

DCGI

DEPARTMENT OF COMPUTER GRAPHICS AND INTERACTION
CZECH TECHNICAL UNIVERSITY IN PRAGUE



HCI, UCD, Ability based design

Zdeněk Míkovec

HCI RESEARCH GROUP

HCI GROUP

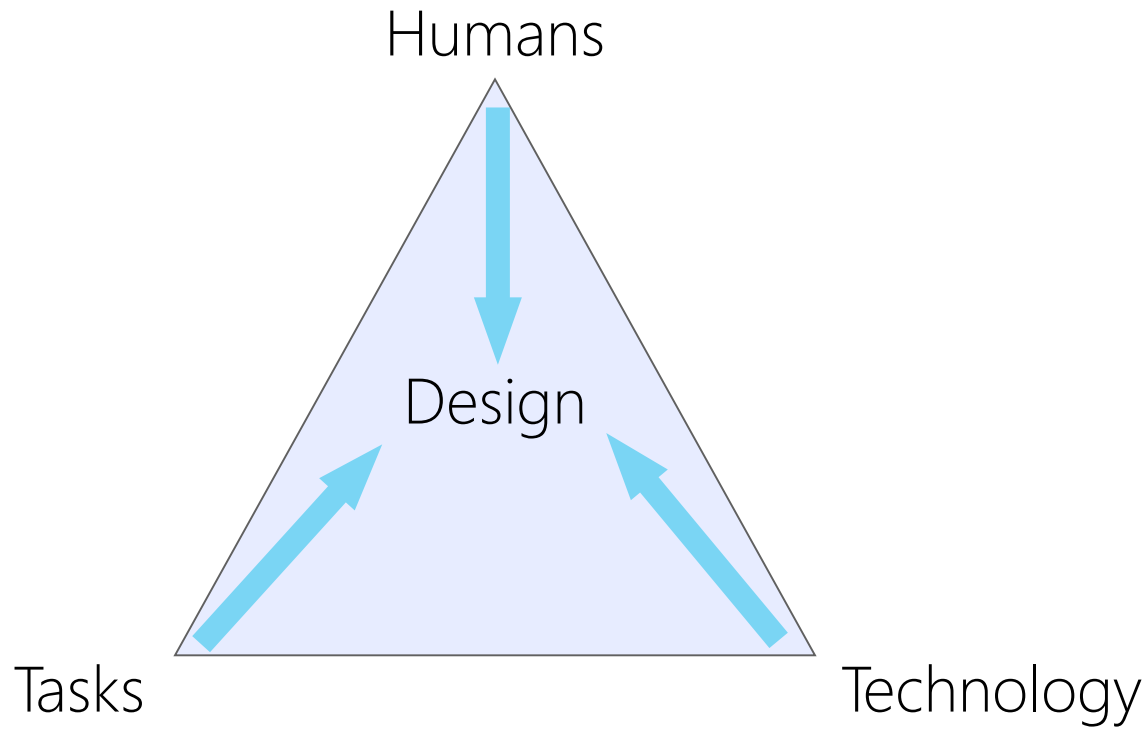
- Research topics
 - multimodal UI
 - UI for specific environments
 - accessibility
 - measurement and evaluation of human factors
- EC funded projects, industrial projects
- 1st usability lab in CZ

HCI RESEARCH

- Interaction between human and an interactive system
- Team work (psychology, ergonomics, HW/SW engineering, design)
- Extensive and long-lasting experiments

HCI DEFINITION

- Design, Implementation, and Evaluation of the interactive systems from the perspective of use by the human.



HUMAN-COMPUTER INTERACTION

- Human
 - End-user of an application
 - Collaborative environment
- Computer
 - The artefact helping to reach given goal
 - Can be a set of interconnected or communicating artefact
- Interaction – two-way communication
 - Initiative on user or computer side
 - Mixed initiative

WHY STUDY THE HCI?

- User interface takes majority of the source code
 - 50% - 80% of code
 - Over 50% of the implementation effort goes to the UI
- Risks of the bad UI
 - Financial (your product won't sell)
 - Lives (air or factory disasters, ...)
- Successful UI requires
 - Good knowledge of the human's abilities
 - Good knowledge of the principles of the UI design
 - Meaningful use case

IDEA OF HCI

„The old computing is about what computer can do, the new computing is about what people can do.“

(Ben Shneiderman)

Good design is about what people can do.

USER INTERFACE (UI)

- The part of the technology, allowing people to:
 - Perform their own tasks
 - Interact with the technology
 - Both are indivisible



Hydroelectric power station Orlik

UI OF PURE PHYSICAL DESIGN

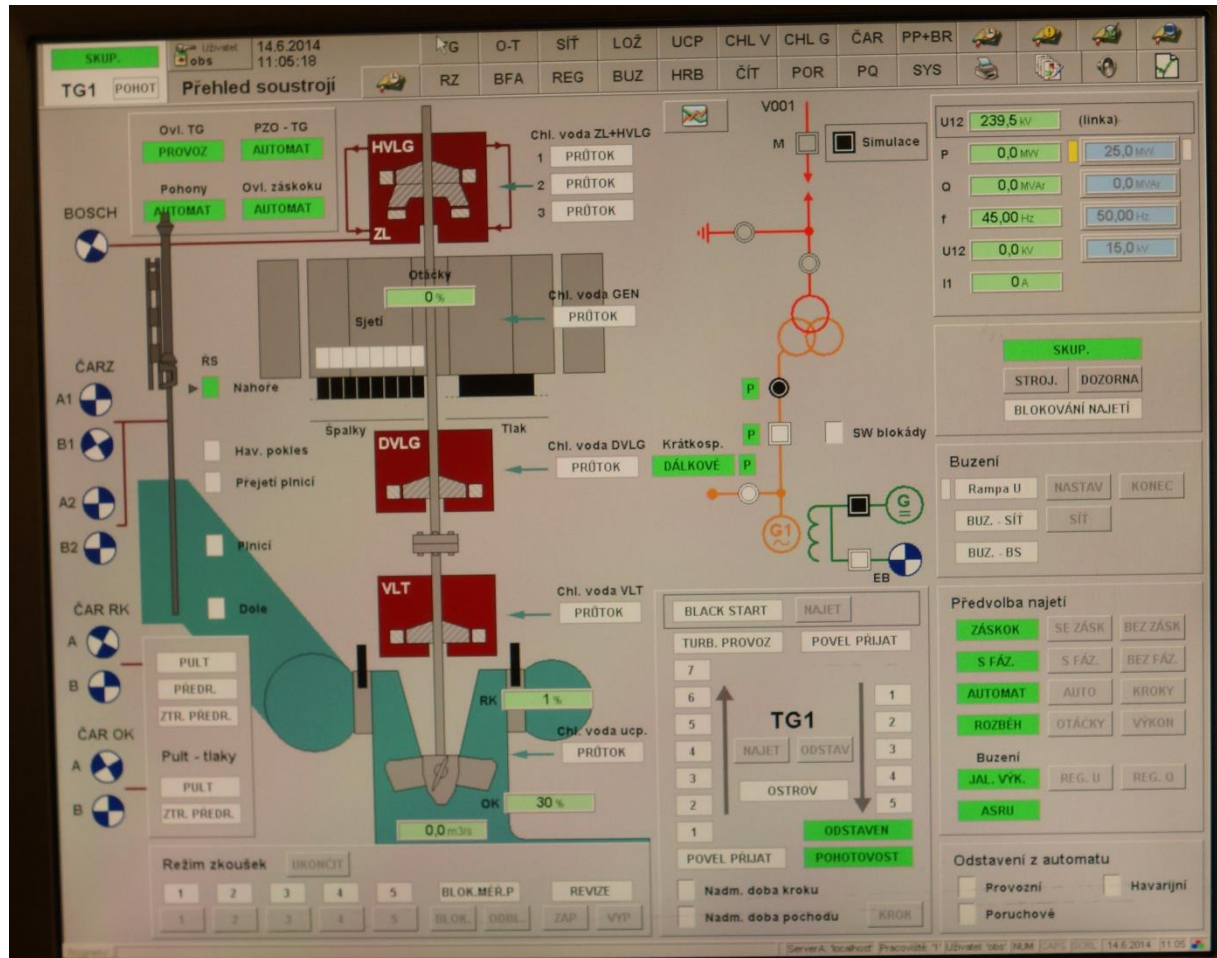


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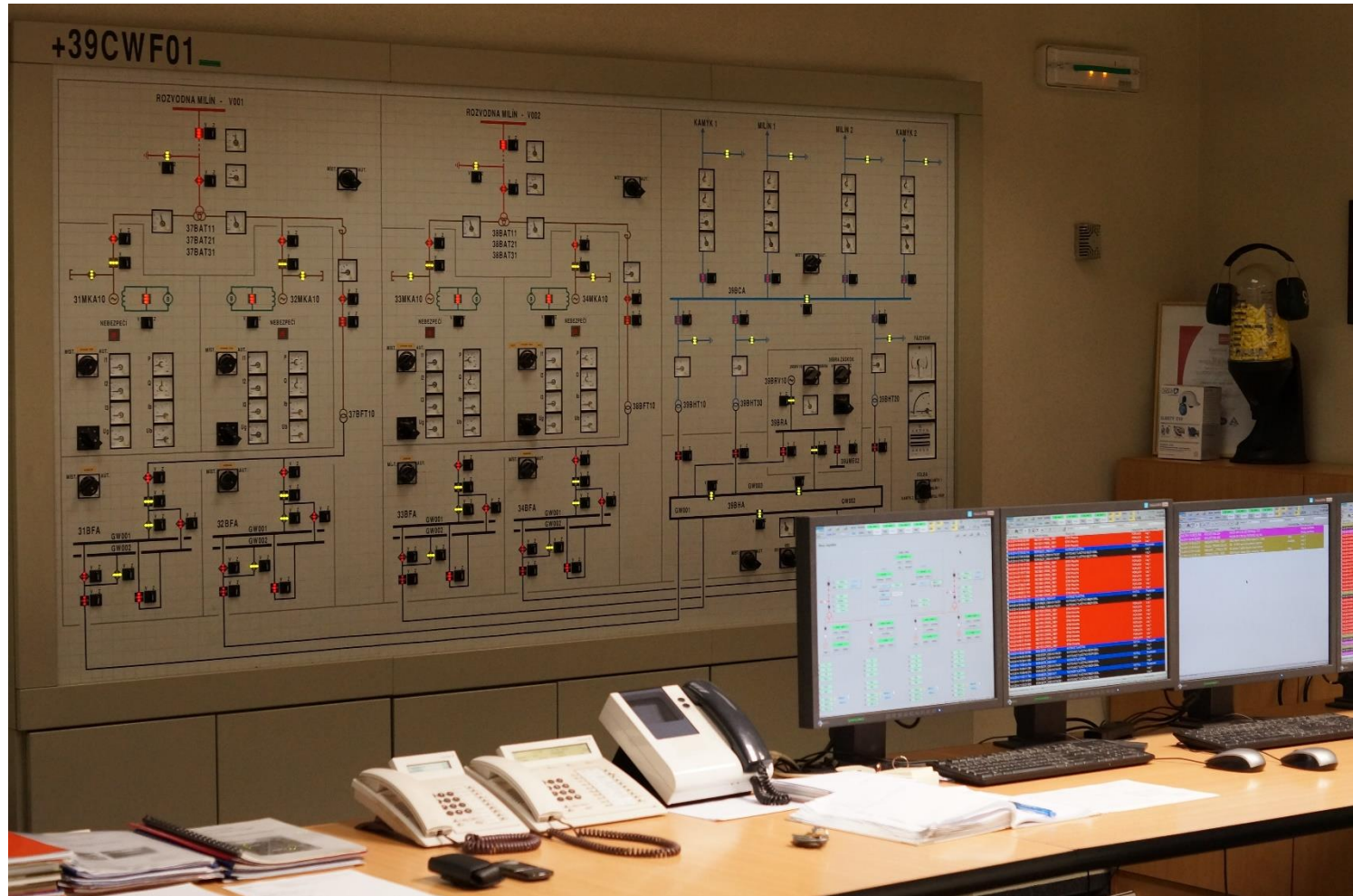
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UI MIMICS THE REAL WORLD



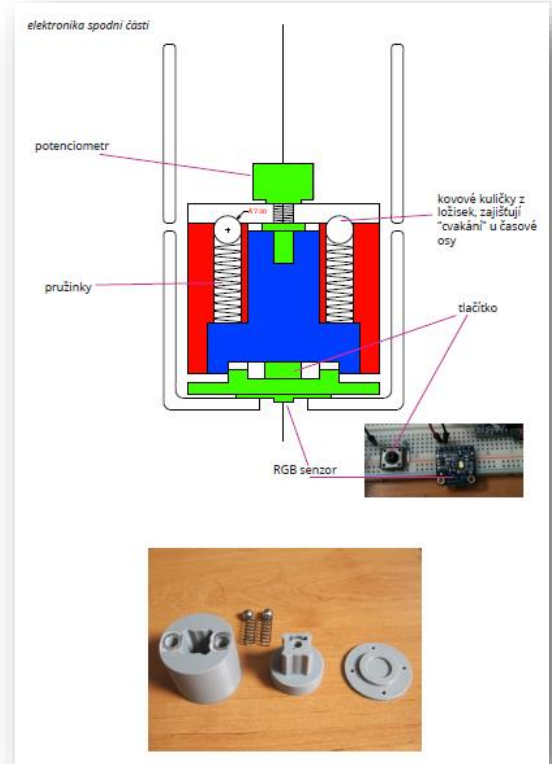
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UI OF COMPLEX SYSTEMS



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HIDING THE COMPLEXITY

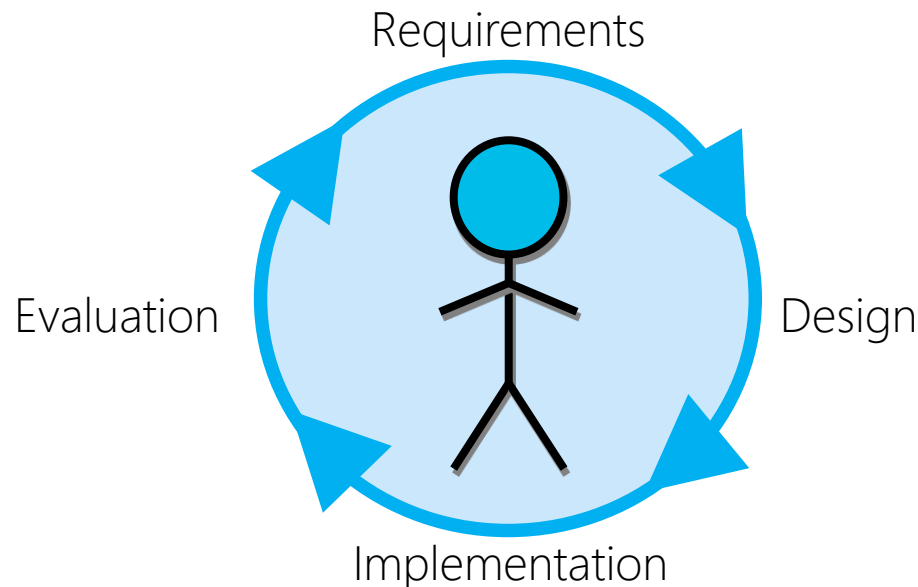


GRAFOOSHA: Anna Kutíková, UPD, FA ČVUT & Miroslav Macík, DCGI, FEL ČVUT

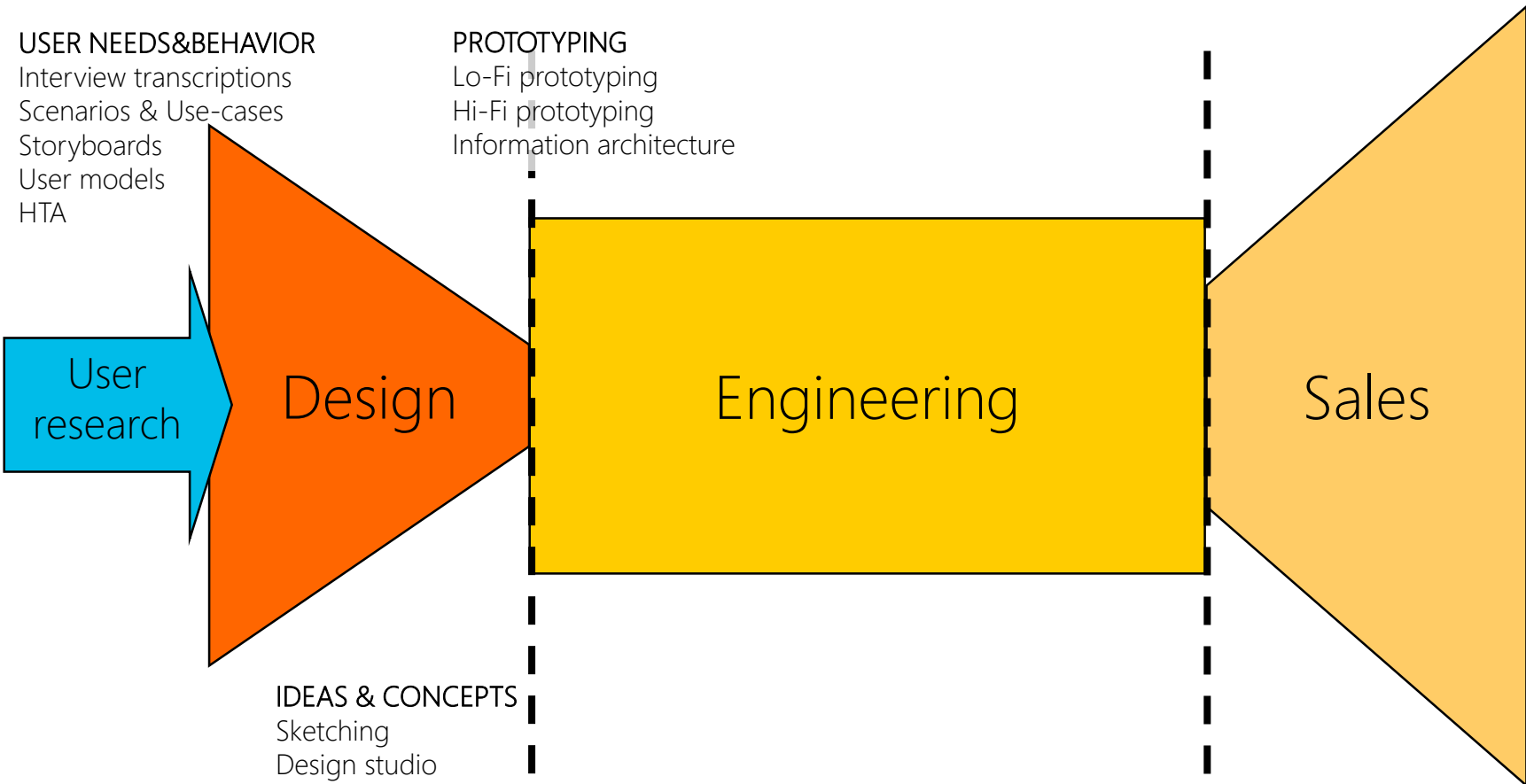
DESIGN PROCESS

DESIGN FOCUSED ON THE USER

- User Centered Design (UCD) **ISO 9241-210**
 - Find what are user needs and take them into account
 - You should be in permanent contact with potential users during the whole design process
 - testing of UI prototypes



DESING VS. ENGINEERING



Source: Buxton 2007

EVALUATION | FORMATIVE METHODS

- Informal user tests of lo-fi prototypes
- Laboratory user tests
 - all kinds of prototypes
 - controlled conditions
 - statistical evaluation possible
- Field tests with users
 - high fidelity prototypes
 - some tests can be done only here
 - collaboration
 - intensive interaction with the dynamically changing environment

EVALUATION | EXECUTION

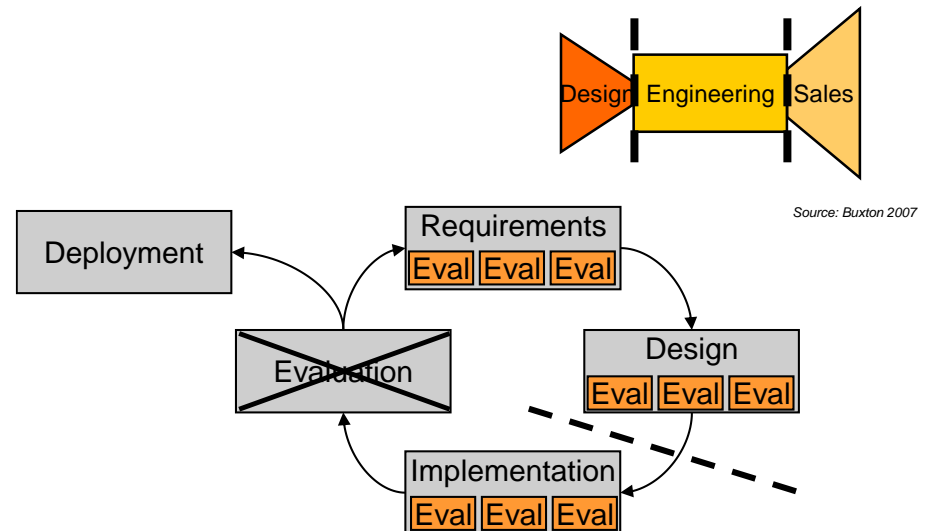
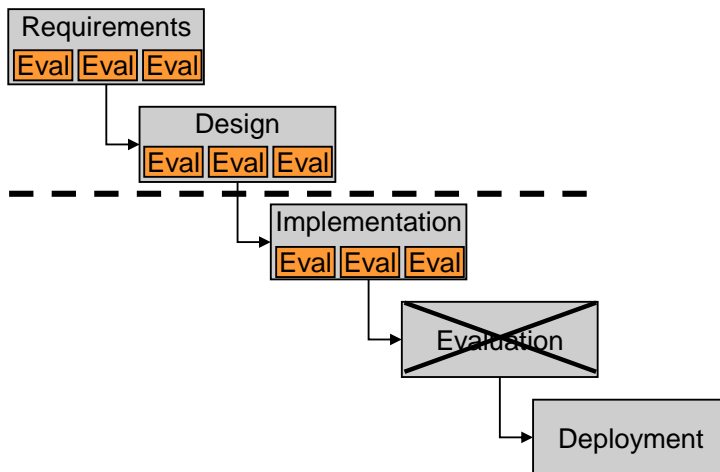
- Focus the evaluation on few specific requirements
 - performance requirements are easy to evaluate
- 1. Usability properties identification (specific requirements)
- 2. Prototype creation
- 3. Experiment design
- 4. Test run and data collection
- 5. Data analysis
- 6. Conclusions and recommendations statement

EVALUATION | PROBLEMS

- 3. Experiment design
 - poor choice of task mix => indistinguishable results
 - wrong choice of participants => misleading results
 - unaware mixing novice and expert users can seem like design improvement
 - accidental changes in the test conditions => insignificant or misleading results
 - large spread of measured values => insignificant results
 - shift of measured values => misleading results
- 5. Data analysis
 - analysis of influence of test conditions on the data measured
 - evaluator bias => analysis performed by more evaluators

EVALUATION | PROTOTYPES

- Do we need prototypes for evaluation?
- YES. Why?
 - user testing needed (empirical evaluation)
 - without prototypes it is impossible
- => Formative evaluation involves prototyping in all stages of the development process



USERS

WHO IS OUR USER?

- People are different
- The particular design is always a compromise
 - we do not consider rare extremes (illiterate user)
- Usually 5% “outlier” cases are eliminated
 - the result of this strategy is that some potential users can be discriminated
- Examples
 - car: height, weight
 - computer: font size, use of colors (colorblind)...



CLASSES OF USERS

- Novices
 - limited set of functions
 - Casual users
 - standard set of functions
 - Advanced users
 - advanced functionality
 - Experts
 - sophisticated functionality
-
- Consequence: necessity to split functions into individual categories
 - How can influence particular class of users implementation of functions?
 - What about the user interface design?



Photo: Alcatel-Lucent

PSYCHOLOGICAL ASPECTS

NOKIA SOLUTION

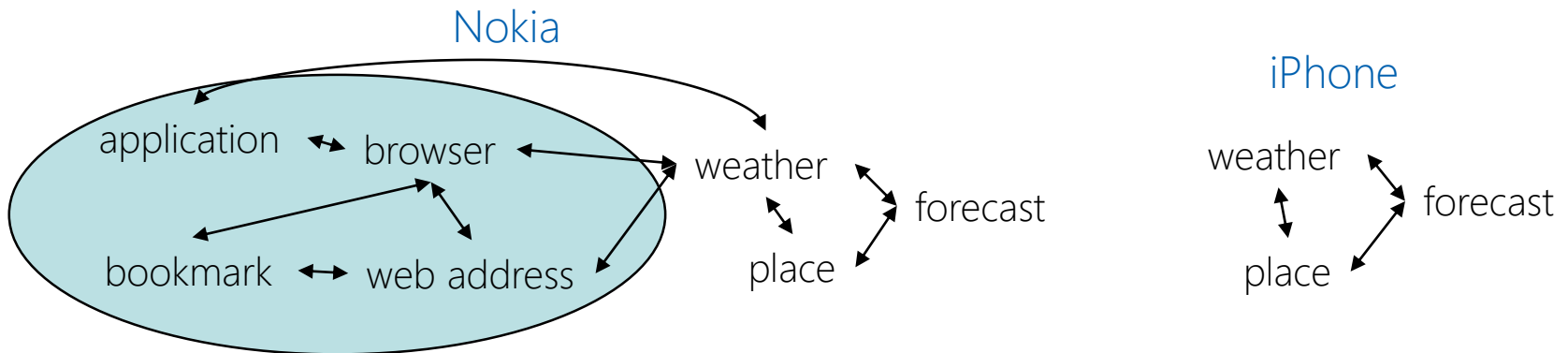


APPLE SOLUTION



DIFFERENCES NOKIA VS. APPLE

- Number of "clicks"?
 - NOT necessarily
- User's mental model?



- Is there anything wrong?
 - complexity of mental model - NO
 - unknown terms and relations (coming from system mental model)
 - What is the weather in Prague for tomorrow?
- What are the consequences?

USABILITY

USABILITY

- Simplicity of learning to use the system
 - System can be learned easily and fast
- Memorability = Recall (Easy to remember)
 - Whether the user is able to use the system after a longer time
- Efficiency
 - Once the user learned how to use the system, the system will be fast to use
 - To carry out the task quickly and efficiently

USABILITY

- Minimum amount of errors
 - Preventing users from making errors
 - If encountered, inform the users on the cause and give an advice

- Satisfaction of the user
 - Subjectively pleasing
 - The users is convinced that the task has been successfully achieved

DESIGN HEURISTICS BY J. NIELSEN

1. Visibility of system status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help users recognize, diagnose, and recover from errors
10. Help and documentation

ABILITY-BASED DESIGN

“Ability-based design makes ability its central focus.”

Jacob O. Wobbrock et al.

IMPAIRMENTS & ABILITIES

■ Visual impairment

- very fast reading
- Braille script
- superior haptics
- superior serial memory
- superior motor memory



■ Hearing impairment

- reading from lips
- sign language



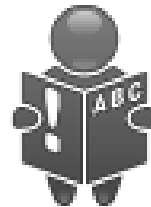
■ Motor impairment

- mastering special input devices
- usage of alternative parts of body



■ Cognitive impairment

- different cognitive styles and maps



Theory of difference
[Passini88, Golledge93]

WHAT IS THE PROPORTION?



Approximately **14 %** of 65+ in 2013

Approximately **21 %** of 65+ in 2040

According to Administration of Aging, U.S. Dept. of Health & Human Services

16 % of citizens suffer from free movement restriction

Sammer et al. 2012

CONCLUSION FOR A11Y DESIGN

- deep research of people abilities
- focus on abilities
 - and later on limitations
- design from scratch
 - and later try fusion with existing solutions

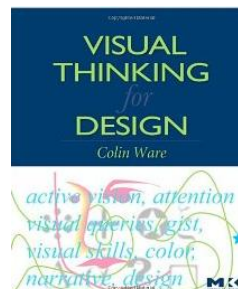
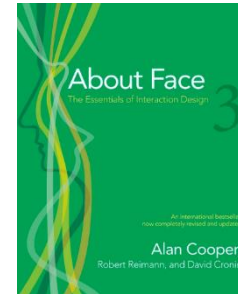
ABILITY-BASED DESIGN PRINCIPLES

- **Ability** – what user can do
- **Accountability** – change system, NOT users
- **Adaptation** – self-adaptiveness
- **Transparency** – make user aware
- **Performance** – measure performance and react
- **Context** – sense context and anticipate effect
- **Commodity** – be inexpensive

Jacob O. Wobbrock et al.

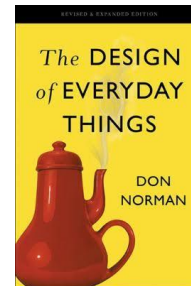
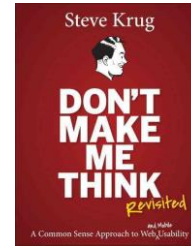
RECOMMENDED READINGS

- Alan Cooper: About Face – The Essentials of Interaction Design
- Bill Buxton: Sketching User Experience
- Colin Ware: Visual Thinking for Design



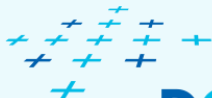
RECOMMENDED READINGS

- Steve Krug: Don't make me think
- Don Norman: The Design of Everyday Things
- Jakob Nielsen: Designing Web Usability



CONCLUSIONS

- focus on abilities
- design from the scratch
- execute serious and deep user research



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Zdeněk Míkovec
xmikovec@fel.cvut.cz

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