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Ethnography and Work Studies

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Ethnography and Work Studies

- Nardi (antropologist). "The Use of Ethnographic Methods in Design and Evaluation", Handbook of Human-Computer Interaction, Ch. 15, Elsevier Science B.V.
- Antropology – The scientific study of the origin, the behavior and the physical, social and cultural development of humans.

Work Studies within HCI

- Ethnography
  - Qualitative research design aimed at exploring cultural phenomena
  - Observe the world from the view point of the subject (not the participant ethnographer)
  - Record all observed behavior and describe symbol-meaning relations using concepts
  - In "quick and dirty" terms: Contextual Design
- Ethnomethodology
  - The study of the everyday methods that people use for the production of social order
- Situated Action
- Participatory design (later)
  - Actively involve all stakeholders in the design process

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Ethnography

- Purpose:
  - To find out what people really do when they work or play.
  - HCI: develop an understanding for everyday work, and technologies used in everyday work.
- Used by sociologists as well as anthropologists

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Ethnography

- Was developed in late 1800s -, early 1900s
- Flexible research design: the study is shaped throughout the study, and unexpected and interesting events are investigated as they occur
- Dominant ethnographic methods are:
  - Interviews
  - Observations
  - Participation-observation
    - To spend lots of time with and participate in the everyday lives of people studied

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Anthropology and Ethnography

- Ethnography was developed as a method to explore life in 'foreign' communities. E.g. in the mining industry
- The personal perspectives of the stakeholders are taken into account and it impacts the analysis of what one sees in the studies
- Central to anthropology is the holistic approach where all aspects of a culture are related - often in relationships characterized by conflicts and contradictions.

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Sociology and Ethnography

- Focus on sub-groups in society
- Ethnography has been developed as an alternative to surveys
- Ethnomethodology
  - Focuses on methods and procedures in social settings for social order
- In common:
  - Capture "tacit knowledge": observations in addition to interviews
  - The observations must take place in the actual environment
  - Looking for related activities

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HCI and Ethnography

- Was first used in the 80's
- Why?
  - Understanding Human-Machine Interaction requires information on the HMI in relation to the situation where it takes place
  - There has been an emerging consensus that human intelligence is socially linked and requires interaction with the environment to be shaped - cannot easily be recreated in a computer
  - Growing interest in developing systems that support people working together, CSCW, GroupWare

Ethnography and Designing Systems – When?

- Useful in several phases of the design cycle. Nardi identifies specifically two occasions:
  - Before the design is shaped
  - When a robust prototype is available

- Pinpoints areas of interest, might be followed up in a quantitative study in which measurable aspects can be explored and give statistical results

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Ethnographer

- Practice is necessary to carry out a good ethnographic study
  - Handle large amounts of data
  - Requires awareness of their own "biases"
  - Necessary emotional resources to cope with the unknown / what separates them from their own values
  - objectivity evolves over time

- Common mistake in ethnographic studies:
  - generalization beyond the studied population

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Ethnographer

- As a member in a design team:
  - Conduct specific studies for a given project or product
  - Project management
  - Act as "first user" of a prototype
  - Keep updated with literature
  - Maintain user's perspective throughout the project.
- *"Programmers have many wonderful gifts and talents, but in the heat of coding, it is easy to forget how unlike they themselves end users are."* Nardi 1997

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Criticism

- When designers claim to have conducted ethnographic studies:
  - The results are often inadequate
  - A superficial overview of the environment with no analytical content
  - Used as a "post hoc" explanation of design decisions already taken

Ethnography and Conversation Analysis

- Complementing techniques
- Different levels of analysis

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Conversation Analysis

- Part of ethnomethodology
- Emerged during 60-70's
- Primary sources are sound+picture recordings of real interactions
- Sometimes supplemented with field studies

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What is Studied?

- Language is viewed as a vehicle for social interaction
- Social organization of common human behavior
- Which resources does the human rely on when producing and recognizing social activity
- How turn-taking in the interaction generates activity, both inseparable from the environment in which it takes place
- Context is defined by the phenomenon that plays a role in activities and interactions

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Method

- Video recordings are analyzed in detail in many iterations to identify phenomenon
- Studies are not conducted starting in a hypothesis (explorative)
  - Instead inductive search methods are used to find patterns of activity and interaction
- Sequence of events where each event is depending on earlier events and generates subsequent events
- ”Moment-by-moment” puts demands on a user, demands that emerges

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HCI and Conversation Analysis

- Transcriptions are done of a situation where every event is registered:
  - User + computer
    - User: mouse click, keyboard strokes, menu choices, ...
    - Computer: response – dialogue forms, sound, movement, ...
- Example: patient + doctor + computer
  - what is said, simultaneous speech, pauses, eye focus, body movements

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Theory and Ethnography

- Impossible to carry out ethnographic studies without a theoretical perspective
  - Filter
  - Focus
  - Otherwise, a risk for biases from the investigator
- Theories: activity theory, distributed cognition (Hutchins), situated action (Suchman).

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Theory 1 – Activity Theory

- Focus for the study:
  - Activity history
  - The larger context in which operations are included
  - The changing aims and objectives of individuals with activities
  - What are the perceptions and knowledge of the individual that participate in the study
  - How artifacts are used to distribute and regulate knowledge and activity

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Theory 2 – Distributed Cognition

- Working at the system level rather than individual level
- Doesn't matter how well you know a particular part of the system (human or artifact) if you do not see the whole system

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Theory 3 – Situated Action

- Suchman (researcher skilled in ethnomethodology)
- "Moment-by-moment" interactions are studied from video recordings (e.g. conversation analysis)
- Perceptions of the world is created in social interaction

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Situated Action

- (1987) "Plans and Situated Actions - The Problem of Human-Machine Communication" - Lucy A. Suchman
- “Every execution of the activity is dependent on its material and social circumstances”
- Instead of abstracting activity away from its context to find meaning in what is happening (as in task analysis), focus is on how the operator uses circumstances to achieve meaningful activity.

Situated Action: Purpose

- Not to find formal models of knowledge and activity
- Rather to explore knowledge and activities, relative to the circumstances / environment in which knowledge and activities are carried out
- The organization of activity emerges through "moment-by-moment" interactions between the actors and the environment, and are not determined by a pre-defined plan
- A situative space model part of egocentric interaction for analyzing the "moment-by-moment" interaction

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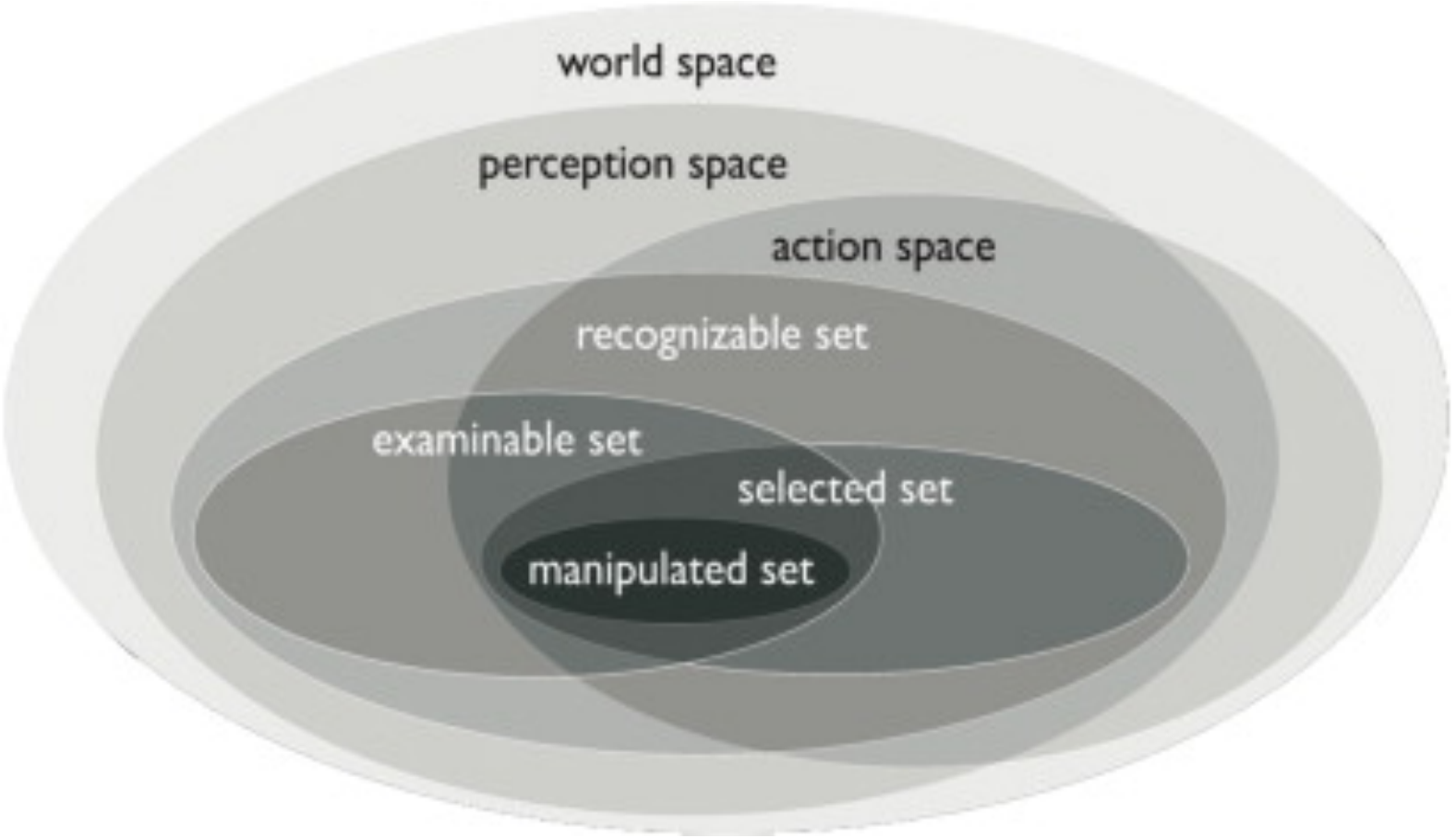
Situative Space Model



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Situated Action: Plans

- Plan -> activity ("Planning Model of Human Activity", e.g., Donald Norman's 7-step model)
  - Seven stages of action
    - Goal: 1. Forming the goal
    - Execution: 2. Forming the intention; 3. Specifying an action; 4. Executing the action
    - Evaluation: 5. Perceiving the state of the world; 6. Interpreting the state of the world; 7. Evaluating the outcome

- Activity -> plan ("Situated Action")
- Plans are sources for activity, do not determine activity
- Plans are continuously modified and may have to be abandoned

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Situated Action: Ideas

- Plans are representations of situated activity
- The representations arise in activity when the activity becomes troublesome
- An objective view of the situation is not given, it has to be formed
- Language is key in this process (e.g. conversation with a friend)

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Situated Learning

- Learning that takes place in the same context in which it is applied
- All activity is ”embodied” within a particular social and physical environment
- Cognitive processes occur simultaneously in a dialectical way with activity
- Therefore learning is always ”situated”
- Knowledge can not ”move” between activities (not transferal)
- Training in ”wrong” environment is meaningless

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People working with Situated Action

- Jeanette Blomberg
- Graham Button
- Lucy Suchman

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Distributed Cognition

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Distributed Cognition (Dcog)

- Psychological theory that emphasizes the social aspects of cognition
- Edwin Hutchins, Univ. of California, San Diego in the mid 1980s.
- Starting point is the basic information processing of cognitive science: the orderly manipulation, transformation, combination and propagation of symbolic representations to accomplish cognitive tasks
- The target is not an individual person, rather a whole (distributed) system
- It is a framework (not a method) for examining the coordination between individuals, artifacts and the environment.

Distributed Cognition (Dcog)

- Edwin Hutchins, (James Hollan, David Kirsh)
- Need to analyze information flows and decision processes over more units of analysis than the individual
- Extension of the traditional cognitive science framework
  - Difference: views cognition as distributed and not only something within an individual

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Tradition and History

- Cognitive psychology and anthropology
  - Cognition as phenomenon within an individual
  - Border is the skull bone

- Perception + memory = cognition

- Theory about how memory works is basis for: Information processing Model
  - Explain and describe mental processes
  - Similar to a computer, human mind takes in information, organizes and stores for later retrieval.
  - Similar to a computer, human mind has an input device, a processing unit, a storage unit and an output device.

The New Paradigm

- Interaction between distributed structures is the phenomena to be studied
- Interaction can be between several individuals and between individuals and information technology

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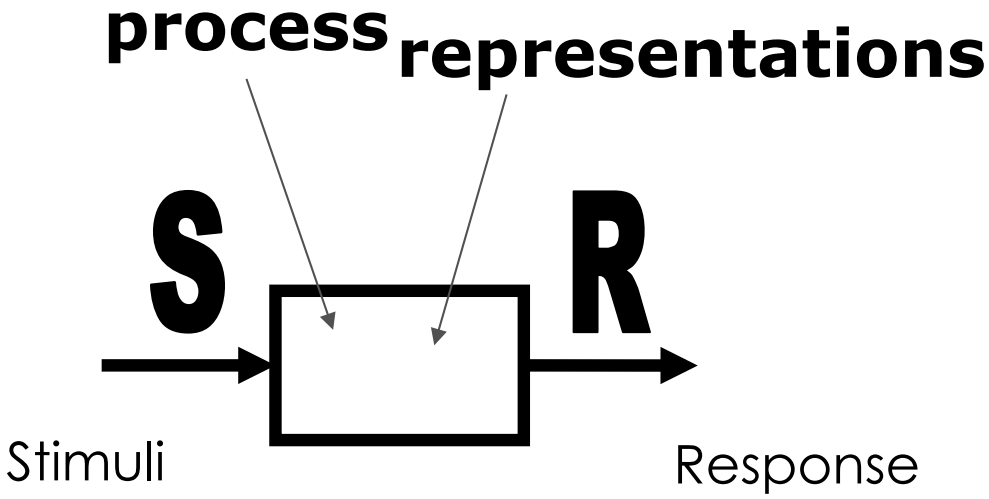
Traditional Information Processing



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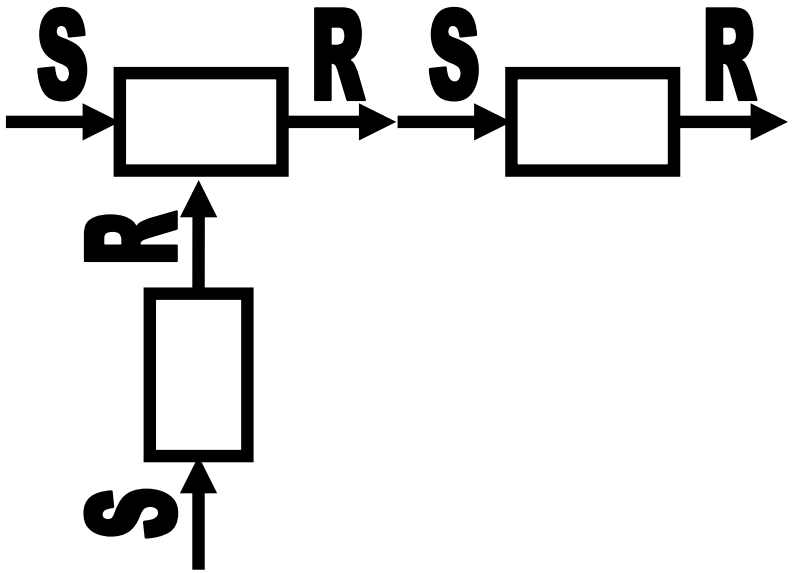
DCog

- Hutchins wants to define distributed cognition in a wider perspective:



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Functional System of DCog

- *Actors + artifacts = functional system of activity*
- *Functional system = functional unit = complex cognitive system*

- *Functional system* of Dcog = *Activity system* in activity theory

- Difference between AT & DCog
  - Activity Theory views cognition as individual activity within a system
  - DCog does not view cognition from the individual's perspective

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Assistive Redundancy

- Assistive redundancy is characteristic of working real-world examples
  - The same information is often represented and transferred in several tokens, formats, locations and channels. E.g. information about Dcog can be obtained from text book, internet, teacher, …
  - Representations, artifacts and actions often serve more than one purpose at the same time
- Many representations and processes in the distributed system can be observed directly (as opposed to brain processes)
  - E.g. navigation of a ship using charts, maps, compass, etc. since it is a group (social) activity

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Boundary & Cognition Distribution

- The resources deployed in solving the task define the boundary of the distributed system:
  - to make sense of tasks done and computations performed, you will normally have to extend the scope of study beyond a single individual or artifact
- Cognition is distributed over persons and artifacts:
  - With regard to representing, storing and transferring information in various forms
  - With regard to the computations taking place in solving the task

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How to analyze using DCog?

- Identify "the functional unit" by identifying the goal of the system
- Specify the parts
- Investigate how "representation *transforming activities*" are coordinated to achieve the goal
  - Method: "cognitive ethnography" – observations

- Results
  - Description of goal
  - Background to the activity
  - Resources, paths, inputs, outputs, representations, processes, transformations

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Similarities with Activity Theory

- Technology plays an important role in the lives of humans
  - AT: tool mediation
  - DCog: cognition is distributed across people and tools
- An individual is not defined strictly by the body and what's in the head
  - AT: an activity is determined by people *and* tools
  - DCog: individuals act within and are part of a cognitive system
- Both has interest in human cognition and activity performance

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Differences between Dcog and AT

- Unit of analysis
  - AT: Activities with humans as key actor
  - DCog: Cognitive (socio-technical) system, possibly without humans
- In DCog humans are described with the same terms as tools and artefacts
  - Could be interpreted as a lack of consideration of individual's internal and personal purpose/motives
  - But awareness and flexibility is considered in DCog literature (if such aspects are important then they are considered)

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Differences between Dcog and AT

- Naming
  - AT: a rich amount of named concepts, gives a common language to communicate and describe results
  - Dcog: lacks naming, thus considered flexible but limited power for communication and description
- Process
  - In AT process descriptions are built into the structure of how AT is presented, gives both descriptive and rhetoric power, even if represented in a static diagram (triangle)
  - The central focus for analysis in Dcog, may become less visible due to this and may or may not be represented in the results of analysis

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The Cockpit Example

- Hutchins accounts for a wide range of artefacts, actions and people being part of the cognitive system of a cockpit
- No single person or artefact is responsible for the entire activity, they all contribute to the activity succeeding
- Using the text, it is also possible to identify most of the elements in Engeström's Activity System

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Coded Exams Example

- Teacher grading exams
- Results noted in a protocol
- Protocol sent using an e-mail system
- Protocol received through e-mail
- Protocol printed to a paper
- Administrator decoding exams using printed protocol, cover sheets and a decoding protocol
- Administrator register results in the Ladok system using decoding protocol
- Artefacts: Exams, exam protocol, e-mail system, printer, paper, cover sheets, decoding protocols, Ladok system
- Roles: Teacher, administrator

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Dcog – People and Literature

- Edwin Hutchins, UCSD, USA
  Cognition in the wild, 1995
  DCOG in aviation (with D.A. Norman for NASA), 1988
- Yvonne Rogers, U of Sussex, UK
  Articles on DCOG and CSCW (Computer Supported Cooperative Work)
- Christine Halverson, IBM, USA
  DCOG and CSCW
- James Hollan, David Kirsh

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Cognitive Work Analysis (CWA)

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Cognitive Work Analysis (CWA)

- Guides the analysis, design and evaluation of interactive information systems (and human-information interaction)
- Work-centered conceptual framework
- For the design of technology for use in work places
- Complex, high-technology sociotechnical systems
- Analyze real-life phenomena while retaining the complexity inherent in them
- Common approach to the design of information systems
  - First: Design and development
  - Later: Evaluation
- CWA
  - First: Evaluation of the system currently in place
  - Later: Develop recommendations for design

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Cognitive Work Analysis

- BookHouse
  - Information retrieval system for fiction books
  - Supports a variety of search attributes: subject, historical period, mood, cover design,…
- Web searching by high school students
  - Uncover problems experienced by students searching the web
- COLLATE project
  - Indexing and retrieval of national film archives from Germany, Austria and the Czech Republic

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Cognitive Work Analysis

- People who interact with information are "actors" instead of "users"
- To design interactive systems one has to understand:
  - The work done by actors
  - Their information behavior
  - The context in which they work
  - The reasons for their actions
- CWA focuses on:
  - The task performed by actors
  - The environmental context
  - Perceptual, cognitive and ergonomic attributes of the actors

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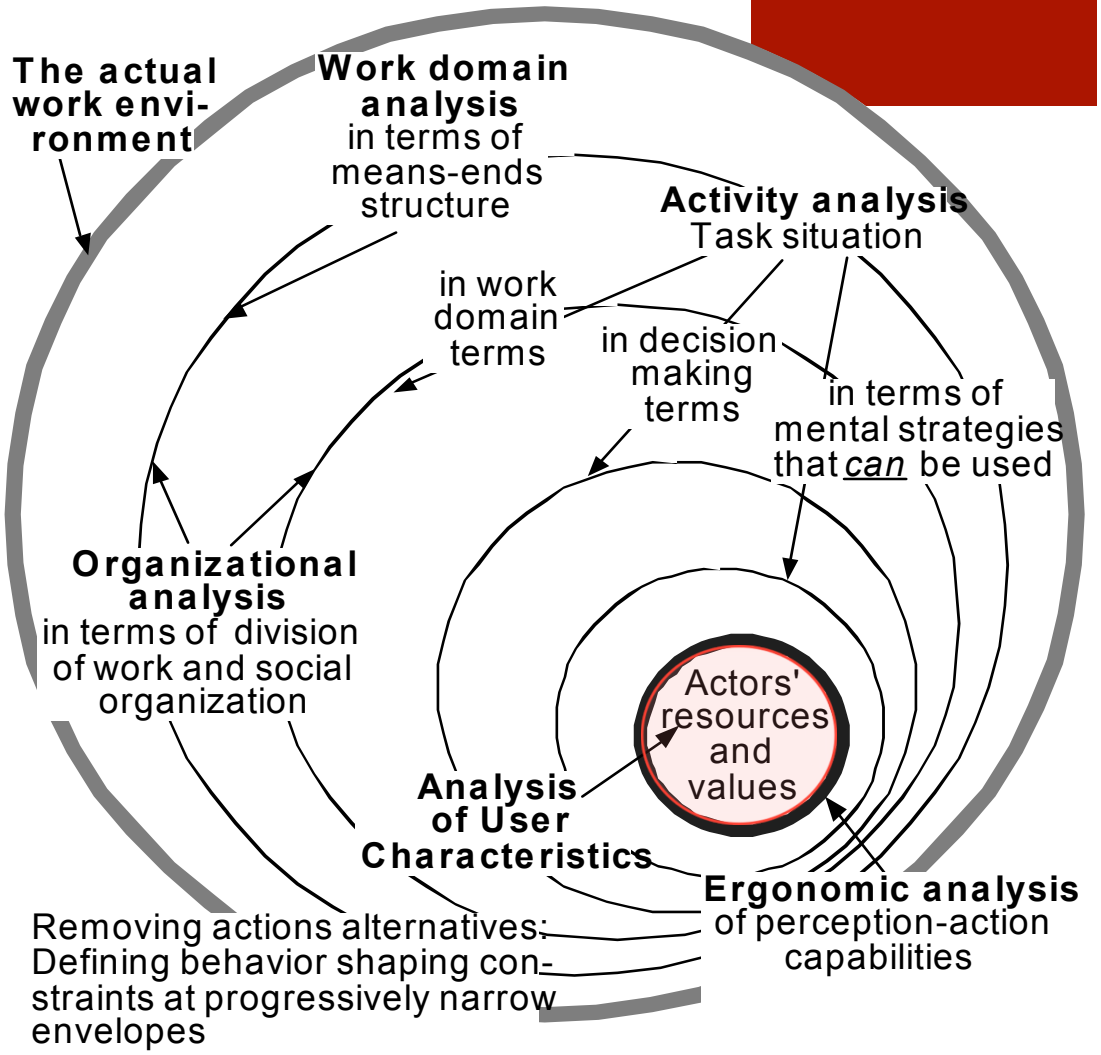
CWA

- The dimensions are interdependent
- A researcher can move from one dimension to another in any path
- Iterative process
- The path is usually dependent on the problem at hand
- Work analysis – analysis of the constraints that shape information behavior

The dimensions for analysis



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Dimension	Examples of Questions to Ask in Analysis
Environment	What elements outside the organization affect it?
Work domain	What are the goals of the work domain? The constraints? The priorities? The functions? What physical processes take place? What tools are employed?
Organizational analysis	How is work divided among teams? What criteria are used? What is the nature of the organization, hierarchical, democratic, chaotic? What are the organizational values?
Task analysis in work domain terms	What is the task (e.g., design of navigation functionality)? What are the goals of the task that generated an information problem? Constraints? The functions involved? The tools used?
Task analysis in decision making terms	What decisions are made (e.g., what model to select for the navigation)? What information is required? What sources are useful?
Task analysis in terms of strategies that can be used	What strategies are possible (e.g., browsing, the analytical strategy)? What strategies does the actor prefer? What type of information is needed? What information sources does the actor prefer?
Actor's resources and values	What is the formal training of the actor? Area of expertise? Experience with the subject domain and the work domain? Personal priorities? Personal values?

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Cognitive Work Analysis

- Investigate information behavior in context
  - Individual studies for designing information systems are valid for the specific context
  - Individual study results cannot be directly generalized, but can be combined with other results in varied context before proposing generalized design guidelines.
- CWA takes a holistic approach where several dimensions are analyzed simultaneously
- Also, CWA facilitates in-depth examination of the various dimensions of a context
- CWA provides a structure for the analysis of human-information interaction (instead of testing and verifying specific theories or models).

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Cognitive Work Analysis

- CWA
  - Rasmussen, Risø National Laboratory (1970s-1980s)
  - Vicente, University of Toronto (1990s)
- Systems-oriented rather than psychologically-oriented approach (even though psychological theories are used)
- Ecological: Instead of modeling activity & mental models alone, the ecology as a whole in which activities take place is modeled. The ecology constraints activity performance and the offers the possibilities for action
- Model not just the activity, but the context in which the activity takes place.
- Support human activities through "ecological interfaces" that minimize the workload through direct perception.

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Cognitive Work Analysis

- The form of analysis is:
  - Neither "normative" – actively dictating how activity should proceed
  - Nor "descriptive" – passively describe existing activity
  - It is "formative" – Points to the future form of an interface, that will lead the human to the most effective behavior
- Design interfaces to support human activity for situations previously un-encountered, particularly situations involving high risk.

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Cognitive Work Analysis

- Modeling at multiple levels:
  - Properties of the work environment, the task, and ways the task can be done
  - Properties of the agent(s) carrying out the activity such as social and organizational roles, and individual competencies
- Modeling at 5 levels
  - Work domain analysis
  - Activity analysis in work domain terms
  - Activity analysis in decision terms
  - Activity analysis in terms of mental strategies
  - Cognitive resource analysis of individual actor
- The 5 levels provide an analysis of how an individual human agent interacts with a system and what the interface design requirements are.

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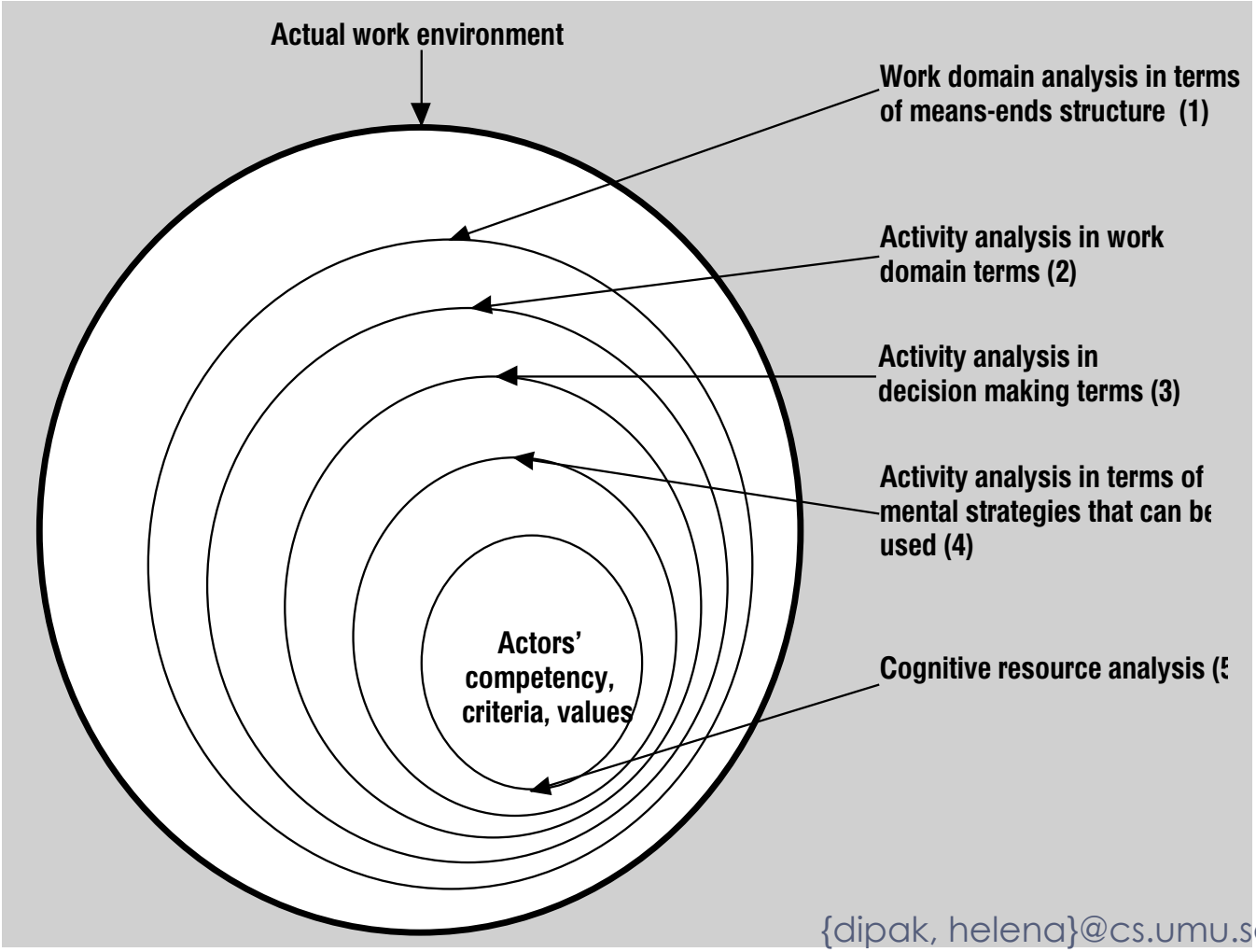
Cognitive Work Analysis

- Ecological, cognitive, and affective influences of an actor in a work domain



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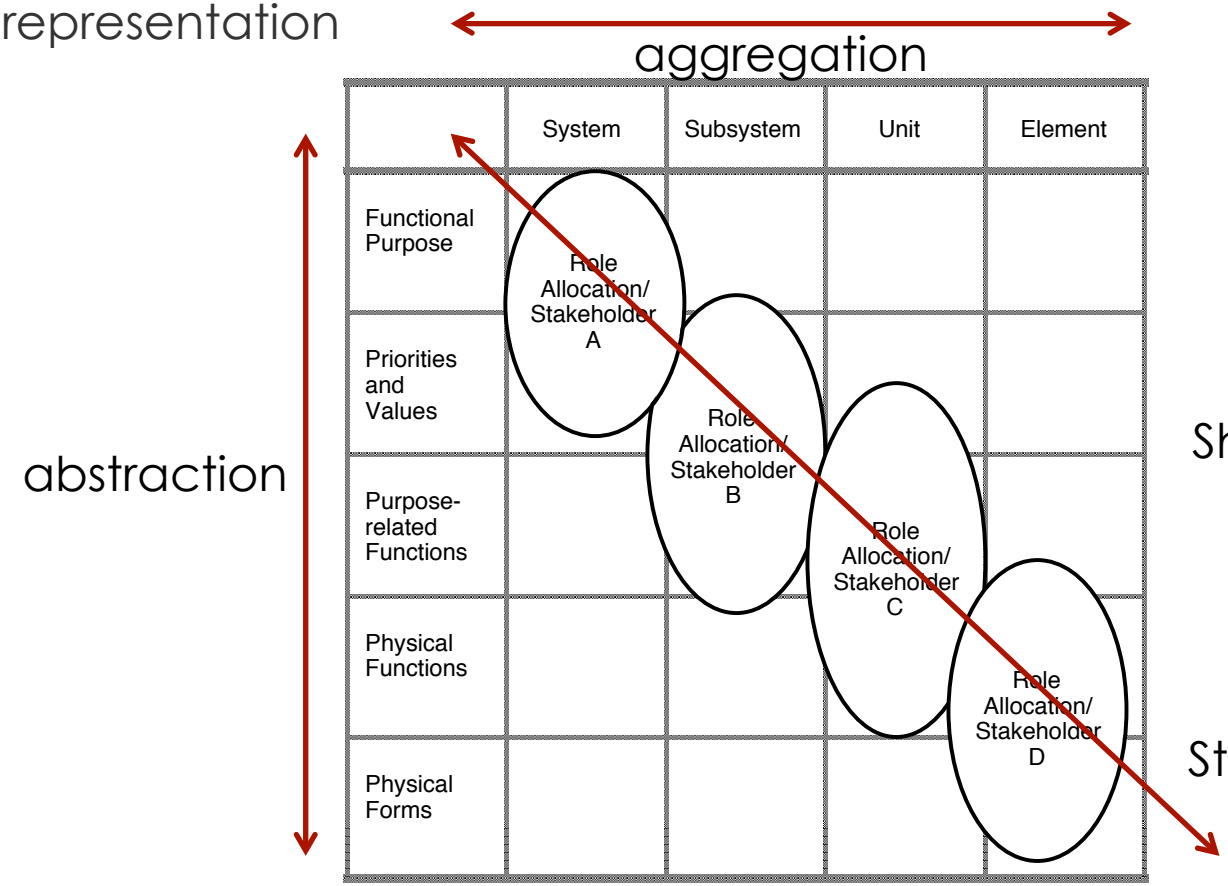
Cognitive Work Analysis

- Work domain analysis (WDA)
  - Foundation for CWA
  - WDA describes physical/intentional system vs. activity graph
  - WDA does not model the activity itself, hence is event-independent representation



Shows an "outside in" view

Stake holders

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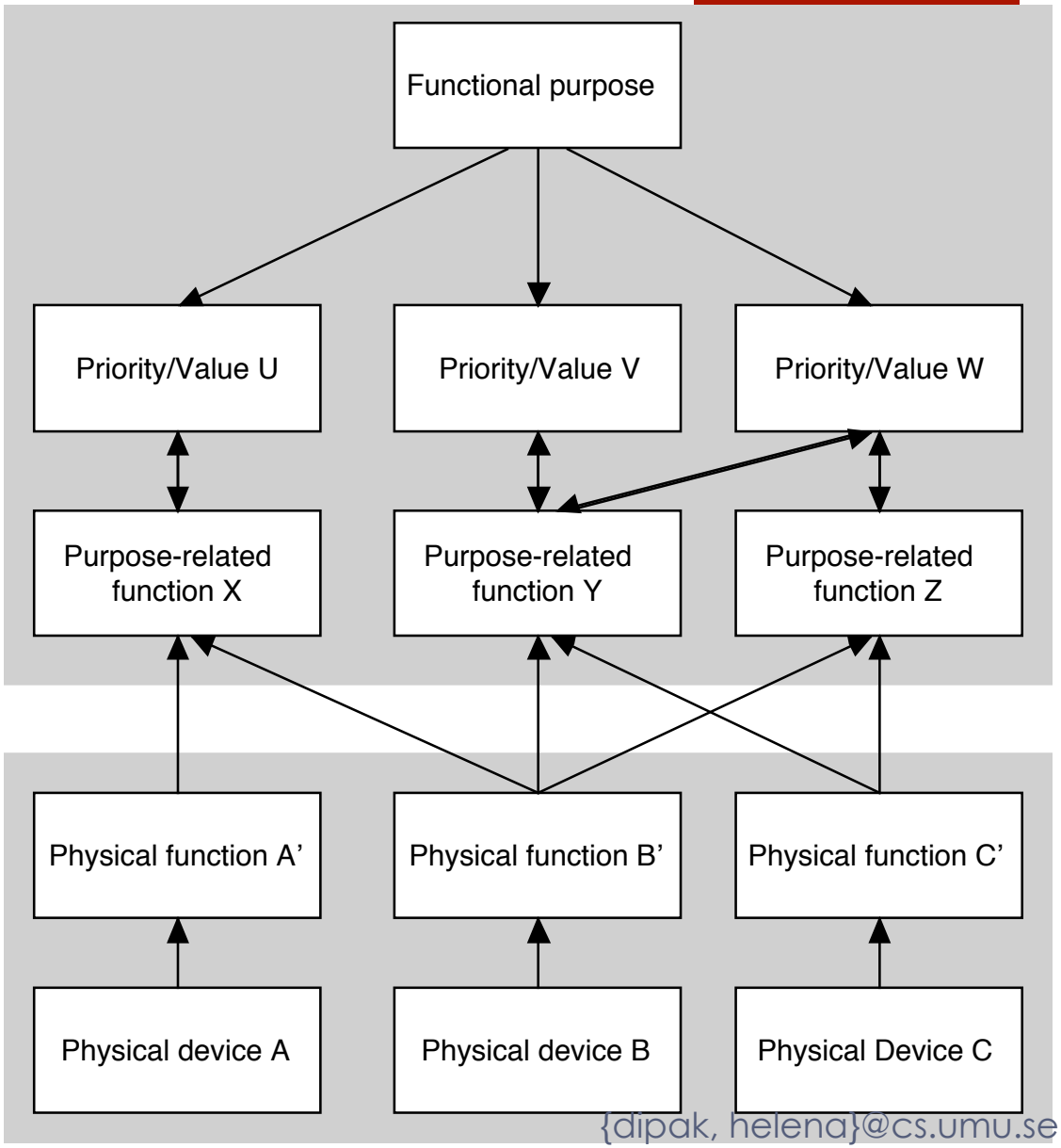
Cognitive Work Analysis

Examination of the abstraction dimension

- Purposive considerations (top three layers)
- Physical considerations (bottom two layers)



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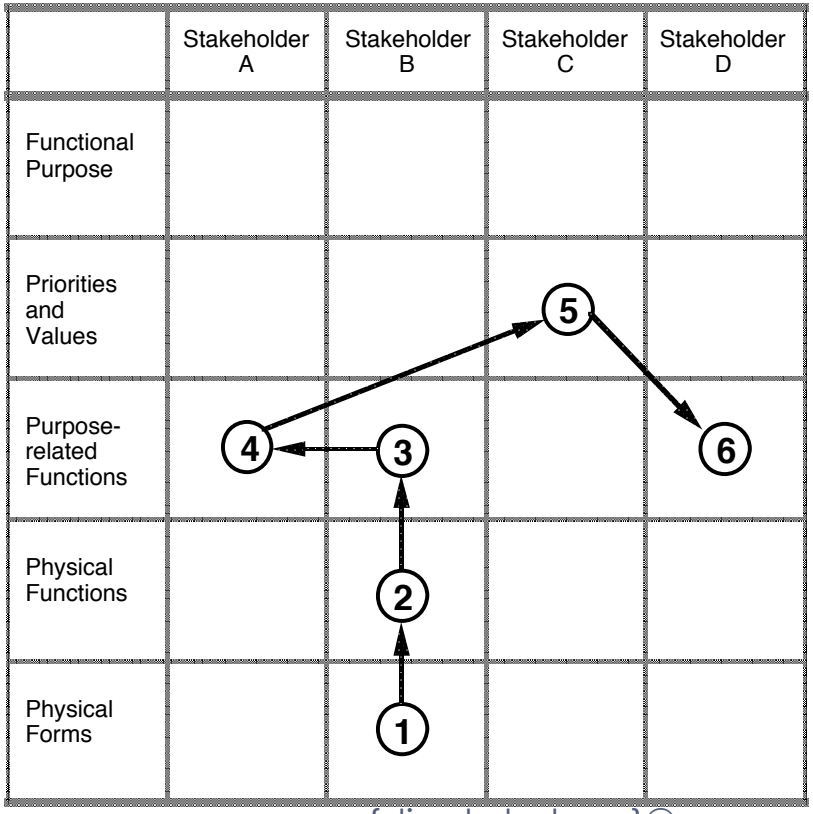
Cognitive Work Analysis

- 2 ways of representing stake holders
  - "Outside in" view (work domain view): individual agents have roles that extend over a certain range in the abstraction-aggregation space
  - "Inside out" view (stakeholder view): individual agents have his/her hierarchy of purposes, priorities, functions and objects

Shows an "inside out" view where stakeholders' roles are aligned, which helps to illustrate how changes within one stakeholder's subdomain may have effects in other stakeholder's subdomain.



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Cognitive Work Analysis

- Implications for interface design
  - Current theories of display design recommend the display of information related to the purposive levels of a work domain, rather than presenting solely to the physical levels.
  - Reising and Sanderson – case studies of designing displays for a pasteurization plant that are based on the purposive rather than physical properties of a pasteurizer.

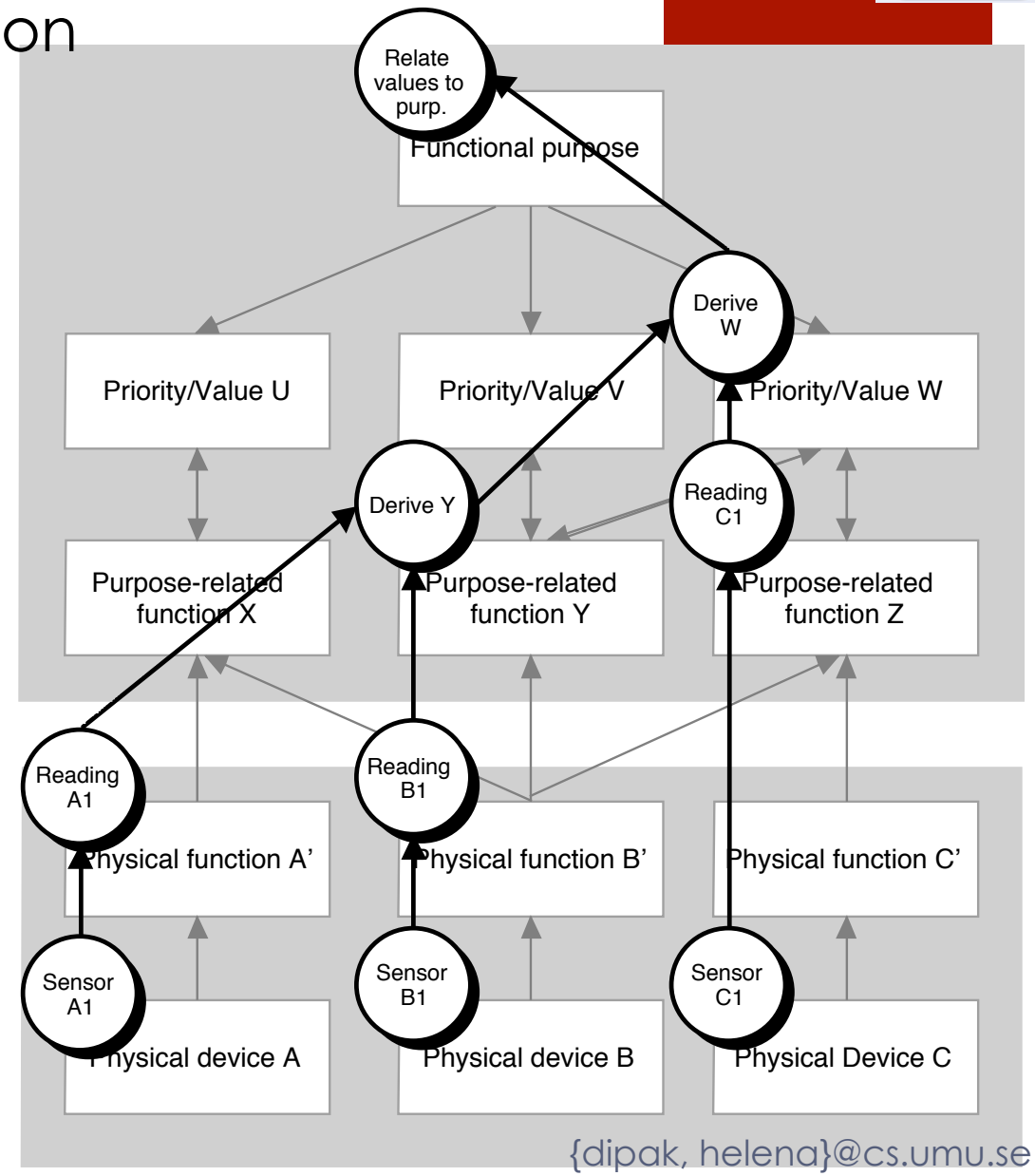
How information is sensed, state variables derived and displayed at different levels of abstraction

Energy balance

Flow rate in a cooling loop

Temperature measure (logical sensor)

Temperature sensor



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Cognitive Work Analysis

- Modeling human activity
  - WDA is event-independent representation of an "ecology" in which activity takes place
  - Activity should be described: without activity, the functional purpose of the system cannot be realized
  - Activity analysis is event-dependent

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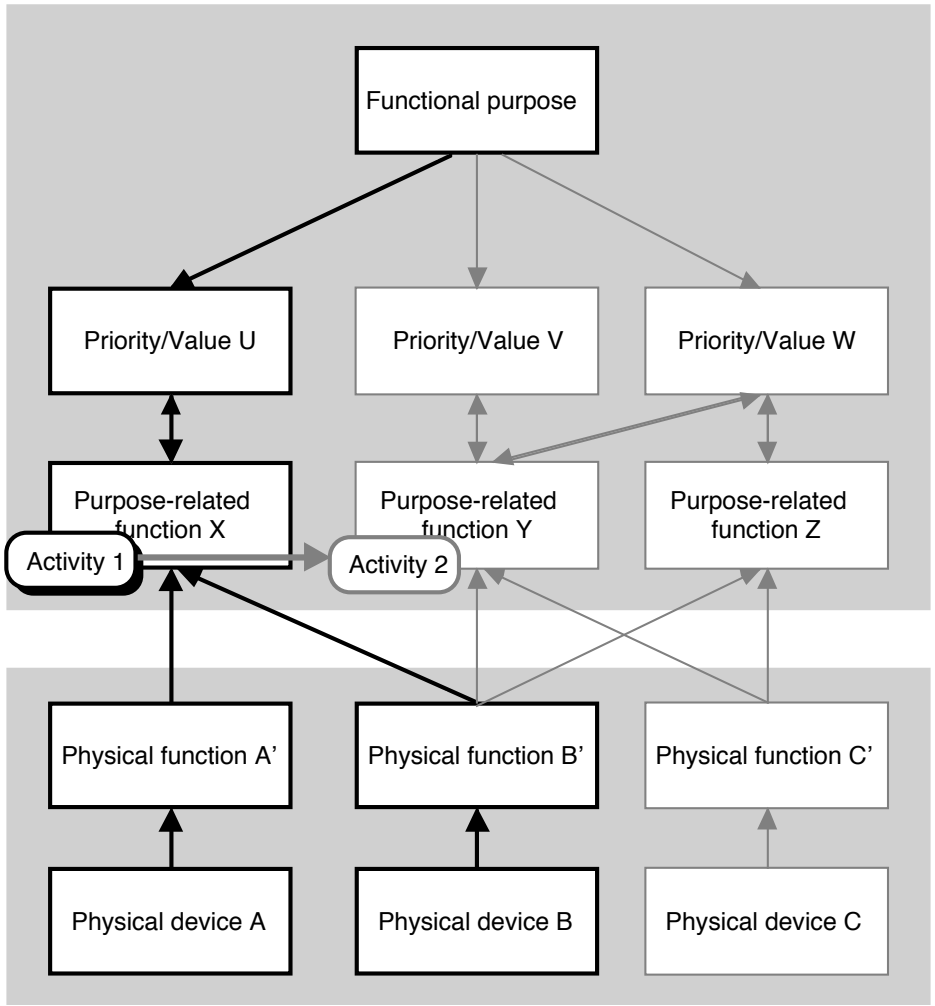
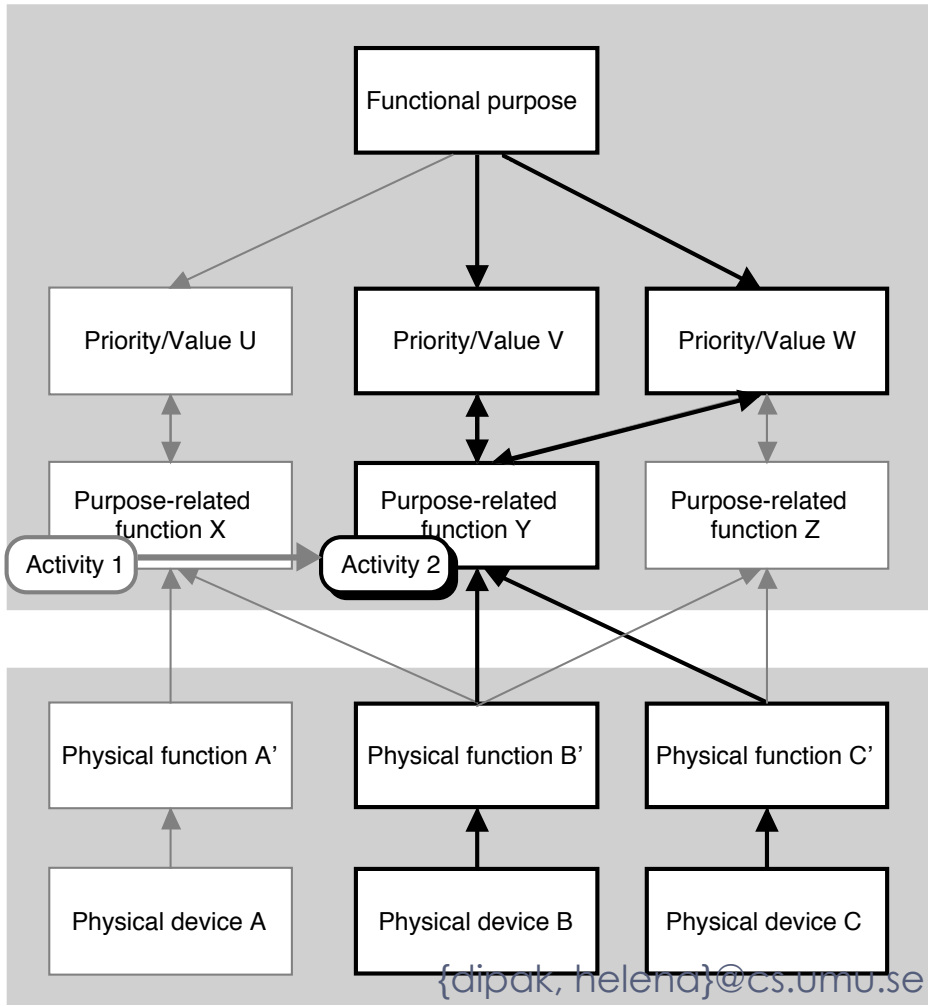
Cognitive Work Analysis

The reasons for activities and means by which they are performed can be read from higher and lower levels of abstraction, respectively, as successive activities occur.





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Activity analysis in work domain terms

Measures of Merit

Human-system integration

Activity as an action sequence related to th domain

Priority(ies) and value(s) served by Activity 1

Activity 1 | Agent(s) for 1

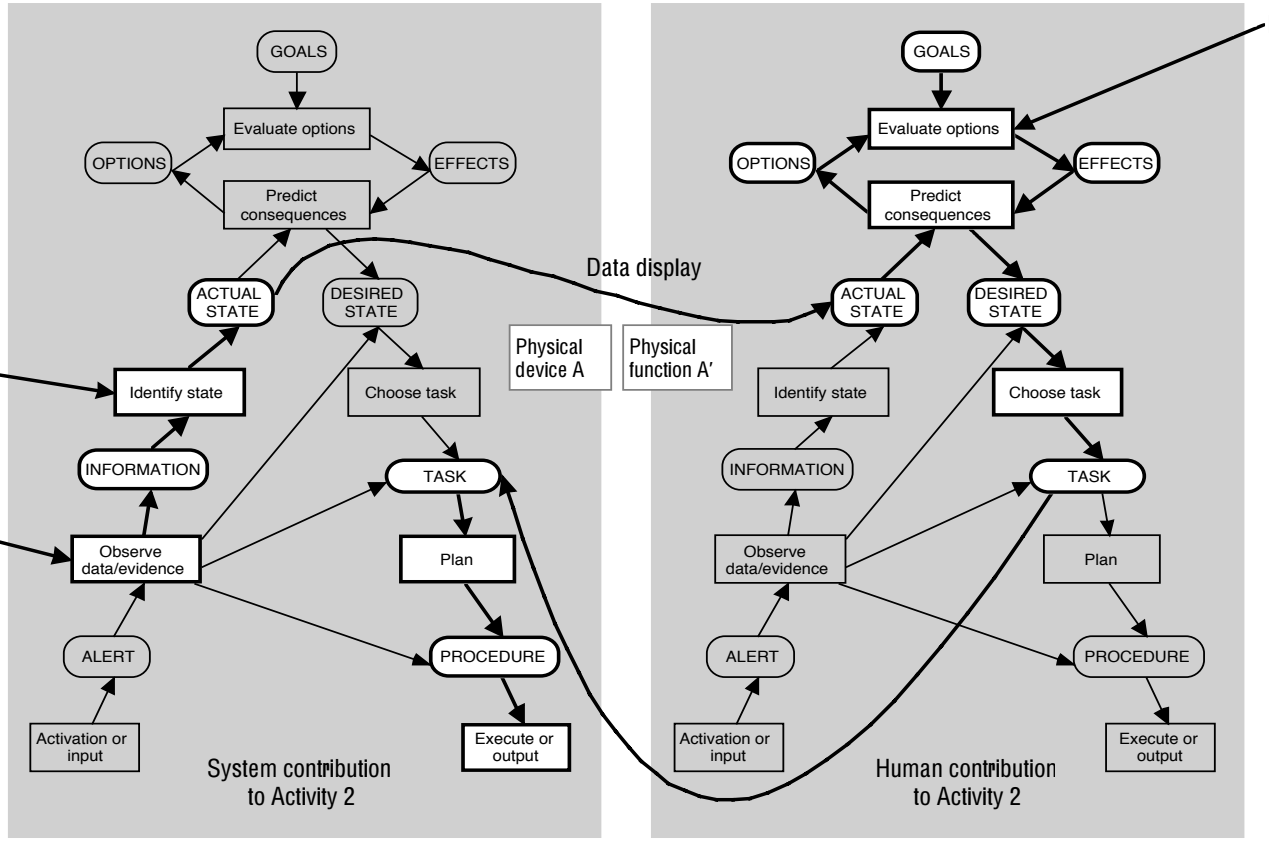
Purpose-related function(s) that Activity 1 represents

Logical or temporal contingency

Priority(es) and value(s) served by Activity 2

Activity 2 | Agent(s) for 2

Purpose-related function(s) that Activity 2 represents



Data display

Physical device A | Physical function A'

Data transformation

Physical device A | Physical function A'

Data collection

Physical device A | Physical function A'

Decision support

Physical device A | Physical function A'

Activity analysis in decision terms

Configuration or communication

Physical device A | Physical function A'

A function is affected by activity that is shared between human and system

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Cognitive Work Analysis

- Modeling role allocations
  - Agents need to be allocated to roles whose roles can be expressed in activity terms
  - Changes in information technology or management can create new sets of affordances in the work domain, new work practices and new work roles.
  - Agents may develop their own work culture, resources, norms, and interests to a degree that they become recognizable as a community in the abstraction-aggregation space.

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Cognitive Work Analysis

- Tools to support CWA
  - CWA is a complex, layered approach to analysis, design and evaluation of interactive systems
  - Difficult and time-consuming to perform CWA without appropriate tools
  - E.g. of complex systems where it is used: engine and fuel subsystem of aircraft, chemical process control in a power plant, etc.
  - Suite of integrated, highly-linked, object-based tools to perform CWA. E.g. Work Domain Analysis Workbench.

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Thank U