

Ecological Interface Design (EID)

An Ecological approach to Interface design

Keys for user centered design

- User studies: identify what users want
- Rapid paper prototyping: get user feedback
- Usability testing: with users to identify usability problems

Problems with UCD

- Few organization managing to implement the UCD process
 - User issues
 - Organizational commitment
 - Developer skills
 - Resource constraints

User's limitation

- Experience
- Knowledge
- Expectation
- User contribution
- User agreement
- User diversity

Other problems

- User studies too easily confuse what users want with what they truly need
- Rapid iterative prototyping is too often a sloppy substitute for thoughtful and systematic design
- Usability testing is a relatively inefficient means of finding problems that often could have been avoided through proper design

Design by user?



Control over 300 functions while drive....

Ecological interface design

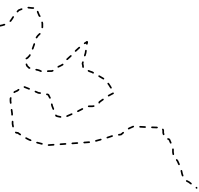
- Some important contributors
 - Gibson (from 1953? -)
 - Jan. Rasmussen (from 1985 -)
 - Kim Vicente (1990 -)
 - John Flach (1998 -)
 - Catherine M. Burns (2000 -)

Ecological Approach (Gibson)

Affordances are *perceivable possibilities for action*. We perceive in order to operate on the environment, as perception is designed for action:

- surfaces for walking, handles for pulling, space for navigation, tools for manipulating, etc.

Herb Simon's ant on the beach



Goal-driven

Giving meaning to world

- People endow their experiences with meaning
 - Will see world around them in terms of relevant cues and expectancies in service of larger goals

Goal-directed behavior

- Not just stimulus or feedback-driven
 - Anticipation of changes in world
 - Mental model of system and situation
- People *manage* entire *situations*
 - Assess situation in terms of possible solutions
 - Find or keep at least one solution to reach goal

Ecological Approach

It is important to begin by analysing the environment before analysing what people are doing, or how they are doing it, or what they know.

It is not possible to understand human behaviour without simultaneously understanding the environment in which people are acting.

Ecology can be any object, event or situation

Meaning arises within the ecology and reflects the *constraints* on action in that ecology.

Classes of constraints

- Constraints on action
 - E.g. Stall speed, coffin corner
- Functional constraints
 - E.g. Resource costs (time, fuel)
- Constraints on information
 - E.g. Displays available in typical cockpit

Expertise reflects *discovery* of significant constraints within the ecology

Ecological Approach

- "Experts perceive large meaningful patterns in their domain" (Cooke, 1992, p. 33)

Ecological Approach

- Problem analysis steps:
 - First analysing environment before analysing what people are doing, or how they are doing it, or what they know.

Classical vs. Ecological

- Classical:
 - Human cognitive system imposes constraints on the processing of information from the world
- Ecological:
 - Environment imposes constraints on goal-directed behavior

Three types of events

- The user will have to deal with three different types of events in complex domains:
 - familiar events
 - unfamiliar but anticipated events
 - unfamiliar and unanticipated events

Events in a complex domain

The EID has been developed in order to deal with all three kinds of events and to offer the operator the most appropriate support in any situation.

Three levels of cognitive control

Three levels of cognitive control:

- Skill-based control
- Rule-based control
- Knowledge-based control

Each level has its own design principle

Skill-Based Behaviour (SBB)

Automated behavioural patterns are used at this level.

"To support interaction via time-space signals, the operator should be able to act directly on the display, and the structure of the displayed information should be isomorphic to the part-whole structure of movements"

Rule-Based Behaviour (RBB)

Cognitive control on this level depends on a set of cue-action mappings.

"Provide a consistent one-to-one mapping between the work domain constraints and the cues or signs provided by the interface"

Knowledge-Based Behaviour (KBB)

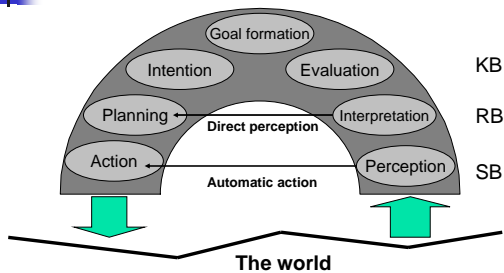
At this level of cognition, problem solving operations on a symbolic representation come into play.

“Represent the work domain in the form of an abstraction hierarchy to serve as an externalised mental model that will support knowledge-based problem solving”

Skills, Rules, Knowledge

<u>Performance Level</u>	<u>Characteristics</u>
Skill based performance	Automatic, unconscious, parallel with other activities
Rule based performance	Recognizing situations and following applicable procedures
Knowledge based performance	Conscious problem solving

Not always all stages



Goal of EID

- support for all three levels
- Keep in lower level if necessary

Ecological Interface Design (EID) (definition)

Ecological Interface Design (EID) is a framework that is based on the skills, rules, knowledge taxonomy of cognitive control. It has been developed for complex human-machine systems with direct manipulation interfaces.

Why use EID?

When interfaces are not based on the constraints that describe how entities actually work, but on how the operator might think that they work.

Identifying constraints by using multiple perspectives

- Published accounts of standard practices
- The opinions of various experts
- Field observation within the particular domain
- Lab experiments
- Experiments with synthetic task environments

Ecological interface design

- A good representation will simultaneously represent:
 - Relevant function
 - The goal states
 - Current states
 - Functional consequences of time
 - Critical boundaries for action

