

TRB EMS Subcommittee ANB10(5)

# EMS Safety Summit 2012 Safety Systems, Strategies and Solutions

## Bridging Ergonomics, Operational Task Analysis and Automotive Safety

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# Bridging Ergonomics Operational Task Analysis and Automotive Safety

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# Bridging Ergonomics Operational Task Analysis and Automotive Safety

- Definitions
- Automotive Safety Technology
- The Ambulance Challenge
  - Bridging the Gap
- Opportunities



# ERGONOMICS



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- **Ergonomics** is the study of designing equipment and devices that fit the human body, its movements, and its cognitive abilities.

The International Ergonomics Association defines ergonomics as follows:



- Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.
- Ergonomics is employed to fulfill the two goals of **health and productivity**
- It is relevant in the design of such things as safe furniture and easy-to-use interfaces to machines and equipment. Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability.



# AUTOMOTIVE SAFETY

"Active safety" is used to refer to technology assisting in the prevention of a crash

"Passive safety" refers to technology of the vehicle (primarily airbags, seatbelts and the physical structure of the vehicle) that help to protect occupants during a crash



WIKIPEDIA  
The Free Encyclopedia



# ACTIVE SAFETY

AVOIDS THIS:



## ACTIVE SAFETY PREVENTS THIS:



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## SAFETY TECHNOLOGY

### Active Safety Technology

- ESC: Electronic Stability Control / Roll-over Prevention
- Antilock Brakes maintain control while braking
- Brake Assist Systems prevent or reduce the severity of collision.
- Adaptive cruise control maintain a safe distance from the vehicle in front
- Lane departure warning systems alert the driver of an unintended departure from the intended lane of travel
- Tire pressure monitoring systems
- Traction control systems restore traction if driven wheels begin to spin
- Infrared night vision systems
- Adaptive headlamps
- Reverse backup sensors, which alert drivers to difficult-to-see objects in their path when reversing
- Backup camera

Electronic Stability Control (ESC):  
Monitors vehicle control

Advanced Head Restraints:  
Reduce potential head/neck injuries in crashes

Advanced Frontal Air Bags:  
Protect in frontal crashes, shielding the driver's and front passenger's head, neck, and chest

Lane Departure Warning (LDW):  
Monitors lane markings on the road and cautions driver of unintentional lane drift

Side Air Bags and Curtains:  
Protect in side crashes, shielding a passenger's head, neck, chest, and pelvis

Safety Belt Load Limiter and Safety Belt Pretensioner:  
Absorb crash energy and tighten belts to restrain occupants

Forward Collision Warning (FCW):  
Detects vehicles ahead, cautioning drivers of impending collisions

### Pre-crash Safety Technology

- Seat Belt Pre-Tensioner
- Automatic Braking

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## SAFETY TECHNOLOGY

### Passive Safety Technology

- Seatbelts
- Airbags
- Laminated windshields.
- Passenger Compartment Safety Cell
- Vehicle Crumple zones
- Side impact protection beams
- Collapsible steering columns
- Door Latch and Hinge Systems
- Pedestrian protection systems
- Impact Friendly Interior Surfaces
- Cargo Restraints

Advanced Head Restraints:  
Reduce potential head/neck injuries in crashes

Advanced Frontal Air Bags:  
Protect in frontal crashes by shielding the driver's and front passenger's head, neck, and chest

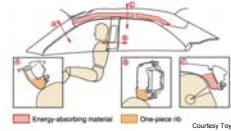
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## DESIGN for SAFETY

- Well Defined Occupant Positions
- Highly Refined Interior and Vehicle Design
- High Volume Manufacturing  
50,000 – 200,000+ Vehicles
- High Capital Investment
- Testing and Certification Processes



### HEAD INJURY CRITERIA

$$HIC = \left[ \frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a dt \right]^{2.5} (t_2 - t_1)$$

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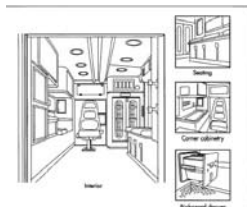
## The Ambulance Challenge

- Small Manufacturers
- Minimal Research Funding
- Working Environment
- High Stress Situations
- Many possible Tasks
- Equipment and Materials on Board

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## AMBULANCE DESIGN

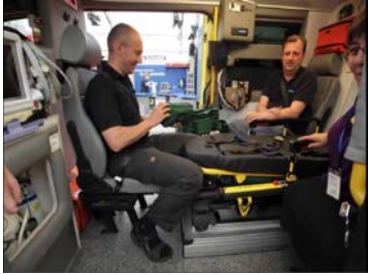
- Emergency Room on Wheels
- Large Variation of Medical Incidents
- Large Variation in Occupants
- Low Volume Manufacturing  
50 - 500 vehicles
- Low Capital Investment



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## AMBULANCE DESIGN CHALLENGE

Seated and Restrained, But can you get the job done?



Courtesy of AmbulanceRanger

## BRIDGING the GAP

BASIC PRINCIPLES: ERGONOMICS      BASIC PRINCIPLES: AUTO SAFETY

Maintain Health (Safety) and Productivity

Prevent Accidents, Minimize Consequences

– Bio Metric Range of Customers  
– Seated when traveling

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– Seated when traveling

– Task Analysis / Performance

- Provide resources required
- Appropriate reach / motion
- Appropriate strength
- Maintain task forces below injury levels
  - Repetitive events

– Passive Safety

- Restrain occupants in seats
- Maintain seat integrity
- Maintain passenger compartment integrity
- Minimize deceleration forces
  - Provide crush zones
- Provide friendly surfaces at impact zones
- Maintain force levels below injury levels
  - Singular events

## OPPORTUNITIES

- Attendant / Patient / Gurney Relationship
- Operator Support Systems
- Interior and Equipment Storage Systems
- Operating Factors

## •Attendant and Patient/Gurney Relationship



Attendant may not be able to get close to patient

No room for attendant's legs below gurney

Attendant must face forward and work sideways

Attendant restraint may suffer

## Operator Support Systems



Bio-Impact friendly hand grips

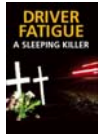
## Interior and Storage Systems



Interiors designed for Ergonomics and Bio-Impacts

## Operating Factors

- Operator Fatigue leads to Accidents
  - Work Rules allow long shifts



- "Lights and Siren" Attitude leads to Accidents
  - Philosophy, Training, Policy, Enforcement



**QUESTIONS?**

**THANK YOU!**