PACTS
Parliamentary Advisory Council for Transport Safety

Lessons from the Ashes: Improving Transportation Safety through Accident Investigation

29th Westminster Lecture on Transport Safety, Delivered at the Institution of Mechanical Engineers, Westminster, London
4th December 2019

Robert L. Sumwalt, FRAeS
Chairman, US National Transportation Safety Board

Acknowledgments

PACTS wishes to thank Hon Robert L. Sumwalt for generously travelling to the UK, delivering his lecture and providing this text. We also thank Carolyn Griffiths, Chair of the PACTS Rail Safety Working Party, for her important role in inviting Robert.

The Lecture was held in partnership with the Institution of Mechanical Engineers who kindly provided the lecture theatre. PACTS is pleased to have established this partnership.

PACTS also wishes to thank Thatcham Research and Michelin who sponsored the refreshments after the Lecture.

PACTS

The Parliamentary Advisory Council for Transport Safety – better known as PACTS – promotes evidence-based solutions to achieve safe transport for all. Established in 1981, its founder members were responsible for the legislation which made front seat-belt wearing in cars compulsory in Britain.

The unique features of PACTS are that it is a multi-modal transport safety body and focuses on working with parliamentarians, professionals and other key stakeholders.

PACTS is a charity with over 100 member organisations which provide advice and technical collaboration. If you would like further information about the benefits of PACTS membership for your organisation, please visit http://www.pacts.org.uk/about/ or contact David Davies, Executive Director, david.davies@pacts.org.uk

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The Speaker: Robert L. Sumwalt, FRAeS, Chairman, US National Transportation Safety Board

Robert L. Sumwalt was sworn in as the 14th chairman of the National Transportation Safety Board on August 10, 2017, after being nominated by President Donald J. Trump and confirmed by the U.S. Senate. He was reappointed as chairman by President Trump on August 5, 2019, after being unanimously confirmed by the U.S. Senate. Chairman Sumwalt began his tenure at the NTSB in August 2006 when President George W. Bush appointed him to the Board and designated him as Vice Chairman of the Board. In November 2011, President Barack Obama reappointed Mr. Sumwalt to an additional five-year term as Board Member.

Under Chairman Sumwalt's leadership, the agency's ranking in the Best Places to Work in the Federal Government has advanced 33 percent to the agency's current position of Number 6 of 29 small federal agencies. He is a fierce advocate for improving safety in all modes of transportation, including teen driver safety, impaired driving, distractions in transportation, and several aviation and rail safety initiatives.

Before joining the NTSB, Chairman Sumwalt was a pilot for 32 years, including 24 years with Piedmont Airlines and US Airways. He accumulated over 14,000 flight hours. During his tenure at US Airways, he worked on special assignment to the flight safety department and served on the airline's Flight Operational Quality Assurance (FOQA) monitoring team.

Following his airline career, Chairman Sumwalt managed the corporate aviation department for a Fortune 500 energy company.

In other notable accomplishments, he chaired the Air Line Pilots Association's Human Factors and Training Group and co-founded the association's critical incident response program. He also spent eight years as a consultant to NASA's Aviation Safety Reporting System (ASRS) and has written extensively on aviation safety matters. He has co-authored a book on aircraft accidents and has published more than 100 articles on transportation safety and aircraft accident investigation.

Chairman Sumwalt earned an undergraduate degree from the University of South Carolina and a Master of Aeronautical Science (with Distinction) from Embry-Riddle Aeronautical University, with concentrations in aviation/aerospace safety systems and human factors aviation systems. In recognition of his accomplishments, he was awarded an honorary Doctor of Science degree from the University of South Carolina, and an honorary doctorate from Embry-Riddle. He is an inductee into the South Carolina Aviation Hall of Fame.

Lecture Transcript

Lessons from the Ashes: Improving Transportation Safety through Accident Investigation

Robert L. Sumwalt, FRAeS, Chairman, US National Transportation Safety Board

Good evening and what an honour it is to be here in London to give this prestigious lecture on a topic that is near and dear to my heart – transportation safety.

The National Transportation Safety Board (NTSB) is an independent federal agency of the US government. We are charged by Congress to investigate transportation accidents, determine probable cause, and issue safety recommendations to prevent future accidents. We have the statutory responsibility to investigate all civil aviation accidents that occur in the US, as well as selected accidents in rail, marine, highway, and even pipeline accidents. We are similar to the UK's AAIB, RAIB, and MAIB, all rolled up into one agency, with the added responsibility of investigating highway and pipeline accidents. Another difference between us and those agencies is that we are completely independent from any other government agencies.

At the time of this lecture, we have three Board Members, who are appointed by the president of United States, by and with the advice and consent of the US senate. When we have a full board, we have five members. Two departed this year, and their replacements have been nominated by President Trump and are awaiting Senate confirmation, which I imagine will happen between now and Christmas. [In fact, on December 19, 2019, the US Senate voted unanimously to confirm each of the two new board members. Subsequently, each joined the Board the first week in January 2020.]

The real backbone of the agency is our staff. We have around 400 employees who are experts in their respective areas. One thing that always impresses me is the dedication of our employees to their work. They are very smart individuals, many have PhDs, but they are quite humble, also.

Our Response Operations Centre (ROC) is staffed around the clock. The ROC watch standers monitor the 13 TVs that line the front wall of the facility, and they monitor social media to learn of accidents. Once word is received of an accident, they notify the appropriate personnel within the agency who will determine the level of response. As the response effort ramps up, the ROC will coordinate phone calls and meetings, along with making travel arrangements for the team.

Figure 1: NTSB Response Operations Centre

Our investigation teams get to the accident scenes any number of ways, including airline travel, flying on a government jet, or simply by driving. We even once walked to an accident, when a subway train in the basement of our building had a serious smoke event, which claimed the life of one subway passenger.

Pedestrian bridge collapse

We recently completed the investigation of a pedestrian bridge that collapsed while under construction on March 15, 2018.[1] Spanning a six-lane roadway in Miami, Florida, the bridge was to be a source of pride for the university community, as it was intended to connect two portions of a college campus. Because the bridge collapsed onto a roadway and onto several occupied automobiles, it was determined to be within our jurisdiction.

The bridge had several unique aspects. One distinguishing feature was that it was a concrete truss bridge. Although truss bridges are quite common in bridge construction, those bridges are usually constructed with steel trusses – not concrete trusses. Steel trusses and girders are typically used because steel can retain its strength in both tension and compression. Concrete, on the other hand, is strongest in compression and loses considerable strength in tension. Additionally, there was only a single line of trusses going down the longitudinal centerline of the bridge, unlike most bridges which have two or more lines of trusses running longitudinally.

Another distinguishing characteristic of the bridge is that it was built using a technique known as Accelerated Bridge Construction (ABC). With this method, the main span of the bridge was cast in a casting yard adjacent to where the bridge would be later be permanently placed. After the main span was completed, it was moved into its final position spanning the roadway. A cited advantage of ABC was that it would greatly minimize time the roadway was closed while the bridge was being built. Instead of taking months to erect the structure across the roadway, through ABC, the roadway would only have to be closed for a few hours while specialized equipment was used to swing it into position.

1. NTSB. (2019). Highway Accident Report: Pedestrian Bridge Collapse Over SW 8th Street, Miami, Florida. March 15, 2018. (NTSB Report No. NTSB/HAR-19/02). Washington, DC: Author. Retrieved from https://www.ntsb.gov/investigations/AccidentReports/Reports/HAR1902.pdf

Figure 2. Artist rendering of the walkway, the single line of diagonal supports (trusses), and the canopy of the completed pedestrian bridge.

On Saturday, March 10, 2018 the main span of the bridge was moved into position and placed on its pylons. Almost immediately, cracks in diagonal truss member 11 began to appear. Over the next few days, the cracks worsened and were photo-documented and sent to the bridge design engineers, Figg Bridge Engineers. Some of the cracks grew to 40 times of acceptable crack width. Repeatedly, the engineer of record for Figg assured the construction team that the cracks were not a safety issue. Unfortunately, he was terribly wrong. In the early afternoon of Wednesday, March 15, the bridge collapsed. Several cars were trapped underneath the rubble, claiming the lives of five vehicle occupants, and one construction worker who was working on the bridge at the time of the collapse.

The NTSB determined that there were three critical errors which led to the collapse and the subsequent loss of life. First, the bridge was under-designed. Figg underestimated the demand loads that would be placed on the bridge and overestimated the capacity (strength) that would resist those loads. Secondly, the contract between the design-build contractor and Figg required an independent peer review of the design plans, using a completely different organization. While a thorough independent peer review should have caught the design errors, unfortunately, the peer review was insufficient. Finally, despite the cracks and a meeting on the morning of the collapse regarding the situation, none of the involved parties made the decision to close the bridge to road traffic and workers.

In a publicly attended board meeting (all of our board meetings are required by law to be open to the public), on October 22, 2019, the Board deliberated this accident and determined that the probable cause was:

The load and capacity calculation errors made by FIGG Bridge Engineers, Inc., (FIGG) in its design of the main span truss member 11/12 nodal region and connection to the bridge deck. Contributing to the collapse was the inadequate peer review performed by Louis Berger, which failed to detect the calculation errors in the bridge design. Further contributing to the collapse was the failure of the FIGG engineer of record to identify the significance of the structural cracking observed in this node before the collapse and to obtain an independent peer review of the remedial plan to address the cracking. Contributing to the severity of the collapse outcome was the failure of MCM; FIGG; Bolton, Perez and Associates Consulting Engineers; FIU; and the Florida Department of Transportation to cease bridge work when the structure cracking reached unacceptable levels and to take appropriate action to close SW 8th Street as necessary to protect public safety.

In concluding the accident investigation, we issued 11 safety recommendations to four different entities.

Southwest Airlines engine failure with passenger fatality

In October we completed the investigation of the April 2018 Southwest Airlines Boeing 737 that suffered an inflight engine failure. As the airplane was climbing though 32,000 feet, a fan blade separated in the number 1 engine.[2]

Portions of the left engine inlet and fan cowl separated from the airplane; one fan cowl fragment impacted the left-side fuselage near a cabin window, and the window departed the airplane, which resulted in a rapid depressurization. Tragically, a 42-year-old woman who had been seated next to the window was partially ejected through the window opening and received fatal injuries.

The flight crew conducted an emergency descent and diverted to Philadelphia International Airport, Philadelphia, Pennsylvania.

The NTSB determined that the probable cause of this accident was "a low-cycle fatigue crack in the dovetail of fan blade No. 13, which resulted in the fan blade separating in flight and impacting the engine fan case at a location that was critical to the structural integrity and performance of the fan cowl structure. This impact led to the in-flight separation of fan cowl components, including the inboard fan cowl aft latch keeper, which struck the fuselage near a cabin window and caused the window to depart from the airplane, the cabin to rapidly depressurize, and the passenger fatality."

[2] NTSB. (2019). Aircraft Accident Report Left Engine Failure and Subsequent Depressurization Southwest Airlines Flight 1380, Boeing 737-7H4, N772SW. (NTSB Report No. NTSB/AAR-19/03). Washington, DC: Author. Retrieved from https://www.ntsb.gov/investigations/AccidentReports/Reports/AAR1903.pdf

Figure 3. The engine cowling latch departed the engine and struck the side of the fuselage, causing the adjacent window to depart. A passenger was partially ejected through the window opening.

Collision between a developmental automated driving system vehicle and a pedestrian

On the evening of March 18, 2018, an automated test vehicle, based on a modified 2017 Volvo XC90 sport utility vehicle (SUV), struck a female pedestrian walking across the roadway in Tempe, Arizona. The SUV was operated by the Advanced Technologies Group of Uber Technologies, Inc., which had modified the vehicle with a proprietary developmental automated driving system (ADS). A female operator occupied the driver's seat of the SUV, which was being controlled by the ADS. Although night-time conditions existed, the road was partially illuminated by street lighting.[3]

[3] NTSB. (2019). Highway Accident Report: Collision Between Vehicle Controlled by Developmental Automated Driving System and Pedestrian. (NTSB Report No. NTSB/HAR-19-03). Washington, DC: Author. Retrieved from https://www.ntsb.gov/investigations/AccidentReports/Reports/HAR1903.pdf

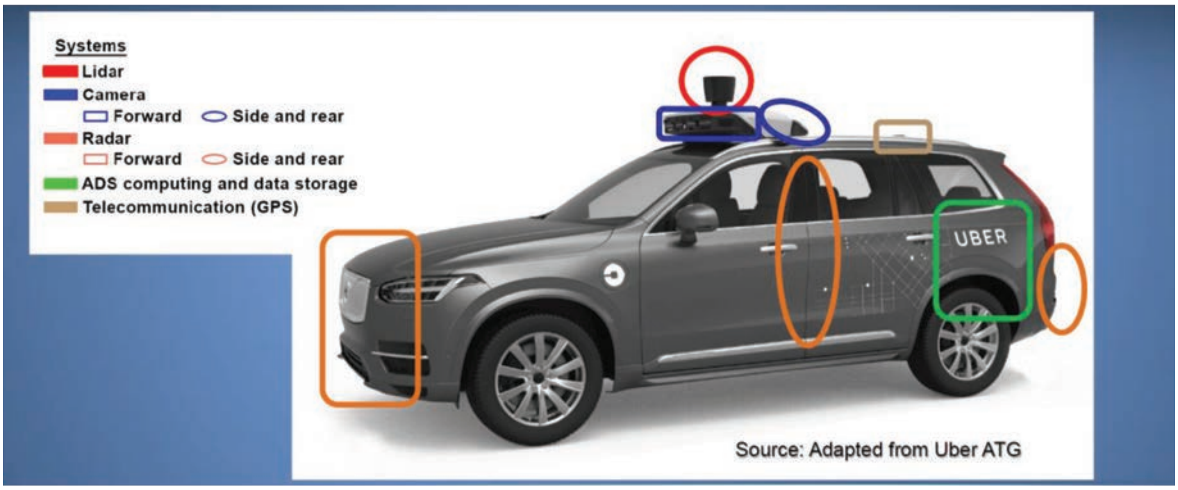

Figure 4. The accident vehicle involved a Volvo SUV modified with proprietary developmental automated driving system.

The SUV was completing the second loop on an established test route that included the section of road where the collision occurred. The vehicle had been operating about 19 minutes in autonomous mode—controlled by the ADS—when it approached the collision site in the right lane at a speed of 45 mph, as recorded by the ADS. About that time, the pedestrian began walking across the street where there was no crosswalk, pushing a bicycle by her side.

The ADS detected the pedestrian 5.6 seconds before impact. Although the ADS continued to track the pedestrian until the crash, it never accurately classified her as a pedestrian or predicted her path. By the time the ADS determined that a collision was imminent, the situation exceeded the response specifications of the ADS braking system. The system design precluded activation of emergency braking for collision mitigation, relying instead on the operator's intervention to avoid a collision or mitigate an impact. Video from the SUV's inward-facing camera shows that the operator was glancing away from the road for an extended period while the vehicle was approaching the pedestrian. Specifically, she was looking toward the bottom of the SUV's center console, where she had placed her cell phone at the start of the trip. The operator redirected her gaze to the road ahead about 1 second before impact. ADS data show that the operator began steering left 0.02 seconds before striking the pedestrian, at a speed of 39 mph. The pedestrian died in the crash. The vehicle operator was not injured. Toxicological tests on the pedestrian's blood were positive for drugs that can impair perception and judgment.

We determined that the probable cause of the crash was "the failure of the vehicle operator to monitor the driving environment and the operation of the automated driving system because she was visually distracted throughout the trip by her personal cell phone. Contributing to the crash were the Uber Advanced Technologies Group's (1) inadequate safety risk assessment procedures, (2) ineffective oversight of vehicle operators, and (3) lack of adequate mechanisms for addressing operators' automation complacency—all a consequence of its inadequate safety culture. Further factors contributing to the crash were (1) the impaired pedestrian's crossing of N. Mill Avenue outside a crosswalk, and (2) the Arizona Department of Transportation's insufficient oversight of automated vehicle testing."

Vulnerable road users

Over the past two years we have conducted safety studies pertaining to vulnerable road users - those road users who are particularly vulnerable to severe injury or death when involved in a roadway collision. These include pedestrians,[4] motorcyclists,[5] and bicyclist.[6] We lose around 6,000 motorcyclist each year in the US, and as documented in our recently completed bicycle safety study, over 800 bicyclists lost their lives last year in the US. The fatality numbers for pedestrians looks quite grim, as well. Last year, over 6,000 pedestrians were struck and killed in the US. Over a recent 10-year period, pedestrian fatalities soared by 27 percent, at a time when overall roadway deaths were down by 12 percent! All told, the lives of around 13,000 vulnerable road user are lost each year in the US.

For sake of brevity of this discussion, I'll only talk about pedestrian safety. Like you in the United Kingdom, we are advocating a safe system approach, meaning, of course, that we must make improvements in the entire system, and not focus exclusively on one particular area. For improvement to pedestrian safety, for example, we believe there are vehicle-based countermeasures that are needed, along with better infrastructure planning, and improved safety data.

Vehicle-based countermeasures

Obviously, one of the most important factors in a motorist's ability to detect pedestrians is driver visibility. A pedestrian's risk of a fatal injury is four times greater at night than in the daytime. This greater portion of fatal pedestrian crashes in darkness suggests that lighting countermeasures have the potential to prevent a substantial number of pedestrian fatalities. The most feasible approach to improving lighting is to improve headlights on cars so drivers can better see and avoid pedestrians.

The US-based Highway Loss Data Institute showed fewer insurance claims on vehicles equipped with swivelling headlights. Their sister organization, the Insurance Institute for Highway Safety, performed new car headlight tests and found that most cars had poorly performing headlight systems, even though the vehicles met the US requirements for their lighting systems.

Adaptive-driving-beam headlights continuously adjust the high-beam pattern, offering high-beam visibility except for a segment of the beam that is blocked to limit glare for oncoming drivers. Some adaptive-driving-beam systems use a matrix of individually dimmable LEDs to selectively control light output. The systems use a forward-facing camera to identify oncoming vehicles and selectively dim or turn off LEDs to limit glare.

[4] NTSB. (2018). Special Investigation Report: Pedestrian Safety. (NTSB Report No. NTSB/SIR-18/03). Washington, DC: Author. Retrieved from https://www.ntsb.gov/safety/safety-studies/Documents/SIR1803.pdf

[5] NTSB. (2018). Safety Report: Select Risk Factors Associated with Causes of Motorcycle Crashes. (NTSB Report No. NTSB/SR-18/01). Washington, DC: Author. Retrieved from https://www.ntsb.gov/safety/safety-studies/Documents/SR1801.pdf

[6] NTSB. (2019). Safety Study: Bicyclist Safety on US Roadways: Crash Risks and Countermeasures. (NTSB Report No. NTSB/SIR-19/01). Washington, DC: Author. Retrieved from https://www.ntsb.gov/safety/safety-studies/Documents/SS1901.pdf

Although European safety standards permit adaptive-driving-beam headlights, which allow beams to light the road without producing the glare that can blind oncoming drivers, US regulations do not allow vehicles manufactured for sale in the US to adaptively alter light levels between high and low. In concluding that advanced vehicle lighting systems have proven safety benefits, the NTSB recommended that the US Department of Transportation revise their safety standards to allow adaptive headlight systems.

In addition to physical vehicle designs that are less likely to injure pedestrians (such as modified hood lines and lower bumpers that can soften the blow to a pedestrian's head and legs during a crash), other design improvements include better sightlines and the use of rear-view camera sensors to detect pedestrians. The European New Car Assessment Programme (Euro NCAP), beginning with a pedestrian protection requirement in 2005, includes hood design for pedestrian safety as a component. Despite safety advantages that can be achieved from "pedestrian friendly" designs, US regulations do not incorporate vehicle requirements intended to protect pedestrians. We therefore recommended that US DOT develop performance test criteria for vehicle designs that reduce injuries to pedestrians.

We also see great promise in the role that collision avoidance technologies can play in reducing pedestrian injuries and deaths, and the advances in this technology offer even greater promise. In addition to independent systems that use camera sensors and computers to assess the driving environment, systems are under development that use heat-sensing technology to detect pedestrians who are not visible because of obstructions. Vehicle-to-pedestrian crash avoidance systems, for example, use wireless technology such as cell phones to alert drivers of the presence of pedestrians via dedicated short-range communication systems. Algorithms for vehicle-to-pedestrian systems identify pedestrians, calculate the time to a crash, determine whether to activate the warning system, prefill the braking system (prepare for braking by filling the brake hydraulics with fluid), and execute automatic emergency braking if the driver does not react. As connected vehicles move to implementation, it is expected that they will incorporate vehicle-to-pedestrian avoidance systems.

One way to advance safety systems and promote them in the marketplace is to inform consumers and respond to their demand. That approach led to recent vehicle requirements such as electronic stability control systems and roof strength standards. Information about safety systems can be introduced through the NCAP and the Insurance Institute for Highway Safety's rating system, among others. Pedestrian detection and collision avoidance systems should be considered in the assessments used by consumers to evaluate the safety of new vehicles. The NTSB concluded that the public would benefit from knowing that the model vehicle they are considering for purchase has pedestrian-safe design characteristics, and their choices could in turn affect the implementation of pedestrian safety systems in new car designs. We recommended that US DOT incorporate pedestrian safety systems, including pedestrian collision avoidance systems and other more-passive safety systems, into the NCAP.

Better infrastructure Planning to Improve Pedestrian Safety

Our report noted that traditional street systems are designed for motor vehicle traffic, which may not serve pedestrians well. For example, our roadway systems are generally designed to allow movement of vehicular traffic. Thus, in many cases, the roadway systems lack sidewalks and crosswalks. The problem isn't the lack of adequate design guidance that is available to local transportation planners; the real issue that we noted was the actual implementation of that guidance.

Improved pedestrian safety data

Reliable data is important because it allows planners and policy makers to prioritize safety improvements. Conversely, as our study pointed out, data gaps hamper the prioritization of projects and the application of limited federal, state, and local funding. While it is known that pedestrian fatalities have increased over the past several years, it is unclear if these increases are due to increases in pedestrian traffic, or due to other factors. Good data can help. We all know that understanding a problem helps us to solve the problem.

Pedestrian trip data are needed to support local traffic-calming projects (which use various means, such as raised crosswalks and lane narrowing, to slow cars as they move through neighbourhoods) and to validate that traffic calming serves to increase pedestrian use of the transportation network. Work by metropolitan planning organizations and state governments to collect pedestrian exposure data and define a common framework is needed to allow combining data sources.

We found that most complete set of pedestrian crash data available for safety analysis and research is more than two decades old, collected at a time when vehicle designs were substantially different from those of current models.

We concluded that planners need localized pedestrian data to support the decision-making process for urban pedestrian plans and to prioritize infrastructure projects; in addition, the larger safety community needs national data about pedestrian use of the transportation network. Because of this, we recommended that the US DOT develop standard definitions and establish methods that states and metropolitan planning organizations can use to collect pedestrian exposure data, then define a common framework that will allow those data sources to be combined into a national metric of pedestrian activity.

Closing

In closing, the NTSB is a busy little agency with a very important mission, and very dedicated, talented staff to carry out our mission. Words etched into glass at the entrance to our training centre pretty much sum up what we do, and why it's so important: "From tragedy we draw knowledge to improve the safety of us all." That's what we do – we take something very tragic, and by completing a quality investigation or a detailed study, we can help prevent future accidents.

Thank you for your time this evening and may God bless the Queen.

Previous Westminster Lectures on Transport Safety.

The Westminster Lecture is an annual event in which leaders in transport safety address topics of concern to practitioners, researchers and policy makers in the field. It is organised by PACTS. 'These previous lectures are available on the PACTS website http://www.pacts.org.uk/events2/westminster-lecture/

28th Prof. Alan F. T. Winfield, Bristol Robotics Laboratory, UWE Bristol
The Implications of Robots in the Transport Sector

27th Christian Friis Bach, Executive Secretary & Under-Secretary-General, United Nations Economic Commission for Europe
Road Safety and the Global Goals for Sustainable Development

26th Ruth Sutherland, Chief Executive, Samaritans
Working Together to Reduce Suicide in Transport

25th Tony Bliss, Global Road Safety Advisor, Monash University Accident and Research Centre, Australia
Road Safety in the 21st Century: Public Expectations of Government

24th Dr Rob Hunter, Head of Flight Safety, BALPA
Staying Awake, Staying Alive: The problem of fatigue in the transport sector

23rd Jeanne Breen, OBE, FRSA, MCIHT, Jeanne Breen Consulting
Managing for Ambitious Road Safety Results

22nd Dr Jillian Anable, Centre for Transport Research, University of Aberdeen
More haste, less speed: changing behaviour for safety and sustainability

21st Danny Dorling, Professor of Human Geography, University of Sheffield
Roads, casualties and public health: the open sewers of the 21st century?

20th Fred Wegman, Managing Director, SWOV Institute for Road Safety Research, The Netherlands
Putting People at the Centre: How to Improve Road Safety in the 21st Century

19th Professor Oliver Carsten, University of Leeds
Technology: Curse or Cure?

18th Professor James Reason CBE, Emeritus Professor, University of Manchester
Recurrent patterns in transport accidents: Conditions and causes

17th Professor Phil Goodwin, Professor of Transport Policy at the Centre for Transport and Society, UWE Bristol, Emeritus Professor at University College London
Determination and Denial: The Paradox of Safety Research and Traffic Policy

16th Professor Ronan Lyons, Professor for Public Health, University of Wales at Swansea
Connecting Public Health and Transport Safety

15th Professor Helen Muir, Director, Cranfield Institute for Safety, Risk and Reliability
In times of crisis how do passengers react?

14th Professor David Begg, Chairman, Commission for Integrated Transport
Transport Safety and Integration: putting the two together

13th Mr Ken Smart, CBE, Chief Inspector, Air Accidents Investigation Branch
Transport Accident Investigations: a question of trust

12th Professor Richard Allsop, Centre for Transport Studies, UCL
Road Safety: Britain in Europe

11th Dr Rod Kimber, Director of Science and Engineering, TRL
2010: Getting there in one piece

10th Simon Folkard D.SC, Department of Psychology, University of Wales at Swansea
Transport: Rhythm and Blues

9th Dr Dianne Parker, University of Manchester
The social psychology of driver behaviour: is it time to put our foot down?

8th Professor Frank McKenna, Department of Psychology, Reading University
Death by Accident: the psychology of human error

7th Mr Stefan Nillson, Director, Automotive Safety Centre, Volvo
A Holistic View on Automotive Safety

6th Sir Alastair Morton, Co-chairman, Eurotunnel
There is no such thing as perfect safety in transport, but life is life, however you travel

5th Dr Leonard Evans, Principal Research Scientist, GM R&D Centre
Traffic Safety Measures, Driver Behaviour Responses and Surprising Outcomes

4th Mr Brian O'Neil, President, Insurance Institute for Highway Safety
Progress in Transport Safety: the US experience

3rd Mr Robert Coleman, Director General, DG VII, European Commission
Transport Safety and the EC

2nd Dr Ian Johnston, Executive Director, Australian Road Research Board
Effective strategies for transport safety: an Australian's perspective

1st Dr Jan C. Tetlow, Secretary General, European Conference of Ministers of Transport
Transport Safety: European cooperation for the 90's

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The Lecture was made possible by the generous support of

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29th Westminster Lecture on Transport Safety

ISSN 1740-0368

Published March 2020