

What Models Model (and what they ignore)

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Abstraction & context

- *Design to meet formally stated objectives*
 - » *An SADT model is a complete, concise and consistent description of a system which is developed for a particular reason”*
 - *Marca & McGowan*
- *Design for fit to a use context*
 - » *When system developers ... become interventionists, they take responsibility not only for the design of the computer system but for its actual use in the organization.*
 - *Dahlbom & Mathiassen (1993, p.122)*

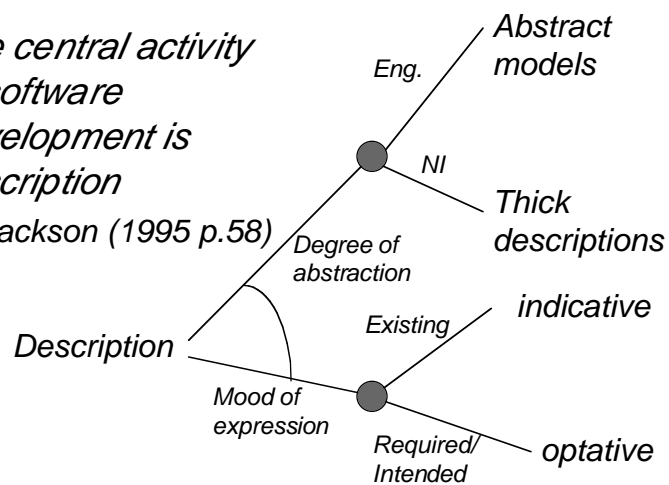
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Description & Abstraction

- *The central activity of software development is description*

» Jackson (1995 p.58)



Abstractionism & Contextualism

	<i>Abstractionism</i>	<i>Contextualism</i>
Role of description	<i>Formal models and specifications</i>	<i>Rich pictures and thick descriptions</i>
Design criteria	<i>Firmness, integrity, & correctness</i>	<i>Commodity & fitness for use</i>
Source of requirements	<i>Customer authority or marketing as customer proxy</i>	<i>Observed work contexts</i>
Role of users	<i>Confirmation of espoused requirements</i>	<i>Demonstration of tacit knowledge</i>
Primary reqts. determination methods	<i>Reqts. interviews and meetings</i>	<i>Workplace ethnography</i>
Research tradition(s)	<i>SE/MIS. Some HCI</i>	<i>HCI. Some MIS</i>

Strengths & limitations

- | | |
|--|--|
| ● <i>Abstractionism</i> | ● <i>Contextualism</i> |
| ✓ <i>Generalization from context to domain</i> | ✓ <i>Accommodation of situation's subtelties</i> |
| ✓ <i>Simplification & manageability</i> | ✓ <i>Concreteness</i> |
| × <i>Oversimplification</i> | × <i>Unbounded richness</i> |
| × <i>Engineering for engineers</i> | × <i>Going from description to intervention</i> |

Families of abstractionism

- *Process-based*
 - » *Model the business process or tasks*
 - *Structured Analysis, SADT, process specs...*
- *Object-based*
 - » *Model the UoD or information*
 - *ERA, OOA, model-based FS, algebraic specs.*
- *Teleological*
 - » *Model the system's purpose*
 - *Goal refinement (Van Lamsweerde, Fickas, Mylopoulos, Anton,...)*

Goal refinement method

- *Analyzing goals, actors & objects*
 - » *Identifying actors*
 - *"The system", classes of users, other systems*
 - » *Identifying & classifying goals*
 - *Achievement goals (of desired state)*
 - *Maintenance goals (of desired state)*
 - *Trajectory goals (improvement, optimization...)*
 - » *Relating goals*
 - *Subgoaling*
 - *Dependencies*

Goal refinement (cont.)

- *Transforming goals into desired behaviors*
 - » *Decide what goals to automate*
 - » *Decide how to automate goals as behaviors*
- *Identifying & handling obstacles*
 - » *Identification*
 - *Likelihood*
 - *Significance*
 - » *Handling*
 - *Defense or prevention*
 - *Recovery or mitigation*

Achievement goals for meeting scheduling

- **** *Goal graph* ****

Meeting scheduling obstacles

- *Every achievement goal can potentially be impeded by obstacles*
- *Scenario-based strategy for exploring goals and obstacles*
 - » *Identify “stories” involving significant goal interactions or obstacles*
 - » *Elaborate identified scenarios following a story grammar*
 - *Elaborate variants that explore different operational requirements*

based requirements exploration

Scenario ::= Setting Episode⁺ Annotation^{}*
Setting ::= Background Role^{}*
Episode ::= Goal Obstacle^{} Action⁺ Outcome*

*Each episode corresponds to the actions involved in achieving or thwarting a goal from the teleological model of the system reqts.
(Potts, 1995)*

Structured scenario

Scenario: *Wrong people invited*

Setting:

Background: *Colin wants to arrange meeting*

Roles: *Colin initiator, ...*

....

Episode: *Requesting participants' constraints*

Goal: *Participants' goals requested*

Obstacle: *Wrong people invited*

Action: *Colin specifies meeting purpose and time*

Action: *Colin invites Idris & Wendy*

...

Outcome: *Idris's and Wendy's constraints requested*

...

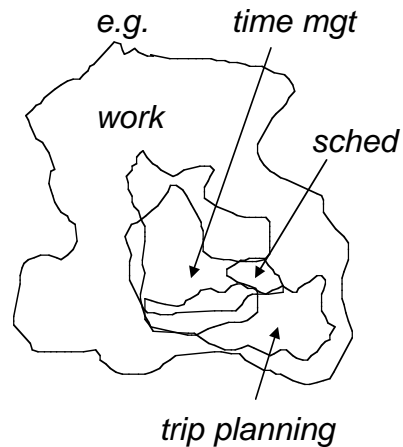
Annotation: *How should initiator modify list of critical participants?*

Assumptions behind teleological model

- *IT products support rational goals*
 - » *Users & organizations have explicit objectives*
- *Goals in question are the customer's*
 - » *Goals don't conflict fundamentally*
- *Designers can discover these goals*
 - » *by questioning, introspection, rationcination*

NI and meeting scheduling

- *Mtg scheduling is itself an abstraction*
 - » *Embedded in broader work situation*
 - » *“Borders” are unclear*
- *Difficult to model*
 - » *Many special cases*
 - » *Personal “policies”*
 - » *Situated action*



Naturalistic evidence

- *Because he's trying to do several things on one trip so he might be flying to two or three different cities like the trip he's on today, he's flying out to Denver for a meeting in Boulder but then he's going on to California to meet with other people so it's never just a round trip...*
- *Maybe he says "I have got to see Dr. C. before such and such a date." Well, we look at the dates and I've got Dr. C's. available dates so of course I take whatever time he's available and I may have to bump two or three people in order for him to do that. So I have to cancel...*
- *The thing about the monthly, it doesn't give me that luxury. It only says at 8:00 you've got this meeting but it doesn't tell me how long it lasts which is what I need to know. And the nice thing about the monthly, though, is it gives this banner option that says he's going to be gone to this conference for three days...*
- *I've been here almost two years, so I have a pretty good feel, on campus, for who gets priority...*
- *Like I start out with a grid, and they start emailing me back, this is lunch and dinner, are you available for lunch...*

Unacceptable responses

● *Inaction*

» *General information management product*

– *E.g. email, DBMS.*

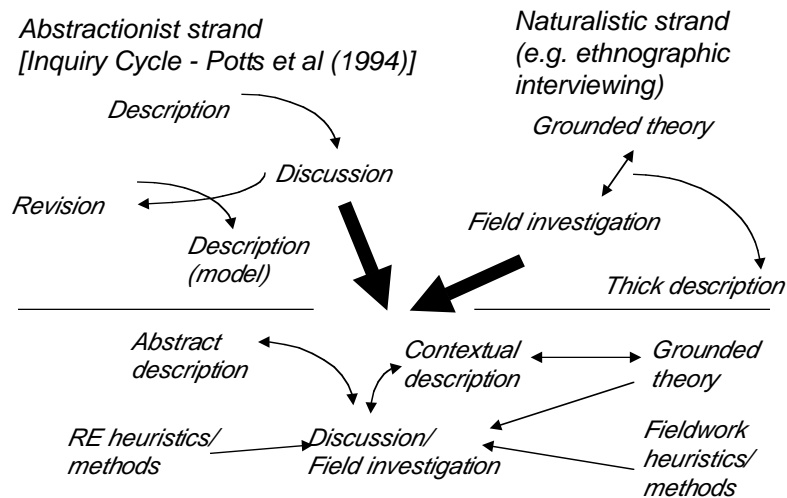
- *Leaves it to others (users / PD) to implement mtg. scheduling*

» *Tailored vs. off-the-peg application*

– *Develop application “for the host organization”*

- *Use focused ethnography of the organization*
- *Economically prohibitive*

Synthesizing the Approaches



General fieldwork heuristics for GR

- *Goal identification*
 - » *Delay commitment to scope & span of system*
 - » *Concentrate on obviously constitutive activities*
- *Object identification*
 - » *Concentrate on workplace artifacts*
- *Responsibility for action*
 - » *Concentrate on information ownership*
 - » *Concentrate on generic scenarios & critical incidents*
 - » *Examine communication patterns in context*
- *Obstacles & defenses*
 - » *Concentrate on them by asking about scenarios & artifacts*

of NI (Potts & Newstetter, 1996)

- *Weak view (technique)*
 - » *NI is a form of data gathering*
 - » *Therefore, for practical benefits to RE, use ethnography, ethnomethodology, etc.*
- *Committed view (paradigm)*
 - » *NI is a paradigm of investigation*
 - » *Few practical benefits unless one adopts this paradigm*

Lincoln & Guba's Axioms

	<i>Positivism</i>	<i>NI</i>
Ontology	Single, tangible reality	Socially constructed reality
Epistemology	Independence of knower & known	Interaction of knower & known
Generalizability	Goal is theory (nomothetic statements)	Goal is working hypotheses (Idiographic statements)
Causation	Causes precede effects	Mutual simultaneous shaping
Axiology	Inquiry is value-free	Inquiry is value-bound

Ontology

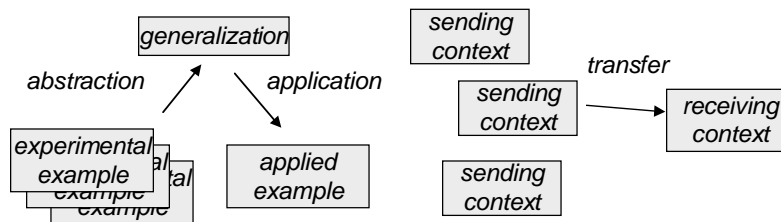
	<i>Consequences for practice</i>	<i>Consequences for research</i>
"Reality" of many systems' environments is socially constructed (e.g. meeting scheduling, library circulation, ATC handoff,...)	(1) Multiply describable phenomena (2) Negotiated determination of who customers are	Negotiated definition of desirable requirements qualities (e.g. ambiguity must be defined w.r.t. interpretation)

Epistemology

	<i>Consequences for practice</i>	<i>Consequences for research</i>
Requirements process affects working environment & product requirements	(1) Requirements engineer becomes a "human instrument" (2) Surfacing of organizational politics as mainstream concern	(1) <i>Industry-as-Laboratory</i> research through detailed case studies (2) <i>Action research</i> - involvement of practitioners in research - intertwining of theory & intervention

Generalizability

	<i>Consequences for practice</i>	<i>Consequences for research</i>
Generalizability is replaced by transferability	Deep study of the contexts in question replaces generic requirements patterns	Transfer of ideas is possible if sending and receiving contexts (cases) are similar Therefore need to characterize both contexts



Causality

	<i>Consequences for practice</i>	<i>Consequences for research</i>
Causality is replaced by mutual influence	(1) A system is an intervention, which inevitably changes the context (2) Look for contradictions in the changed context	Research, narrowly construed, should be replaced by scholarships of discovery, integration and application

Axiology

	<i>Consequences for practice</i>	<i>Consequences for research</i>
All requirements analysis activities are value-laden	(1) Recognize conflicts in stakeholder values (e.g. process efficiency vs. autonomy over work) (2) Recognize that development team also have values	Recognize value system of agency (e.g. DOD: public accountability, contractual nature of reqts. NASA: emphasis on safety)

Implications

- > *Negotiated outcomes*
- > *Case study reporting mode & idiographic interpretation*
- > *Tentative application*
- > *Focused-determined boundaries*
- > *Grounded theory & emergent design*
- > *Natural setting & human instrument*
- > *Utilization of tacit knowledge*
- > *Qualitative methods, purposive sampling & inductive data analysis*
- > *Special criteria for trustworthiness*

Trustworthiness criteria

	<i>Positivism</i>	<i>NI</i>
Truth	Internal validity - Real-world correspondence	Credibility - Prolonged engagement - Persistent observation - Triangulation - Peer debriefing - Negative case analysis - Referential adequacy - Member checks
Applicability	Generalizability - Abstraction	Transferability - Thick description
Consistency	External validity - Stability of phenomena	Dependability - Triangulation - Stepwise replication - Inquiry audit
Neutrality	Objectivity - Investigator independence	Confirmability - Inquiry audit

Conclusions

- *Requirements engineering is*
 - » *Naturalistic inquiry & intervention*
 - *emphasizing context*
 - » *using engineering tools & techniques*
 - *emphasizing abstraction*
- *Abstraction & context must be joint focus*
 - » *Suggestions for integrated process & heuristics*
- *Positivism underlies most thinking about RE*
 - » *but it is inappropriate*
 - » *the alternative requires equal rigor*