Mawson Institute

Ergonomics and Human Factors
The Ergonomics of interfacing a human operator with the control

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Human Factors & Ergonomics
My background

- Control Engineer in SME
- Research Assistant (TU Darmstadt)
- Automotive Industry (Ford, Daimler, Faurecia, IDP)
  - Seating
  - Vehicle Engineering - PD
  - IT
- SRF University of South Australia
  - supported by AutoCRC and DTED
My “Ergonomic System”

• Complex vehicle packages
• Integration of systems
  • navigation
  • entertainment
  • complex vehicle controls
  • business
• An ageing population
• High density traffic
**Controls** –
Knobs, buttons, switches or any other item that provides a means of making a selection or providing input.

**System** –
The portion of a vehicle feature or function that acts on inputs from users and provides feedback to users.

**Human Machine Interface (HMI)** –
A set of controls, displays, or other design elements that provide a method of interacting with a feature or set of features in an automobile.

(Craig Simonds, FMC)
My “System”

Examples
Roadmap for talk

- Ergonomic Design tools
- Common Design Problems
- Integration
- Drive-by-wire
- New modes
- Design Rules
Ergonomic Design Tools
Ergonomic Design Tools

ANYBODY
Typical mistakes

- Failure to adhere to principles
- Non intuitive design
- Poor operability
- Poor accessibility
Common Design Problems
Failure to adhere to principles

What’s different?
Common Design Problems
Failure to adhere to principles

- Separation of functions
- Single line display
- Tactile button
  - Shape
  - Surface
- Anthropometric design
  - Button size
  - Button separation
- Icon design & visibility
Common Design Problems
Failure to adhere to principles

What’s different?
Common Design Problems

Failure to adhere to principles

• Separation of functions
• Tactile button
  • Shape
  • Surface
• Anthropometric design
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  • Button separation
• Icon design & visibility
• Single icon button
Common Design Problems

Intuition
Common Design Problems

Intuition
Common Design Problems

Intuition
Common Design Problems

Intuition

- Conformity of function and control
  - Direction of operation
- Identification of function
  - Shape
  - Mode of operation
- Position of controls
- Separation of controls
Common Design Problems

Operability
Common Design Problems

Operability
Common Design Problems

Operability

- Control shape
- Control surface
- Control size
- Force to operate control
- Direction of operation in relation to hand-arm
Common Design Problems

Accessibility
Common Design Problems

Accessibility

- Flip Pack on Door Panel: 68%
- Controls on Door Panel: 17%
- Controls on Side of Seat: 15%

Reasons Given for Preference (Qualitative):
- Very good location
- Good accessibility
- Easy to reach
- Generous amount of options

All pictures courtesy Lear
Common Design Problems

Accessibility

• Control location
• Handroom
• Hand-arm articulation
• Package constraints
  • Seat adjustment
  • Seat foam deflection
  • Door stowage
• Driver posture
• Driver vision
Integration of Control and Display

Roof Module Switches
- Interior light
- Power sun / moon roof

Interior Mirror Switches
- Electro-chromatic interior mirror
- Electro-chromatic exterior mirror

Center Stack display with Menu structure

Display Switches
- Store Station / Select CD-slot 1…6
- Forward / Seek / Rewind / Seek
- Volume on / off
- Stop / Pause / Media Select
- Eject Media
- Temp up / down
- Blower Speed Auto On/Off
- AC On/Off
- Front/Rear Demist
- Recirculation
- SOS
- Menu Switch

Center Stack/Console Switches
- Heated Windscreen
- Heated Backlite
- Hazard Warning
- Perimeter Lighting
- Interior area illumination
- Auto shift manual / power shift
- Electronic parking brake

Steering Wheel Switches
- (Adaptive) Cruise Control
- Horn
- Voice recognition
- Menu Switch

Steering Wheel Stalk Switches
- High beams
- Side Indicators
- Wipers (front / rear)
- Washer Pump Front/Rear

Instrument Panel Switches
- Cluster Dimming
- Headlamp On/Off
- Headlamp Levelling
- Fog lamps
- Parking lamps

Next to Seat
- Tailgate / Boot release
- Fuel Filler Flap release
- Seat adjustments
- Heated seats
- Misc seat functions

Door Panel Switches
- Child safety release
- Mirror control and folding
- Panic lock
- Power window
- Power window lock out

IP display with Menu structure

Interior Mirror Switches

Center Stack display with Menu structure
Integration of Control and Display

IP Display and Menu Switch

Center Console Display and Menu Switch

Pictures courtesy Ford
Integration of Control and Display

Bitte berühren Sie einen Richtungspfeil Ihrer Wahl auf der Sitzdarstellung.

Höhenstellung

100%

0%

Längeneinstellung

0%

100%

Verstellgeschwindigkeit

30%

100%

SPEICHER / MEMORY

MEMORY POSITION 1

MEMORY POSITION 2

VOREINSTELLUNG

MASSAGEPROGRAMM

KLIMASTEUERUNG

SPRACHSTEUERUNG

STOP

Pictures courtesy Keiper/Recaro
Drive-by-wire
New Modes for Controls

Pictures courtesy Lear
Satisfy all domains of Ergonomic Design:

- Anthropometric Design
- Physiologic Design
- Biomechanic Design
- Information Design
Design Rules

• Minimize workload (cognitive, memory and physical)
• Compatible with driving task
• Make driver feel comfortable and confident
• Support readiness to react to unexpected occurrences
• Not to distract
• No long, uninterrupted sequence of interaction
• Intuitive, easily recognizable
• Not too small or obscure
• Easy to read icons, using ISO standard
• No more than 2 levels of integrated function
Design Rules

- Mechanical mode of coupling
- Material and surface properties
- Actuation force and distance
- Control recognition, coding
- Control feedback (resistance)
- Control dynamics (range)
- Dimensionality of control
- Vision and reach zones
- Control environment (distance to other controls)
- Signal-Reaction compatibility (control-display)
- Usage frequency and importance
Thank you!

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