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Taking a systems approach to road safety

The UK DfT funded Road Collision Investigation Project

Elizabeth Box
Head of Research
@elizabethcbox
11 April 2019

Outline

- Background and history
- Purpose and approach taken to the Road Collision Investigation Project (RCIP)
- Model and method selection
- A case study example
- Current work and next steps
- A note on some related PhD research…
- Final observations

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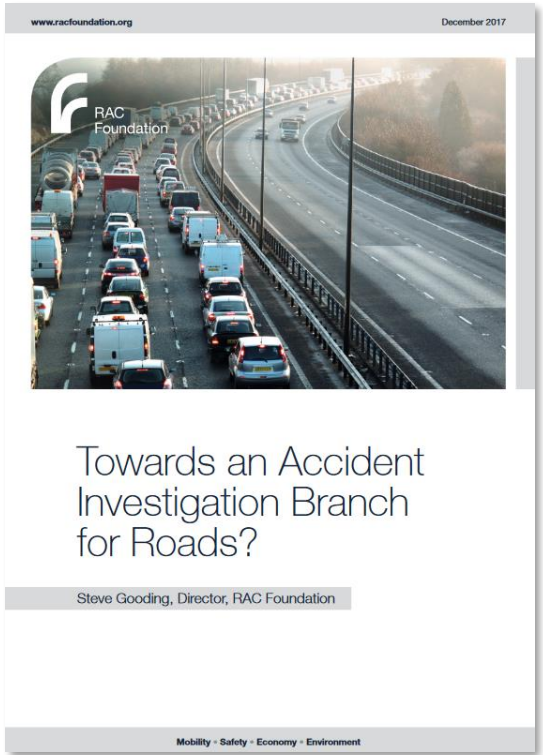
Transport safety: is the law an ass?

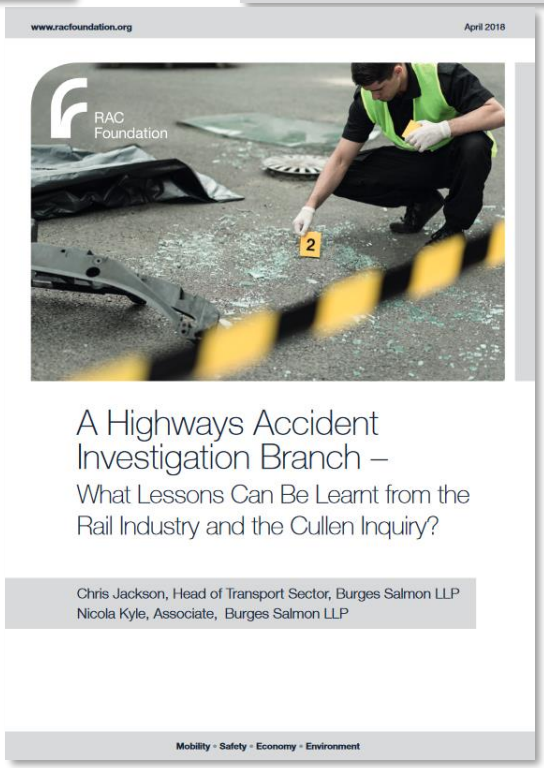
Dr Chris Elliott FREng

5 May 2009

The author presented the 2008 Lloyds Register Educational Trust/Imperial College 2008 lecture on Transport Risk Management, with the title "Transport risk – is the law an ass?" This report is based on that lecture. The author would like to thank Lloyds Register Educational Trust, Imperial College and the RAC Foundation for their support, and many friends and colleagues who contributed ideas and information.

These are the personal views of the author and not necessarily those of the RAC Foundation or of anyone or any organisation with which he is associated.





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Published 11 June 2018
From: Department for Transport and Jesse Norman MP

- government announces bold package of measures to improve road safety
- measures include £350,000 for a competition to bring a new mobile breathalyser to the market
- £480,000 for the RAC Foundation to trial an innovative new approach to road casualty investigation, looking more closely at what is really causing road collisions

Road Collision Investigation Project (RCIP) - Announced

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SHARE

Road Collision Investigation Project (RCIP)

PDF
Crash investigation funding Q and A

PDF
Models and methods for collision analysis - Neville Stanton - March 2019

Project update (21 March 2019)

Report published – *Models and methods for collision analysis*

Road Collision Investigation Project (RCIP)

- Project run by the RAC Foundation
- In collaboration with, and supported by the DfT, Highways England, National Police Chiefs Council and others

Department for Transport

highways england

NPCC National Police Chiefs' Council

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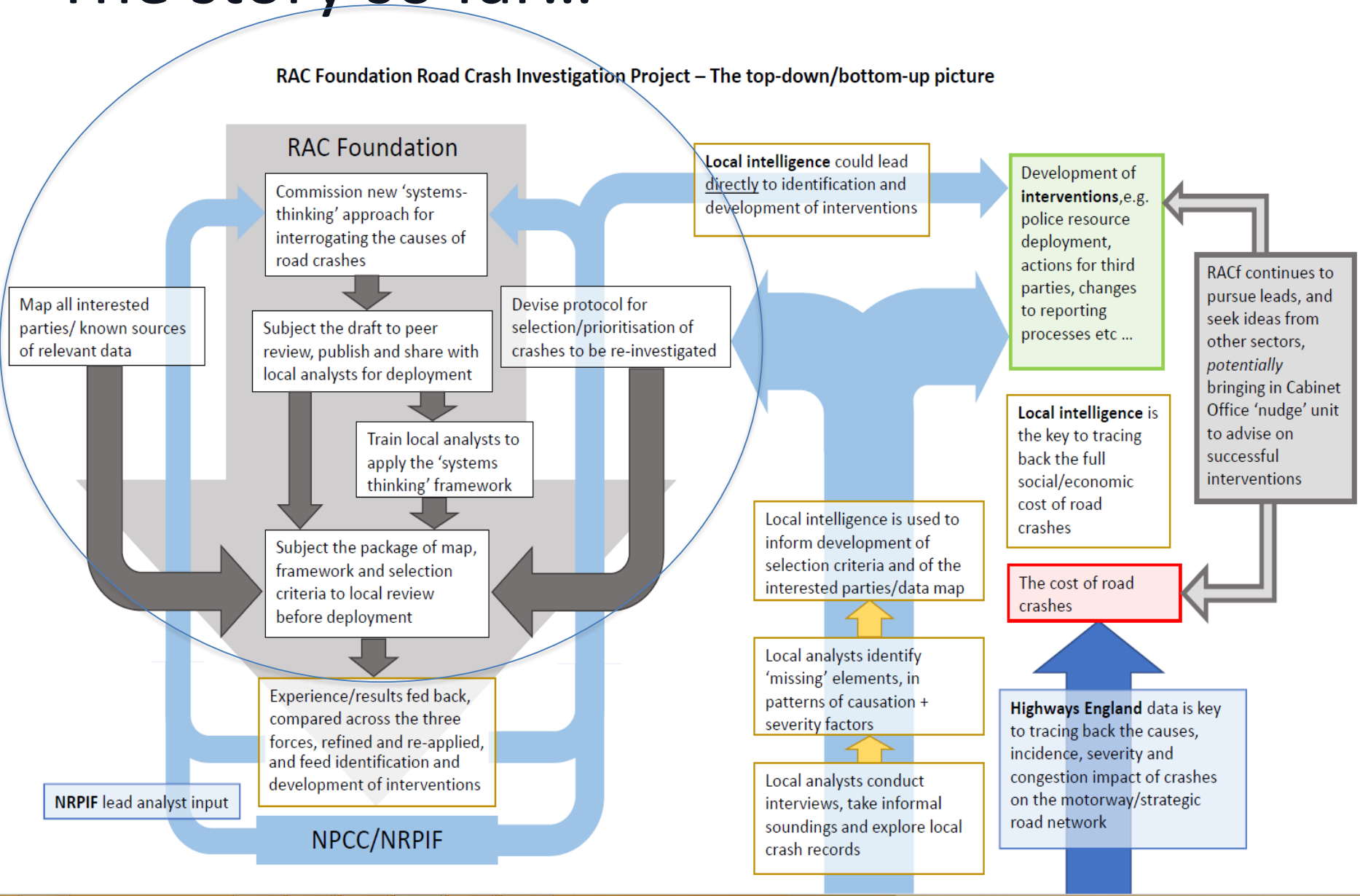
Purpose

- To establish whether there is a business case for putting more resource into the investigation of road crashes based on a comparison with the approach to crash investigation used for other modes (Rail, Air and Sea) and safety critical industries (Oil & Gas)

Purpose cont…

- Establishing how feedback from investigation of individual incidents can better inform policy development.
- Developing new approaches to harvesting and analysing of data from different sources, including information from police investigations beyond that captured in STATS19.

The story so far…



the **Safe Systems approach** is based on a kinetic energy model where road safety outcomes are achieved by separating sources of **kinetic energy** in moving vehicles in order that it is not transferred to road users

Mistakes

Injury thresholds

Shared responsibility

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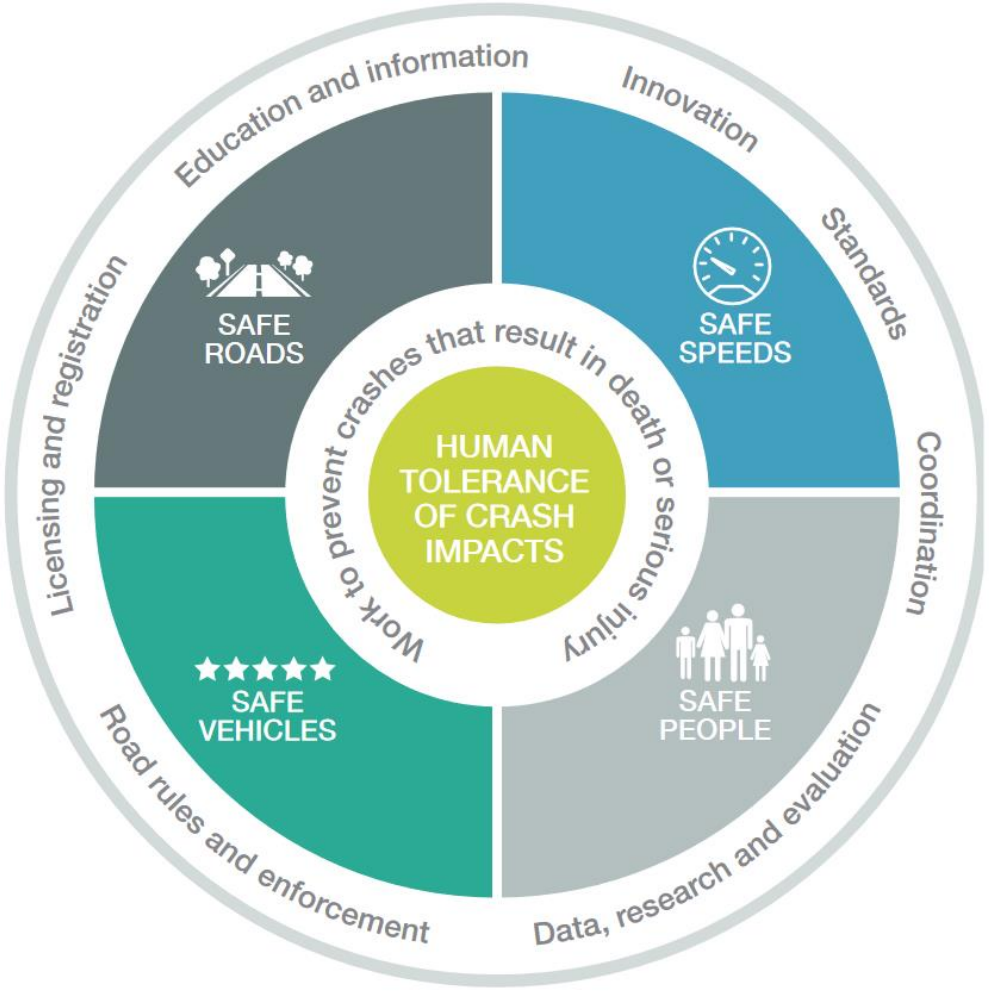
Conceptualisation of the safe system



Source: NRSS (2016)

UN Decade of Action for Road Safety 2011-2020

Pillar 1
Road safety management

Pillar 2
Safer roads and mobility

Pillar 3
Safer vehicles

Pillar 4
Safer road users

Pillar 5
Post-crash response

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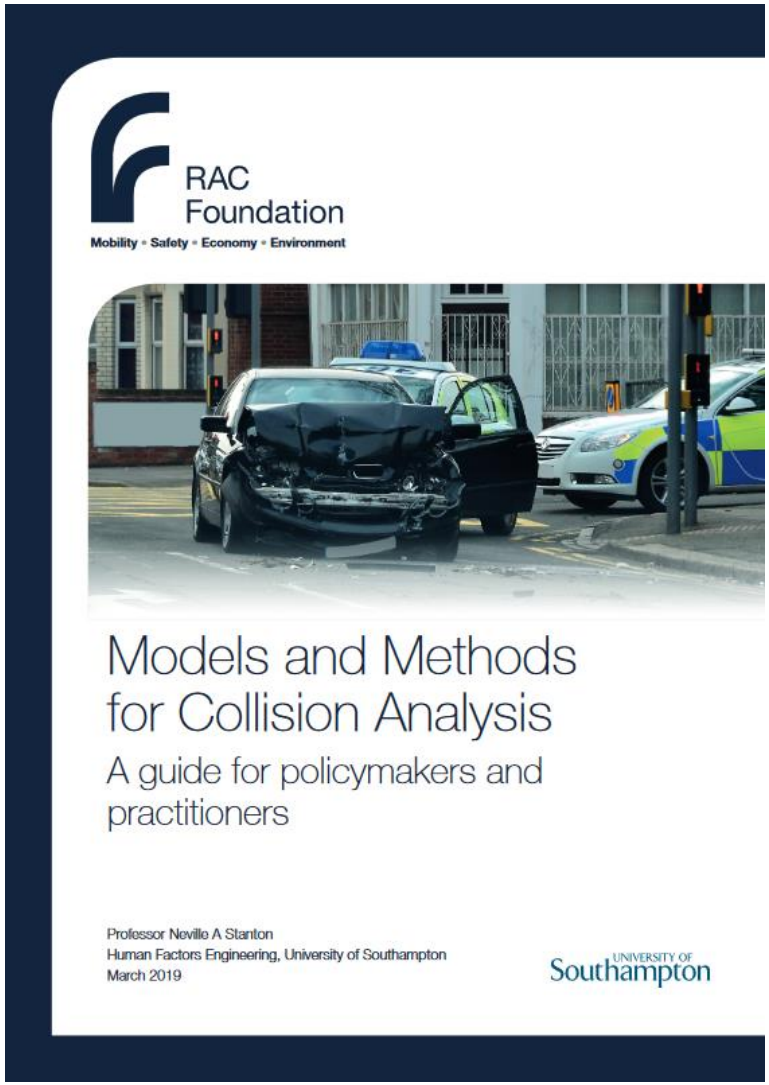

Prof Neville Stanton, University of Southampton, UK

Expert review:

Prof Paul Salmon, USC, Australia
Prof Guy Walker, Heriot-Watt, UK

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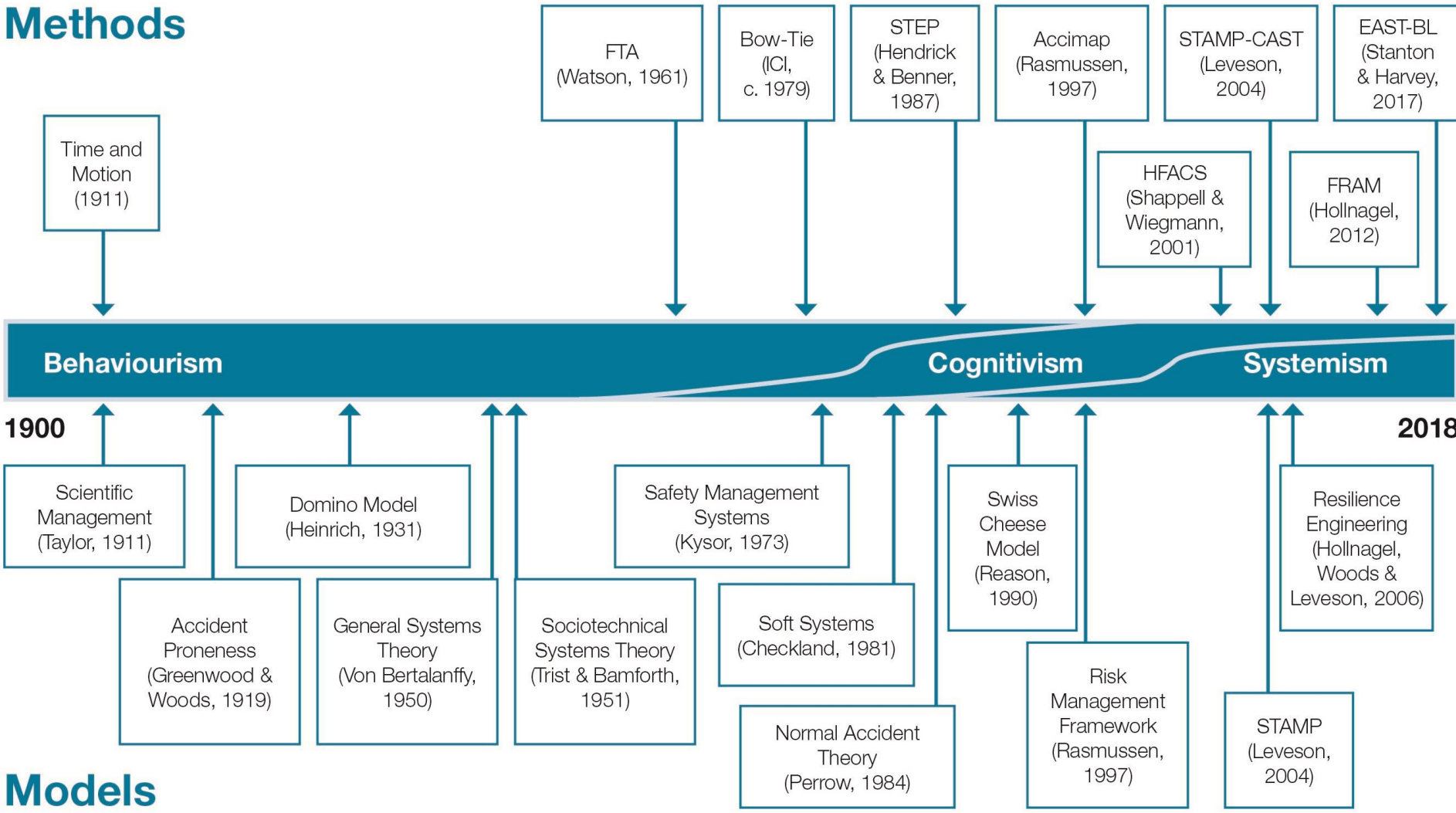

Note: (a) Watson's work on FTA for Bell Laboratories in 1961 is referenced by ScienceDirect, undated;
(b) EAST–BL: Event Analysis of Systemic Teamwork – Broken Links;
FTA: Fault Tree Analysis;
FRAM: Functional Resonance Analysis Method;
HFACS: Human Factors Analysis and Classification Scheme;
STAMP–CAST: Systems–Theoretic Accident Model and Processes – Causal Analysis using Systems Theory;
STEP: Sequential Timed Event Plotting

Table 3.1: List of methods and corresponding models

Method	Model type	Pioneer(s)	Date	Source
AcciMap*	Heterarchy	Rasmussen	1997	*Safety Science*
Bow-Tie	Tree structure	ICI	c. 1979	ICI
EAST–BL	Networks	Stanton and Harvey	2017	*Ergonomics*
FTA*	Tree structure	Watson	1961	Bell Laboratories
FRAM	Network	Hollnagel	2012	Book (Ashgate)
HFACS*	Taxonomic	Shappell and Wiegmann	2001	*Human Factors and Aerospace Safety*
STAMP–CAST*	Control structure	Leveson	2004	*Safety Science*
STEP	Multilinear	Hendrick and Benner	1987	Book (Marcel Dekker)

Source: Author's own

Notes: (a) * methods specified in RCIP call for proposals;
(b) Watson's work on FTA for Bell Laboratories in 1961 is referenced by ScienceDirect, undated.;
(c) EAST–BL: Event Analysis of Systemic Teamwork – Broken Links;
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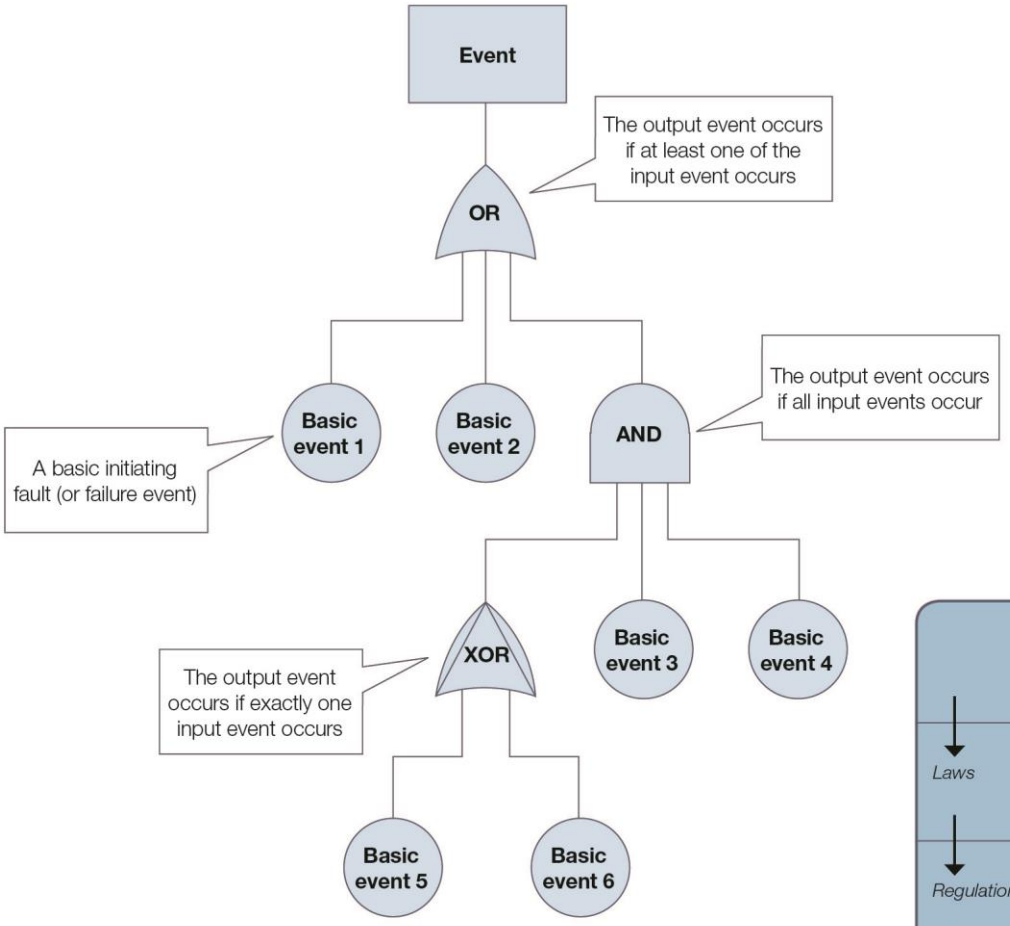
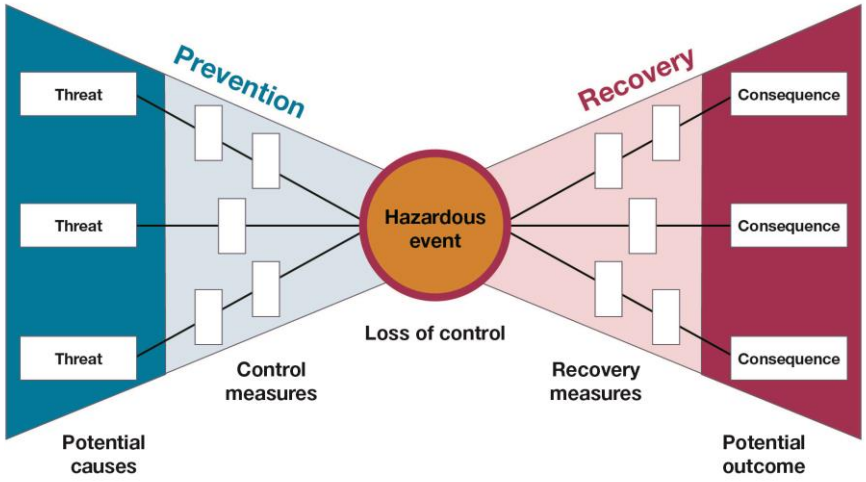
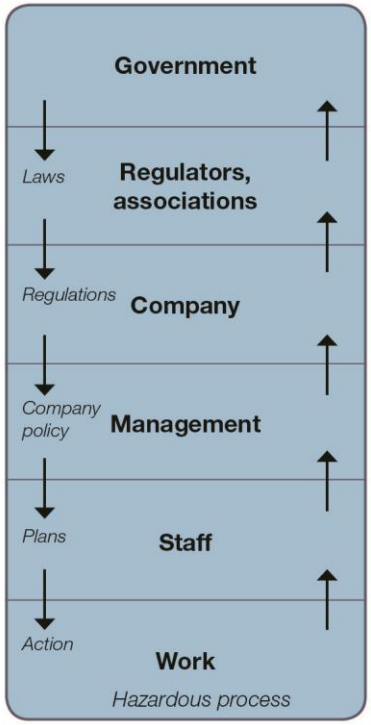
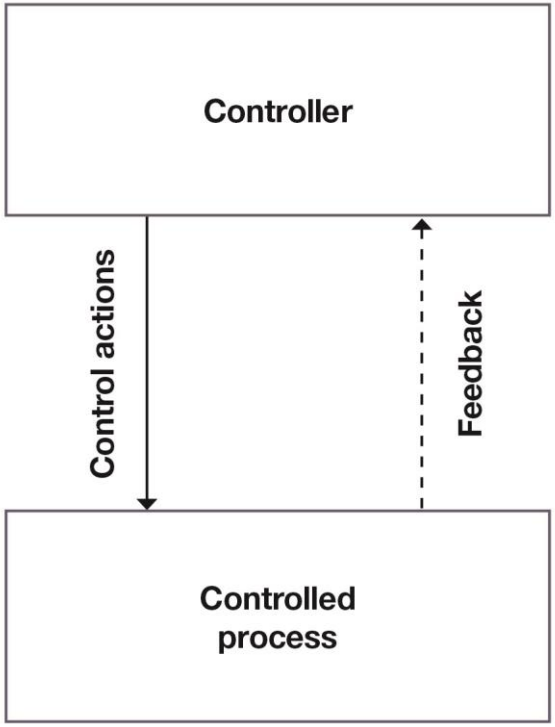


Source: https://conceptdraw.com/a362c3/p1/preview/256



Source: https://slideplayer.com/slide/12655534 (slide 8)





Source: Rasmussen (1997); Leveson (2011)

https://www.racfoundation.org/wp-content/uploads/Models_and_methods_for_collision_analysis_Stanton_March_2019.pdf

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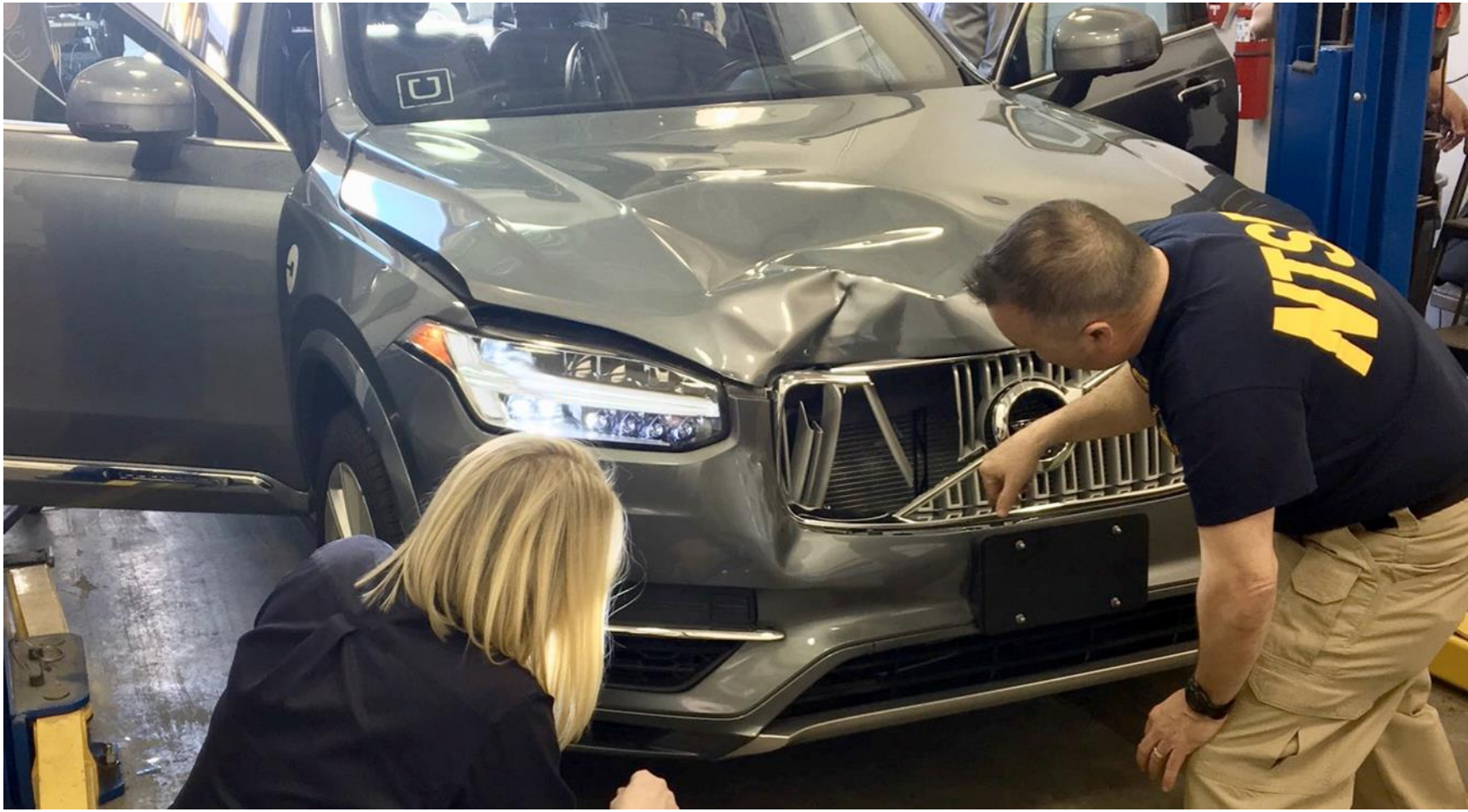
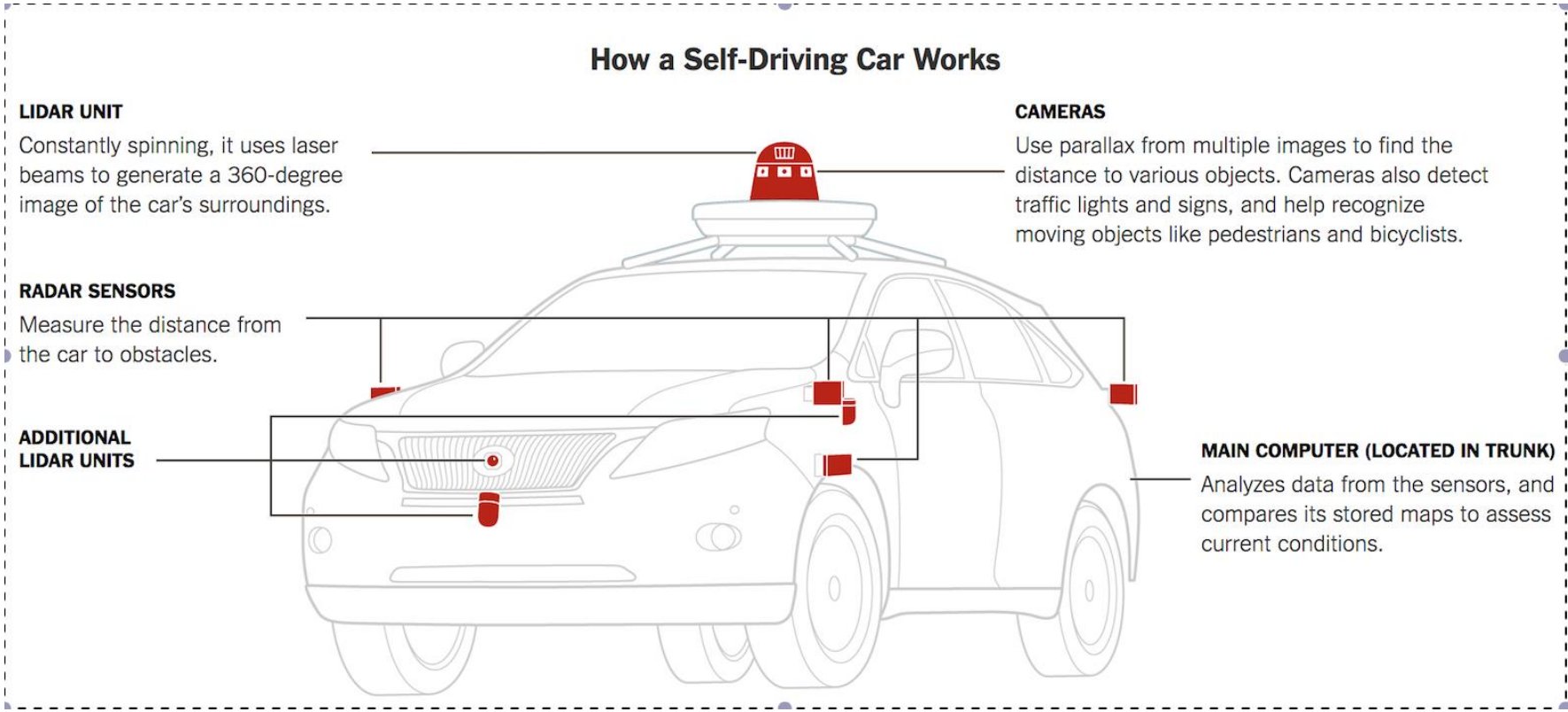
Case Study – Uber Collision with Cyclist



Slide by: Prof. N Stanton

Automated driving



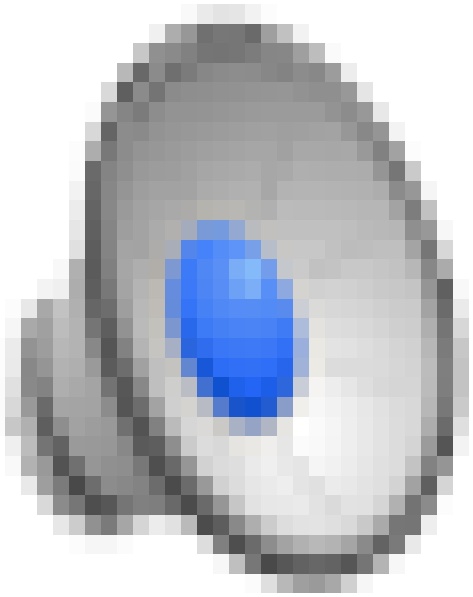
Slide by: Prof. N Stanton

Timeline 18th March 2018

- **6:30 p.m.**: 44-year-old Rafaela Vasquez arrives for work at the Uber facilities in Tempe, Arizona.
- **9:14 p.m**.: Vasquez leaves the Tempe facilities in a self-driving 2017 Volvo XC90 operated by Uber to run an established test route through downtown Tempe.
- **9:39 p.m**.: The vehicle is switched to autonomous mode.
- [A report from Tempe police states Vasquez begins streaming "The Voice" on the Hulu app on a cellphone. During this time, the Tempe police state that Vasquez can be seen frequently looking down at the lower center console area near her knee and frequently smirking and laughing. Her hands are not visible in the frame of the surveillance footage. Police determine she looks down 204 times over the course of 11.8 miles. Her eyes were off of the road for 6 minutes and 47 seconds during this period (i.e., over 25% of time)]. *This report is not yet substantiated by NTSB.*
- **9:58 p.m.**: Vasquez looks up while driving northbound on Mill Avenue toward Curry Road, approximately 0.5 seconds before the crash. She attempts to swerve left before striking 49-year-old Elaine Herzberg at 39 mph (speed zone posted at 45 mph) as she crosses the street mid-block. Hulu's records also show the streaming of the show ended at this time.
- Vasquez calls 911 and is released later that night after speaking to police. She stated she was monitoring the self-driving system interface and neither her business or personal phones were in use.

Slide by: Prof. N Stanton

Video Footage



Slide by: Prof. N Stanton

NTSB interim report

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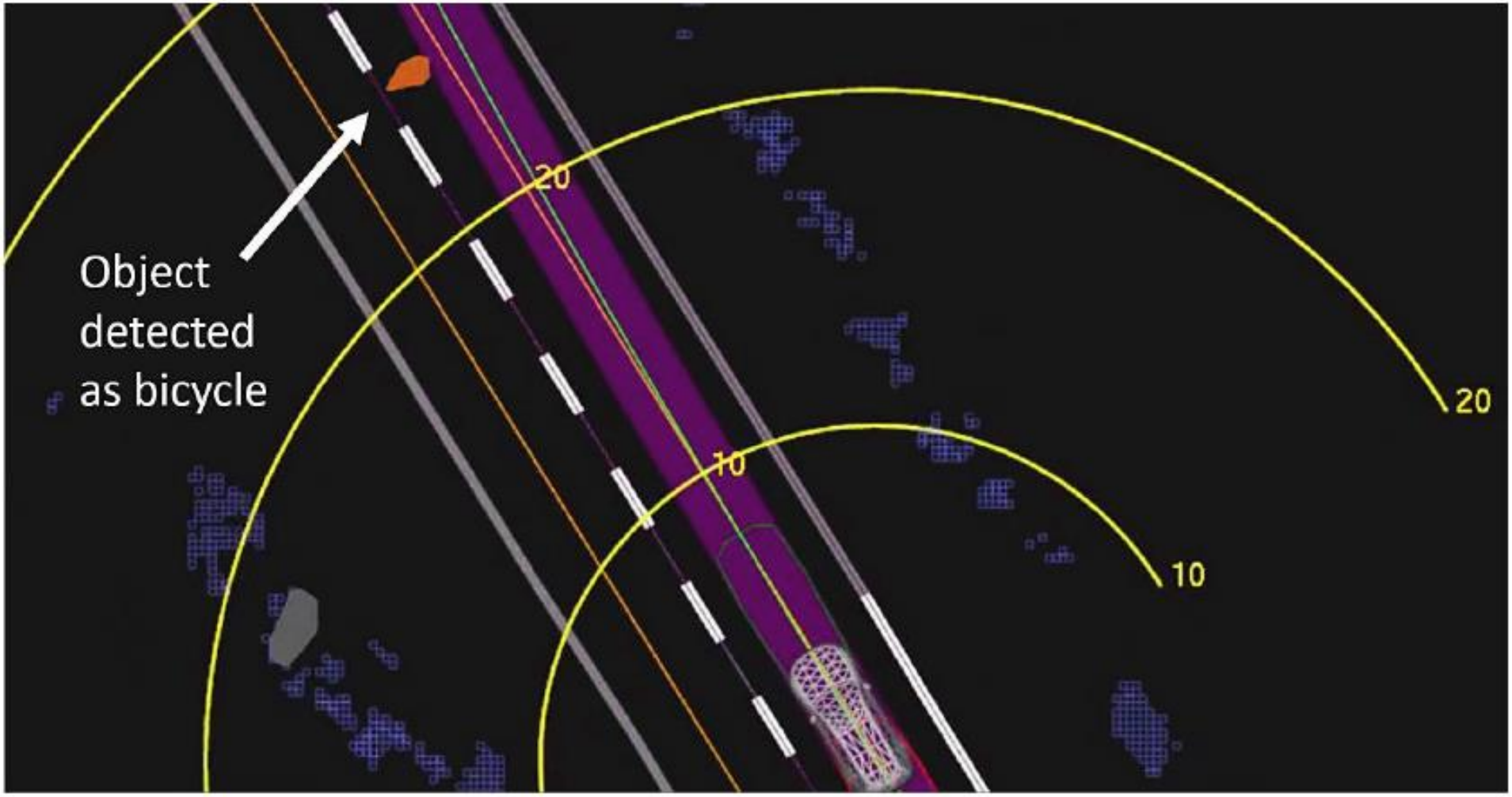


Figure 2. View of the self-driving system data playback at about 1.3 seconds before impact, when the system determined an emergency braking maneuver would be needed to mitigate a collision. Yellow bands are shown in meters ahead. Orange lines show the center of mapped travel lanes. The purple shaded area shows the path the vehicle traveled, with the green line showing the center of that path.

Collision site

Slide by: Prof. N Stanton

Paths of cyclist and vehicle

Slide by: Prof. N Stanton

Slide by: Prof. N Stanton

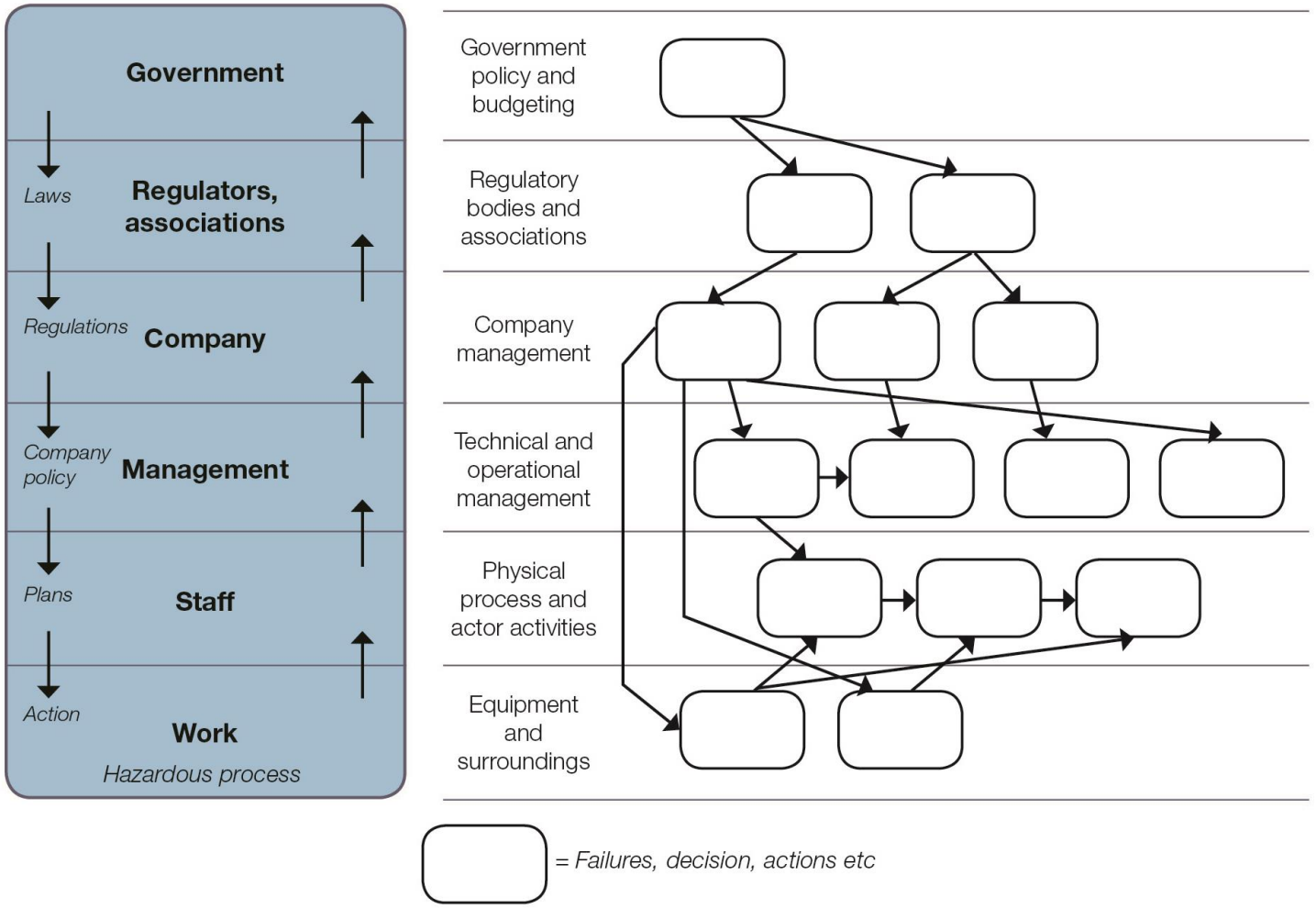
Junction approach (daytime)

Slide by: Prof. N Stanton

Paved median (no crossing sign)

Slide by: Prof. N Stanton

The AcciMap Model



Source: Svedung & Rasmussen (2002)

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Actor Map

International influences	International Organization for Standardization					
National committees	Society of Automotive Engineers					
Federal and state Government	Federal Government	California State Government	Arizona State Government			
Regulatory bodies and associations	California regulators	Arizona regulators				
Company management and local area government	Uber	Volvo	Urban planners			
Technical and operational management	Uber engineers					
Driving processes	Driver	Pedestrian				
Equipment and environment	Automated vehicle	Road	Median	Junction	Bicycle	Signage

Source: Author's own

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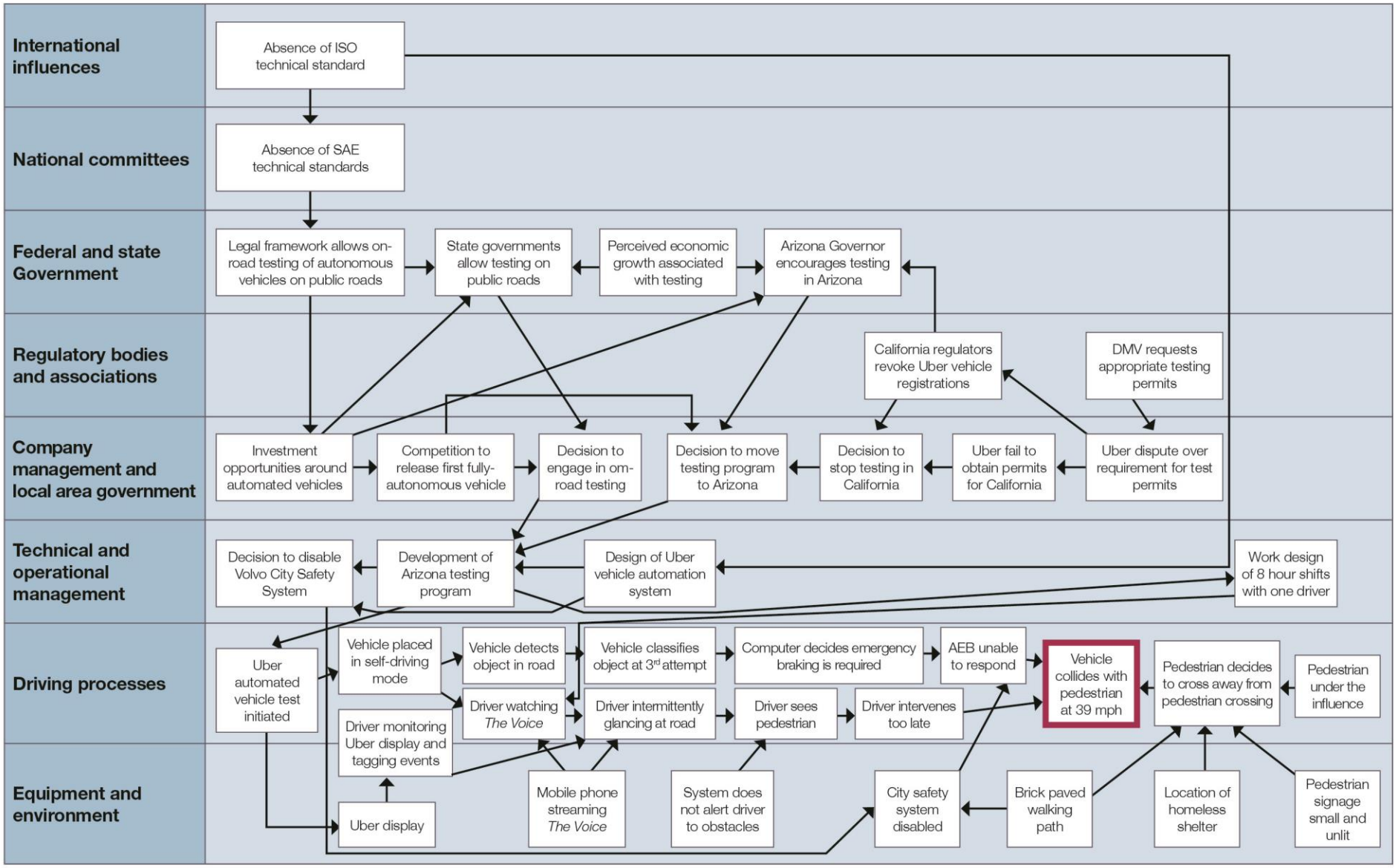
AcciMap



Source: Author's own

Selection of method

- Systems levels addressed (Top: AcciMap, STAMP-CAST)
- 7 Tenets of Accidents (Rasmussen, 1997)
  - Multiple contributory factors, multiple actors, interactions between contributory factors, verticle integration, communications and feedback, migration of performance to safe to unsafe, triggering events (Top: AcciMap)
- Criteria ratings
  - Evidence of reliability & validity, complexity, reliance on SMEs, audit of system influences, applicability to road traffic safety, in built classification(Top: AcciMap & Fault tree)
  - Ease of use, application time, training demand, simplicity of interpretation, tools required, evidence of practical impact (Top: AcciMap)

Recommendations - Method

- AcciMap method (incorporating Actor Maps) appears to be ‘best’ approach in terms of coverage across theoretical, methodological and practical criteria
- A classification scheme needs to be developed to help with consistency and aggregation of data (identifying systemic factors in collisions)
- Tablet-based data collection at road scene followed by desktop analysis with database (Actor and AcciMap)

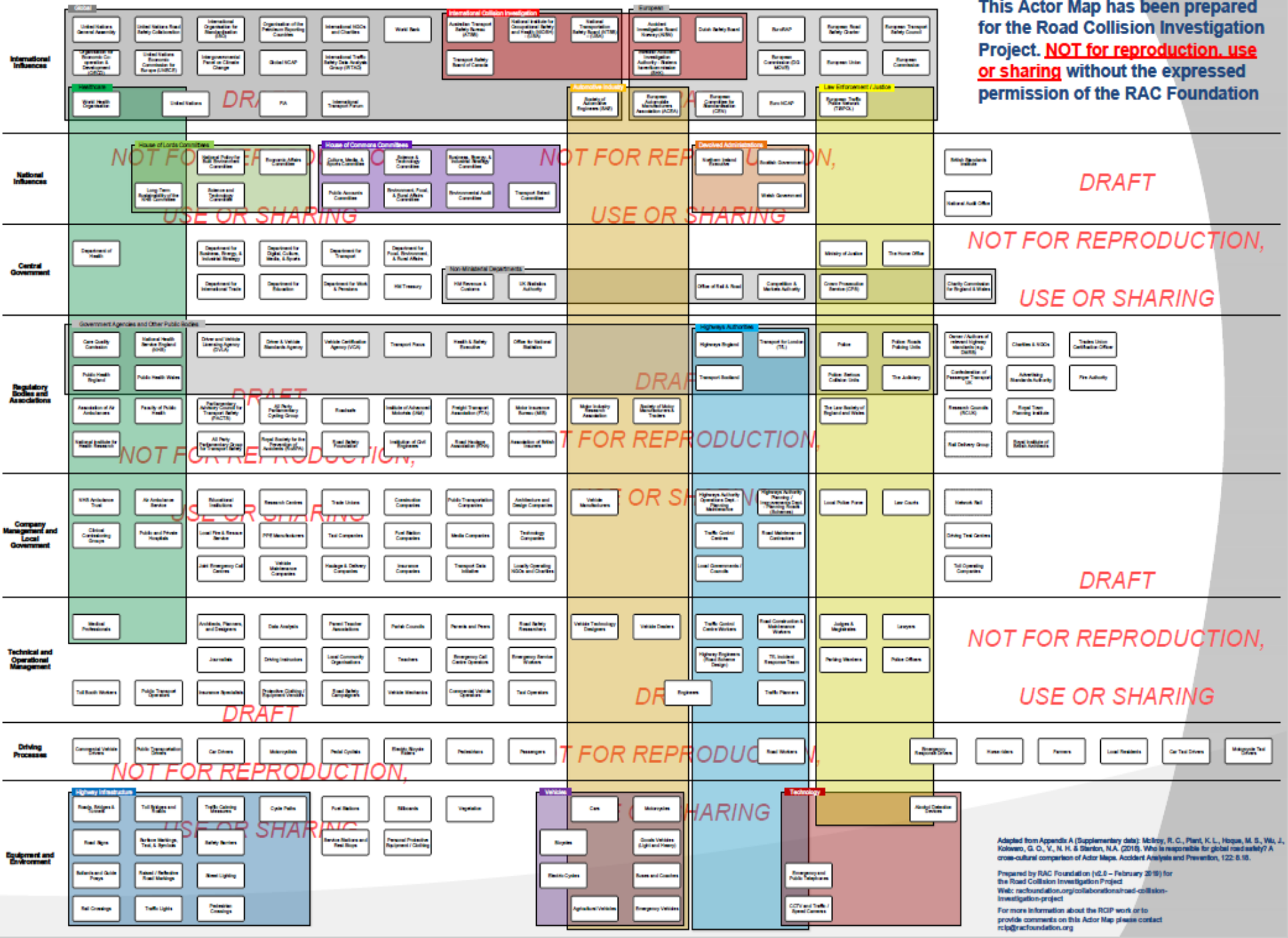
Recommendations - Training

- Development and roll-out of training in data collection with Actor Map and AcciMap classification scheme (which needs to be developed)
- Studies of reliability and validity during training
- Studies of adherence to methods at intervals across the lifetime of the RCIP

Next steps for implementation

- Develop classification scheme for Actor Maps and AcciMaps
- Matrix for linking of events in AcciMaps
- Development of training materials for Actor Maps and AcciMaps
- Pilot study conducting training in Actor Maps and AcciMaps
- Revision of training materials
- Roll-out of training for RCIP study

DRAFT UK Road Safety System Actor Map



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Adapted from Appendix A (Supplementary data): McIlroy, R. C., Plant, K. L., Hoque, M. S., Wu, J., Kokwaro, G. O., V., N. H. & Stanton, N.A. (2018). Who is responsible for global road safety? A cross-cultural comparison of Actor Maps. Accident Analysis and Prevention, 122: 8.18.

Prepared by RAC Foundation (v2.0 – February 2018) for the Road Collision Investigation Project
Web: racfoundation.org/collaborations/road-collision-investigation-project

For more information about the RCIP work or to provide comments on this Actor Map please contact rcip@racfoundation.org

DRAFT UK Road Safety Data Source Map

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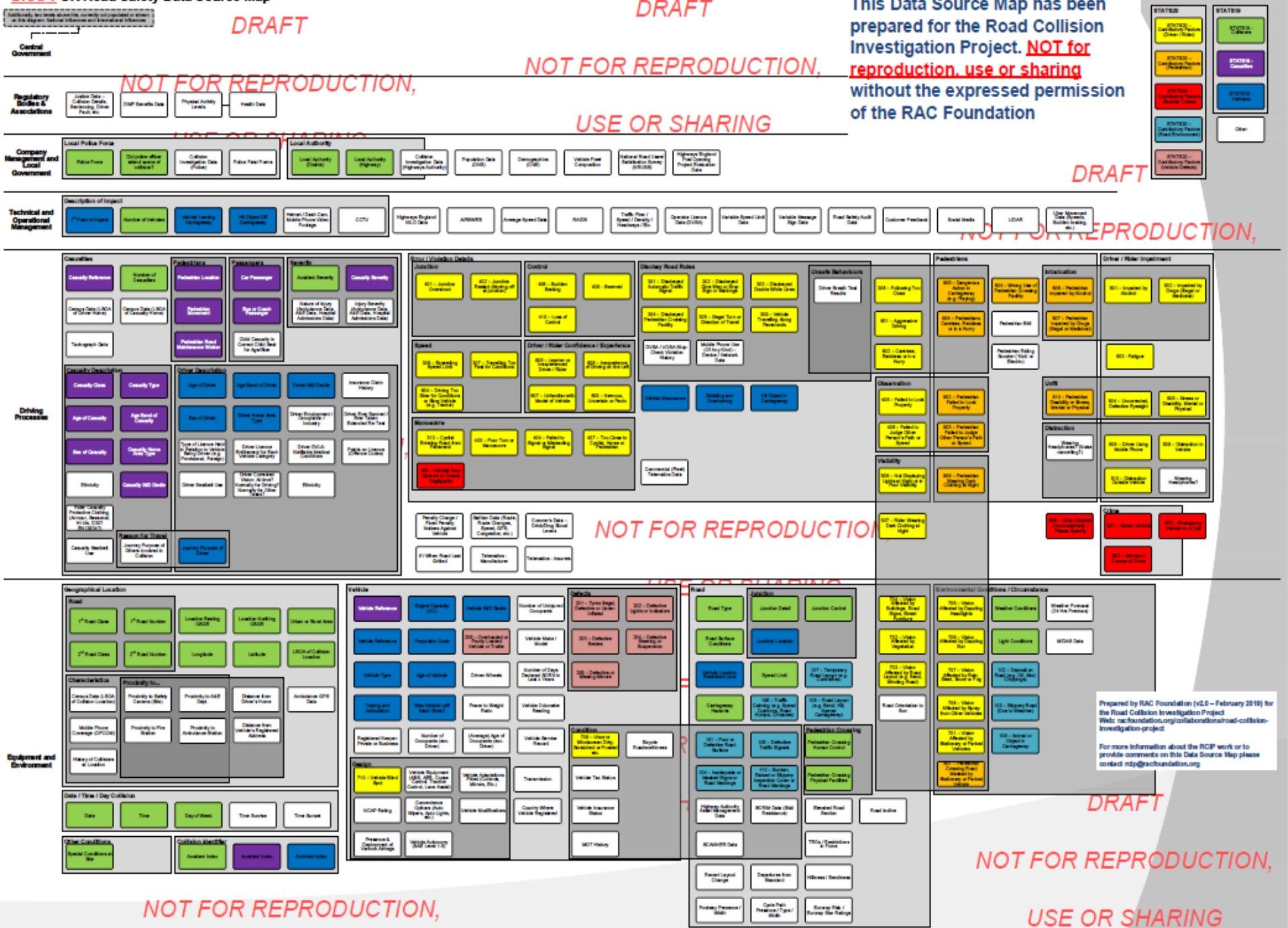

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Participant Information Sheet – RCIP Interviews

Road Collision Investigation Project

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You are invited to take part in an interview to inform the Road Collision Investigation Project (RCIP)

- Please take the time to read the following information carefully.
- You are free to decide whether or not to take part in this study and to withdraw from the project at any stage.
- Please do ask if anything is not clear or you would like more information.

Key information

- This study is being run, with £480,000 of Government funding, to develop and trial, in a number of police force areas a different approach to identifying and understanding common themes and patterns that result in

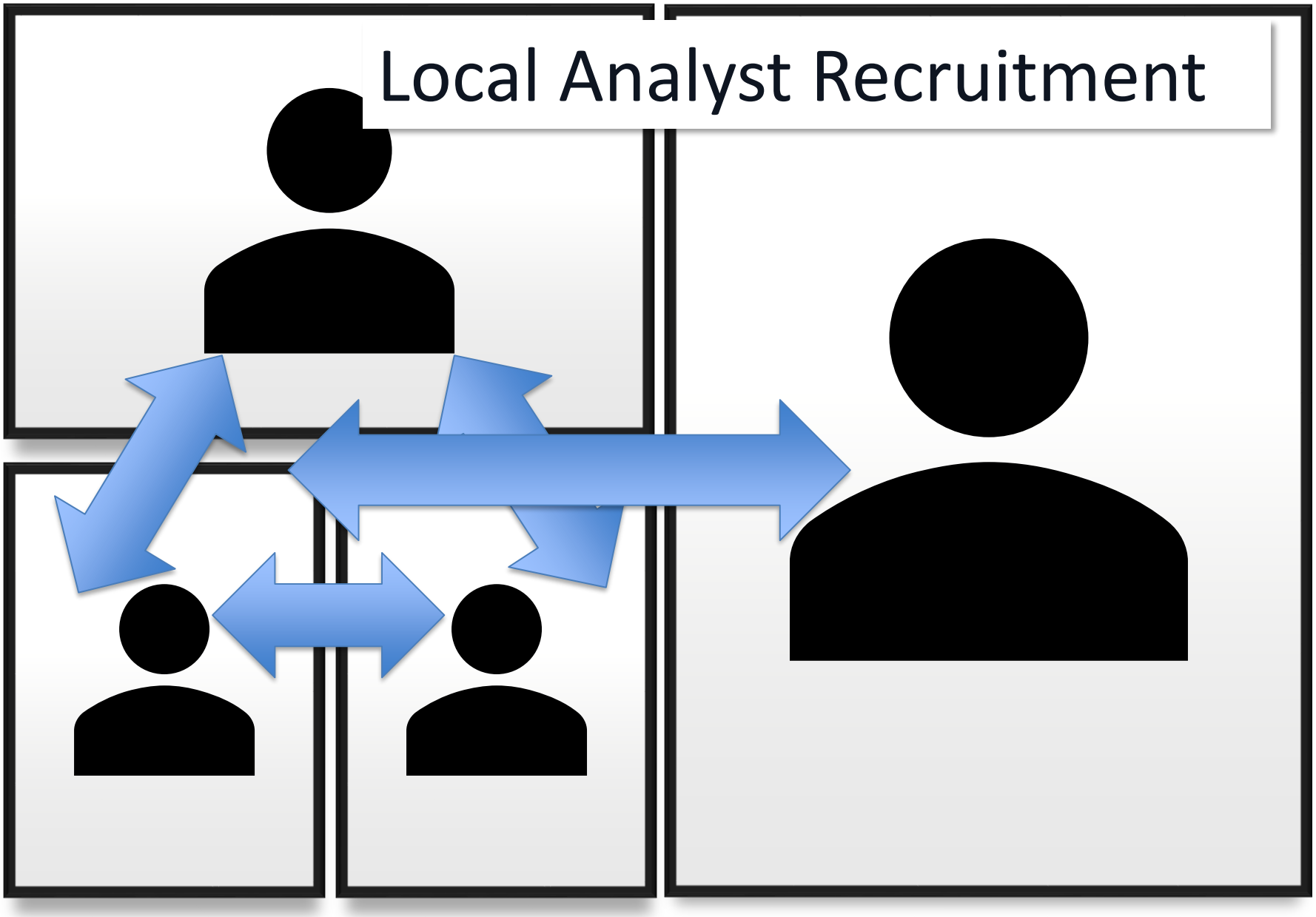
Contents

Contact details

If you have any questions about this study, please talk to the RCIP Project Director,

Steve Gooding
steve.gooding@racfoundation.org Tel no: 020 7747 3485

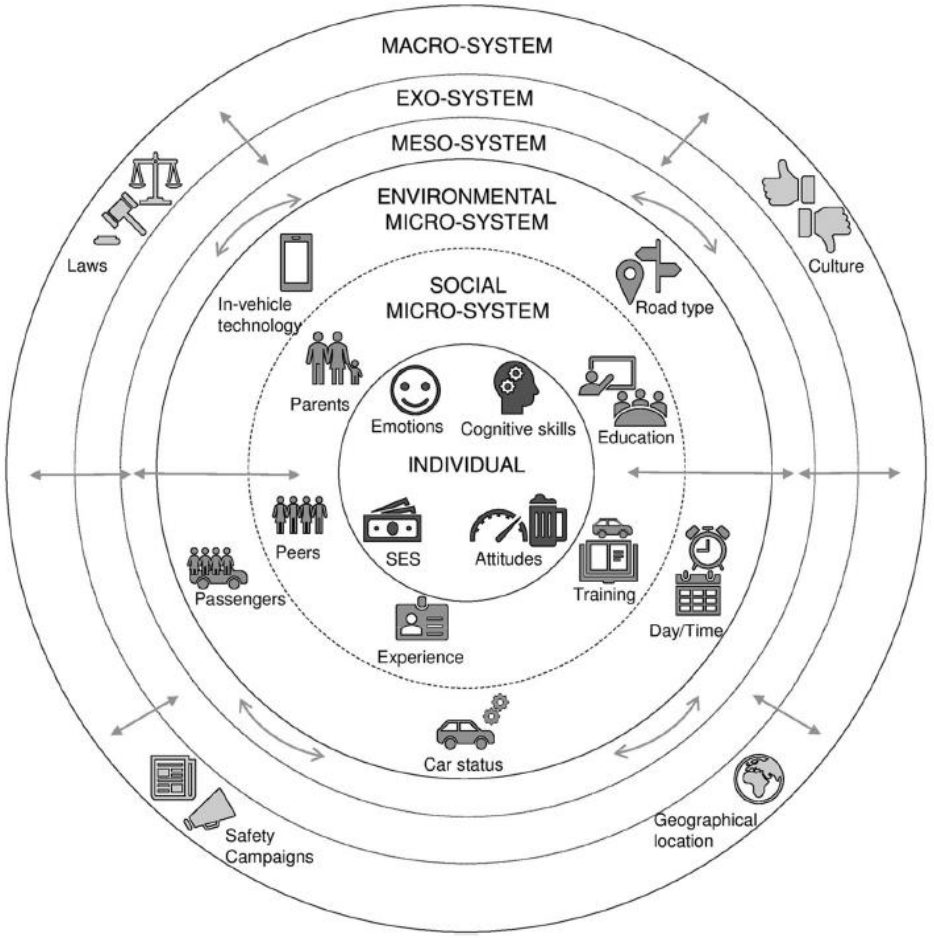
Local Analyst Recruitment



More systems…

Framework of individual, social and environmental factors intervening in young novice drivers' risk using an ecological systems (Bronfenbrenner, 1979).

Nb. Arrows indicate links between factors within and between systems



Source: Cassarino, M. & Murphy, G. (2018) Reducing young drivers' crash risk: Are we there yet? An ecological systems-based review of the last decade of research, Transportation Research Part F 56, 54-73, Fig 1. p.56

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Observations on the project

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