Evaluating a Real-time Invehicle Driver Monitoring and Auditory Feedback Device for Improving Fleet Driver Performance

Sydney, Australia, November 11, 2009
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Research Director

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In this weeks consumer news..

NewScientist Tech

Spy-in-the-cab could improve teenage driving

08 November 2009 by Paul Marks

ACCIDENT rates among teenage drivers could be slashed using in-car technology that warns them when they are driving recklessly.

So says safety engineer Oren Musicant at Ben-Gurion University in Israel, who wanted to know if in-car technology could help reduce the appalling number of teenage deaths on the roads. In the US, for instance, car crashes are the leading cause of death for teenagers, accounting for over one-third of all deaths of those aged between 16 and 19 years old.

In March 2008, Staffordshire County Council in the UK trialled in-vehicle data recorders with 10 local teenage drivers over six months. The IVDRs, made by GreenRoad of San Francisco, California, are more commonly used to help

http://www.newscientist.com/article/mg20427335.100-spyinthecab-could-improve-teenage-driving.html

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In this weeks consumer news..

[November 02, 2009]

BusinessWire

inthinc Delivers tiwi Driving Safety and Fleet Management Solution

SALT LAKE CITY --(Business Wire)-- inthinc Technology Solutions (News - Alert), Inc. (www.inthinc.com), a developer and manufacturer of tiwi-branded solutions to improve driving safety, today announced its tiwi driving safety system is in full production for light commercial fleets as well as heavy duty and special purpose applications. With tiwi, companies get the only comprehensive system that changes driving behavior in real time to improve safety and fleet efficiency.

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Visual, Auditory and Haptic Feedback

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To mention a few ….

- Auditory Feedback
  - Roadsafety
  - Tiwi
- Visual Dash Alerts
  - Greenroad
- A recorder
  - Carchip

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Availability of after market consumer 'e-safety' technologies is accelerating rapidly – but – how can the consumer decide which aftermarket device is effective and suited to their needs

- Marketing appears to be driving safety decisions in this arena – rather than reliable scientific data

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Are these valuable aftermarket safety tools? and Are we about to enter an impending minefield of confusion…..?

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Lexicon….

- Vehicle e-safety systems
- Intelligent Speed Adaptation - ISA
- Advanced Driver Assistance Technologies
- Invehicle Telematics
- Adaptive Integrated Driver-vehicle InterfacE – AIDE
- Invehicle data recording - IVDR
- …… ??

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Alerts and warnings

- Visual - What color means what?
  - On the dash?
  - Heads up display?
- Auditory - What tone means what for which device or which safety or behavior alert?
  - Tones, beeps, growls?
- Haptic
  - Steering wheel?
  - Seat?

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Real-time feedback means…

- Milliseconds
  - How many?
- Seconds
  - How many?
- That day
- That week…

So…

- Evaluating a Real-time In-vehicle After market Driver Monitoring and Auditory Feedback 'E-safety' Device for Improving Fleet Driver Performance
- In the setting of a special fleet – ambulance vehicles in the USA

- To quote Steve "Sid" Caesar – Director IHS ES

"We want everyone to get home safely each day"

Emergency Medical Services (EMS) An important and unique transport system

- Public safety, public health and emergency service
- Is there to save lives

Uniquely suited to fleet 'telematics' evaluation

- High volume of risky driving practices
- High crash and injury rate
- Large cohort of high risk drivers – young males
- System is protocol driven
- Strict performance monitoring from a clinical perspective is an accepted norm
- Benchmarking is in response times…

USA EMS transport safety data estimates

- ~ 50,000 vehicles
- ~ 9,000 crashes a year
- ~ One fatality each week
  - ~ 2/3 pedestrians or occupants of other car
- ~10 serious injuries each day
- Cost estimates > $500 million annually

*FARS/BTS 2007

Ambulance transport a serious USA transport safety problem…

- the most lethal vehicle on the road both per mile travelled and per vehicle
- is exempt from federal fleet safety oversight
- 2/3 fatalities not in the ambulance
- Exempt from most FMVSS standards AND…..
- Is THE VEHICLE THAT COMES TO RESCUE YOU ON THE HIGHWAY!!

Some odd USA facts

- 97% of ambulance transports are routine
- <3% are critical or life threatening
- Ambulances are generally not built by the automotive industry
- No ESC, or ISA or….
- The most lethal commercial vehicle on the road

Very Important Principle

Ambulance transport safety is part of a SYSTEM, the overall balance of risk involves the safety of all occupants and the public

Firstly!

- An accident ?
- or

  a predictable and preventable event

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Last month... October 22, 2009 Provider and Patient Killed

Thursday, October 22, 2009 - Two people have been killed after an ambulance slammed into the back of a TDOT vehicle on Interstate 65 near Wedgewood Avenue.

Officials said the RuralMetro ambulance was travelling in the northbound lanes when it hit the truck.

The two fatalities are the driver of the ambulance and the patient being transported.

An off-duty Metro firefighter, Evans Johnson, was transported to Vanderbilt University Medical Center in critical condition. Johnson was tending to the patient in the ambulance.

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April 30, 2009 - Tennessee

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Primum Non Nocere...??

Is a license enough for ambulance drivers?

Extent of EMT training questioned by widower

By DAVID DOEGE

Cindy Theune

Quotable

"It's no different than someone who delivers pizzas."

- Gregg Theune, crash victim's husband, on training

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National Academies TRB Ambulance Transport Safety Summit October 29, 2009 -

http://www.objectivesafety.net/TRBSummit2009.htm

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Driver behavior monitoring and feedback device

EMS Education Articles

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What about changing driver behavior in the real world??

AN OPTIMAL SOLUTION FOR ENHANCING AMBULANCE SAFETY: IMPLEMENTING A DRIVER PERFORMANCE FEEDBACK AND MONITORING DEVICE IN GROUND EMERGENCY MEDICAL SERVICE VEHICLES

Nadine R. Levick, MD, MPH
Maimonides Medical Center

REAL WORLD APPLICATION OF AN AFTERMARKET DRIVER HUMAN FACTORS REAL TIME AUDITORY MONITORING AND FEEDBACK DEVICE: AN EMERGENCY SERVICE PERSPECTIVE

Nadine Levick
Objective Safety LLC
United States of America

Larry Wiersch
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Objective

- To evaluate and compare outcomes of the use of a real-time driver monitoring and feedback device for improving driver safety performance in two ambulance transport settings

The conceptual approach to this end user market -The "Feedback Box" -
A transportation safety monitoring and feedback device

"This technology is conceptually like a vehicle safety 'pulse oximeter' – that with auditory feedback - can save your life, your coworkers life, your patients life, and others on the road"

Purpose of 'Monitoring and Feedback box' Program

- Enhance Safety
- Improve Driver Performance
- Save Maintenance Dollars
- Aid Accident / Incident Investigation

How the Device Works

- Computerized monitoring device installed on each vehicle to measure parameters
- Each driver has individual key "fob"
- Data collected every second
  - including: vehicle speed and performance, driver behaviors and emergency mode

- Immediate auditory feedback of warning 'growls', and penalty tones to driver
- Can also alert management via cellular network
- Data downloaded automatically every day

Key fob for driver specific activation of the system

Video Demonstration

- Log on procedure
- Hard cornering
  - Freeway entrance ramp – tighten turn radius
- Over-speed
  - Shortened warning period to high overspeed
  - Low overspeed during deceleration

Over speed - accelerating

- Listen for growl – 15 sec warning begins
- Growl frequency increases near end of warning
- Tone on – penalty points awarded
- Slow down – tone stops
- Accelerate again - growl on – slow down – growl stops - no points

Methods

- Implementation of an aftermarket onboard real-time driver monitoring and auditory feedback device in the setting of two ambulance services
- Sites compared for fleet use and environment
- Data collected for driver performance, vehicle parameters and safety behaviours during the three phased period.
- System performance comparisons conducted

The implementation sites

	Site A	Site B
Population Served	500,000 people in Little Rock area, Arkansas	Serves The Lehigh Valley area, Pennsylvania
Ambulance Units Deployed	29 units daily	13 units daily
Ambulance calls	58,000 calls per year	34,000 calls per year
Service Area	2,400 square mile service area	~1,000 square mile service area
Operational Employees	195 full time / 75 part time uniformed employees	152 drivers (including part time and volunteer)
Ambulance Miles Travelled	1.9 million miles annually	450,000 miles annually
Mean response time	6 minutes	11 minutes

Site A

Site B

Implementation Phases

- **Phase I-**
  Blind data - no tones, no ID capture
- **Phase II-**
  Warning and penalty tones only
- **Phase III-**
  Fully operational

Implementation Phase Duration

	Site A	Site B
Phase I- Blind data - no tones, no ID capture:	3/2003 to 4/2003	11/2004 to 5/2005
Phase II- Warning and penalty tones only:	4/2003 to 6/2003	5/2005 to 7/2006
Phase III- Fully operational:	6/2003 to 7/2006	7/2006 to 9/2006

Parameters Monitored

- Vehicle Speed (against user set limits – both hot and cold)
- Hard acceleration/braking
- Cornering velocity and G- forces
- Use of Emergency Lights and Sirens
- Parking brake
- Back up spotter

Onboard Computer Device Settings used in this study

	Site A	Site B
Speed **Low Speed (LSCOUNT)** **High Speed (HSCOUNT)**	15 second warning period - 74 / 78 mph - 84 / 88 mph	10 second warning period - 73 / 78 mph - >79 mph
Cornering **Low Over Force (LFCOUNT)** **High Over Force (HFCOUNT)**	warning at 25% - 39% - 55%	warning at 25% - 38% - 48%
Reverse Count (RVCOUNT)	- 1 count for each time the vehicle is placed in reverse without the reverse spotting switch being engaged	- 1 count for each time the vehicle is placed in reverse without the reverse spotting switch being engaged
Seat Belt Distance (SBCOUNT)	- 2/10ths mile (0.2 mile)	- 1/10ths mile (0.1 mile)

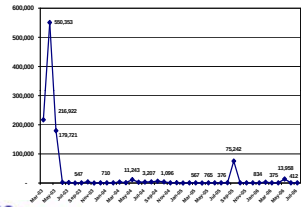
Performance incentives

- Both services incentivized good performance
  - Free lunch
  - Team competition
  - Bonus
  - Schedule benefits
- Both services highlighted perfect drivers not the goal

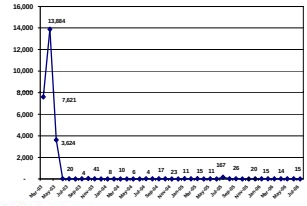
Implementation Specifics

- No inservice training during Phase II & III
- No time out in drivers Ed classes
- Extended Phase II period in Site B to capture low frequency driver mix
- Speed tolerances and seat belt tolerances were more stringent at Site B
  - Speed warning period is 30% shorter
  - Seat Belt warning distance 50% shorter

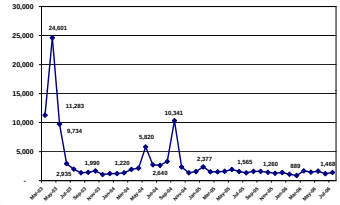
Site A: Overspeed violations



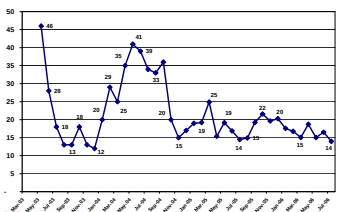
Site A: Seatbelt violations



Site A: Overforce violations



Site A: Driver Performance



Site B: Overall Results

	Phase I	Phase II	Phase III
Distance (miles)	193,210	682,320	75,957
LSCOUNT [LSCOUNT/mile]	89,259 **[2.16]**	100,195 [0.5]	96 **[0.001]**
HSCOUNT [HSCOUNT/mile]	12,936 **[14.94]**	14,448 [0.02]	2 **[0.00003]**
LFCOUNT [LFCOUNT/mile]	37,347 [0.19]	64,328 [0.09]	1,250 [0.02]
HFCOUNT [HFCOUNT/mile]	552 [0.003]	1,210 [0.002]	56 [0.001]
RVCOUNT [RVCOUNT/mile]	15,697 [12.31	69,779 [0.10]	7,100 [0.09]
SBCOUNT [SBCOUNT/mile]	40,893 **[4.72]**	45,366 [0.07]	90 **[0.001]**

Response times

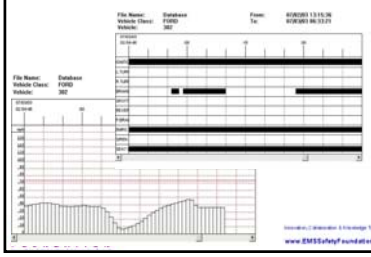
- Site A
  - Call volume increased 20%, vehicle and personnel resources remained constant
  - Response time remained at 6 minutes
- Site B
  - Stable call volume and resources
  - Response times- 11:14/10:36/10:46 minutes

Crash Rates

- Site A
  - No serious/injury crashes during study period
    - One unavoidable crash due to a bridge obstruction
- Site B
  - 19 vehicle incidents in Phase I
  - 11 vehicle incidents in Phase II
  - None in Phase III

when a crash happens…. (Site A)

Unit 302 Crash data



Direct Benefit

- 20% cost saving in vehicle maintenance within 6 months.
- No increase in response times
- Fewer crashes and less severe crashes
- Sustained improvement in safety proxies, with no inservice or retraining after the initial introduction period.

Extensive Indirect cost savings

- Fewer out of service vehicles
- Improved transport times
- Decreased administrative lost in managing unsafe behaviors
- Decreased legal burden
- Automatic system wide data
- Insurance benefits

Other monitoring devices

- Primarily to record events during and immediately preceding a crash
- Give no driver crash prevention feedback
- Administratively burdensome
- Intrusive
- Not demonstrated to be as effective in improving vehicle maintenance costs or as effective in modifying driver behavior long term

You want a system that works!!

- Does the system really work
- Is it going to be a major burden on your staff to implement
- What are the real costs
- Are you going to have video of your company vehicle on you tube??

Limitations

- Need for categorization of ambulance crash severity, and for determining risk exposure rates for each driver.
- Determining a baseline profile of transportation safety challenges, system load and system wide safety hazards for each service is not yet well understood, limiting comprehensive comparative system performance analysis.

Summary

- Implementation well received by the providers.
- Both services demonstrated system wide major and sustained improvements in driver behaviour, safety performance and safety proxies over 18- 40 months, with a 1,000 fold sustained improvement in distance travelled without breach of safety performance thresholds (speed, torque, seat belt use), a reduction in crash frequency and severity, and improved emergency response times.

In a nutshell

- The system works
- Objectively improved performance
- No increase in response times
- At fault accidents reduced
- Accepted into the culture

However:

- The system requires monitoring
- Must be reinforced by management
- Must be incentives for good performance
- Must be consequences for poor performance

Challenges: Its NOT a Black Box

- 'Black box' has transportation wide negative connotations

SO what is it ??

- In vehicle telematics….
- An in vehicle e-safety device….?

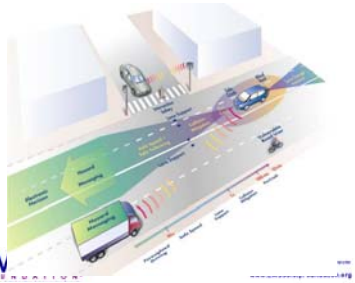
What does it really mean?

- Real time
- Feedback
- Alerts
- Warning
- Monitoring
- Penalty

Challenges

- Lexicon
  - Unstable lexicon relating to these devices is hampering dissemination
- How can the consumer make a sensible purchase decision if they don't know what it is called or how to compare one device to another – and the researchers haven't even worked it out yet!!

Integration with GIS/GPS



Quandry…?

- Being a silver bullet is clearly not enough…
- Cultural challenges
- Gap between what works and what is what consumers will want and seek
- Applications to special populations as target groups
  - Fleets
  - Recidivist
  - Adolescents

Business Case for Safety

- ROI
- How to make the business case for use of these type of transport/fleet safety interventions
- How to educate the consumer ? Invehicle video monitoring has been successfully preferentially marketed broadly – absent any compelling or independent data and very high real costs of implementation

Management Incentives?

- Insurance benefits
- Tax incentives
- Grants

Additionally

- Ambulance services are a valuable model for evaluating this type of technology – given the nature of the fleet and its management

And…

- Safety researchers, emergency medical service providers and fleet managers should collaborate and consider use of these devices for both enhancing ambulance driver safety performance, and augmenting system wide ambulance transportation data capture.

Caution…

- Scope for confusion regarding the features and efficacy of these aftermarket devices
- Potential for conflicting types of alerts across platforms – with other aftermarket devices and also OEM features

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In conclusion

- A technology based systems safety approach such as invehicle real-time feedback devices has been demonstrated to be highly effective in these settings.
- This high risk fleet setting may be an excellent model for evaluating 'e-safety' devices
- Applications for these aftermarket devices should be considered for high risk drivers (ie. adolescents) and other vehicle fleets.

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Thank you!

Any Questions??

Electronic handout available online

http://www.objectivesafety.net

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