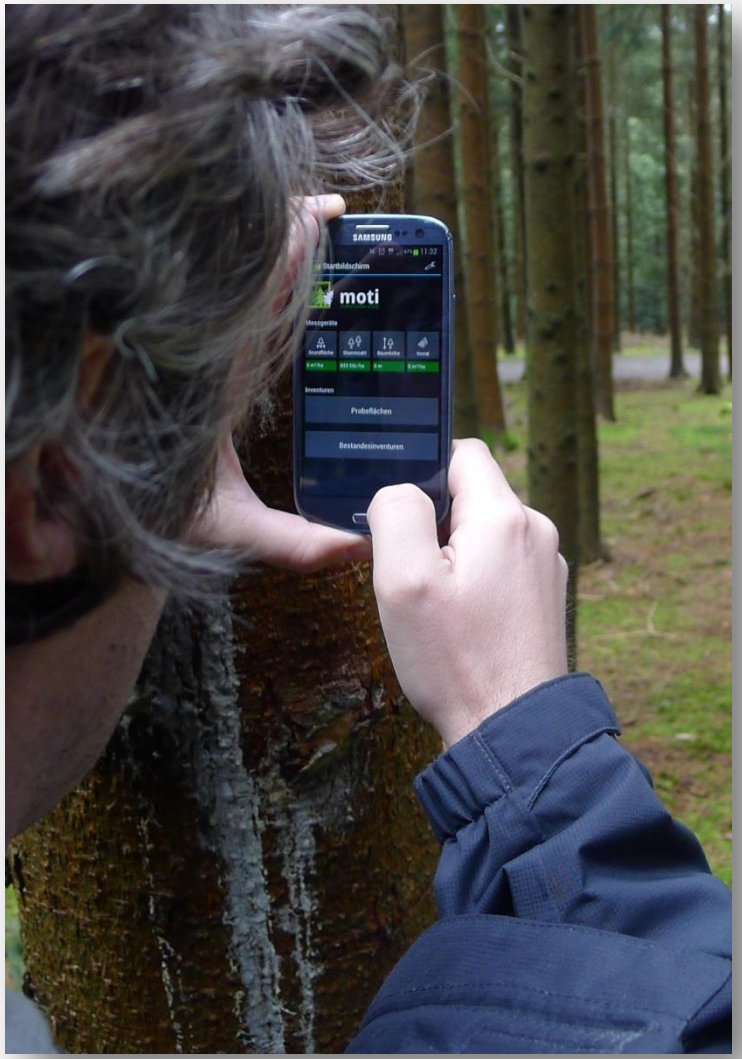
Use of Smartphone technologies to facilitate decision making in the forest



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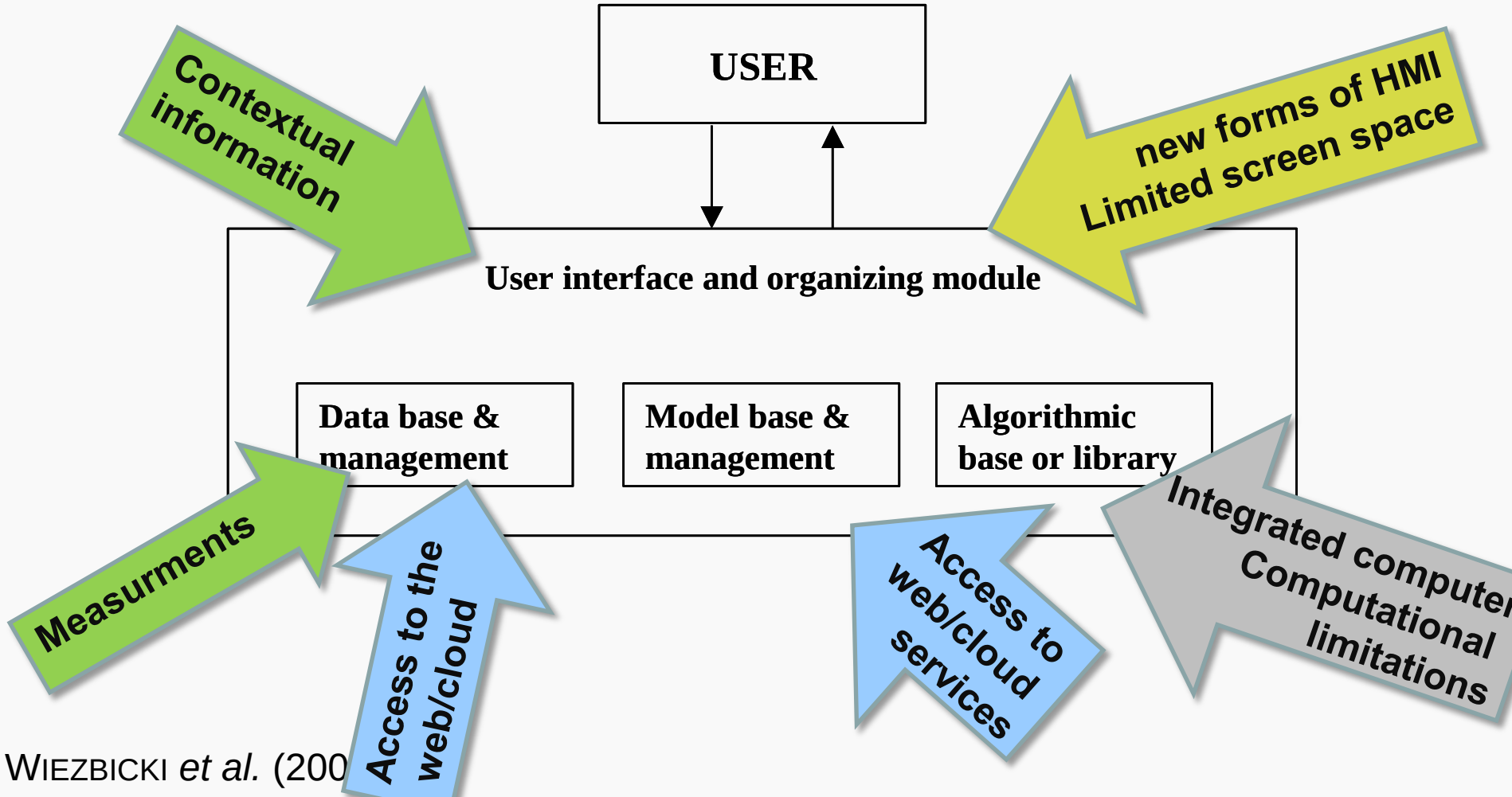
Christian Rosset[1]
Jean-Philippe Schütz[2]
Roland Brand[1]
Clotilde Gollut[1]
Dominique Weber[1]
Ulrich Fiedler[3]

[1] Bern University of Applied Sciences BFH,
School of Agricultural, Forest and Food Sciences HAFL
[2] former ETH-Zürich
[3] BFH, Department of Engineering and Information Technology

Smartphone and DSS > potentialities

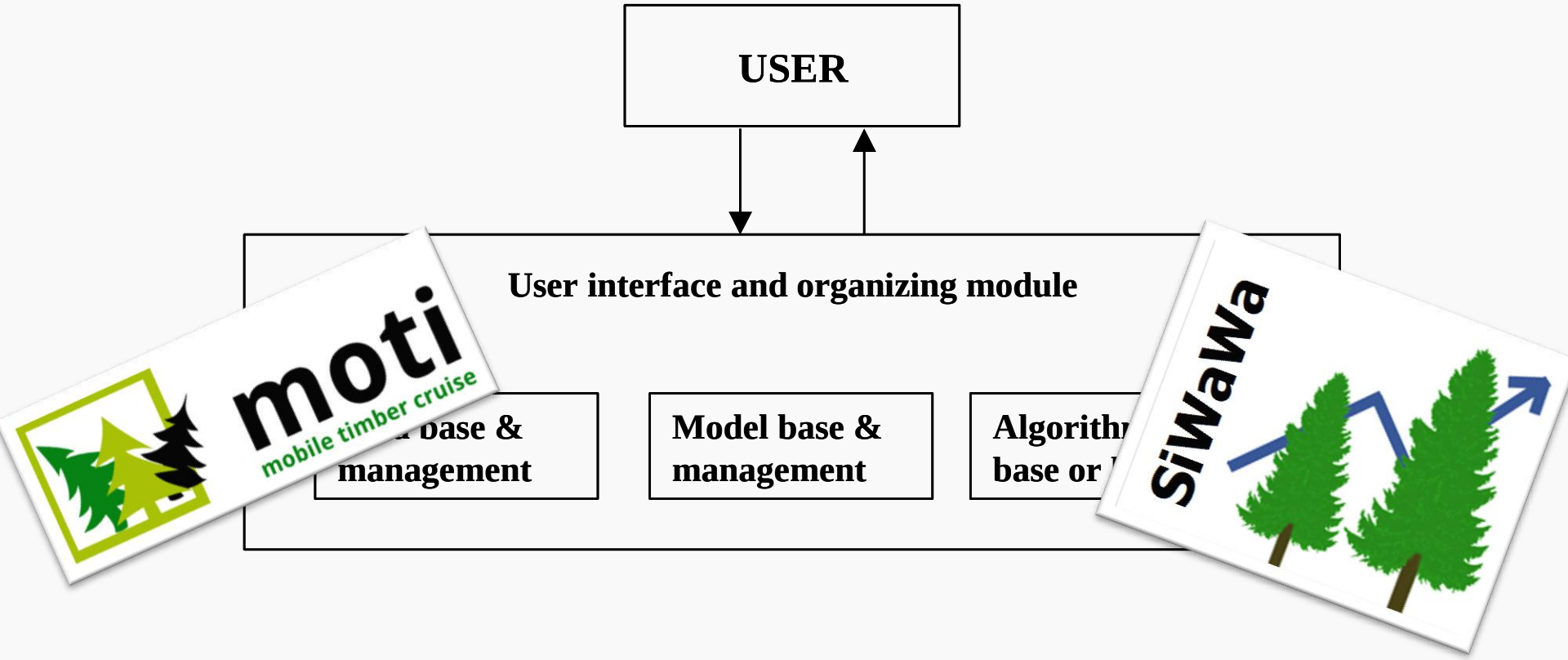
Limited access in forest area

computing | HMI (human machine interface) | embedded sensors | connectivity



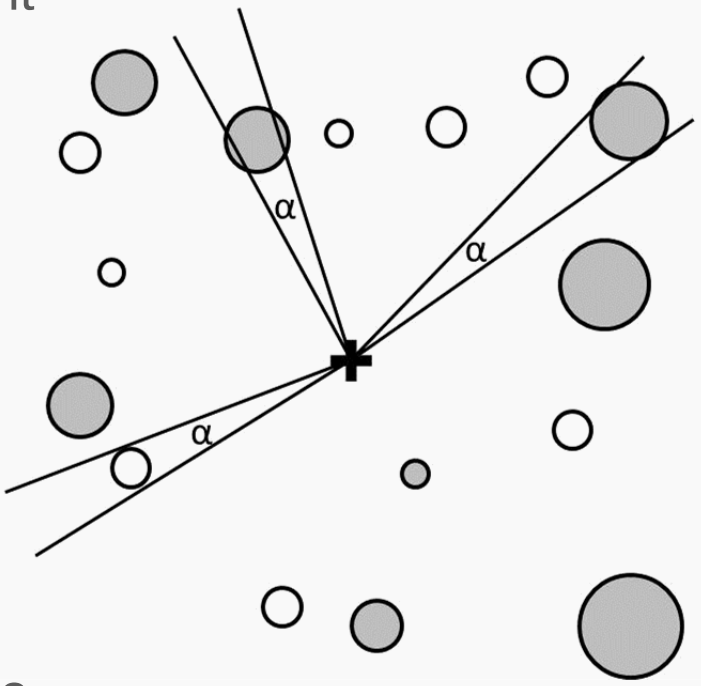
WIEZBICKI *et al.* (200

Two new tools for combined forest inventory and growth model system to support silvicultural decision making on mobile devices



moti WZP > determination of the basal area per ha (G)

- Smartphone app for Android
- Based on the Bitterlich sampling (angle count sampling)
- Use of embedded sensors to simplify measurements (flexible count factor, slope)
- Use of the touch screen for easy measurement taking
  (zoom in/out > limits tree, counting button)
- Limitations:
  - Calibration of mobile device necessary
  - Battery capacity, screen contrast
- Prototype available on the Google Play Store > already more than 1’000 downloads
- Author: Roland Brand (Brand 2012)



moti
mobile timber cruise

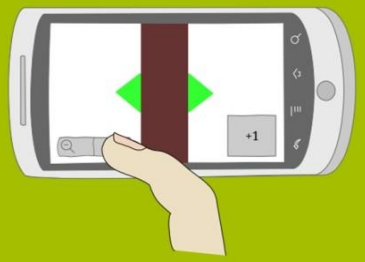
Easy way to determine the basal area

> Built-in sensors that simplify taking measurements
> Measurements easily taken through the user interface

Einfache Bestimmung der Grundfläche

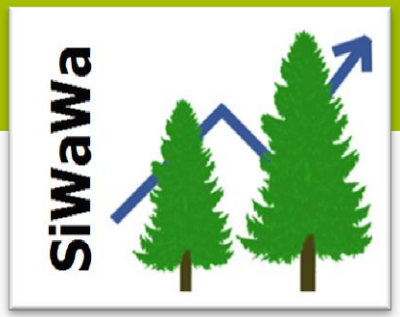
1. Mit dem nächststehenden Baum beginnen, 360° abfahren.

2. Alle Bäume zählen, die breiter als das Visier erscheinen. Hangneigung wird automatisch berücksichtigt.



3. Bei Grenzbäumen kann die Zoomfunktion Klarheit schaffen.

SiWaWa > stand growth simulation model

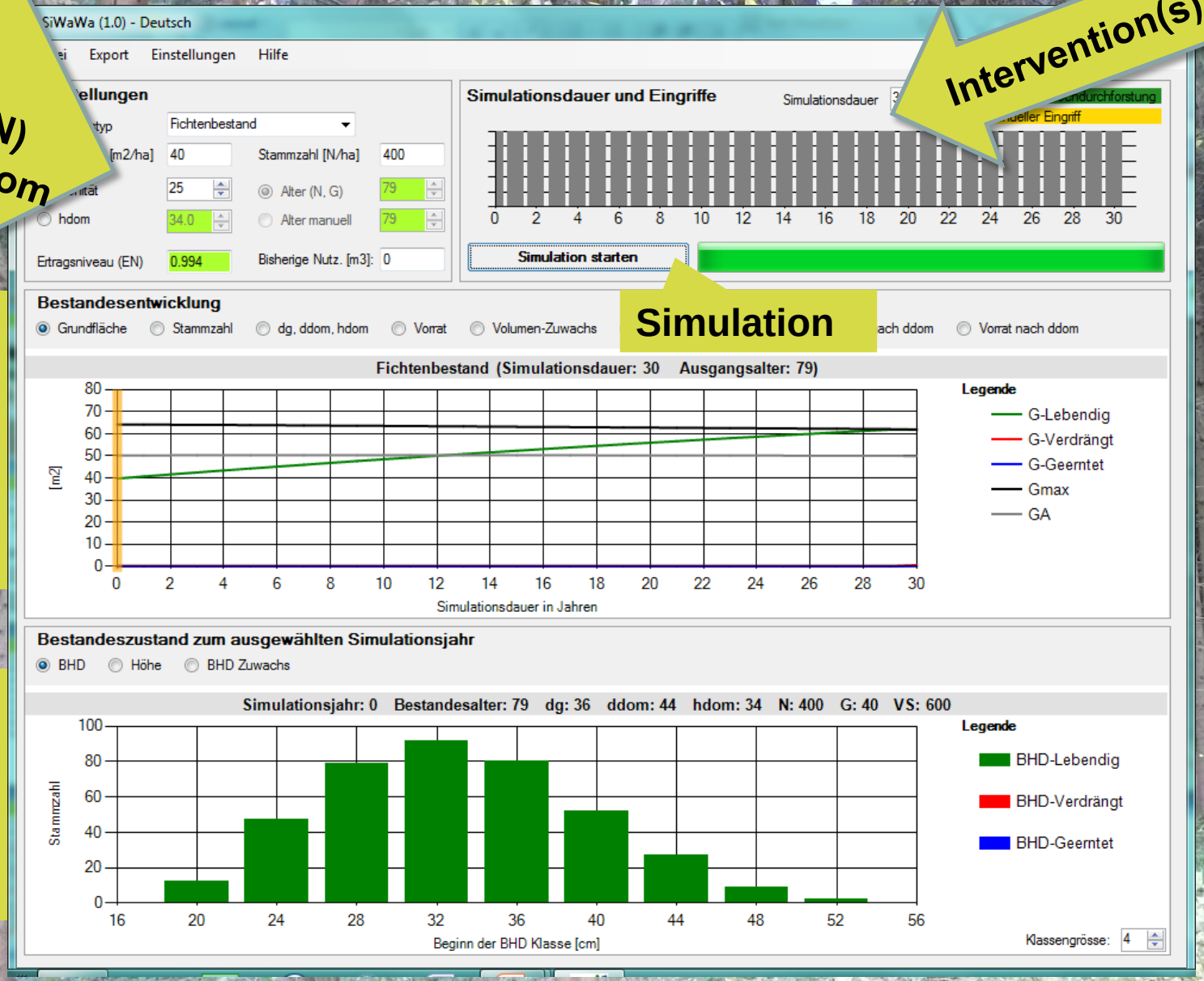


- Stand-alone Windows application
- **Input**: basal area per ha (**G**), number of stems per ha (**N**), site index (**SI**) or dominant height (**hdom**)
- **Model**:
  - ↳ stem distribution (Weibull-function)
    - ↳ tree growth based on the cumulative basal area of each tree (**Gcum**); means the basal area of all trees larger than the considered tree
  - ↳ maximal stand density (**Gmax**) > mortality
    - ↳ intervention: model-based or entered by the user in the stem distribution
- **Results**: basically usual dendrometric structure characteristics
- **Particularity**: stem distribution specific to the observed stand, no need for any age references
- **Limitations**: even aged and single tree species > spruce, beech, ash
- **Authors**: Jean-Philippe Schütz and Andreas Zingg (Schütz and Zingg 2007)

SiWaWa: stand growth simulation model provided on a single and simple user interface

Basal area (G)
Stems per ha (N)
Site index or hdom

Intervention(s)



Stand development:

- G, N, hdom
- Volume (V)
- Increment (Iv)
- …

Stand state:

- Stem distribution
- Increment of the single trees

Decision support tool based on SiWaWa and moti WZP: Requirements

- Measurement:
  - not only G, but also N and hdom (inputs to SiWaWa)
  - simple calibration methods for Smartphones and tablets
- Stand inventory:
  - sample plots inventory with calculation of the margin of error of the measured dendrometric data (standard deviation)
- SiWaWa:
  - same functionalities and information as on the current stand-alone application
  - margin of error displayed on graphics > visualizes uncertainty
  - integration of an assortment model

- Special focus: simplicity, reliability, practicability, cost

Development process

- Actors:
  - Project team: 5 people from ICT and forest management (all BFH) + two external experts (silviculture and modeling + forest inventory)
  - Partners: 6-7 Swiss Cantons (ZH, VD, LU, VD, GR, FR, possibly. TI)
- Workshops:
  - February 2013: requirements of base solution, paper prototyping
  - April 2013: test of the first prototype (half of the base solution) in the forest, requirements for extensions and paper prototype
  - June/July 2013: test in the forest of a second prototype of the complete solution
- Main modeling techniques: paper prototyping, UML (unified modeling language; e.g., use case, activity diagram)

Focus: Paper Prototyping

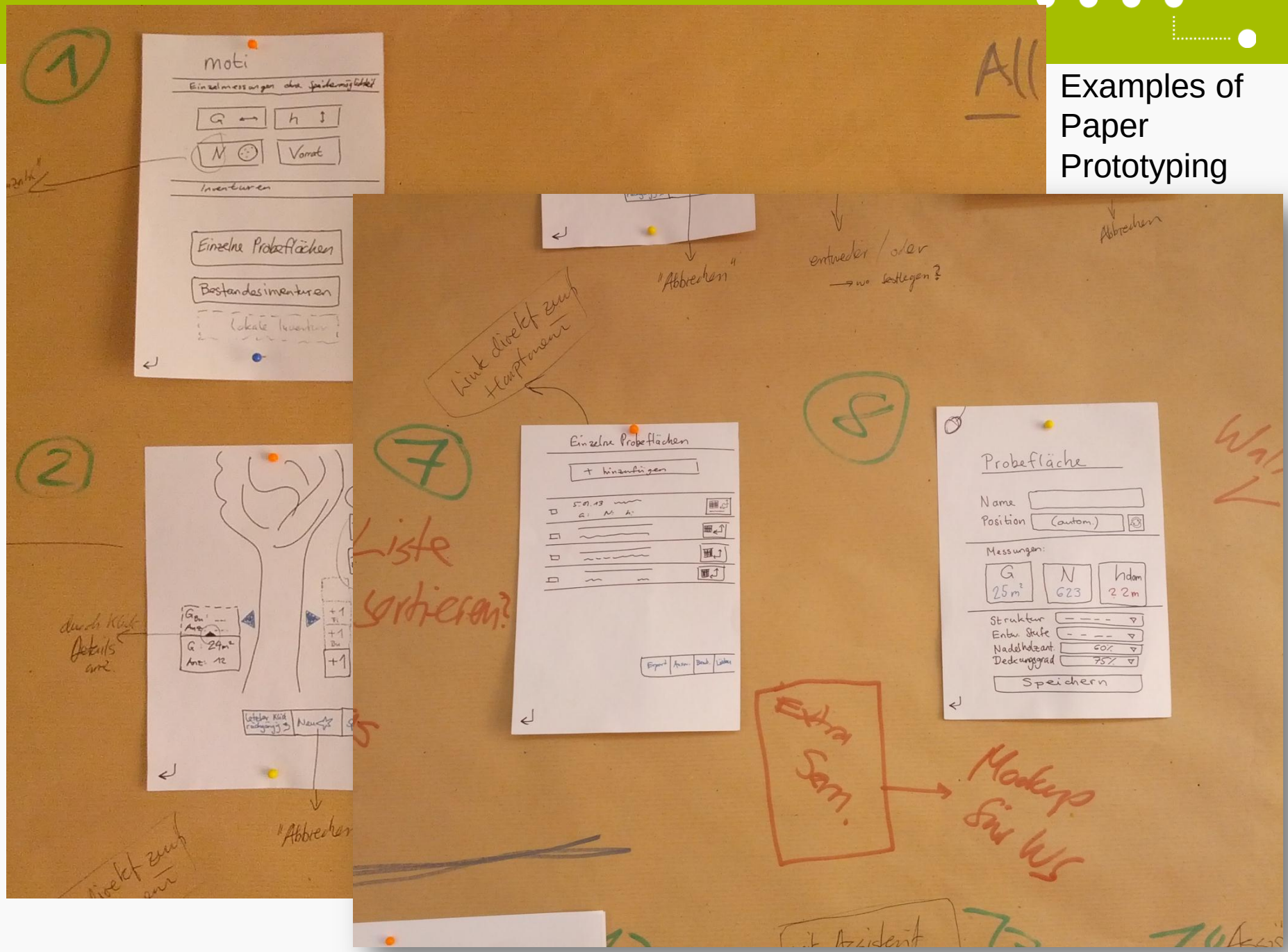
Simple method for the **design and testing** of the user interface.

Simple **hand sketches** are created, which represent the user interface or the **individual screens** of the future app. This makes the app **visually tangible** at an early stage.

Users play a **central role** in this method. They can **handle the sketches** and perform realistic tasks, just as if the app already existed. Thus, they are already **in a position to assess** the user-friendliness and usefulness of the app.

Challenge: design of a well-balanced and convenient user interface considering the **small space** available on Smartphone screens

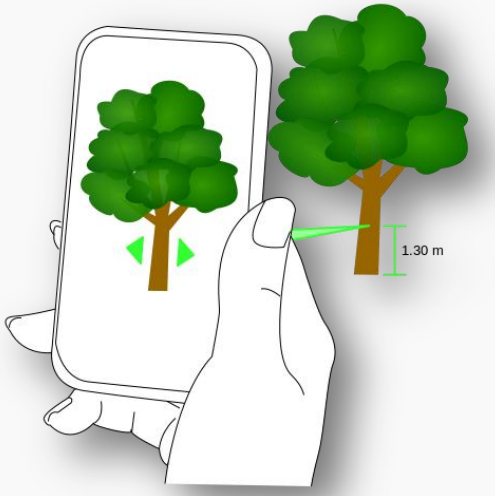
Examples of Paper Prototyping

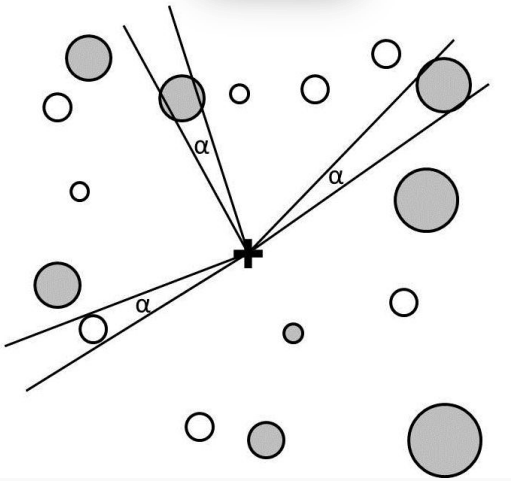


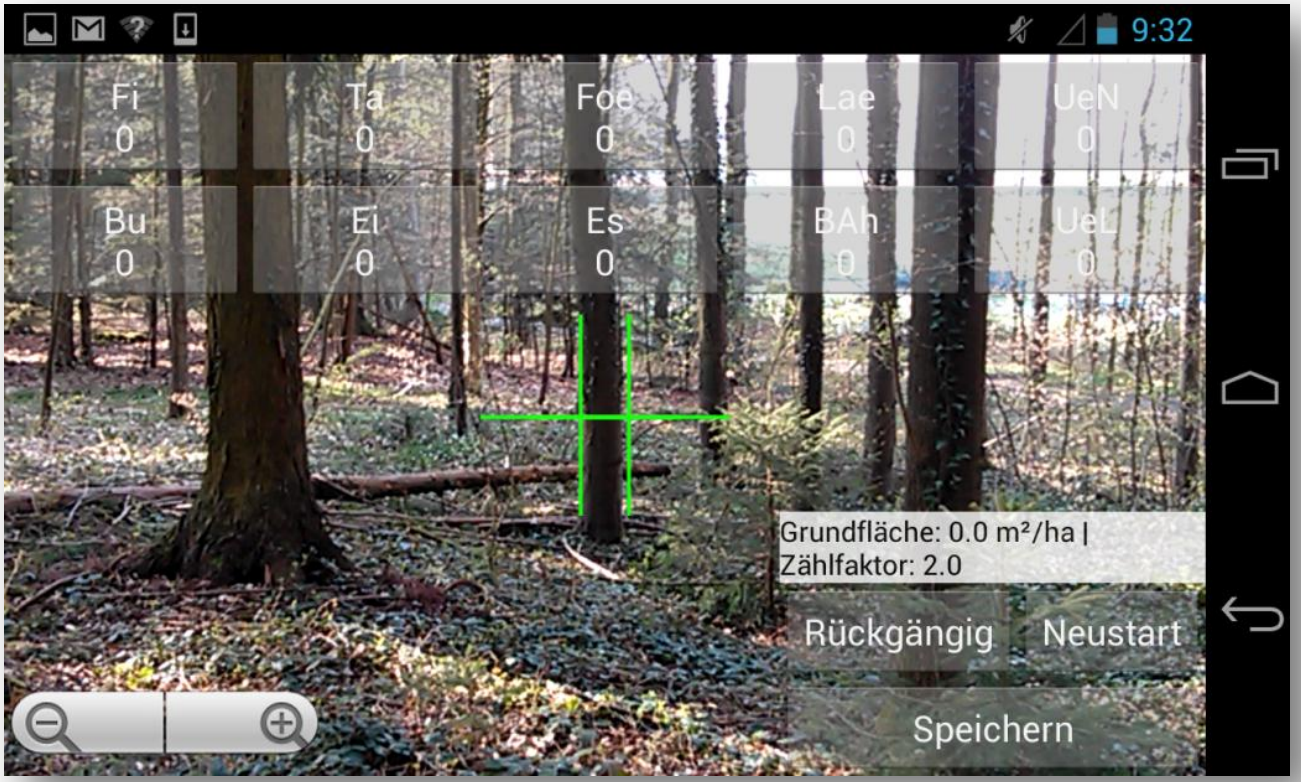
First prototype

> Measurement tools and sample plots inventory

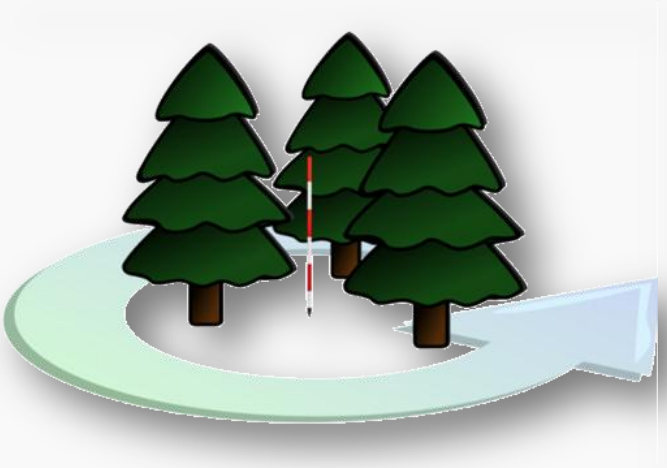
Basal area per ha (G)

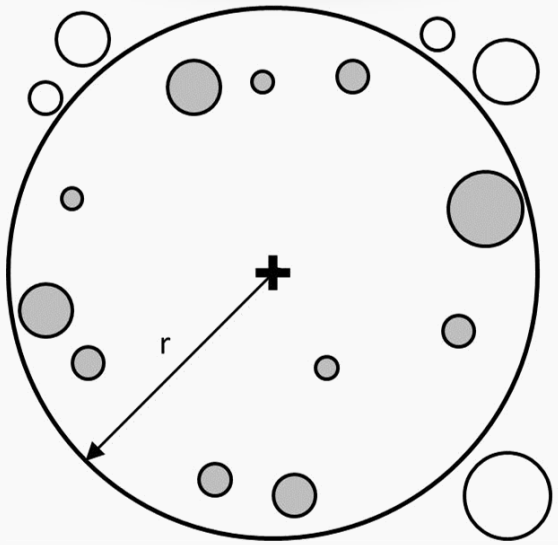




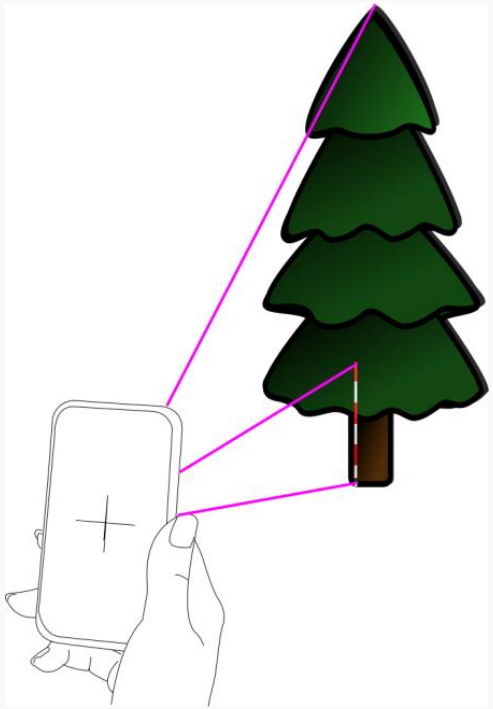


Number of stems per ha (N)

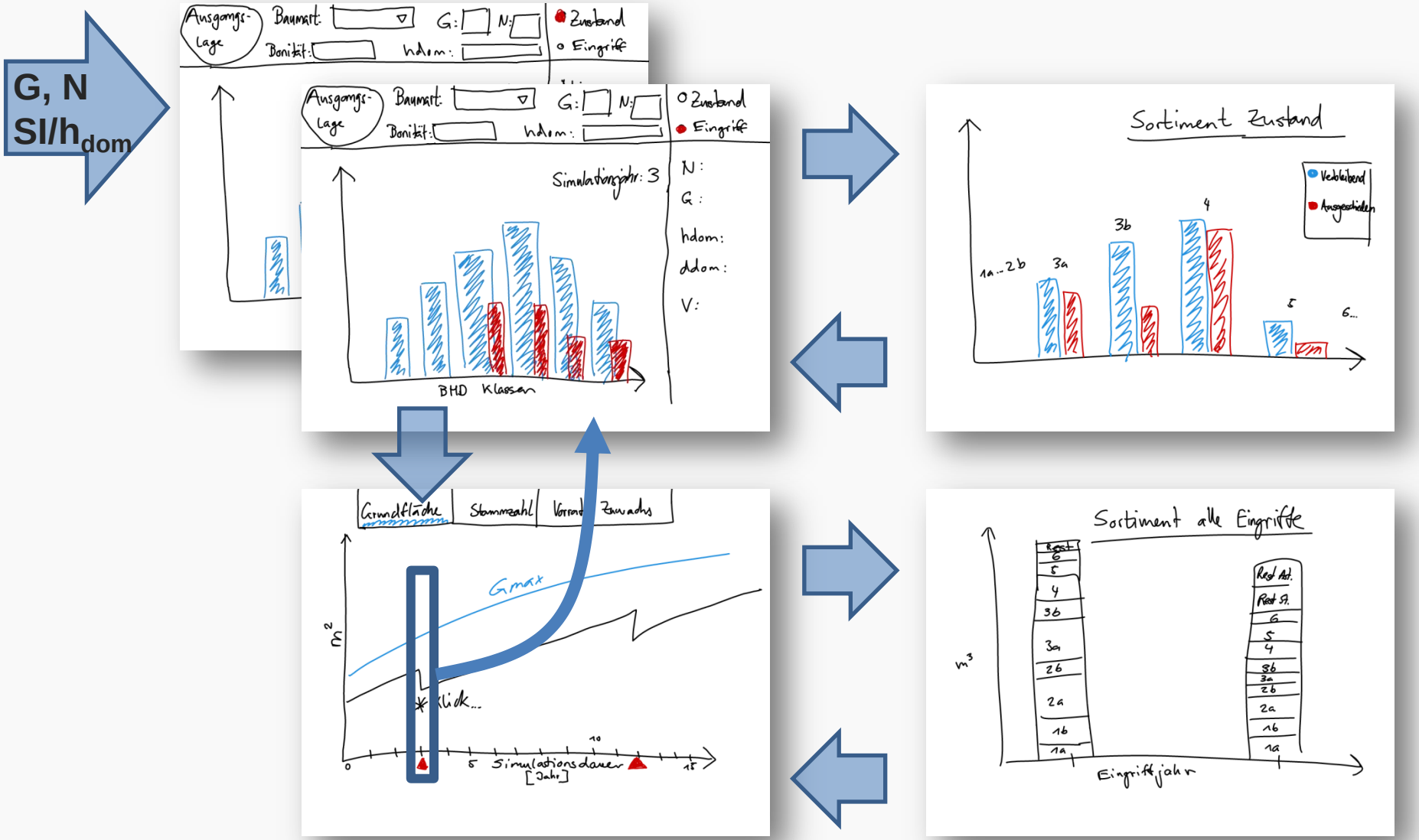




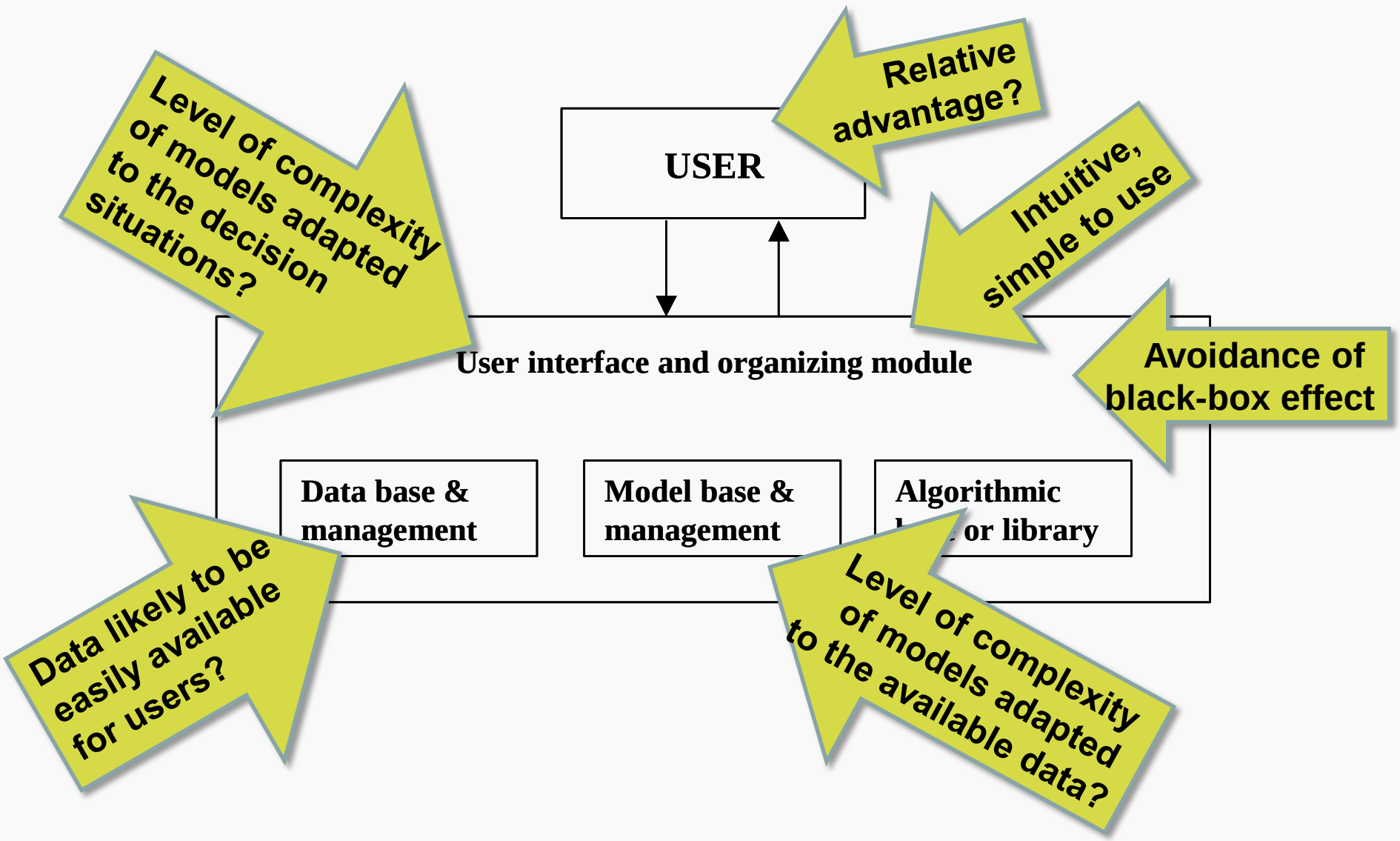
Tree height (h)



Paper Prototyping: SiWaWa



Decision support systems: challenges



Conclusions

- Stakeholder involvement from the beginning of the development, with financial participation
- Paper prototyping proved to be very useful and time-efficient:
  - Modeling the complexity of the app without writing a code-based prototype > precondition to design a simple-to-use app
  - Stakeholder participation > valuable feedback to improve the app
  - Easy to adapt and integrate the user feedback > iterative development process
- Mobile devices open new dimensions for decision support in the forest (HMI, sensors, connectivity) > strong interest from practitioners
- Change of attitude by practitioners regarding forest inventory and growth model?

Thank you for your attention!

… and special thanks to the following supporting organizations:

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