HADRIAN

Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs

Conceiving Systems from the Perspective of HSI

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January 30, 2021

www.hadrianproject.eu/

HADRIAN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 875597

PRINCIPLE ASSUMPTIONS FOR THE HADRIAN PROJECT

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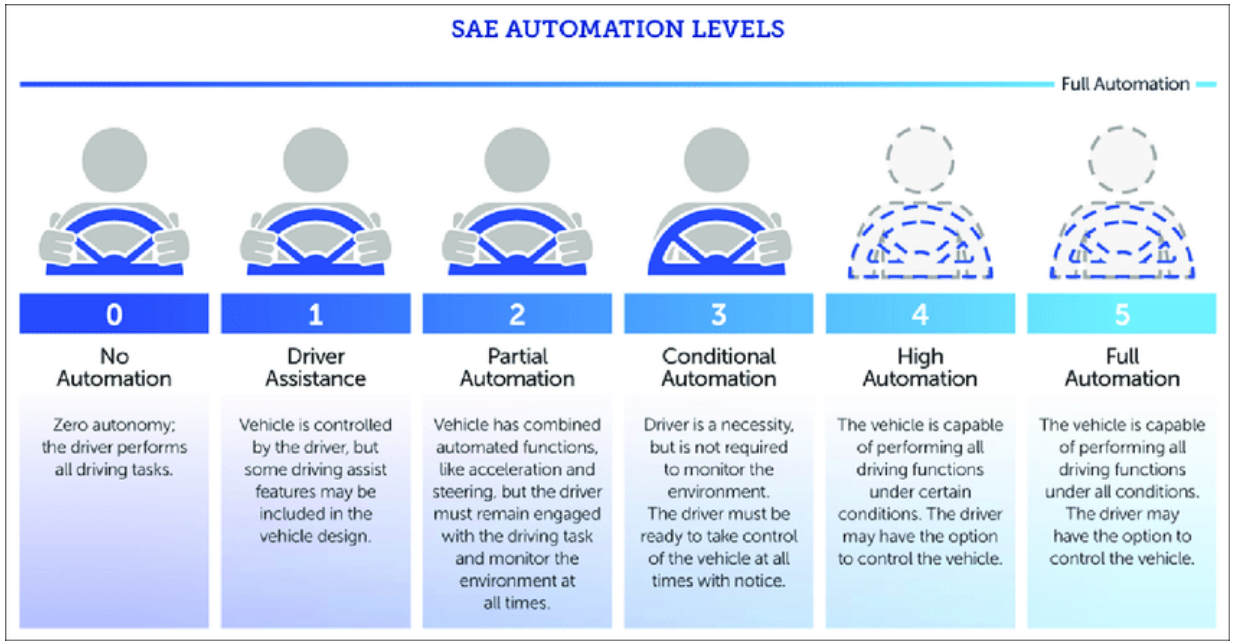
- Humans will remain part of automated driving in the foreseeable future to address critical transitions
  - Take back control of the vehicle when needed
  - Maintain mode awareness of automation
  - Calibrate trust for automated driving system
  - Handle changes in automated driving level
- There is significant research world-wide that investigates the human role in automated driving
  - Especially in Europe



SAE J3016

iDREAMS
https://idreamsproject.eu/wp/

Mediator
https://mediatorproject.eu/

interACT
Designing cooperative interaction of automated vehicles with other road users in mixed traffic environments
https://www.interact-roadautomation.eu/

TRUSTONOMY
https://h2020-trustonomy.eu/

SUaaVE
http://www.suaave.eu/

TRUSTVEHICLE
https://www.trustvehicle.eu/

AUTOMATION AND LIMITATIONS

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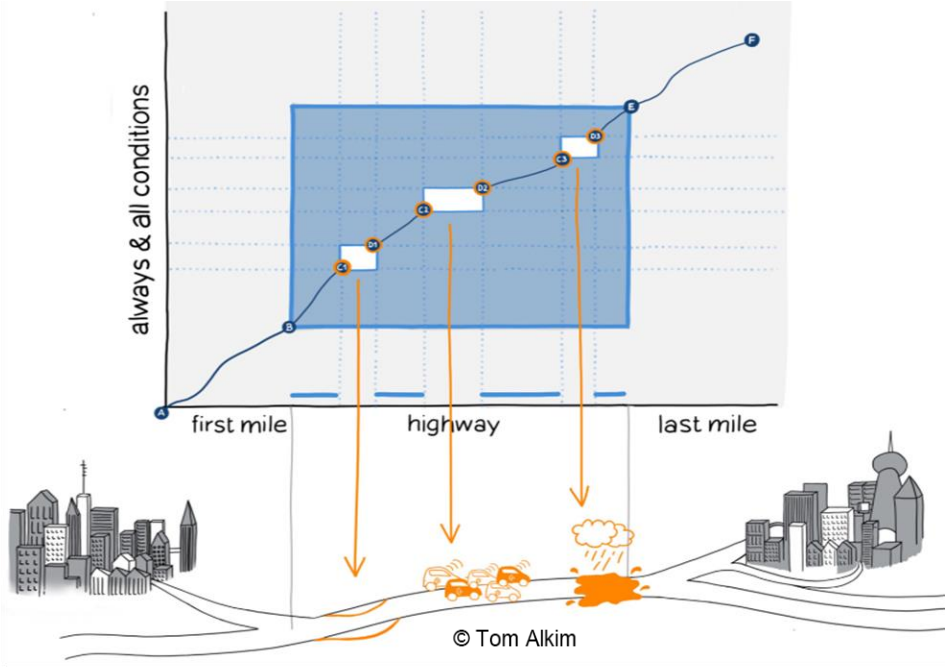
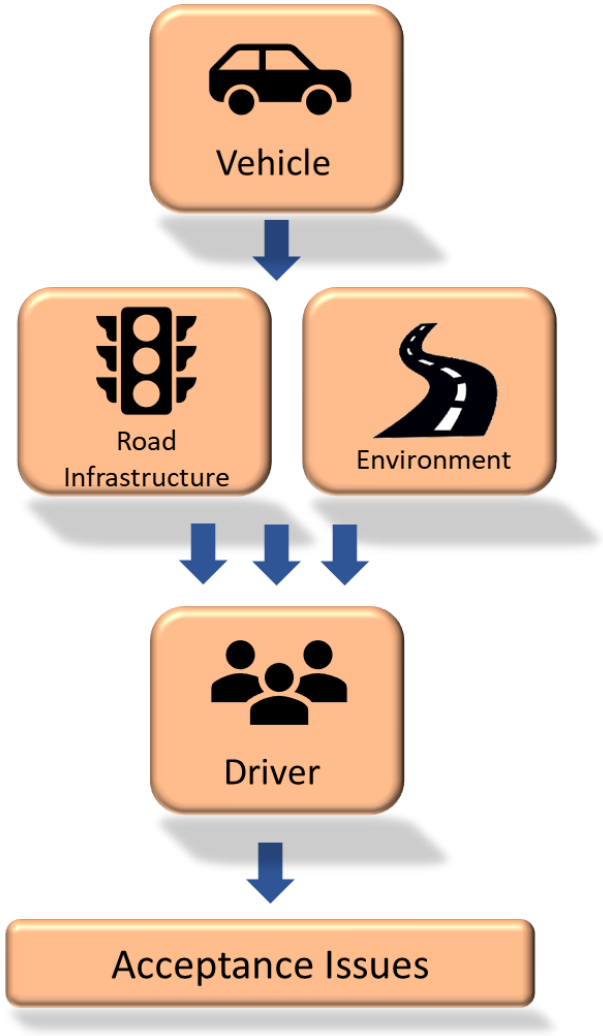
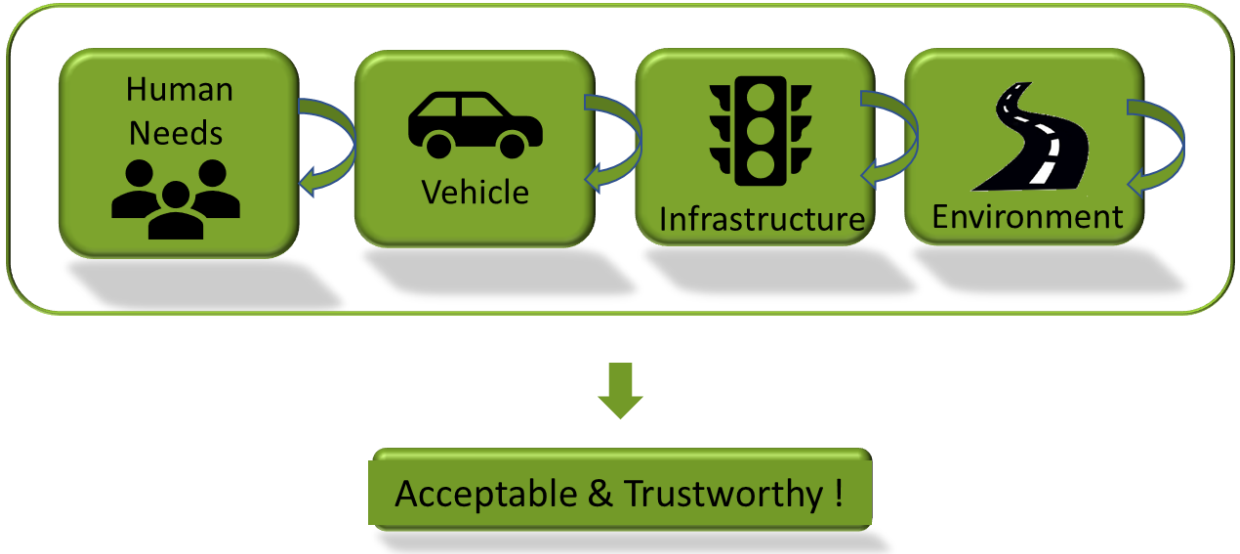
- Automated Driving at Level 3: Fallback-ready user can engage in some non-driving related tasks
- OEMs are starting to bring this functionality on the market
  - ADL 3 is available in certain Operational Design Domains (ODD)
    - limited to fully access-controlled highways
    - up to a specific maximum speed
    - Machine-detectable lane markings
    - The absence of tunnels, toll booths and traffic control devices
    - Within geo-fenced boundaries
    - Within specific transient conditions
      - inclement weather, such as heavy rain, snowstorms or heavy fog, or
      - adverse traffic conditions, such as a temporary construction site.
- The human driver is left to manage the complexities that arise out of the interaction between vehicle and real-world conditions



HISTORIC AND HSI APPROACH

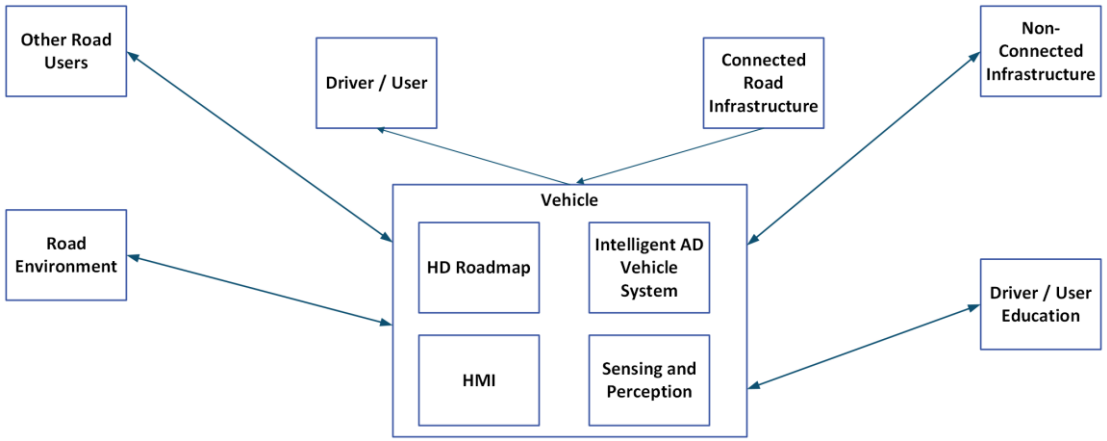


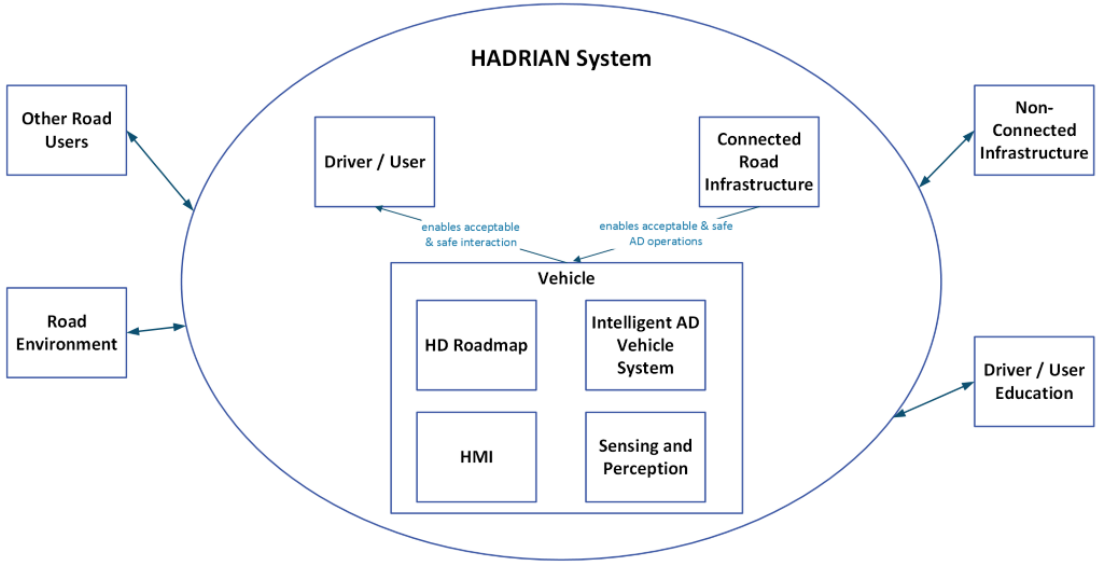
Historic Approach



HSI Approach

HSI PERSPECTIVE CHANGES THE VIEW OF THE SYSTEM





"*Sometimes it requires a change in what we view as the system to start seeing the problems and their solutions*."
(Hadrian Consortium)

HADRIAN HOLISTIC APPROACH

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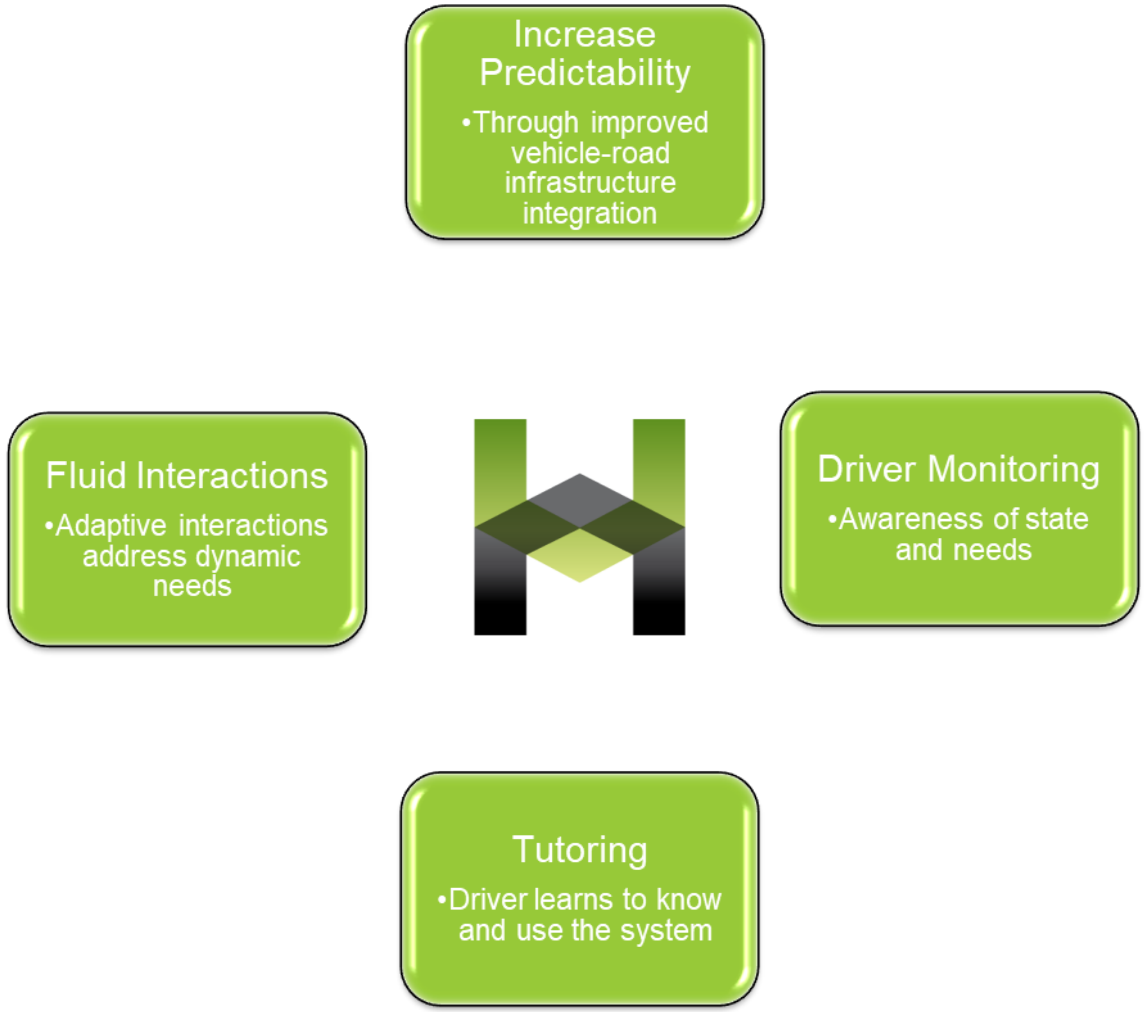
- HADRIAN uses a three-pronged approach to achieve acceptable & safe driver roles
  1. The **predictability** of automated driving states & transitions can be improved through **integration** of onboard vehicle sensors with **road infrastructure** sensors and communication
     - "Innovate" automated driving levels: 2, 3, and 3+
     - Guarantee ADL transition durations
     - Guarantee ADL durations
  2. Advanced driver monitoring capabilities facilitate in-cabin **fluid interactions** that offer the "just needed" information and interventions based on information from detailed **driver monitoring** systems
     - During automated driving
     - Before and during the transition to manual driving
     - During manual driving
  3. **Active tutoring** can improve the skills and knowledge of drivers to safely and comfortably use the automated vehicle
     - Before the drive
     - During the drive
     - After the drive



FLUID INTERACTION COMPONENTS

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- **Ambient Lighting**
  - Facilitates mode and situation awareness
- **Head-Up Display**
  - Highlights critical information or provides explanatory information necessary for safety and comfort
- **Fluid Tutoring**
  - Context sensitive, step-wise driver education
- **Haptic steering wheel**
  - Allowing active and passive signaling to help transitions between manual and automated driving
- **Turning seat and HMI concept**
  - allowing the driver to quicker and safer return to manual driving after periods of high-level automated driving.

MOBILITY PERSONAS AND MODES OF AUTOMATION

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Harold
is an elderly driver wanting
to stay mobile

Sven
is a truck driver within
the challenges of increasing
competitiveness

Florence
is a business women wanting
to keep up productivity
during transportation

Manual Driving Aid for Elderlies

Innovation to ADL 2 Driving

Innovation to ADL 3 Driving

Innovation to ADL 3 Driving for Extended Disengagmt.

Guarding Angel

INVESTIGATED INNOVATIONS

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- Benefit of an environmental awareness assistant to simplify driving task for elderly drivers
- Reduced human monitoring need during ADL 2
- Benefit of minimum guaranteed time for human driver to transition from ADL 2, 3 & 3+ to manual driving
- Benefit of guaranteed minimum ADL 3/+ duration
- Active driver monitoring & fluid guidance during the transition back to manual driving
- Adaptive tutoring to improve driver skills, knowledge, and competences for AD usage
- Guarding angel as safety protector during manual driving

HADRIAN INNOVATIONS AND MODES OF AUTOMATION

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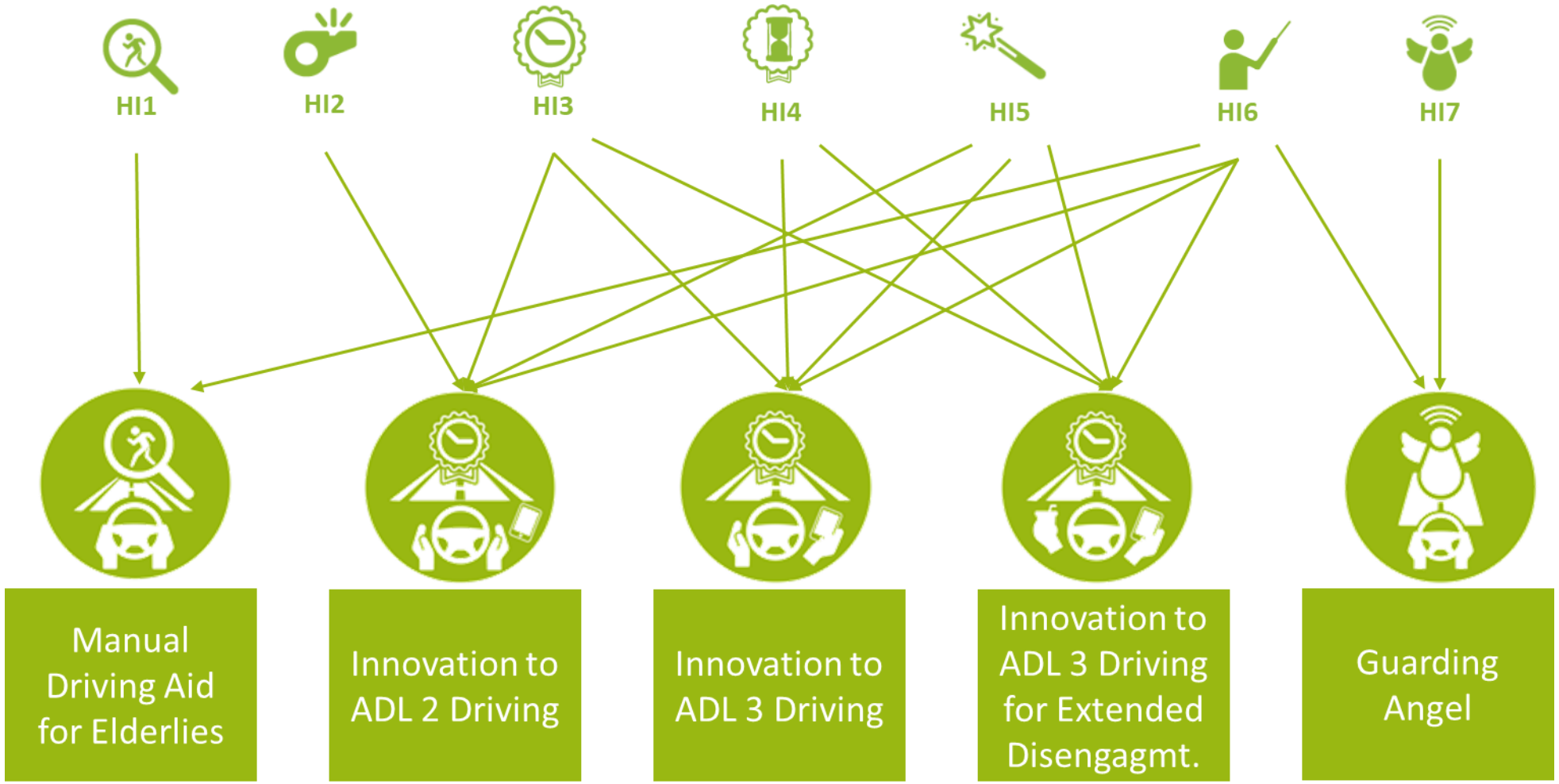

DRIVING SIMULATIONS

- Ensure consistent and coordinated research among partners
  - Need a common frame of reference
- Scenario based development of operational concepts
  - Definition of common user, environmental, vehicle, and infrastructure characteristics
  - Standardized set of simulation scenarios
  - Developed early on in PM 1 - 12
    - Nervtech: SCANer
- Mobile driving simulator
  - Travels to different research partners to ensure comparable instrumentation
  - Sharing of scenarios across partners for consistent development

PLANNED DEMONSTRATIONS

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No.	Demonstrator	Field Demonstration	Demo Vehicle	Partner
1	Visual Aiding Fluid Interface HUD System	X		NVT
2	Real-time driving state estimator			UGR
3	Haptic feedback f-HMI		1, 2, 3	TEC
4	Truck driver monitoring system	X	3	FORD
5	Ambient display and indicator f-HMI	X	3	PLUS
6	Multi-modal f-HMI	X	1, 2	VIF
7	Basic Fit2Drive App	X	1, 2, 3	CEA
8	Adaptive Fit2Drive App			CEA
9	Haptic f-HMI			IKA
10	Fluid Interaction Tutoring System	X	1	VIF
11	Collaborative AD demonstrator		3	NVT
12	FLUID Platooning HMI	X		FORD
13	Lab-implementation of holistic integrated in-vehicle f-HMI		1, 2	PLUS

PROJECT SHORT INFO

- **Response to call** H2020-DT-ART-2018-2019-2020
  - Human centred design for the new driver role in highly automated vehicles
  - **Coordinator**: VIF
  - **Duration**: 42 Months
  - **Start**: Dec 2019
  - **Funding**: 8 Mio EUR

virtual vehicle

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CONCLUSIONS

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- "*Sometimes it requires a change in what we view as the system to start seeing the problems*."
  - This change in perspective becomes often only visible from an HMI perspective
- Processes to substantiate the implications
  - Benefits of integration
  - Numerification
  - Simulations
  - Field-tests
- Show the way to view the system

- Learn more about the HADRIAN project at https://hadrianproject.eu/

https://hadrianproject.eu/

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OBJECTIVES

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1. **Demonstrate** how the **characterization of novel driver roles based on fluid interaction design leads to 90% safe AD level transitions** for a set of HADRIAN applications cases e.g. shared and individual mobility and professional freight transport.
2. **Demonstrate safe AD level transitions** for a set of HADRIAN application cases using fluid interaction designs that at least 80% of users find acceptable
3. **Demonstrate** that at least 80% of users **achieve calibrated trust in AD and AD level transitions** over time when using fluid interaction designs for a set of HADRIAN applications cases.

WP 1-5

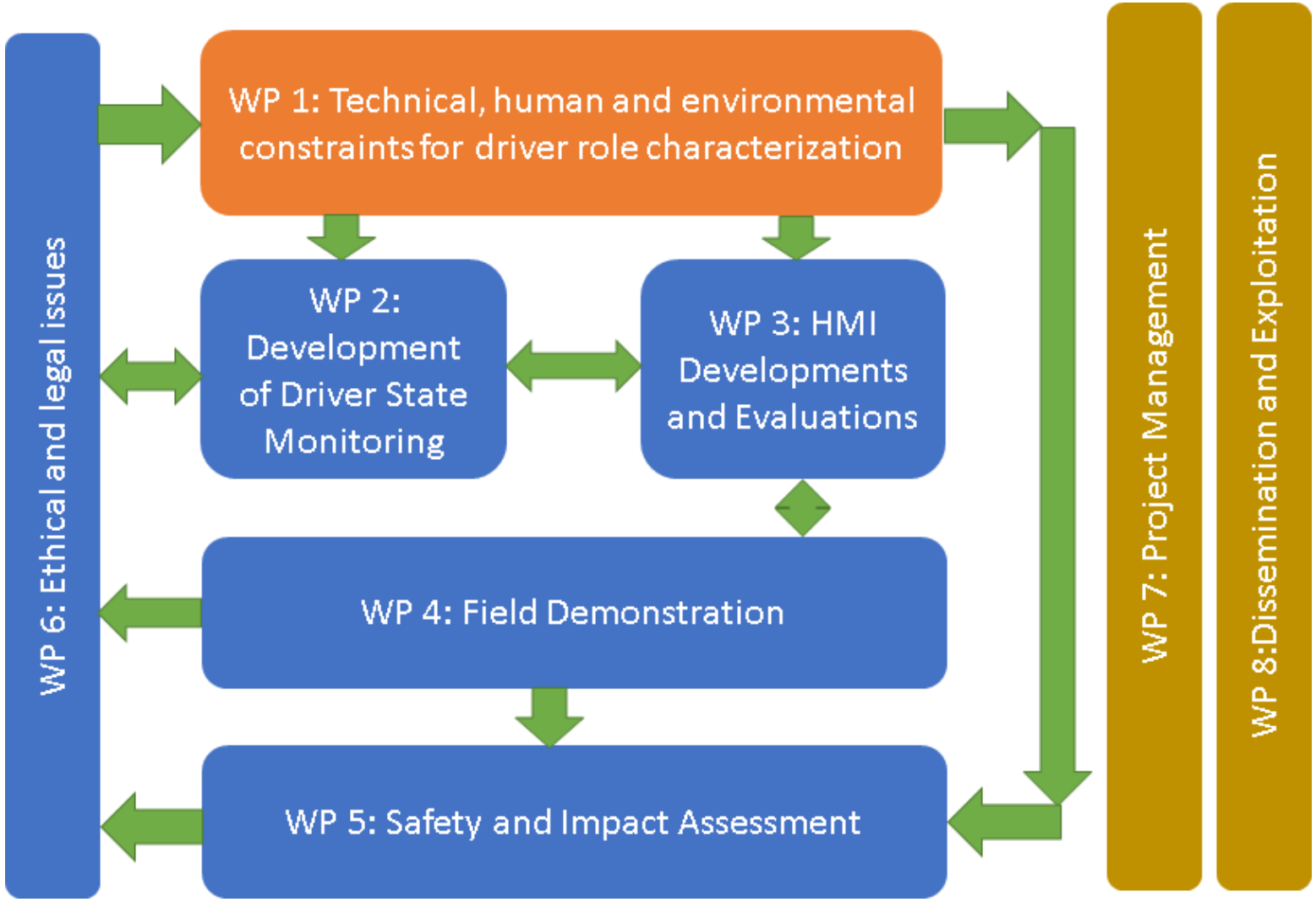
4. **Develop innovative technology bricks** regarding fluid HMI, sensor data-fusion, driver-models, and decision logic

WP 2 & 3

5. **Develop Human-Systems, Integration guidelines & recommendations** around a human-centred methodology to create safe, acceptable as well as usable, and trustworthy AD technologies & AD level transitions.
   These recommendations and guidelines are intended for infrastructure providers, road operators, and OEM's

WP 3.4, 6 & 7

WP STRUCTURE



HADRIAN SCHEDULE

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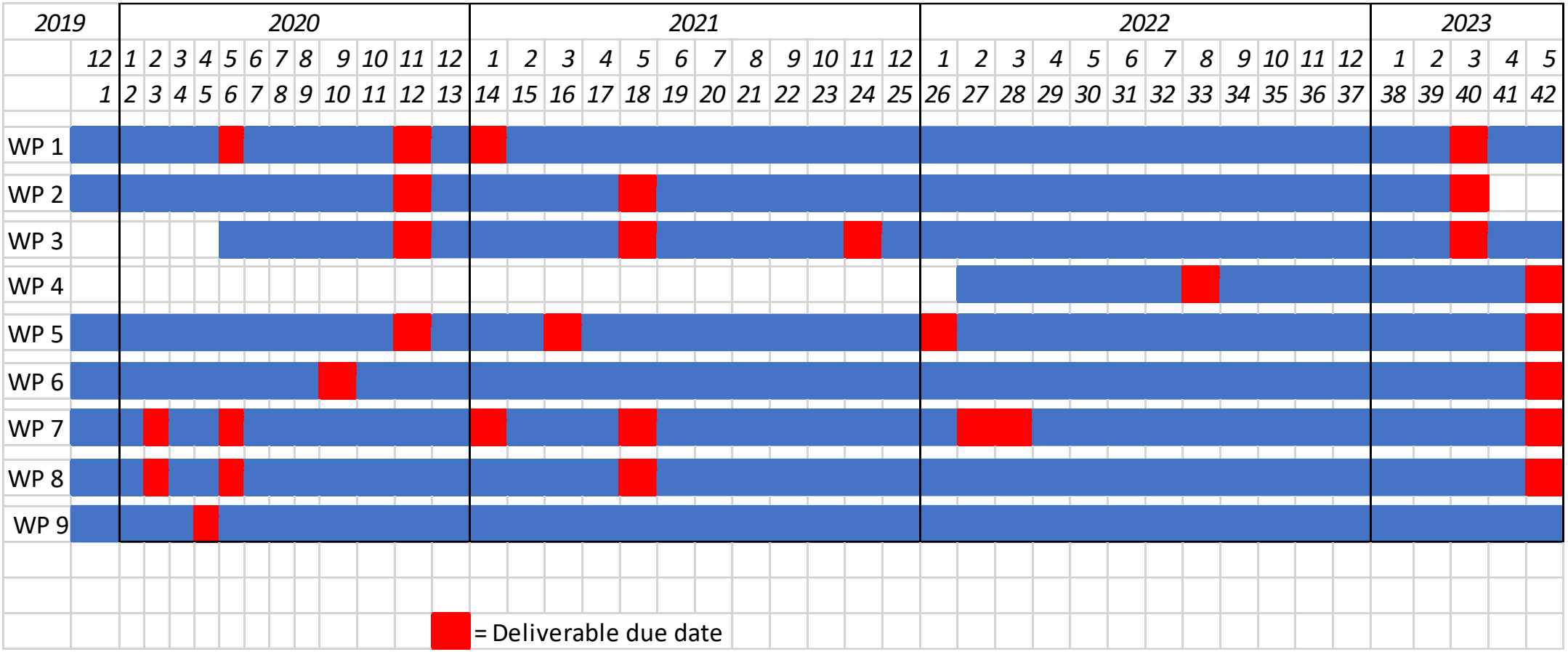

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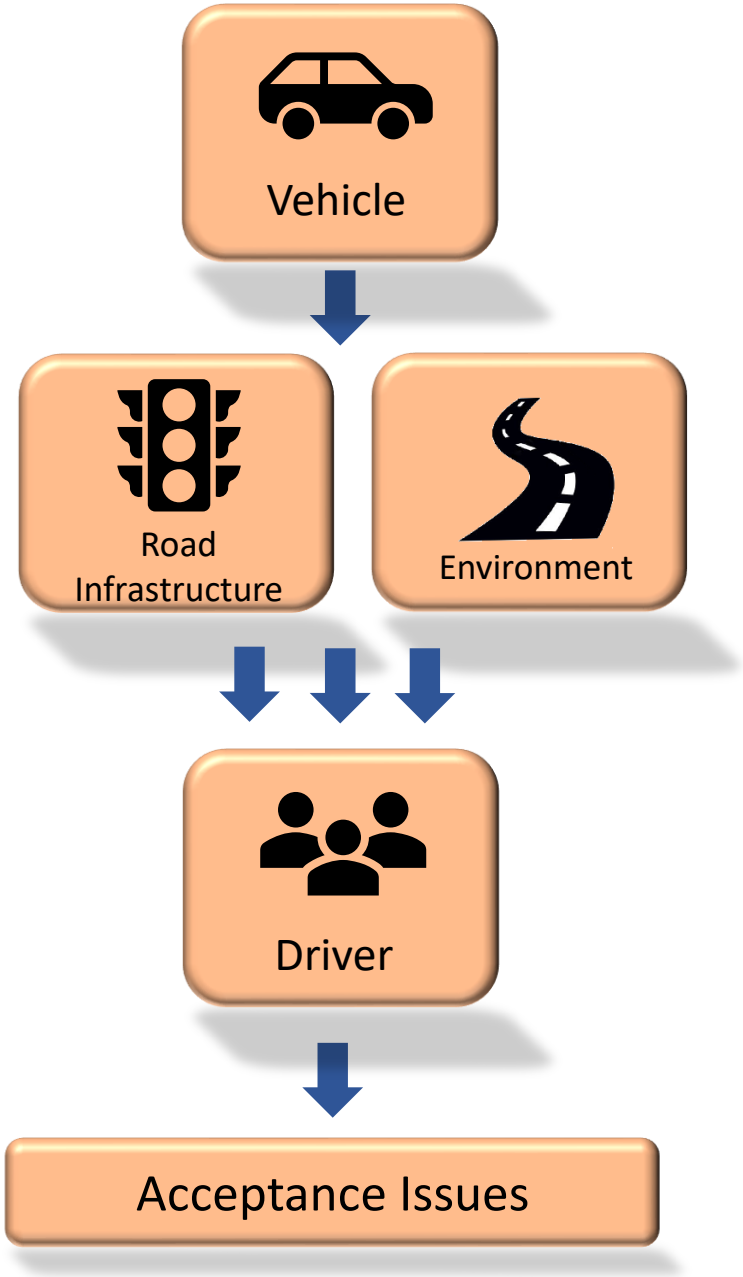
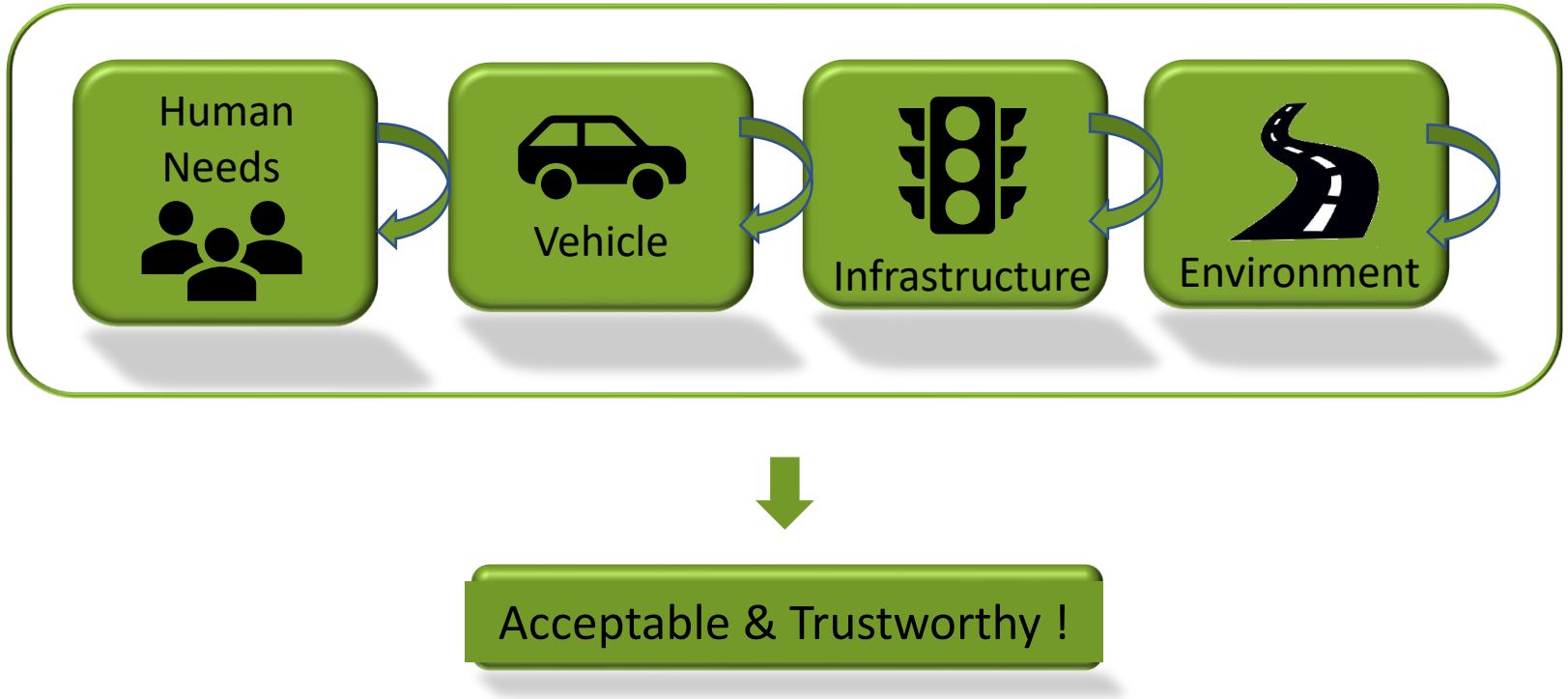
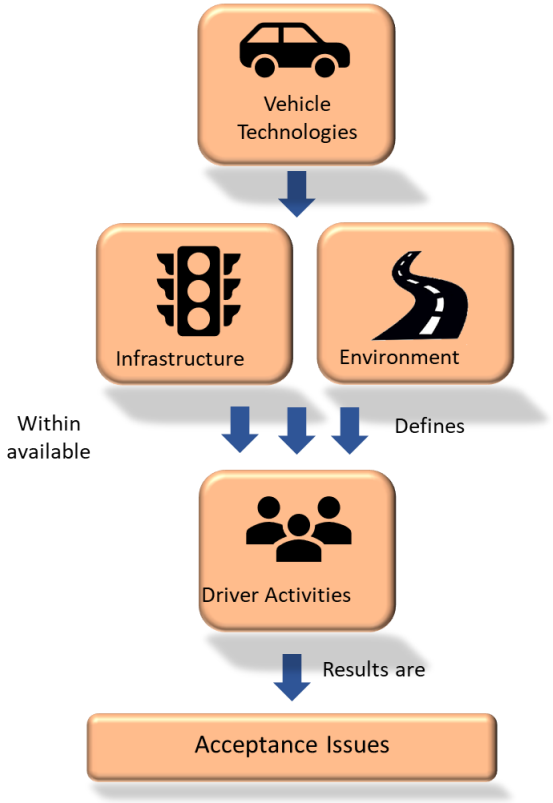
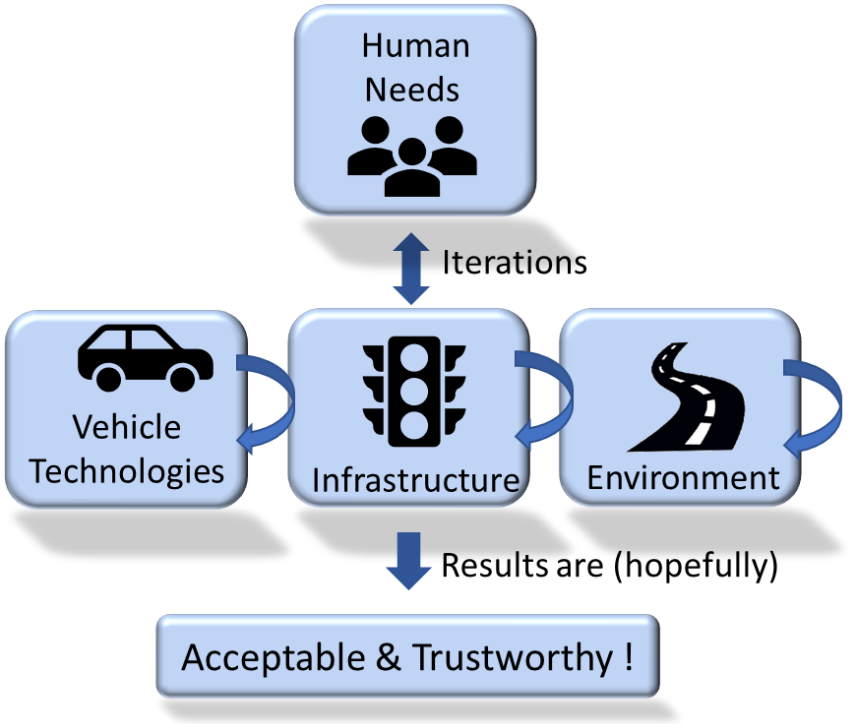




Historic


Vehicle Technologies
Infrastructure
Environment
Within available
Defines
Driver Activities
Results are
Acceptance Issues


Human Needs
Iterations
Vehicle Technologies
Infrastructure
Environment
Results are (hopefully)
Acceptable & Trustworthy !