Standards for Warning Interfaces

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International Harmonize Research Activities - ITS Working Group

Mandate: exchange information on ITS safety research, present national safety-related interests in ITS, coordinate research and encourage collaborations.

Research Goals:

1) Improve understanding of the safety benefits and risks associated with ITS,
2) Develop procedures and criteria for evaluating safety of ITS
3) Coordinate policy-oriented research to optimize the safety performance of on-board ITS technologies.

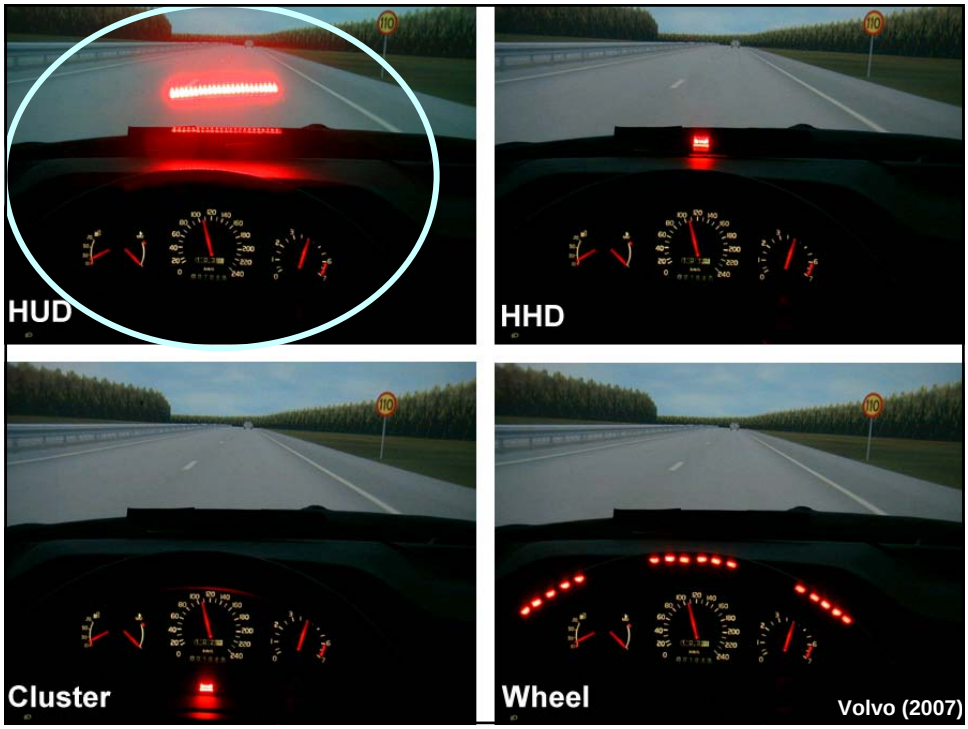
Need for Warning HMI Standards

- Lack of specific standards for driver assistance system HMI
- New technology provides good opportunity to standardize
- Standard HMI will improve system performance by:
  - Better understanding and attention from drivers
  - Reducing confusion
  - Accurate expectations

Where to start?

Safety Critical Warnings

A signal informing the driver of a hazardous situation, which if not corrected by an immediate action (0 to 3 seconds), will result in equipment damage and/or personal injury.



Lane departure warning

Heads-up Display (HUD)

Warning comes with rumble strip sound

SAVE-IT (2004)

Blind spot/ Lane change assistance

A WARNING SYSTEM CAN BE NO BETTER THAN ITS INTERFACE

HAZARD → WARNING SYSTEM → WARNING!

TIMELY & APPROPRIATE RESPONSE

WARNING FAILURE
- No response
- Inappropriate respons
- Slow response

WARNING FUNCTION
- Senses road traffic environment
- Filters & processes information for hazard
- Calculates severity & urgency
- Issues warning

WARNING PERFORMANCE
- Sensor coverage
- Sensor reliability
- Sensor accuracy
- Warning decision logic
- Warning itself

FAILURE DUE TO:
- Not noticed
- Confusion
- Misunderstood
- Ignored it…

Factors mediating warning effectiveness

- Conspicuity
- Comprehension
- Driver frustration and annoyance
- Expectancy
- Frequency of warnings
- Individual differences and condition
- Response options/ uncertainty
- Trust
- Willingness and/or ability to comply

Warning design considerations

- Activation criteria – When? ….. Frequency
- Levels and priorities of warnings
- Presentation modality, information and location
- Response options

Crash avoidance response options

1. Immediate hard braking.
2. Immediate steering manoeuvre.
3. Immediate termination of initiated or initiating action.
4. Seek awareness of situation and perform one of the above responses.
5. Immediate decision to retake control by the driver.

Warning Modality and Characteristics

- **Auditory** – speech, tone, loudness, musicality, duration, direction…
- **Visual** – symbols, text, light, brightness, location, colour, flashing…
- **Haptic** (touch) – vibration, location, intensity, direction.
- **Kinaesthetic** (body motion) – vehicle slowing

Visual Displays

Visual displays can be used to convey higher criticality and urgency by:

- **Colour** – red
- **Luminance** – greater luminance and contrast
- **Blinking** – shorter blinking cycle, smaller duty rate, (rather than continuous display)
- **Size** – larger

Auditory Tones

Higher criticality and urgency can be indicated by:

- **Intensity** – higher sound pressure level (dB(A))
- **Tone frequency** – higher frequencies
- **Periodicity** - shorter intermittent cycle, larger duty rate (rather than continuous tone display)

Current status

Some good generic warning guidelines are available

- Need to be consolidated, promoted & applied

Concerns & Limitations with Guidelines

- Lack specifics
  e.g. “Warnings should be distinguishable”
- Inconsistent adoption & application

U.S. Department of Transportation
National Highway Traffic Safety Administration

NHTSA
www.nhtsa.gov

DOT HS 810 697 January 2007

Crash Warning System Interfaces: Human Factors Insights and Lessons Learned

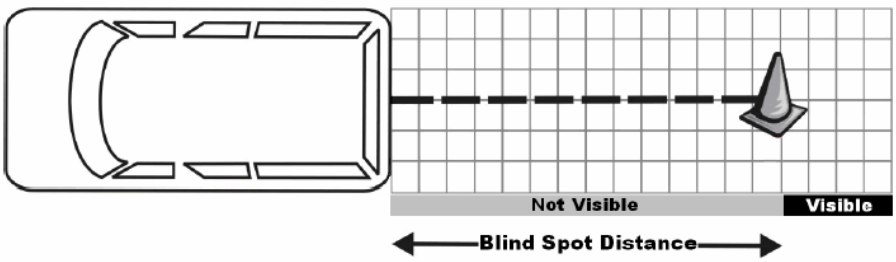
Final Report

Guideline 1- Warnings are not the best strategy

Warnings are not the most effective and reliable way to protect people and property:

1. Eliminate the hazard through improved design, or
2. Offer some form of protection to limit damage.
3. If that does not work then - Warn

Warning System Last: Example



1. Eliminate the blind spots
2. Actively prevent back-up collisions
3. Warn

Warnings Assessment

Standard performance tests that are practical, meaningful, reliable, and objective do not exist.

- Equipment performance (sensor coverage, accuracy and reliability, detection performance)
- Driver-system performance (fast or timely, appropriate and successful response).
- Range of scenarios (context, integration, prioritization)
- Range of potential users (typical, least informed most endangered)

Warnings Research Needs

- Need for comprehensive science-based model of driver responses to warnings
- Warning design guide
- Assessment methods
- New warning concepts (e.g., adaptive intelligent warnings)

Summary and Conclusions

- HMI is crucial for ITS warning system effectiveness
- HMI must be considered from the start of design
- Consistent application of good HMI standards will improve system performance
- Think of ways to eliminate or mitigate hazards rather than relying on a warning system
- Needs rather than technology driven.
- Research to gain a better understanding of warning parameters, particularly for design guidelines and assessment procedures.

Thank you