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TECHNOLOGICAL ADVANCES FOR STUDYING HUMAN BEHAVIOR

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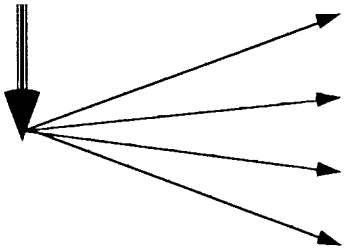
Requirement/Justification

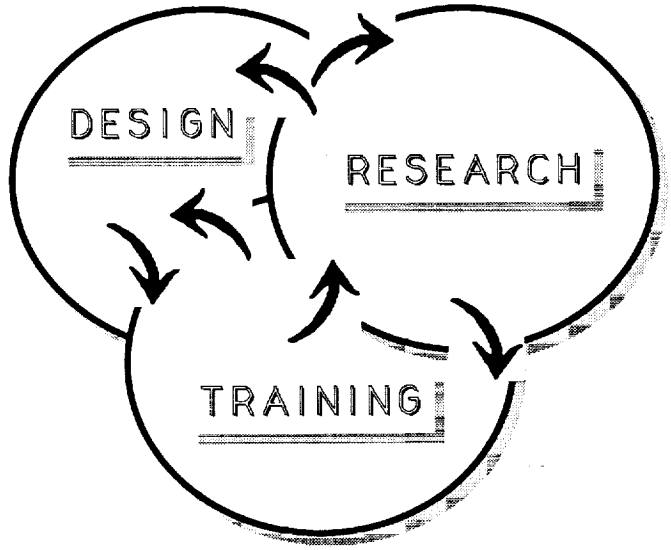
GOAL: To conduct principled human-systems interaction research:



- Develop Significant Design Principles
- Develop Timely Design Alternatives
- Develop Appropriate Design Tools
- Develop Meaningful Evaluation Instruments

JUSTIFICATION: Performance-Aiding Systems are proliferating without a fundamental understanding of how they should interact with the humans who must control them.

HUMAN-CENTERED AUTOMATION INVOLVES INTERACTION IN ALL THREE DOMAINS



THE EVOLUTIONARY RESEARCH PROCESS (adapted from W. Rouse, 1989)

- What you know you can do
- What you are willing to promise you can do
- What you would like to do

Two Views of Automation Research

HARDWARE VIEW:

- Focus on Hardware Capability
- Focus on Hardware Performance
- Focus on Hardware Testing
- Focus on Sensing Criteria & Logic

HUMAN-CENTERED VIEW:

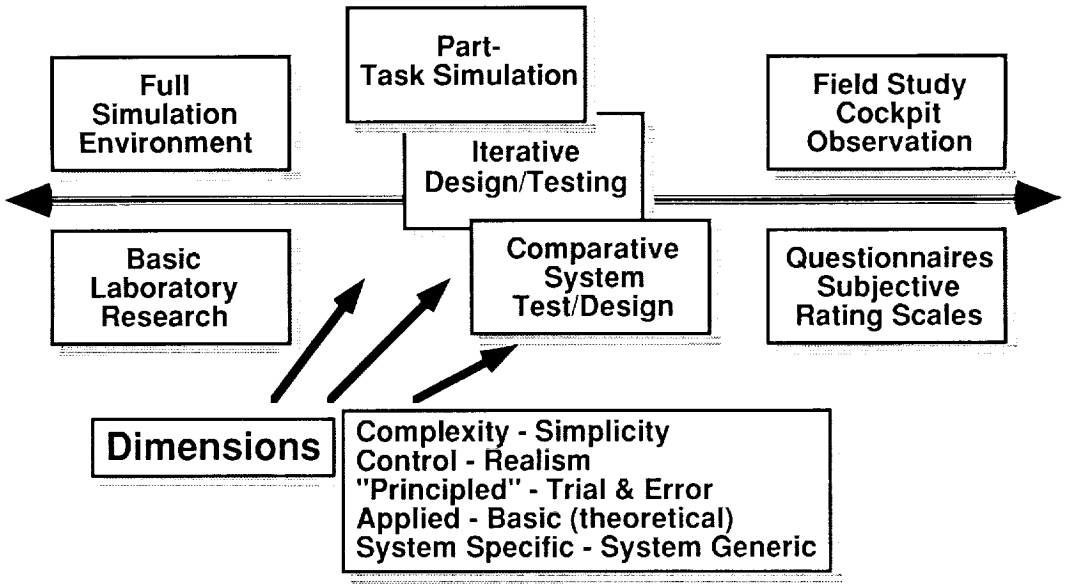
- Focus on the User
- Focus on User Performance
- Focus on Human Performance Testing
- Focus on Matching Information to user need and current context

PERFORMANCE-AIDING SYSTEMS (just as any technological systems) WILL SUCCEED IN THEIR PURPOSE TO THE EXTENT THAT THEY EFFECTIVELY DELIVER THEIR CAPABILITIES TO THEIR USERS !!!

VITAL ELEMENTS FOR HUMAN-CENTERED RESEARCH

• DOMAIN MODEL	Event-Driven Task and Performance Constraints Scenario Specification
• BEHAVIORAL MODEL	User goal / intent structure User Understanding Performance Predictions
• PERFORMANCE TRACE	Measurement Technology Testing Environment Analysis Technology

A Continuum of the Research Process



Available Technologies

- Personal Computer Work Stations
- Local Area Network (LAN) connection
- Interactive Digital Video
- Sophisticated Hyper-Type Software
- Integrated Input/Output devices :
  keyboards, mice, track-balls,joy sticks, microphones, touch-screens, speakers, printers, telephones, video tape recorders/players, cameras, scanners, sound digitizers etc.

NEW TECHNOLOGIES FOR PERSISTENT PROBLEMS

PROBLEMS:

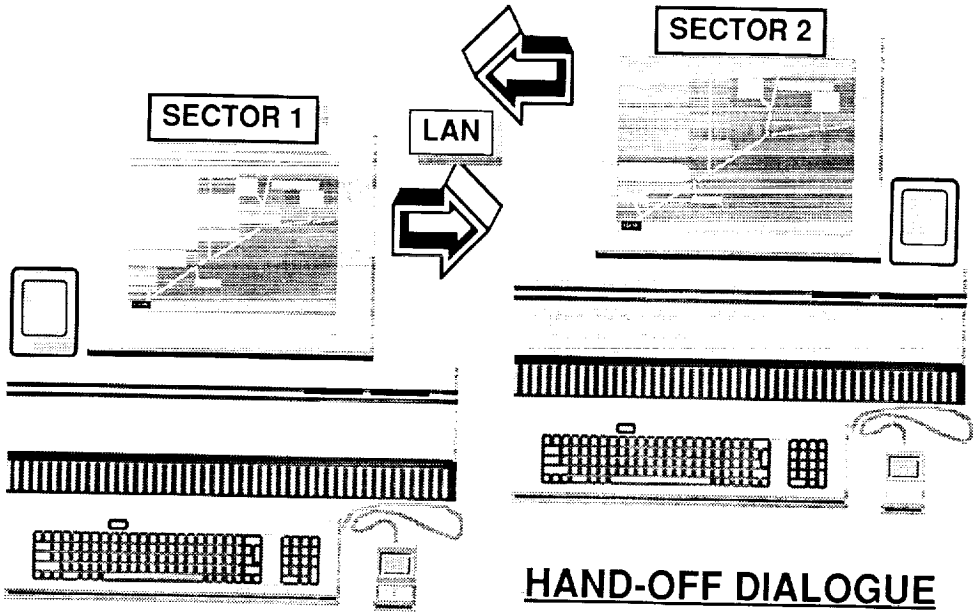
- Access to Expert subjects (potential users)
- Limited time frame
- Cost & scheduling of Full Simulation
- Data translation / lack of comprehensive analysis

SOLUTIONS:

- Portability
- Rapid Dynamic Prototyping
- Coarse-Grain Simulation
- Integrated Measurement

Example: PASS = Portable Air traffic control Simulation System

THE "PASS" SYSTEM



Sample Research Infrastructure

• Scenario Specification

-Dynamic Scenario Generator
-Simulation Event Editor
-Scenario Bank

• Rapid Dynamic Prototyping

- Easy to Use Object Behavior Specification
- Reusable & Copyable Code
- Quick to Adjust/Change Feature Specification
- Alternative Design Concepts Specification

• Simulation in the Field

- Quick set-up
- More subjects
- Automatic collection of data
- On-line Evaluation

Sample Research Infrastructure (continued)

- Integrated Data Collection
  - Time-Stamped Event Protocol Files
  - Screen - Configuration
  - Summary Files (Action Breakdown)
- Integrated Data Analysis
  - Statistical Software Packages
- Design Documentation and Training Module
  - Concept Communication
  - Criterion Practice and Testing

Popular Statements based on Misconceptions about Human Factors and Interface Design

"The system will use a mouse and icons and will have multiple windows - therefore it will be easy to use."

"The new interface, using color coding, command echoing, text editing, and a variety of input modes, has resulted in a substantial improvement in operation over the old system."

"AVIATION-SAFETY GENERAL'S WARNING:

USING THIS TECHNOLOGY CAUSES OPERATIONAL ERRORS, PANIC, INCREASED WORKLOAD, AND MAY COMPLICATE YOUR JOB"

NEED FOR METRICS

- What constitutes safe and efficient performance ?
- How can and should we measure the impact of new devices ?
- How can we translate system capacity improvement goals into standards for acceptable human performance ?

Example metric for Performance Analysis with new Interfaces (after Whiteside, Wixon, and Jones, 1988):

$$S = \frac{1}{T} PC$$

A rate measure that expresses percentage of the task completed per unit of time - the higher the score, the better, the more efficient the performance

S= Performance Score
T= Time spend in task
P= Percentage of task completed
C= A constant (example 5 minutes)

FACT: SYSTEM TYPE MAKES LITTLE DIFFERENCE IN USABILITY!

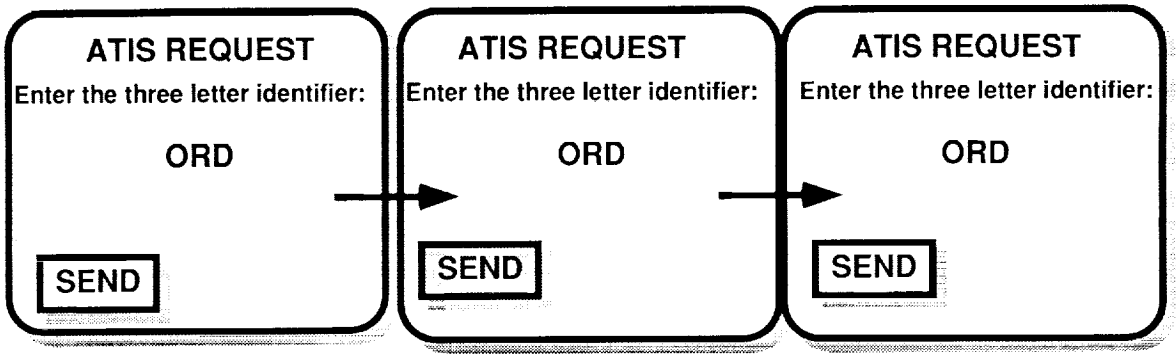
New problems are found in the
"new and improved" systems
which renders them ineffective

TYPICAL Predictable Problems:

- Lack of feedback....what is the system doing ?
- Unanticipated Interdependencies....why is it not accepting this ?
- Lack of "impedance matching"....why does it take 3 steps when I think of it as just one step ?
- Lack of consistency of input forms (and labelling) ....which do I use "cancel" or "delete"?
- Lack of proper information management.....where is the information ?

Examples for Data-Link Technology

"THE FEEDBACK PROBLEM"



A CONFIRMATION MESSAGE IS NEEDED ESPECIALLY WHEN SENDING INFORMATION FROM ONE STATION TO THE NEXT !

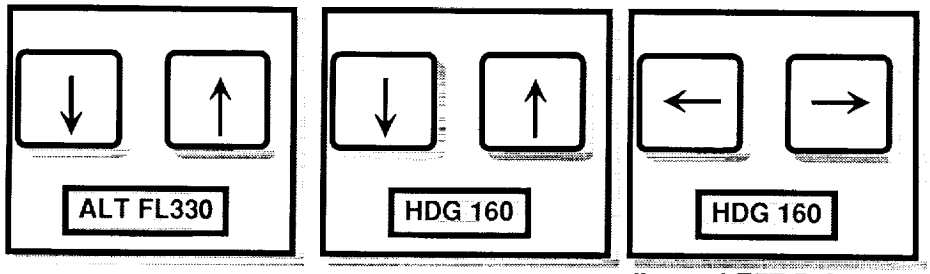
Examples for Data-Link Technology (continued)

"THE LABELLING PROBLEM"

A. CLEAR | CANCEL | DELETE

? clear the current display, message, paragraph, line, word ?
? cancel the current selection, this message, the last request ?
? delete WHAT FROM WHERE ?

B.



OK ??? "..turn LEFT/RIGHT ..."

FACT: "MATURE" SYSTEMS ARE BETTER

A HUMAN-CENTERED APPROACH MEANS CRAFTSMANSHIP AND ATTENTION TO DETAILS !

- stress clear system and performance goals
- involve users at all phases of design
- conduct empirical tests

DESIGNERS MUST BE PREPARED TO REEVALUATE THEIR ASSUMPTIONS>>>WE NEED A FLEXIBLE AND HOLISTIC APPROACH TO USABILITY OF NEW AUTOMATION !