Organizational issues in technology innovation: a work psychological perspective

Prof. Dr. Gudela Grote

Department Management, Technology, and Economics

ETH Zürich

Overview

- Framework for our research: Uncertainty management
- On the interplay between organization and technology - Examples from previous work
- Current project on organizational risks in pervasive computing - presentation by Hannes Günter
- Support for organizational risk assessment in innovation projects - The method KOMPASS

Overview

- Framework for our research: Uncertainty management
- On the interplay between organization and technology - Examples from previous work
- Current project on organizational risks in pervasive computing - presentation by Hannes Günter
- Support for organizational risk assessment in innovation projects - The method KOMPASS

Current research projects

- Effects of work flexibility on personal identity and psychogical contract (Sabine Raeder, Anette Wittekind, Marius Gerber)
- Leadership in virtual teams (Lille Springall)
- Supply chain management in forestry (Hannes Günter)
- Support for appropriate technology-organization linkage in ubiquitous computing applications (Hannes Günter, Daniel Boos)
- Sociotechnical analysis and design of e-learning (Alexandra Totter)
- Adaptive team coordination and leadership in cockpit crews and anaesthesia teams (Enikö Zala, Barbara Künzle)
- Analysis and design of rules in the railways (Enikö Zala)
- Instruments for auditing safety culture, safety management and organizational change

The significance of uncertainty management in organizations

- Work systems as open / operationally closed systems
  - Requirements for dealing with variances and disturbances stemming from internal transformation processes and the system environment
- Power in organizations as control over the distribution of uncertainties
- Common approach for handling technical and organizational uncertainties as core of “scientific management”

Two approaches to managing uncertainties (Grote, 2004)

Minimizing uncertainties	*Coping with uncertainties*
• complex, central planning systems	• planning as resource for situated action
• reducing operative degrees of freedom through procedures and automation	• maximizing operative degrees of freedom through complete tasks and lateral cooperation
• disturbances as to be avoided symptoms of inefficient system desig n	• disturbances as opportunity for use and development of competencies and for system change
▼	▼
Dependence / feedforward contro l	***Autonomy / feedback contro l***

▲ ***Balance through loose coupling*** ▲

Motivation through task orientation
Higher order autonomy
Flexible changes between organizational modes
Culture as basis for coordination/integratio n

* Uncertainties may stem from the system environment and/or from the transformation processes within the system.

Overview

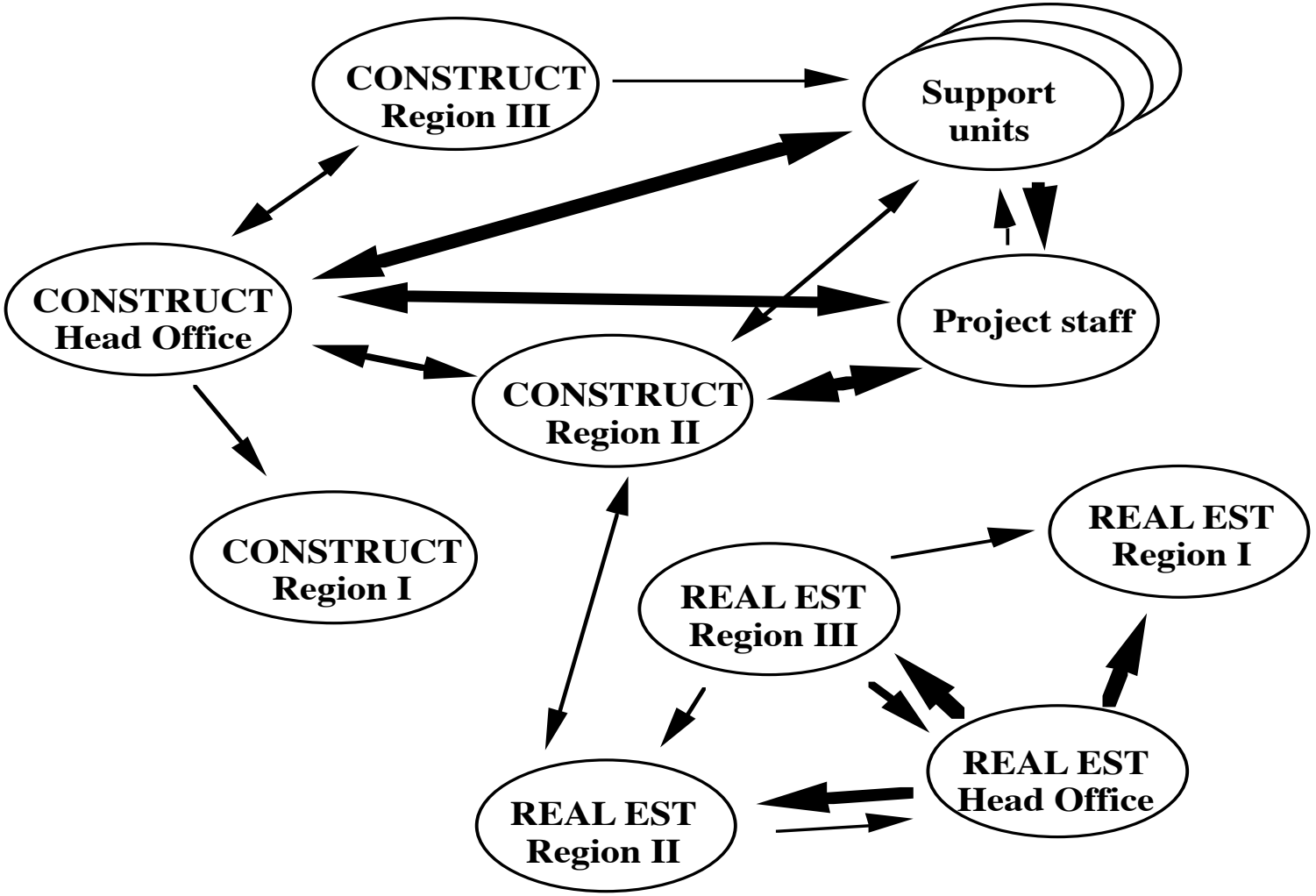
- Framework for our research: Uncertainty management
- On the interplay between organization and technology - Examples from previous work
- Current project on organizational risks in pervasive computing - presentation by Hannes Günter
- Support for organizational risk assessment in innovation projects - The method KOMPASS

Example 1: Effects of automation on task distribution and communication in train dispatching

	Technology	Dispatcher	Third person
Obtain data on current traffic situation	BLZ Zürich	ZÜ Luzern	
Determine differences current/planned sit.	BLZ Zürich	ZÜ Luzern	
Determine causes of differences		BLZ Zürich	ZÜ Luzern
React on differences		BLZ Zürich	ZÜ Luzern
Plan for differences			BLZ Zürich ZÜ Luzern

Communication...	BLZ Zürich (N=474 communication units)	ZÜ Luzern (N=1309 communication units)
... to / from dispatcher	54%/46%	91%/9%
... concerning several topics	7.8%	6.3%
... with time horizon 5 min -2 hrs / > 2 hrs	24.5%/1.3%	1.7%/0.2%
... with personal words	4.6%	0.9%

Example 2: Technology use as reflection of organizational culture (Grote & Baitsch, 1993)



Example 2: Technology use as reflection of organizational culture (Grote & Baitsch, 1993)

Table 1. Main differences between the two groups CONSTRUCT and REALESTATE.

CONSTRUCT	REALESTATE
One of the company's core departments, well established	New department, founded three years ago to increase the efficiency of real estate use
Indispensable to reach the organization's primary goal (transportation)	No contribution to the organization's primary goal
High acceptance within the company	Low acceptance within the company
Employees with long careers within the company, mostly in the transportation field	About half-half employees with careers within the company and newly hired employees
Mainly engineers with high identification with the company and its products	Mainly marketing and law specialists with low identification with the company's products
Leadership aimed at supporting work processes with few elements of control	Leadership aimed at establishing new hierarchy with strong elements of control
Slight conflicts between the units in the headquarters and the regional offices regarding decision competence	Strong conflicts between the units in the newly founded headquarters and the regional offices regarding decision competence

Example 2: Technology use as reflection of organizational culture (Grote & Baitsch, 1993)

Table 2. Description of organizational culture in the two groups.

	CONSTRUCT	REALESTATE Headquarters	REALESTATE Regional offices
Artifacts	Offices with few or no status symbols, but always symbols of strong identification with the company	Offices with strong status symbols (non-company furniture, art), usually no symbols of identification with the company	Offices with few status symbols
	Usually casual dress except in formal meetings	Dress with strong attention to style and fashion ('dress for success')	Mostly casual dress except in formal meetings
	Relaxed, friendly atmosphere	Stiff atmosphere, general air of self-importance	Tense atmosphere
	PCs mainly for secretarial tasks, some PCs and terminals for computational tasks	PCs for secretarial tasks and as status symbols	PCs for secretarial tasks
Values	Engineering ethic: high quality and security	Priority of efficiency	
	Contribution to company's primary task as first priority	Need for innovation in the company	Contribution to company's primary task as first priority
	Supportive leadership style	Strong leadership and control	
Assumptions	Only people, who identify with the company's primary task, count	All companies can be managed the same way	Only people, who identify with the company's primary task, count
	We build our country's future		
	Money must not be an issue	Profit always comes first	Human issues come first
	Professionals can be trusted		
		New ways are better than traditions	Traditions are better than new ways

Example 2: Technology use as reflection of organizational culture (Grote & Baitsch, 1993)

Table 3. Motivation and expectations in the two groups regarding introduction of the communication system.

CONSTRUCT	REALESTATE
Decision about inclusion by staff team co-ordinating the construction project with little participation by chosen employees	Decision about inclusion by headquarters with little participation by chosen employees
Decision about inclusion motivated by task and communication structure within the construction project	Decision about inclusion motivated by the aim to consolidate control over the regional offices
Medium expectation level regarding usefulness of communication system	Very high expectation level in headquarters, very low expectation level or even apprehension in regional offices regarding usefulness of communication system

Overview

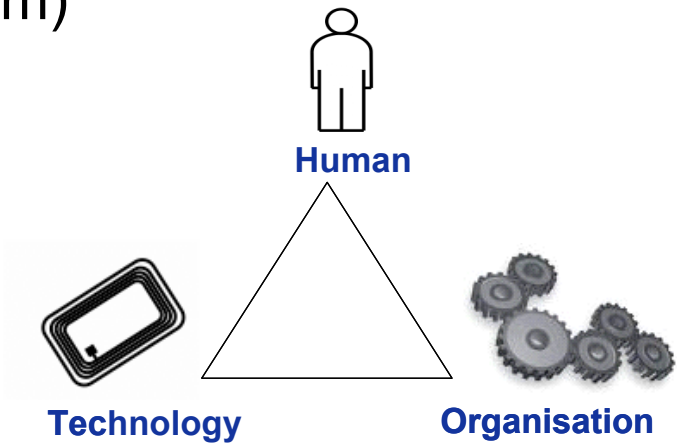
- Framework for our research: Uncertainty management
- On the interplay between organization and technology - Examples from previous work
- Current project on organizational risks in pervasive computing - presentation by Hannes Günter
- Support for organizational risk assessment in innovation projects - The method KOMPASS

Outline

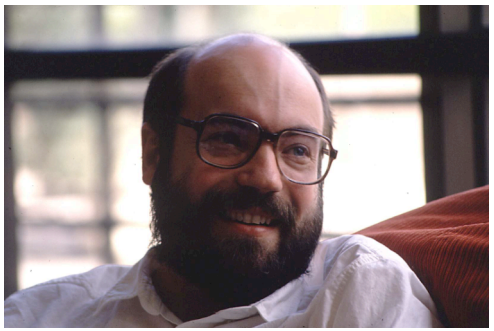
- Introduction of research project
- Definition of ubiquitous computing and organizational issues
- Conceptual background
- Pilot study:
  - Research questions and setting
  - Results and discussion

Interplay between technology and organization

- Project „Management of downstream organizational risks in technology innovation “ (May 2006 – April 2009): main question
- Cooperation with research industry consortium developing ubiquitous computing technologies
- Longitudinal field study of product development projects in ubiquitous computing (related to consortium)
- Pilot study on organizational issues in ubiquitous computing development projects (May to November 2005)



Ubiquitous computing technology



"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" (Marc Weiser, 1991)

Characteristics:

- Integration of microcomputers into everyday objects (embedded computing)
- RFID technology (identification, localization, sensing, and control)
- Examples: intelligent medicine cabinet, goods tracking (supply chain management)

Purpose of ubicomp technology:

- Monitor and control distributed activities in complex human-machine systems

Mark Weiser (1991), The Computer for the 21st Century. Scientific American, 265 (9),94-104.

Organizational issues

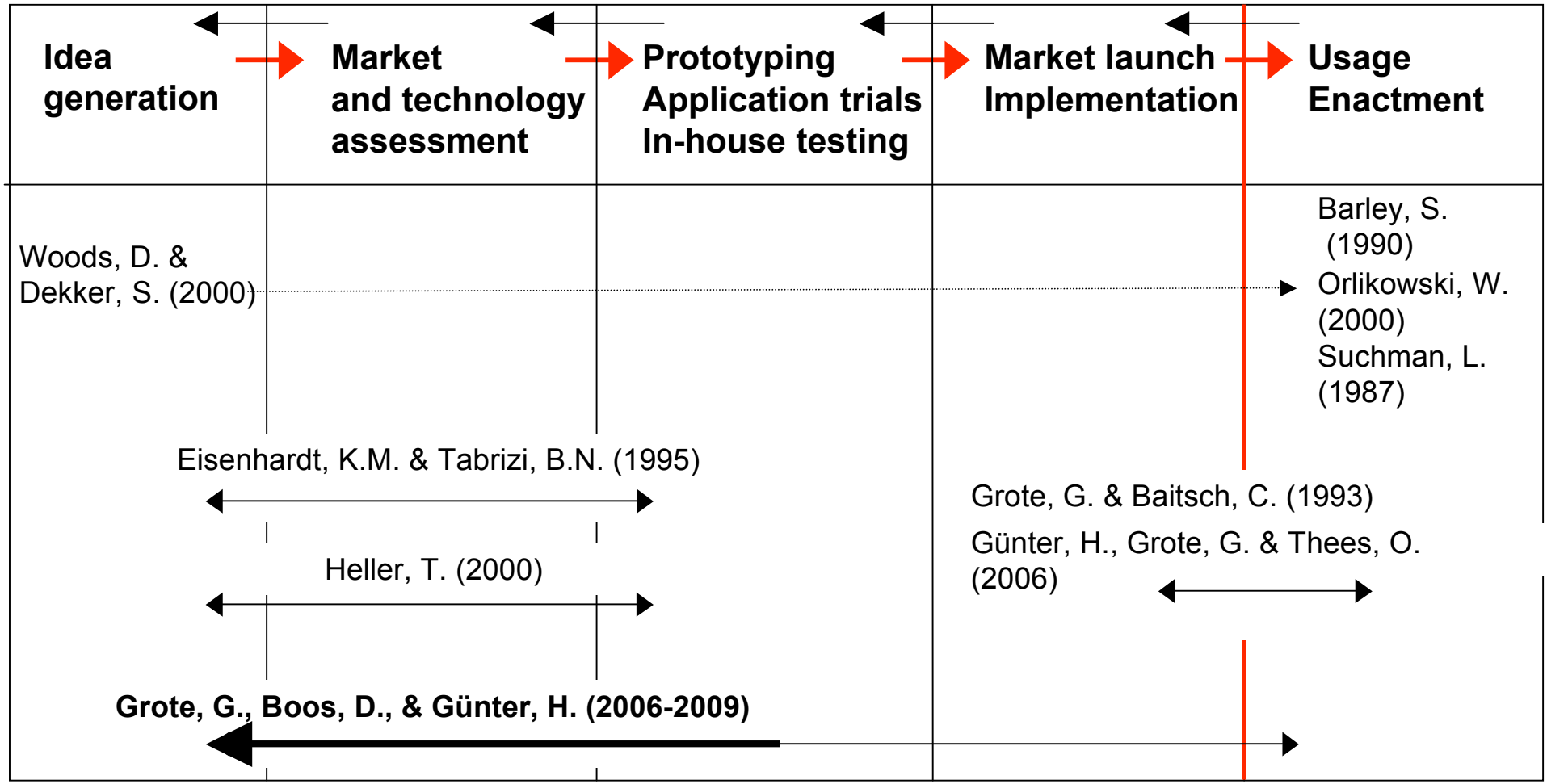
- Doherty, N. F. & King, M. (1998a, 1998b, **2001**, 2003, 2005):

  Those issues which need to be treated during the systems development process to ensure that the individual human, wider social, and economic impacts of the resultant technical system are likely to be desirable. (pp. 149-150)

- Clusters of organizational issues:
  - organizational contribution
  - human centred issues
  - organizational alignment
  - transitional issues

Doherty, N. F. & King, M. (1998a, 1998b, 2001, 2003, 2005).
An investigation of the factors affecting the successful treatment of organisational issues in systems development projects.
European Journal of Information Systems, 10(3), 147-160.

Product development process



Cooper, R.C. (1996), Overhauling the new product process, Industrial Marketing Management, 25, 465-482.

Tsokas et al (2004), Navigating the new product development process, Industrial Marketing Management, 33, 619-626.

Pilot study: research questions

- What organizational issues do system developers perceive to be of importance in ubiquitous computing innovation?
- What organizational issues do system developers deal with in ubiquitous computing projects?
- Do perception and action of system developers match?

Research design:

- Pilot study (exploratory design)
- 7 interviews (1 ½ to 2 hours) with experts from research industry consortium on ubiquitous computing, 150 statements

Methods:

- Open ended questions: What are the success factors of ubiquitous computing projects?
- Structured questions about critical incidents (Flanagan, 1954)

Analysis:

- Content analysis of verbatim protocolls with Atlas.ti
- Deductive coding of organizational issues (thematic units) on basis of a categorization scheme developed by Doherty & King (2001)

Flanagan, J. C. (1954). The Critical Incident Technique. *Psychological Bulletin, 51*(4), 327-358.
Doherty, N. F. & King, M. (2001). An investigation of the factors affecting the successful treatment of organisational issues in systems development projects. *European Journal of Information Systems, 10*(3), 147-160.

Overview on findings

	Influence factors	Concrete incidents	Examples
Organizational contribution	**21 (44%)**	**49 (48%)**	**Costs and benefits, technology systems strategy, re-engineering**
Organizational alignment	**0 (0%)**	**10 (10%)**	**Organizational culture, re-distribution of power**
Human centred issues	**18 (38%)**	**36 (35%)**	**Training requirements, effects on safety and working strategies**
Transitional issues	**9 (19%)**	**7 (7%)**	**Organizational disruption, societal issues**
Societal issues	7 (15%)	3 (3%)	**Privacy and security concerns**
Total	**48 (100%)**	**102 (100%)**	

Important findings

- Economic viability and user centred issues dominate design process but transition and alignment issues are touched upon relatively rarely
  - Results similar to Doherty & King (2001, 2003): economic viability most often (in 90% of projects), alignment issues rarely treated (in 35% of projects)
- Mismatch between perceived importance and treatment:
  - organizational alignment: treated but not important
  - transitional issues: important but not treated
- Findings suggest that human centred issues are taken more often into account in system development today in comparison to the 90s

Interpretation

- First-order vs. second-order effects (Hochstrasser, 1990; Fitzgerald, 1998): second-order organizational issues

- Further explanations:
  - Delayed effects
  - „Not our business“ structures

- Some organizational issues (e.g. transitional issues) are perceived to be important but rarely treated explicitly: why?
  - Lack of knowledge about organizational assessment techniques (lack of systmatic treatment …)

Overview

- Framework for our research: Uncertainty management
- On the interplay between organization and technology - Examples from previous work
- Current project on organizational risks in pervasive computing - presentation by Hannes Günter
- Support for organizational risk assessment in innovation projects - The method KOMPASS

Objectives of the method KOMPASS

- Embedding function allocation decisions in job and organizational design
- Supporting task design that considers cognitive as well as motivational preconditions and outcomes
- Supporting prospective design in interdisciplinary teams
- Balancing of user participation and reliance on expert criteria
- Implementing a complementary design philosophy

The design principle of complementarity

Design of the *interaction* between human operator and technical system based on *complementary differences* creating a *new quality of performance*

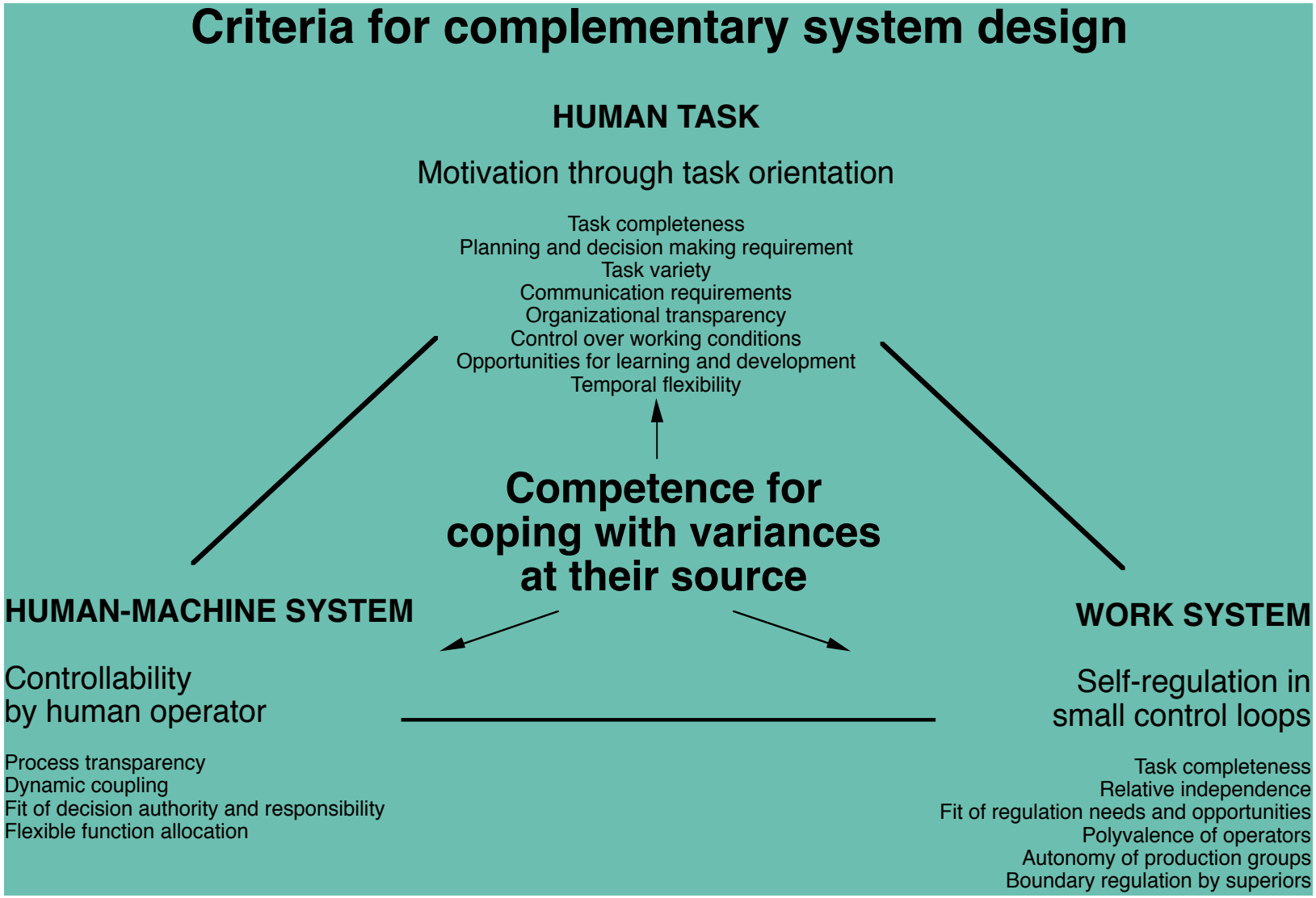
i.e. technology serves

- *not as competitor* and *not as imitation* of the human operator, aiming at replacing him
- but as *complementary support* of human strengths and compensation of human shortcomings

KOMPASS: Global design criteria

- Work system:
  Local regulation of system variances and disturbances
- Individual work task:
  Competence development and intrinsic motivation
- Human-machine interaction:
  Human control over technology

Criteria for complementary system design



KOMPASS: Design heuristic

Phase 1: Expert analysis of existing work systems.

Phase 2: Discussion of design philosophy.

- *Step 2.1. Definition of the primary task and the functions of the planned work system.*
- *Step 2.2. Definition of a shared evaluation concept to differentiate between successful and unsuccessful work systems.*
- *Step 2.3. Identification of the main potentials for improvement and design objectives*
- *Step 2.4. Identification of the potential contributions to a successful work system by human operator, technical system and organizational conditions.*
- *Step 2.5. Specification of the working conditions required for human operators to make their specific contributions.*
- *Step 2.6. Decision on usefulness of the KOMPASS criteria for the analysis, evaluation and design of work systems.*

Phase 3: Derivation of concrete design requirements.

- *Step 3.1. Derivation of requirements for system design.*
- *Step 3.2. Definition of work packages.*