Automotive HMI – Current Status and future Challenges.

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BMW Group

Automotive HMI – Status & future Challenges.
Overview.

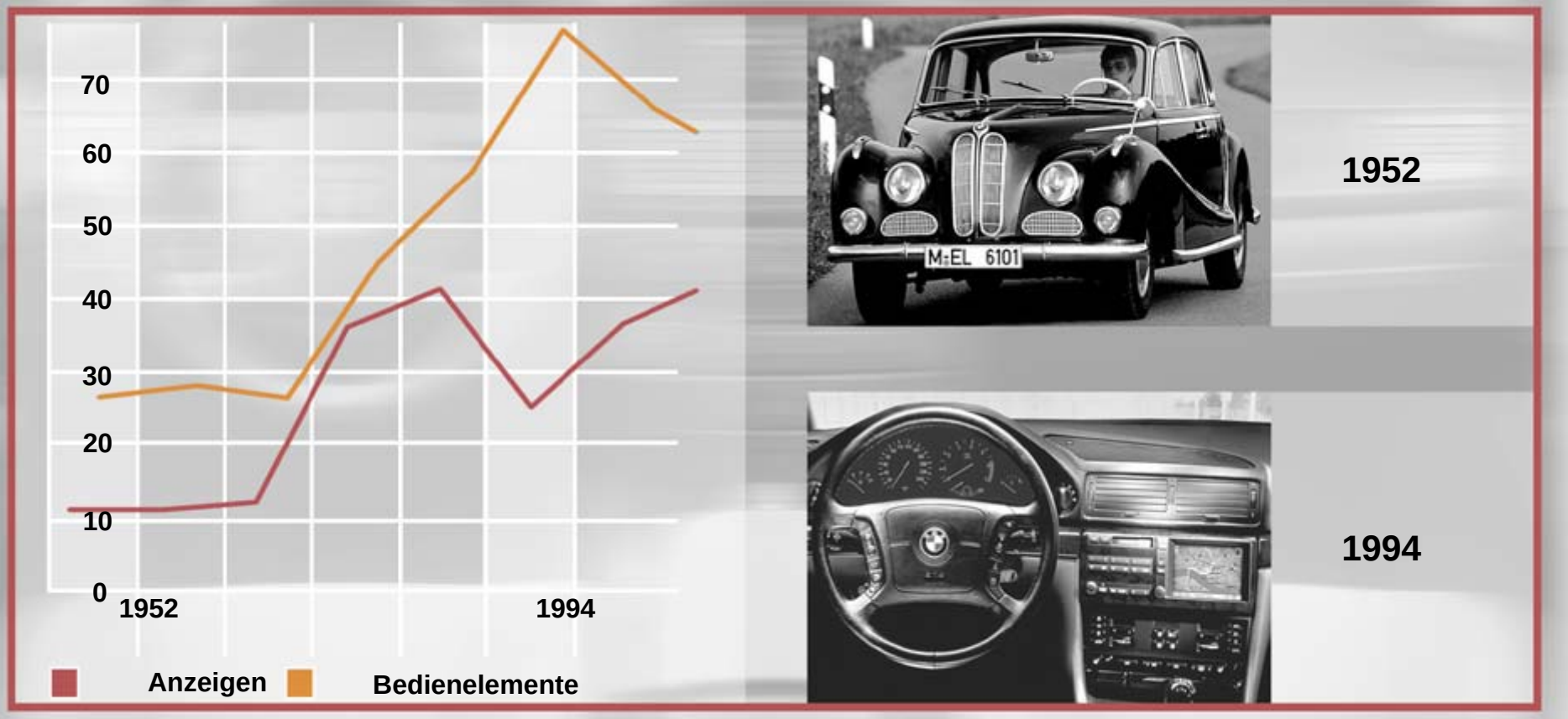
I. Situation Analysis

II. Challenges

III. Approach

IV. Conclusions

I. Situation Analysis – Automotive HMI.
History.



⇨ **steadily increasing number of displays and controls led to the introduction of the first bordcomputer in 1994 with built-in navigation**

I. Situation Analysis – Automotive HMI.
Concepts today.

Classic Concept: 1 Unit comprising Display and Controls

Japanese Concept: Touchscreen

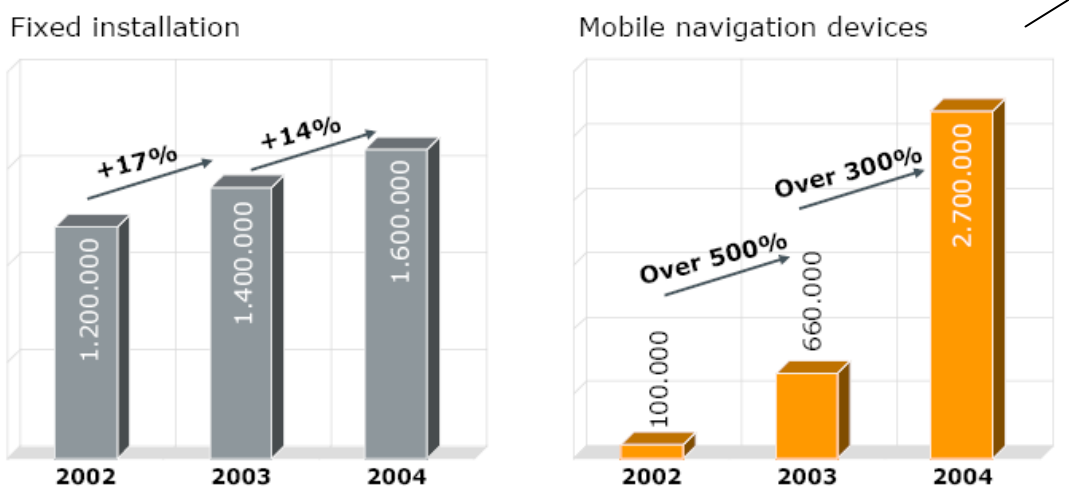
iDrive Concept: Control(s) separated from Display

I. Situation Analysis – Market

Rapid increase of number, types and functionality of systems

Market development of fixed installation vs. mobile navigation 20

Europe



by 2011
100 Mio. PNDs
global sales volume

Source: Canalys 2004

NAVIGON

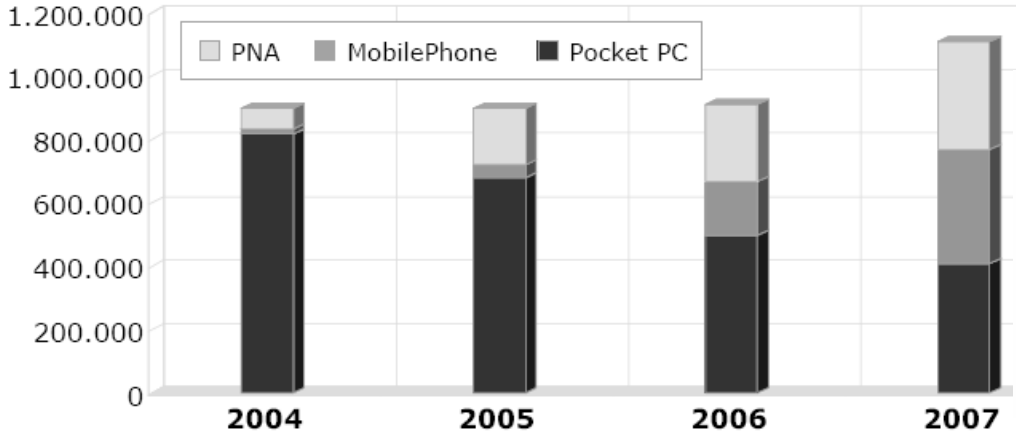
⇨ **Even by today far more mobile navigation systems than fixed installed systems are used while driving.**

I. Situation Analysis - Market

Functionality becomes more and more independent of system type

Trends – change in demand for mobile navigation systems 26

Assumption of various device types up until 2007



Source: Canalys 2004

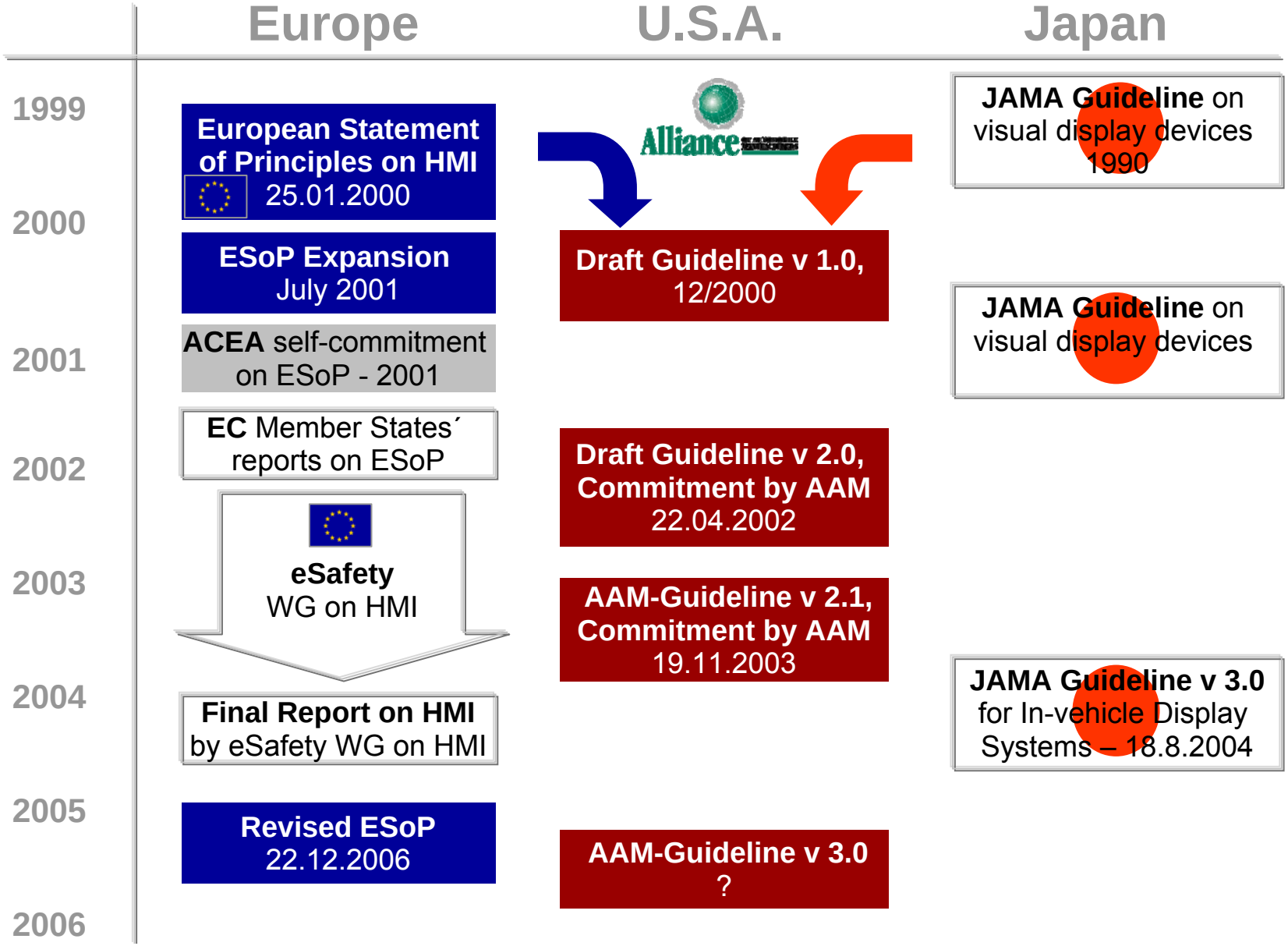
NAVIGON

⇨ **By 2012** *telematics* UPDATE **expects 90 Mio. GPS-phones to be shipped to Europe alone.**

⇨ **HMI significantly differs according to system type – but the driver´s capabilities are always the same**

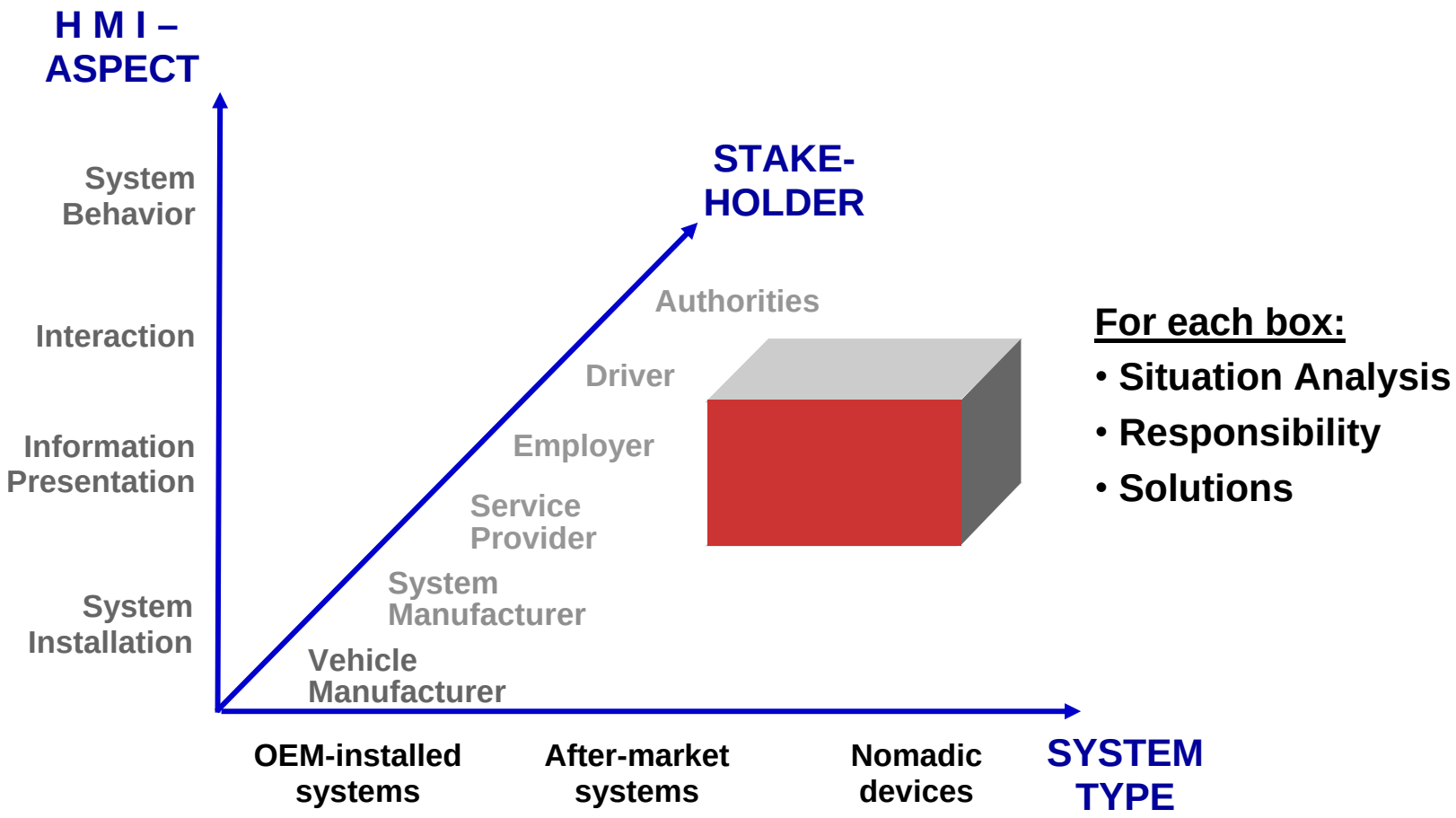
I. Situation Analysis – HMI-Guidelines

HMI-Guidelines evolving from each other



I. Situation Analysis – HMI-Guidelines

3D-HMI-Matrix, applied by eSafety-WG HMI



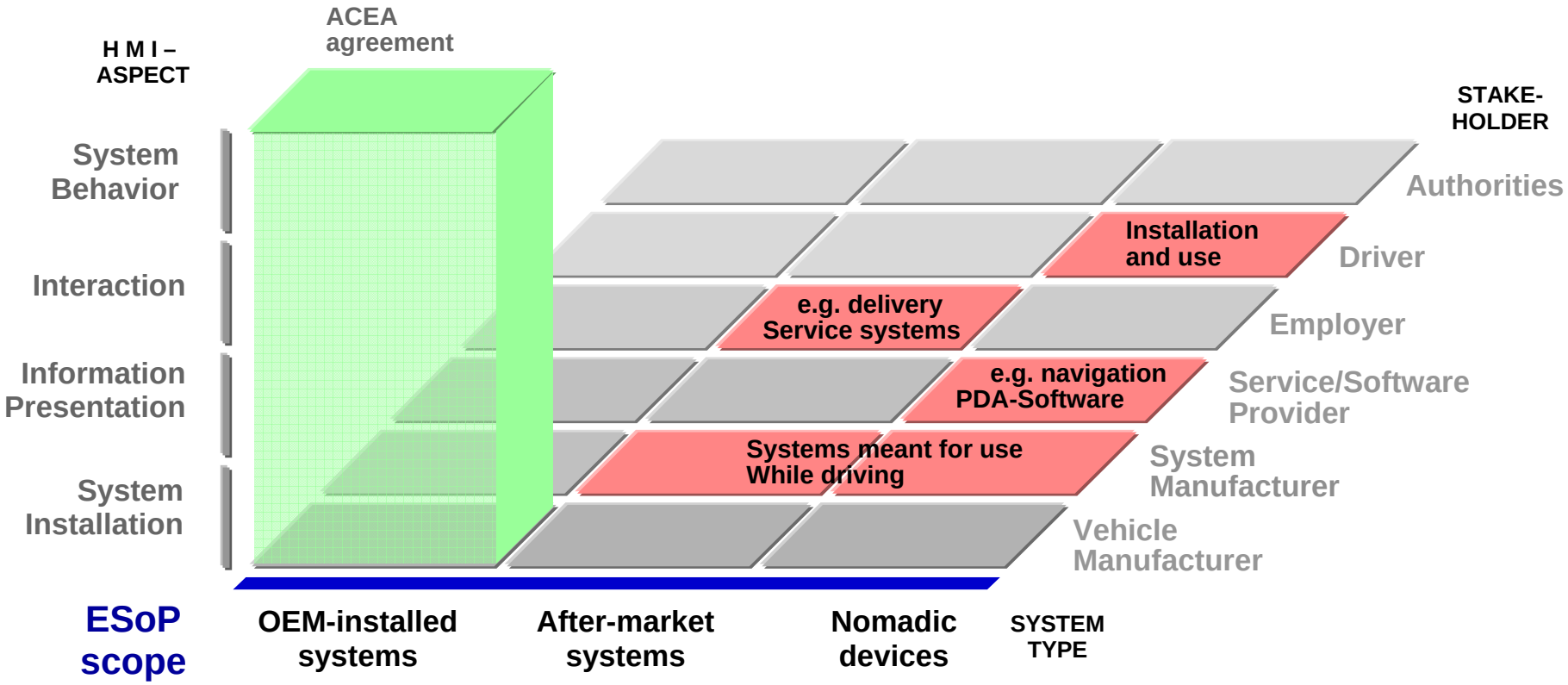
For each box:

- **Situation Analysis**
- **Responsibility**
- **Solutions**

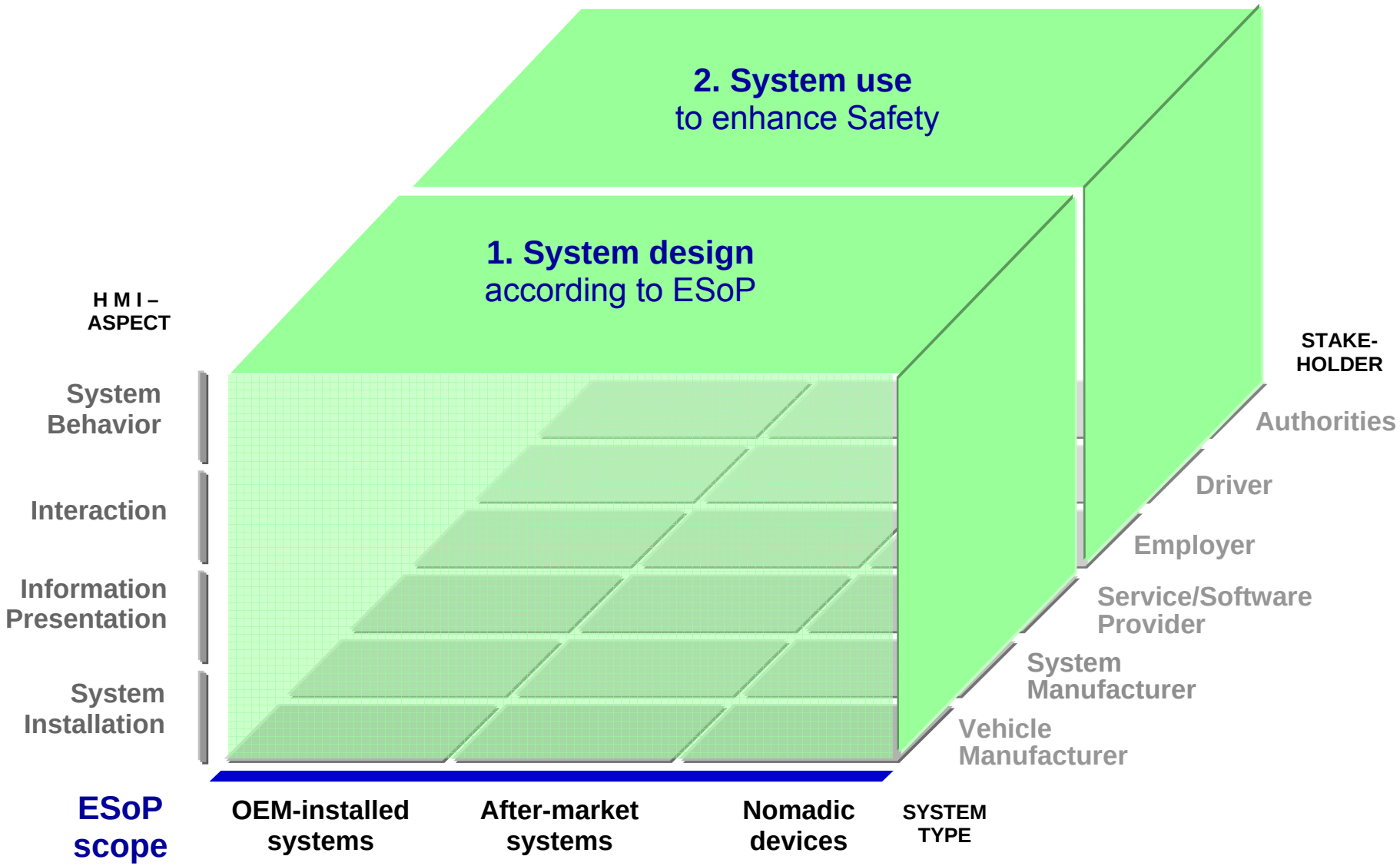
I. Situation Analysis – HMI-Guidelines.
Problem Analysis by eSafety-WG HMI.

Existing ESoP covers all system types, but ...

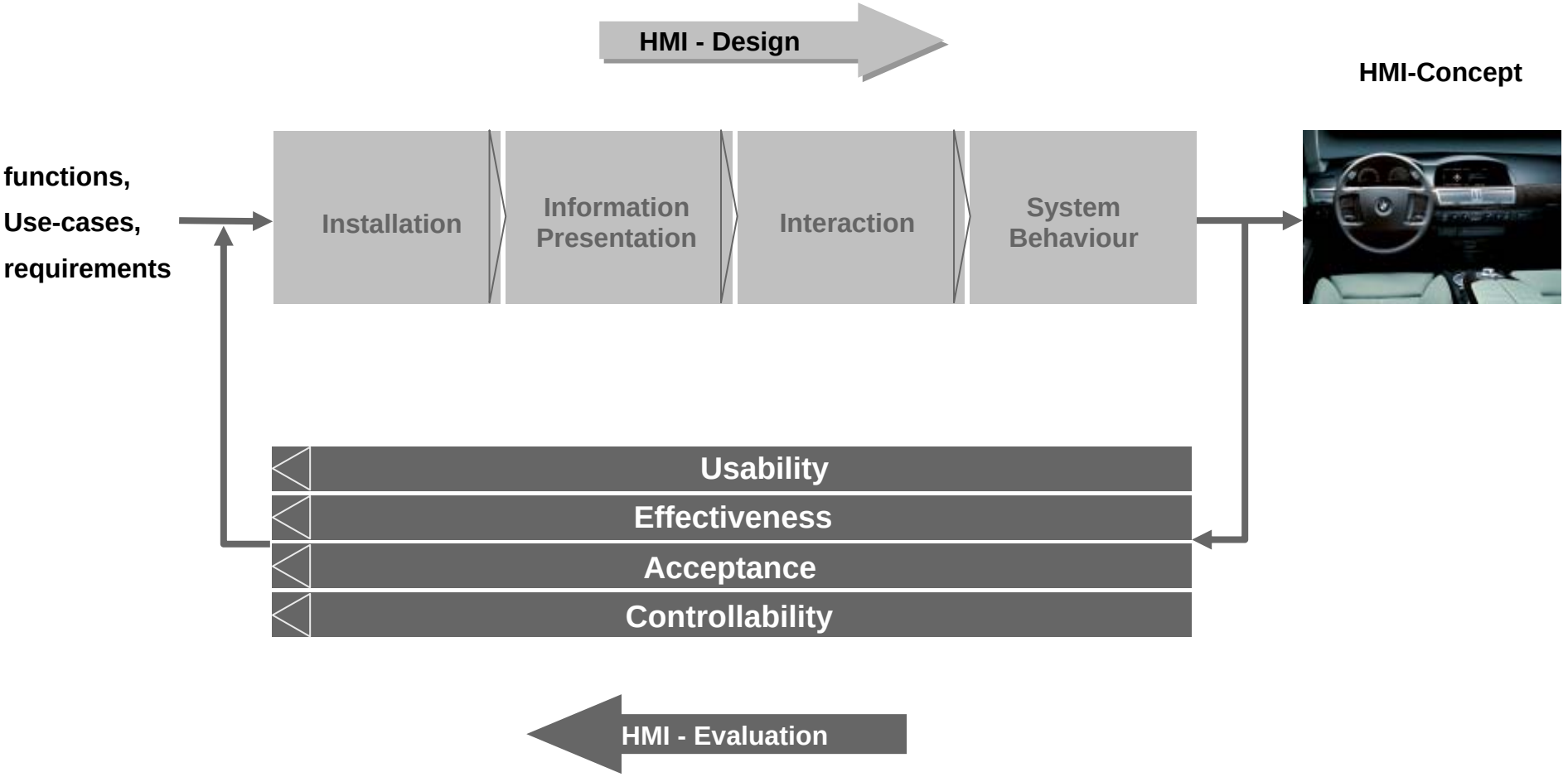
- is not applied by all stakeholders.
- does not fully cover all issues related with Nomadic Devices.
- needs to be supported by a communication/implementation strategy



I. Situation Analysis – HMI-Guidelines
eSafety Goals on HMI

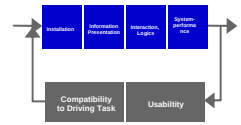


I. Situation Analysis – HMI-Guidelines
ESoP Application by OEMs



I. Situation Analysis – HMI Guidelines

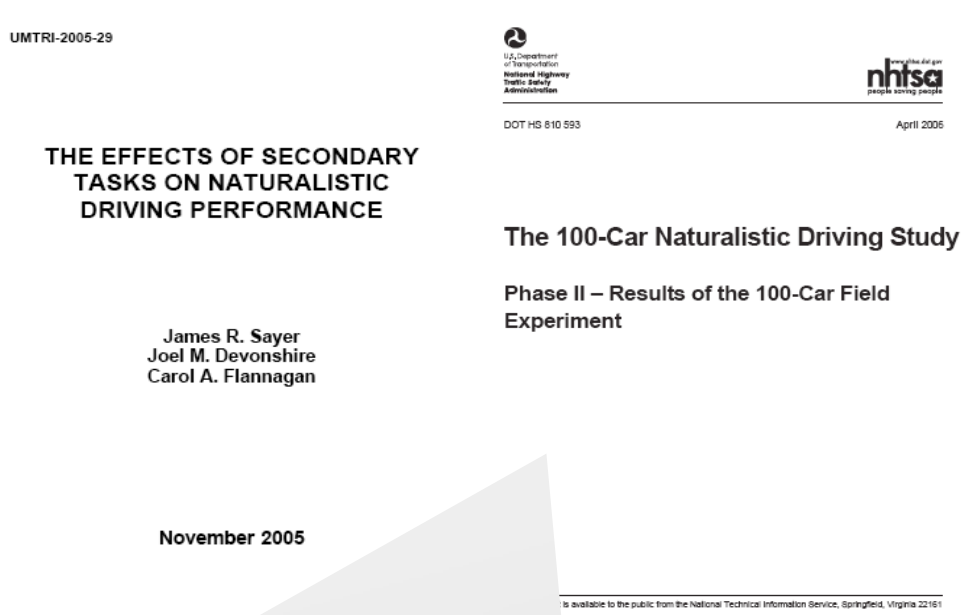
iDrive Concept reflects the ESoP



Installation	Information Presentation	Interaction, Logics	System-behaviour
Highly mounted display	ISO-Character sizes	driver-paced interaction	TV, Video are switched off automatically
Easy to reach control, no need to glance at	Display minimizing glare and reflections	driver can interrupt interaction at any time	No uncontrollable sounds

I. Situation Analysis – Driver Behaviour.

Drivers often engage in other activities parallel to driving.



UMTRI-2005-29

THE EFFECTS OF SECONDARY TASKS ON NATURALISTIC DRIVING PERFORMANCE

James R. Sayer
Joel M. Devonshire
Carol A. Flannagan

November 2005

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

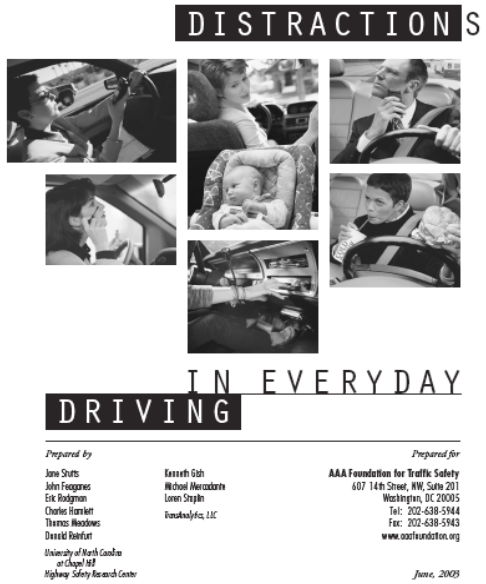
nhtsa
people saving people

DOT HS 810 593

April 2006

The 100-Car Naturalistic Driving Study

Phase II – Results of the 100-Car Field Experiment



DISTRACTIONS IN EVERYDAY DRIVING

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June, 2003

1. In 54 % of all 20000 six-second baseline epochs drivers were engaged in tasks other than driving, in 73% drivers did not solely concentrate on driving.
   ⇨ People make use of the steadily increasing amount of time they spend in their vehicles.

2. “Reaching for a moving object” had the highest impact on the likelihood of crash or near crash followed by “external distraction”, “reading”, “applying makeup”, and “dialing a hand-held device”.
   ⇨ Driver distraction must be regarded, therefore, as a societal problem.
   ⇨ Driver pragmatically chooses any possible way to fullfill his demand.

I. Situation Analysis – Driver Behaviour.

Integrating functionality means to offer a more suitable way of interaction.

Driver´s way of integrating functionality is pragmatic but often safety critical:

- **Fixation to windscreen restricts forward field of view**
- **Holster may cause injuries**
- **regulations on forward field of view, EMC and passive safety usually not fullfilled**

⇨ **Offering integrated functionality does not mean to offer more functionality, but to offer a more appropriate solution**

⇨ **Most drivers only use a small fraction of their systems functionality, which largely differs interindividually.**

II. Challenge 1.

How to ensure that all system types are designed according to the ESoP?

- ⇨ **All system types need to be designed to the same standards – the driver`s capabilities are always the same.**
- ⇨ **System Installation should comply with regulations on driver´s field of vision, passive safety and EMC ⇨ Certificate**
- ⇨ **Without certificate, using the system while driving is not allowed.**

H M I – ASPECT	Problems (examples)
System Behavior	• **TV, Videos, Games accessible** while driving.
Interaction	• **Interaction not driver-paced**, i.e. system state changes after timeout. • **Interaction not sufficiently interruptible**, e.g. character input with pen.
Information Presentation	• **Very small font size**, not in accordance with ISO15008 • Display with **low contrast**, glossy display causing **glare & reflection**.
System Installation	• Fixation to windscreen **obstructs forward field of view**. • In case of crash, **injuries** by „flying“ device and sharp edges.

Nomadic Device, e.g. PDA

II. Challenge 2

How to promote competent driving while offering information, communication and entertainment functionality.

1. **100-car-study shows, that drivers do not resign from information, communication, entertainment.**

⇨ **Provide functionality in the most appropriate way while driving. ESoP helps to design a good HMI.** ☑

2. **Similar Information is provided by different systems in varying quality,** e.g. traffic information by AM/FM, satellite radio, internet, I2C …

⇨ **Provide validated, up-to-date, exact and reliable information instead of leaving this task with the driver.** ☐

3. **Most accidents involve driver mistakes on the maneouvering level,** e.g. wrong estimation of following distance, relative speed, curve radius etc.

⇨ **Strengthen anticipation of route and traffic situation, thus enabling the driver to distribute his attention adequately.** ☐

III. Approach
Classification of tasks and functionality

Secondary Task

Entertainment
Music, video

Communication
Private, business, traffic

Information
News, Traffic, Travel

Information- & Communication Systems (IVIS)

Life: AM/FM, Satellite Radio, DAB …
Replay: CD, MP3, DVD

Telephone, messaging, e-mail

Services, z.B. auf Basis von Radio, Internet, C2C, C2I

Driving Task

Navigating
Choice of route

Manoeuvering
Choice of course and speed

Stabilizing
Operating steering wheel and pedals

Assistance System

Navigation System

Advanced Driver Assistance System
e.g. ACC, Lane Keeping Assistance

Chassis Control Systems
e.g. ABS, DSC/ESC

3. communicate

GPS, C2X, DSRC….
≡
hear & speak

2. See

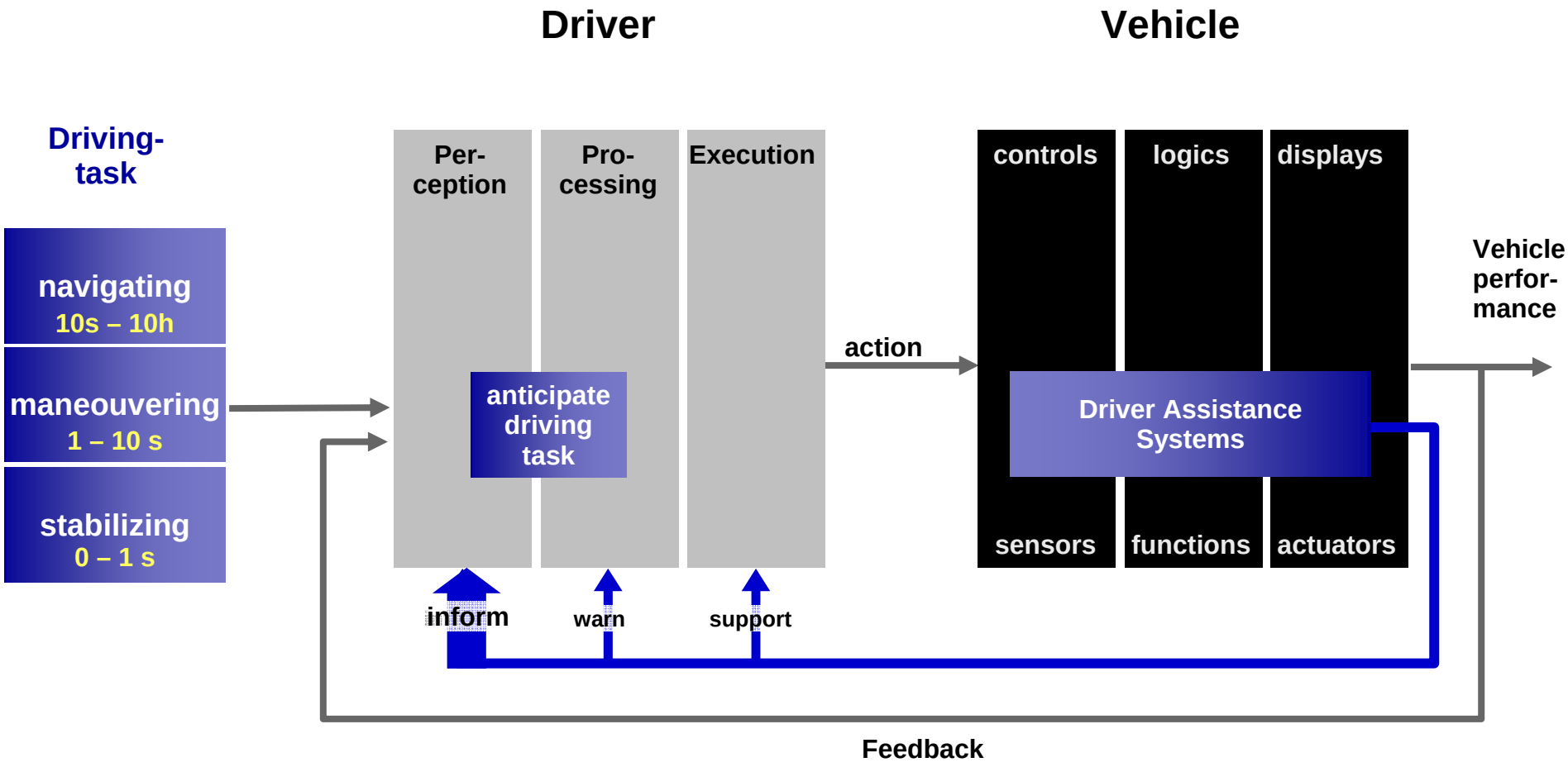
Radar, Lidar, Camera….
≡
eyes

1. Feel

Acceleration sensors
≡
Equilibrium organ

III. Approach: competent interaction
means to decide timely and correctly.

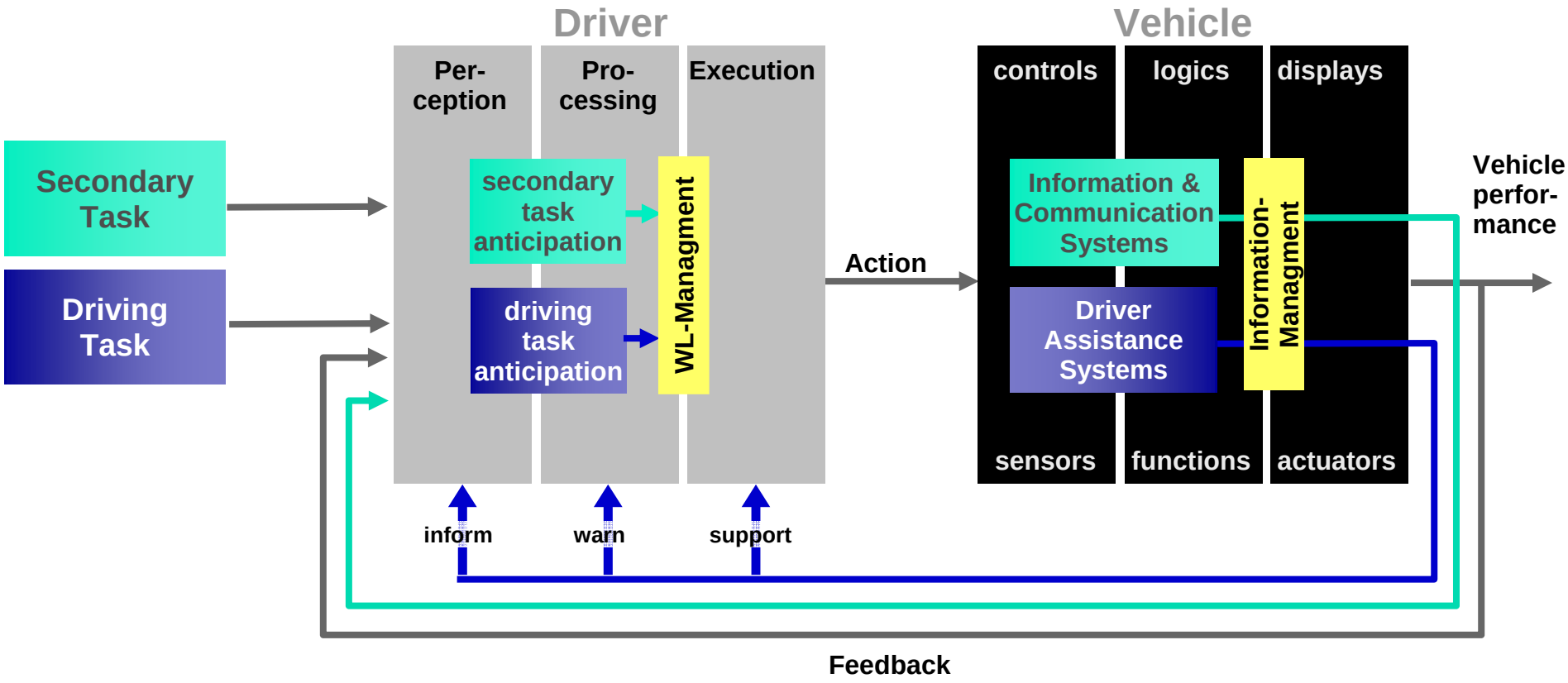
⇨ Driver Assistance Functionality in order to increase Anticipation capabilities



III. Approach

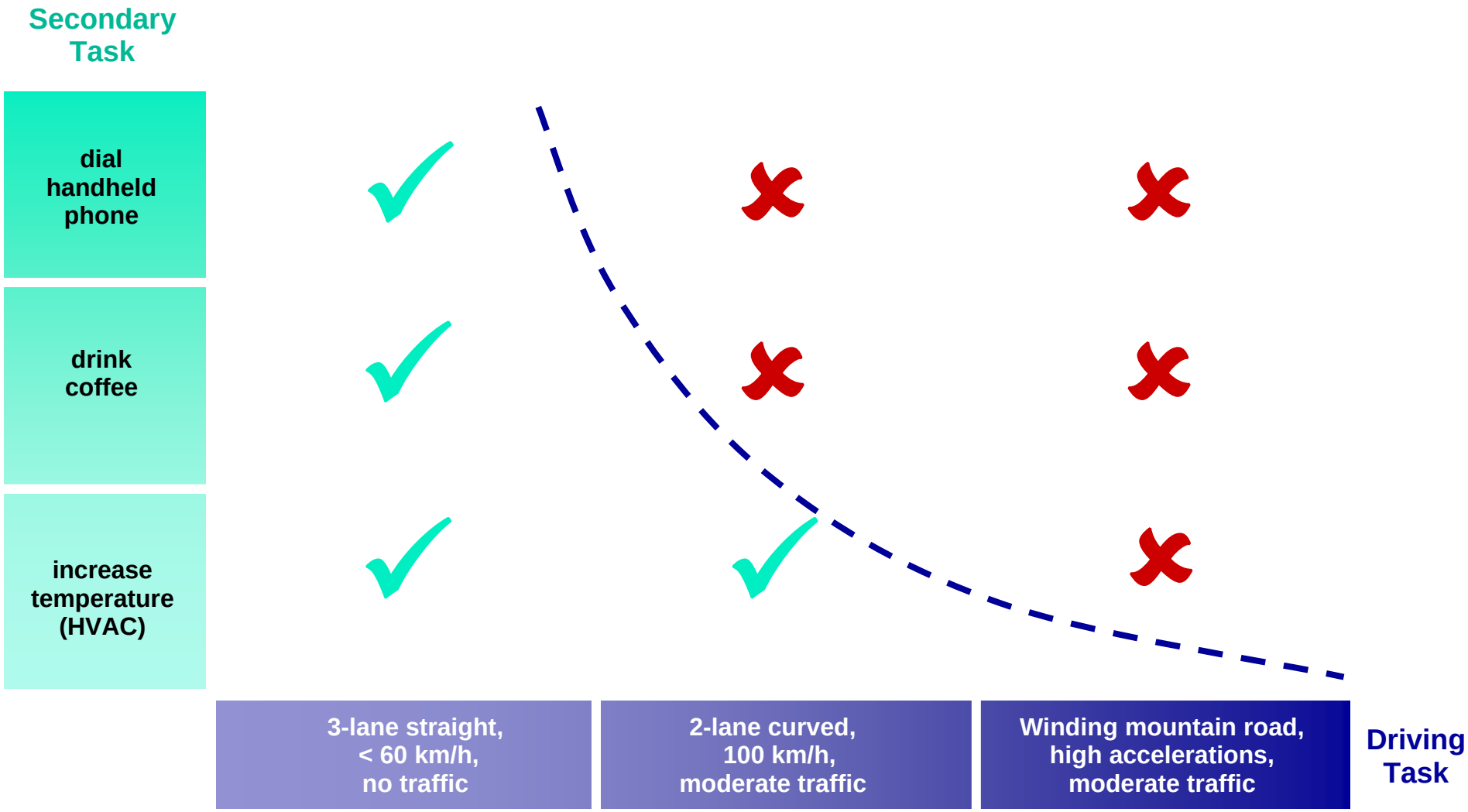
deciding timely and correctly requires anticipation of workload.

- ⇨ Initiating secondary task operation also requires the driver to anticipate its associated demand and matching it with the demand expected from the driving task.
- ⇨ Information Management can ease Workload Management by driver .



III. Approach.

workload imposed by secondary task must be compatible to that of the driving task.



IV. Conclusions

Automotive HMI: Current status and future challenges

- **Major achievements ten last years**
- ESoP 1999 = HMI design guideline formulated by scientists and industry. ESoP 2006 supported by AIDE is almost ready to use.
- ESoP is applied by OEMs and has easily noticable effect on system design.
- Market driven Introduction of Driver Assistance Systems has significantly improved traffic safety.

Major problems, now and in coming ten years

- ESoP is not applied by large parts of the industry.
- Number of systems used while driving, but not designed for this use-case has rapidly increase and will continue to increase – 100 Mio by 2011.
- Navigation functionality on mobile phones will further compromise traffic safety.

IV. Conclusions

Automotive HMI: Current status and future challenges

- **Most promising solutions**
- ESoP needs to be applied to all system types, leading to secure installation, good information presentation, driver paced interaction and lock-out of TV, DVD, Gaming & free Internet while driving.
- System design which respects the driver as ultimate workload manager and assists him in anticipating the future workload imposed by the driving task, but also by secondary tasks.

Research needs

- Analysis of workload managing strategies by the driver.
- Analysis and Validation of HMI-design parameters improving workload managment by the driver.
- Analysis of driver behaviour when interacting with whole continuum of systems formulating minimum requirements for integration (installation ... system behaviour)