GENERATING RESEARCH IDEAS

- AN EXPERIMENTAL COMPUTER SCIENCE PERSPECTIVE

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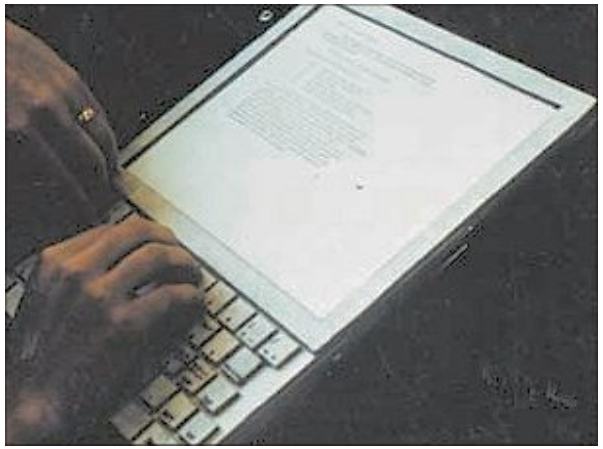
”The best way to predict the future is to invent it”

(Alan Kay 1971, at Xerox PARC)



KAY PROPOSED THE DYNABOOK AND OBJECT-ORIENTED PROGRAMMING WHILE COMPUTERS WERE CLOSET SIZED AND FORTRAN/COBOL WERE *THE* LANGUAGES

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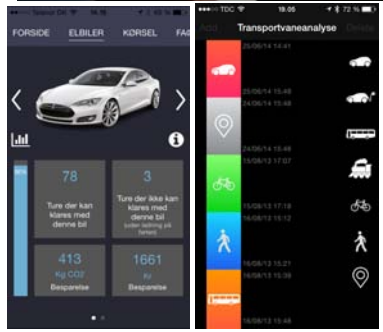
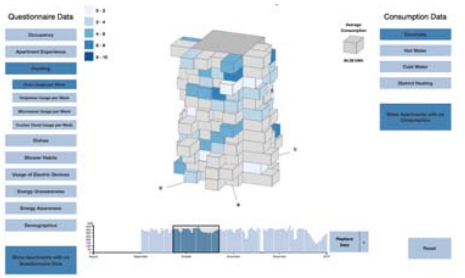
UBI GROUP – RESEARCH TOPICS

› Interaction Design
› Interactive Spaces
› Kinesthetic Interaction
› Sensor actuator based interaction
› Augmented Reality
› Ubiquitous and Pervasive Computing
› Positioning (GPS, WiFi,...)
› Context Awareness
› Crowd and Participatory Sensing
› Mobile Computing
› Peer-2-Peer computing,
› Hypermedia, Web, and Social Media





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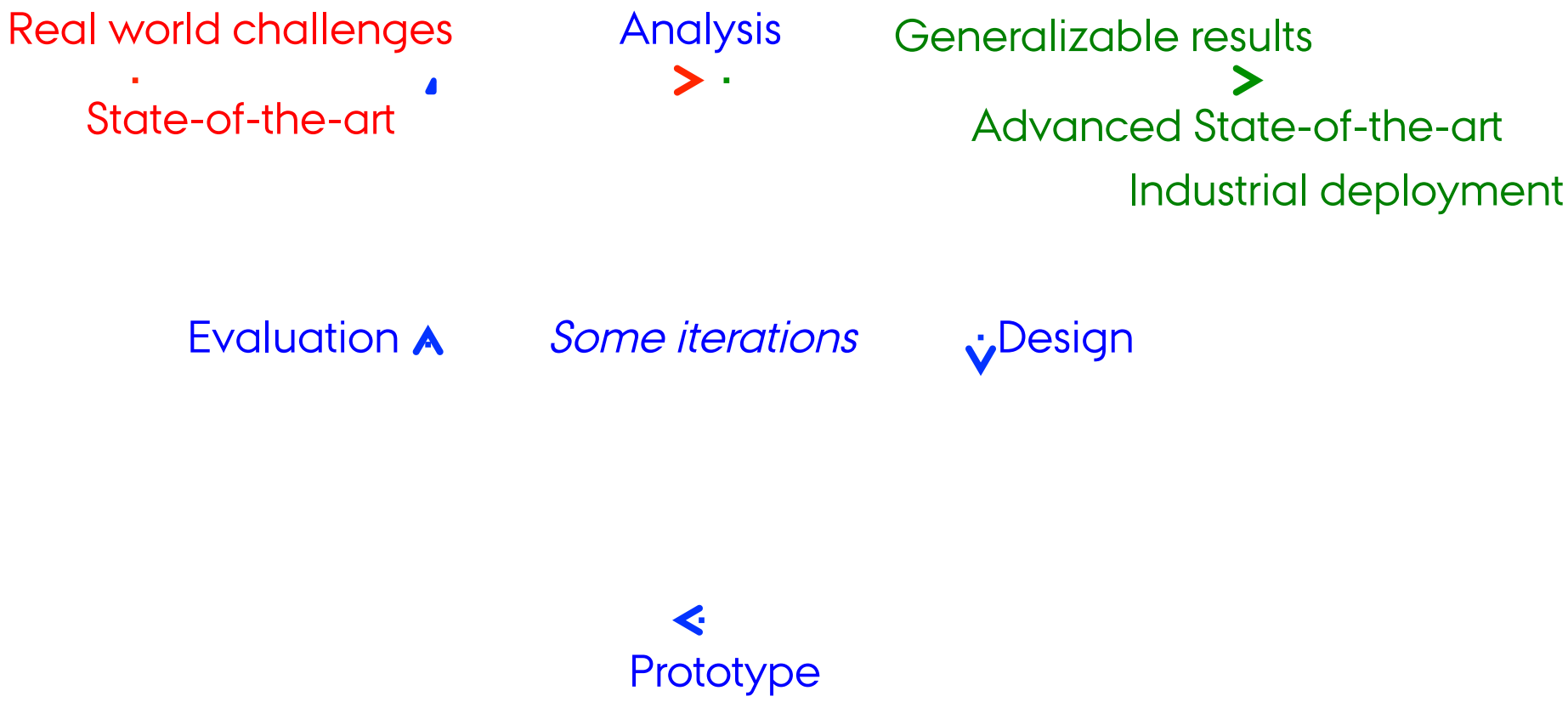
EXPERIMENTAL COMPUTER SCIENCE RESEARCH APPROACH

Kaj Grønbæk

APRIL 2015

EXPERIMENTAL COMPUTER SCIENCE



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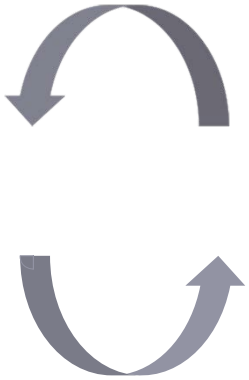
DEEPER LOOK AT EXPERIMENTAL APPROACH

- Formulate the idea and expected results in terms of hypothesis and/or success criteria
  - Investigate state of the art!!
- Create relevance by involving real world partners
- Early prototypes are important vehicles
- Deploy prototypes in real world settings
  - Evaluate by means of technical benchmarking
  - Evaluate by means of field studies with the users
- Conceptualize, reflect and publish



Ideas may change in the process!

DEMO OR DIE!

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RESEARCH RESULTS

- Prototypes are only research vehicles and not the final result
  - Some prototypes move into industrial deployments
- Contributions are: theoretical concepts, design concepts, interaction techniques, algorithms, infrastructures, methods, software frameworks,…
- Evaluation in lab and in real world settings
  - Both technical benchmarking and usability evaluations
- Publishing the results
  - New types of interaction or system concepts (Figure 1 before abstract ;-)
  - Evaluation needed
  - The state-of-the-art papers are the baseline for comparison

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QUICK EXAMPLE OF CYCLE:

ECOSENSE

Macroscopic analysis and collective sensing for understanding and reducing climate impact

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COLLECTIVE SENSING AND ETHNOGRAPHIC INQUIRIES IN COMMUNITY HOUSEHOLDS

- Grundfos Dormitory as a Living Lab
- 3000+ energy and climate sensors installed
  - Water usage and indoor climate
  - Inferring electricity activity based on powerline sensing
- Qualitative analysis of inhabitant energy awareness and behavior
- Analyzing and visualizing data
- Interventions to stimulate green living and smart grid participation

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STATE OF ART
MACROSCOPIC

- See patterns in lar
- Based on InfoViz
- Employed e.g. f
  networks

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GENERATING IDEAS

Kaj Grønbæk

APRIL 2015

MOTIVATION

- Creating a research career in a niche with open opportunities?
- Get the next grant?
- Make a difference to the world?
- Get an idea to become an entrepreneur and become rich?
- …

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IDEA GENERATION: DISNEY METHOD

› Three creativity phaser from fantasy to reality

› **1. Dreamer "Want to" Phase**:
  › State the specific goal in positive terms
  › Establish payoffs of the ideas
› **2. Realistic "How to" Phase**:
  › Ensure progress is testable through sensory experience
  › Establish time frames and milestomes for progress
  › Make sure it can be initiated and maintained by the appropiate person or group.
› **3. Critic "Chance to" Phase**:
  › Define the context in which it is workable and problematic
  › Make sure it is ecologically sound and preserves any positive products of the current way(s) of achieving the goal.

› The three phases take place in different physical spaces

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IDEA GENERATION:
SIX THINKING HATS AND MANY MORE...

Edward de Bono

- **White Hat**:
  With this thinking hat you focus on the data available. Look at the information you have, and see what you can learn from it. This is where you analyze past trends, and try to extrapolate from historical data.
- **Red Hat**:
  'Wearing' the red hat, you look at problems using intuition, gut reaction, and emotion. Also try to think how other people will react emotionally. Try to understand the responses of people who do not fully know your reasoning.
- **Black Hat**:
  Using black hat thinking, look at all the bad points of the decision. Look at it cautiously and defensively. Try to see why it might not work. This is important because it highlights the weak points in a plan. It allows you to eliminate them, alter them, or prepare contingency plans to counter them.
- **Yellow Hat**:
  The yellow hat helps you to think positively. It is the optimistic viewpoint that helps you to see all the benefits of the decision and the value in it. Yellow Hat thinking helps you to keep going when everything looks gloomy and difficult.
- **Green Hat**:
  The Green Hat stands for creativity. This is where you can develop creative solutions to a problem. It is a freewheeling way of thinking, in which there is little criticism of ideas. A whole range of creativity tools can help you here.
- **Blue Hat**:
  The Blue Hat stands for process control. This is the hat worn by people chairing meetings. When running into difficulties because ideas are running dry, they may direct activity into Green Hat thinking. When contingency plans are needed, they will ask for Black Hat thinking.

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POSSIBLE SOURCES OF IDEAS

- Societal challenges
  - Typically not IT-research from the outset
  - Formulated by politicians or funding sources ☺
- Empirical studies
  - Analysis of real life problem from a certain perspective,
  - Typically multidisciplinary and with collaborating partners
- The bright idea: A new UBI or application concept
  - Experimental solution to problem
  - Proof of concept prototype implementation + evaluation
- Theoretical Work
  - Survey of a research area or problem, propose new perspective

H2020 SOCIETAL CHALLENGES

1. Health, demographic change and wellbeing;
2. Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy;
3. Secure, clean and efficient energy;
4. Smart, green and integrated transport;
5. Climate action, environment, resource efficiency and raw materials;
6. Europe in a changing world - inclusive, innovative and reflective societies;
7. Secure societies - protecting freedom and security of Europe and its citizens.

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INNOVATION FOUNDATION CHALLENGES

1. Bioresources, food, health and lifestyle
2. Future energy technologies and systems
3. Future welfare – social innovation
4. Competitive environmental technologies
5. Coastal tourism
6. Salmon stock
7. Production systems and strategic growth technologies
8. Psychiatry
9. Healthcare and clinical research
10. Transport, infrastructure and drones
11. Ecology

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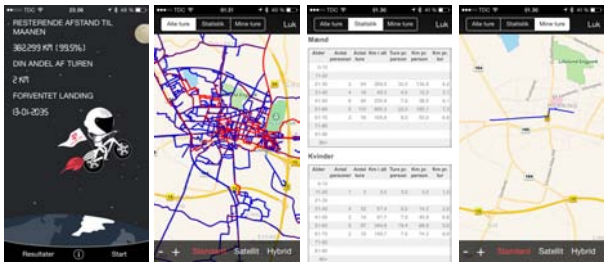
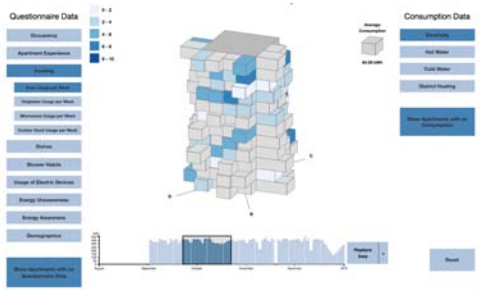
RESEARCH IDEA EVOLVES (1)



Soceital challenges

1. Smart transport
2. Better environment
3. Future energy tech

"EcoSense"
type project
Collect and analyse data to create energy awareness



State-of-the-

1. Mobile Sensing
2. Internet of Things
3. Visual analytics

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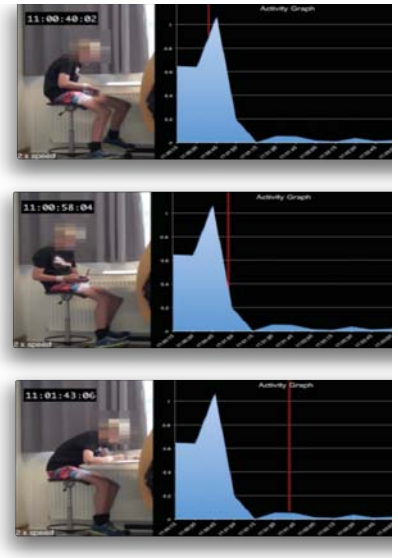
RESEARCH IDEA EVOLVES (2)



Soceital challenges

1. Health and wellbeing
2. Healthcare
3. Future welfare

"Assistive Technology for ADHD"
Analyse child activity and invoke interventions to assist

State-of-the-art

1. Wearable Sensing
2. Physiological comp
3. Machine Learning
4. Cognitive training

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RESEARCH IDEA EVOLVES (3)

Soceital challenges

1. Health and wellbeing
2. Healthcare
3. Future welfare

"Interactive Ball Games"
Advanced sensor technology for kinesthetic interaction

State-of-the-art

1. Sensor technology
2. Kinesthetic interaction
3. Game design

WRAP UP

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NOVEL RESEARCH IDEAS…

- Require multiple disciplines to meet
  - Often collective processes
- Are grounded in empirical understanding
  - Real world is an invaluable source of ideas
- Based on strong IT-research competences
  - Solid understanding of state-of-the-art
- Require ability to generate disruptive ideas
  - Brainstorming without barriers
  - Being selective - 1 out 100 ideas are worth pursuing
- Overall idea commenced in application phase
  - Detailed ideas and research contributions evolves

FOR GROUP WORK

Try to combine ideas from:

› Your deep technical research interest

with

› Some important societal challenges

› State some research ideas from this process!