5.3
European roadmap for connected and automated driving (Final Draft)

SCOUT

Authors: Jörg Dubbert, Gereon Meyer, Benjamin Wilsch

Benjamin.Wilsch@vdivde-it.de

Date: 18.09.2018

Document change record

Version	Date	Status	Author	Description
0.1	22/04/2018	Draft	Benjamin Wilsch (VDI/VDE-IT)	Creation of document
0.2	05/07/2018	Draft	Benjamin Wilsch (VDI/VDE-IT)	First draft
1.0	20/07/2018	Final	Benjamin Wilsch (VDI/VDE-IT)	Final
1.1	18/09/2018	Updated Final	Jörg Dubbert (VDI/VDE-IT)	Reference to policy recommendation added

Consortium

No	Participant organisation name	Short Name	Country
1	VDI/VDE Innovation + Technik GmbH	VDI/VDE-IT	DE
2	Renault SAS	RENAULT	FR
3	Centro Ricerche Fiat ScpA	CRF	IT
4	BMW Group	BMW	DE
5	Robert Bosch GmbH	BOSCH	DE
6	NXP Semiconductors Netherlands BV	NXP	NL
7	Telecom Italia S.p.A.	TIM	IT
8	NEC Europe Ltd.	NEC	UK
9	Rheinisch-Westfälische Technische Hochschule Aachen, Institute for Automotive Engineering	RWTH	DE
10	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V., Institute for Structural Durability and System Reliability FHG	FHG	DE
11	CLEPA aisbl – The European Association of Automotive Suppliers	CLEPA	BE
12	Asociación Española de Fabricantes de Equipos y Componentes para Automoción SERNAUTO	SERNAUTO	ES

1 Roadmap creation and validation

This document describes the roadmap creation and validation processes, which build upon the state of the art for Connected and Automated Driving (CAD) established in the first one and a half years of the SCOUT project and which serves to define paths toward the conceived vision for highly automated driving.

The focus of this Deliverable D5.3 is the further description of the **roadmap development process** in SCOUT after the Brussels Expert Workshop and of the experience made during this process rather than the final roadmap itself – as the document title may suggest. The end result of this process is described in Deliverable D5.4 "Roadmap Visualisation". The SCOUT consortium took this decision in connection with the **conclusions** laid out in chapter 1.3 at the end of this document. The partners felt that another conceptual step was necessary.

As for the previous work and deliverables in the SCOUT project, the roadmap for CAD will also be based on the five-layer model introduced by Prof. L. Eckstein to provide a structure for the analysis of the diverse influencing factors and fields of CAD development as well as of their interactions. This model is provided in **Fig. 1** and links the technical layer to the non-technical layers concerning societal, legal, economic and human factors. The interaction between driver, vehicle and environment is also considered for all individual layers.

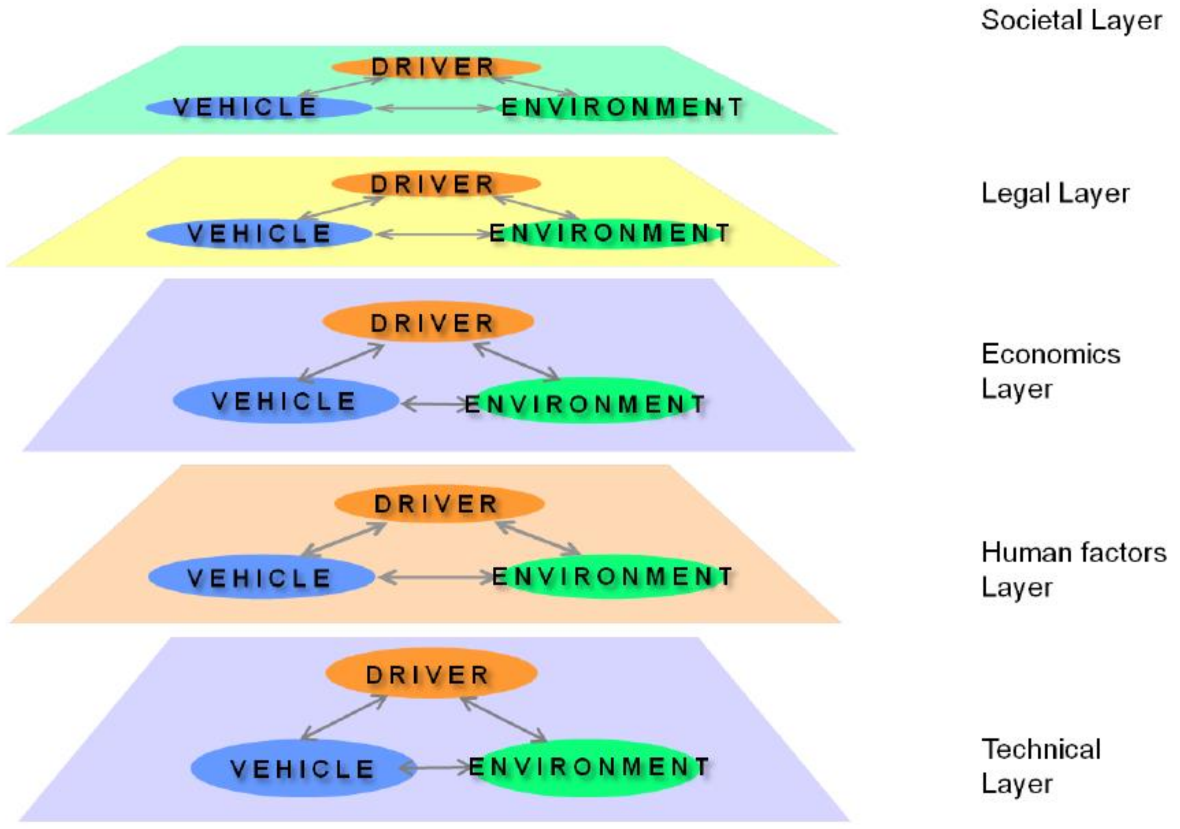


Figure 1: Five-layer model for the analysis of factors contributing to CAD development, as introduced by Prof. L. Eckstein.

The roadmap creation and validation processes build on the previous results and deliverables of the SCOUT project, specifically the context map (Deliverable 2.2) focused on the identified vision (Deliverable 2.4) for CAD in and beyond 2030 and the analysis of influencing factors across all of the five layers. The roadmap should consequently serve to link the state of the art, summarized in the context map, to the vision for level 4/5 automated driving.

To identify main actions for an accelerated deployment of automated and connected driving in and beyond 2030, the SCOUT project organized an expert roadmap creation workshop in Brussels on March 7th, 2018 followed by an expert validation workshop as part of the Interactive Symposium on Research & Innovation for CAD in Europe on April 19th and 20th, 2018, which was held in conjunction with the TRA Conference in Vienna.

The main goal of the workshops was to highlight the hurdles regarding level 4/5 connected and automated driving with respect to the layers defined above and to develop action items, on the timeline, for an accelerated deployment of connected and automated driving in and beyond 2030.

1.1 Roadmap creation workshop

1.1.1 Workshop methodology and participants

Over 40 experts participated in the initial workshop titled “Building a comprehensive European roadmap for level 4/5 connected and automated driving” including members of the consortium of SCOUT (and its sister-project CARTRE), representatives of the involved European Technology Platforms such as EPoSS and ERTRAC, as well as officers of DG CONNECT, DG MOVE, DG RTD and other relevant directorates of the European Commission were invited to join the workshop.

The SCOUT project coordinators, Gereon Meyer and Carolin Zachäus, from VDI/VDE-IT, welcomed the participants and gave a brief overview of the objectives and main activities of the project, with a focus on the roadmap development process and its relation to other roadmaps, entities and projects.

The project partners introduced the already accomplished results along the roadmap development process within the project. Leandro D’Orazio (CRF) and Roberto Baldessari (NEC), referred to the analysis of user expectations and requirements, as starting point to co-create a vision of CAD in Europe beyond 2030. According to the results of this analysis, level 4/5 automation would be the most preferred scenario from a users' perspective. Devid Will (ika) and Steven Von Bargen (NXP) presented key aspects of the state of the art assessment, based on the 5-layer model detailing technical and legal aspects of CAD. Finally, Heiko Hahnenwald (LBF) referred to the methodological approach used for the business model evaluation of CAD. A business model structure has been defined, including the value proposition, the stakeholders or value creation partners and the monetization aspects of each business model

External experts introduced the challenges and opportunities of the five layers mentioned above: Jochen Langheim (ST Microelectronics), Benjamin von Bodungen (German Graduate School of Management & Law), Suzanne Hoadley (Polis), Stella Nikolaou (CERTH) and Gereon Meyer (VDI/VDE-IT) presented the technical, legal, societal, human factors and economics layers, respectively.

During the interactive session, the participants split up in five groups related to the five layers and identified the existing **hurdles** (gaps) before they developed recommendations and **actions** to bridge those gaps on a timeline. The individual actions were further grouped into **action fields** for each of the layers. In a final step, **links** of the proposed actions to other layers of CAD development were defined in order to identify opportunities for acceleration

The roadmap layout is provided in **Figure 2**. Each group was moderated by one expert in the field and supported by the SCOUT partners. At the end of the workshop, all findings were summarized by the moderators, highlighting the specific actions on the timeline to overcome hurdles and turn the vision for CAD in 2030+ into reality.

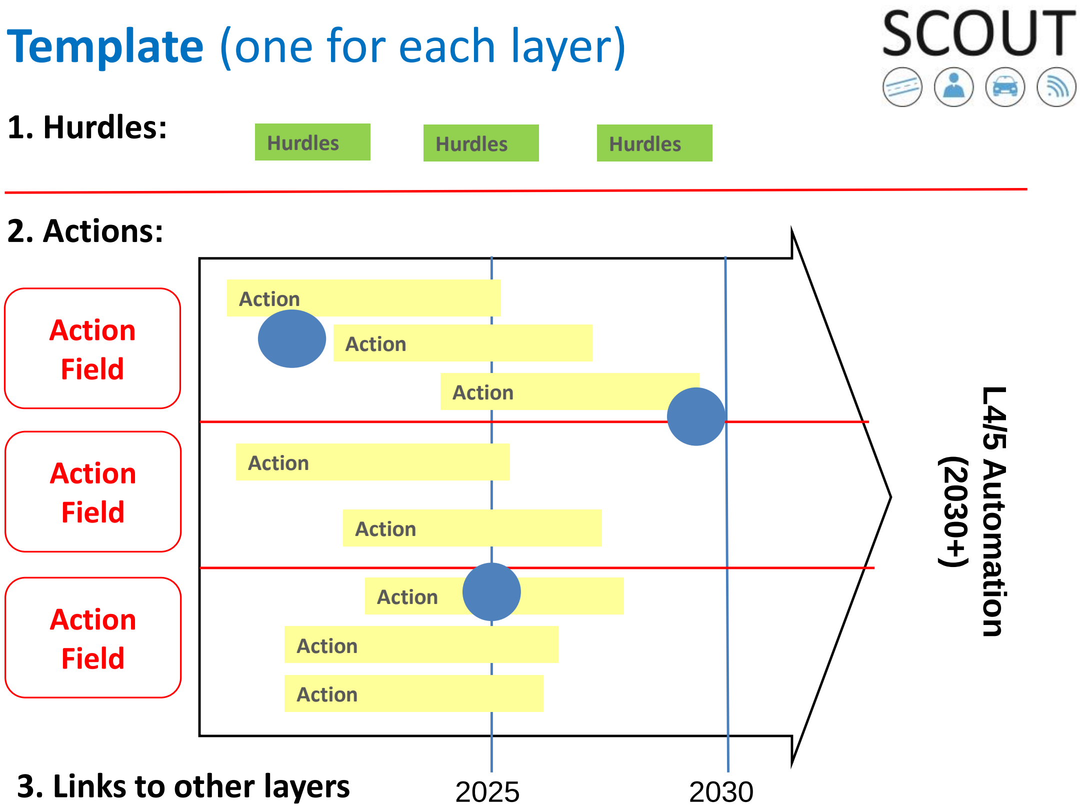


Figure 2: Roadmap template as presented to the workshop participants. For each layer, the experts identified hurdles, actions (grouped in action fields) and links to other layers.

1.1.2 Creation workshop results

The discussion and work process for the creation of the roadmap in each of the five CAD development layers is displayed in

Figure 3 along with the final poster results at the end of the workshop for all five layers.

Figure 3: Photos showing the discussion at the poster panels and the result for each layer of CAD development.

After the roadmap creation workshop the results were consolidated and transferred to a digital format. The content for each layer is provided in the Appendix. A first conclusion from the discussions at the workshop was that the number of influencing factors (and layers), the variety of possible implementation paths and the resulting uncertainty in the sequence and timing of individual development steps is not reflected in the use of specific years (2019, 2025 and 2030) on the time scale, which should rather differentiate between short-, mid- and long-term actions. This uncertainty is magnified by the dependencies between layers that can result in considerable hold-ups. The relative positioning of the actions thus serves to identify the order in which certain hurdles should be tackled in each respective layer and to align actions that must be implemented in sequence.

The results of the roadmap creation workshop are summarized below for each layer.

Societal:
The central issues on the societal layer can be assigned to one of the following three action fields:

- *Vision for a sustainable future*: the potential benefits of CAD can, if directed appropriately, provide a significant contribution towards solving central challenges such as an increasing urbanization or vehicle emissions. The discussion of the implications, potential benefits and uncertainties of CAD for society and the formation of a social consensus about the introduction of CAD require a vision as a focal point. This in turn calls for an integration of CAD with shared and electric mobility to arrive at a complete vision for future mobility. This can then be used to promote CAD amongst society, e.g. using desirable use cases.

- *Ethics*: current discussions, in particular concerning the ethical dilemma that arises when an automated vehicle must (if it can) decide between two possible outcomes and (group of) victims in cases where an accident is unavoidable, already highlight the significance of solving ethical issues in connection with CAD. It is thus necessary to agree on fundamental ethics principles in the short-term, translate these into requirements that feed the technical, legal and economic layers in the mid-term and to address newly emerging conflicts in the long-term. As for other fields in which control will shift from humans to machines, the ethics discussion will thus be a permanent companion of CAD development.
- *Policy Framework*: the third integral component of the social layer covers the need for a policy framework that builds on the vision for sustainable transport and aims for achieving the benefits CAD offer. It is therefore necessary, to define a policy framework that can serve as a guideline, especially for the technical and legal layer. Further support should be provided by training decision makers and guiding the long-term and widespread implementation of CAD.

Economics:

On the economics layer, hurdles and actions pertaining to the following three action fields were discussed:

- *Investment*: since the willingness to invest critically hinges on the expected return on investment and thus also the associated risk, the lack of legal framework presents a central hurdle for this action field. The cost factor of vehicles and communication infrastructure as well as an incomplete cost-benefit analysis further complicate this field. The discussions at the workshop sketched out an approach for the overcoming of these hurdles that starts with the creation and alignment of investment incentives, based on the technical and policy framework, and is shortly afterwards accompanied by an effort to balance investments amongst stakeholders. These two steps should be accomplished in the imminent future to provide an input for the definition of the legal guidelines that increase certainty and can subsequently accelerate the investment cycle.
- *Business models:* mobility has already been strongly affected by the large-scale introduction of ride hailing offers over the past years and the increase in vehicle automation will bring with it a large number of new business opportunities, starting with ride offers and extending to new advertisement and sales potentials for vehicle users freed of the driving task. Suitable business models should thus be developed in the mid-term, but must also be accompanied by an adapted framework that balances competition and thereby again serves to ensure that the benefits of CAD will be achieved and not inverted as a consequence of business or even monopolistic interests. Actions concerning the creation and development of business models thus exhibit strong links to the policy framework to be established as part of the social layer and the creation of adapted legislation in the legal layer. In addition, new and successful business models will influence further technical function development.
- *Use cases*: due to the disruptive nature of CAD with respect to mobility, in particular the new applications and services it enables, but also in view of the necessary

integration in the established transport system, the level of clarity concerning potential use cases is currently insufficient. The workshop participants thus identified a short-term need to define use cases, linking to all of the other four layers in a continuous exchange of requirements and inputs, followed by a perpetual refinement based on user feedback and depending on the acceptance of individual use cases.

Human Factors:

The discussion on human factors showed that the hurdles and actions of this layer can be categorized into the following action fields:

- *User acceptance*: is strongly dependent on user expectations as well as user experience with automated cars (or systems in general). It is also a central prerequisite for the successful and widespread introduction of automated vehicles. Existing reservations should thus be mitigated by promoting the benefits (traffic safety, social inclusion and optimized car usage) amongst the general public and studying the user-vehicle system under real conditions in living labs,
- *User responsibility*: the clear definition of user responsibilities in vehicles of increasing levels of automation is a fundamental challenge of vehicle design, with direct implications for driver safety. This also encompasses behavioural schemes in case of incidents/accidents,
- *User-system interaction:* requires user condition monitoring and the definition of interaction mechanisms both between the vehicle driver/user and with Vulnerable Road Users (VRUs). In the mid-term user expectations and user feedback from trials can be incorporated in vehicle design to improve user-system interaction and, in consequence, user acceptance and safety. In later stages, it should allow for a clear distinction between operative roles.
- *Skills:* the change in user responsibility and in-vehicle experience with increasing levels of automation calls for new corresponding user training and education efforts. This concerns both the individual driver/user and occupational profiles, e.g. traffic management skills. User education should also serve to combat skill degradation, especially in cases where the level of automation requires rare but skilled take-over of driving tasks. The education needs and profession profiles must be determined immediately, in order to increase safety and to foster user acceptance.

Legal:

The hurdles and actions identified for the legal layer of the factor analysis model can be grouped according to the following action fields:

- *Road traffic legislation*: presents a central hurdle for the implementation of both CAD trials on public roads and the regulation of automated vehicle use (e.g. user licensing) and its implications for mixed traffic. The discussion also focuses on the question, whether a gradual adaptations of existing legislation, i.e. the Vienna Convention on Road Traffic, or a fundamental overhaul presents the best approach. A comparison of international approaches allows for an evaluation of the benefits and risks of different procedures. In a subsequent step, national regulations must also be harmonized to account for cross-border driving. As an important enabler and potential accelerator of CAD deployment, the legislative actions were prioritized as short-term actions in the discussions. They should further be accompanied by standardization efforts for both vehicle and infrastructure functionality

- *Type approval*: although this action field only includes a single hurdle and action, addressing the need for a redefinition of approval requirements and procedures, it plays a central role for CAD deployment and should therefore also be tackled in the short term and in close interaction with the technical layer.
- *Liability*: includes open questions concerning the liability for damages in shared and operator-less vehicles (user misbehaviour) and for system failures (e.g. between OEM, service provides, telecom and users) as well as the need to adapt and expand law enforcement procedures. These actions should be fed by a societal discussion on the ethics of automated vehicle use and will provide outputs for the human factors (user responsibility) and economic layers (business models).
- *Data security*: the aggregation of large amounts of high-detail personal data, which accompanies the widespread introduction of automated and connected vehicles, including data amassed from user monitoring, is a very sensitive issue that should be addressed early in the development process and will likely extend to the mid- and long-term, as new services and technical features are introduced. Similar to the liability action field, the design of new data protection frameworks requires input from discussions of expectations amongst users and society as a whole. Furthermore, the threat of cybercrime attacks on connected vehicles must be eliminated by suitable protective mechanisms on the technical layer, but must also be supported by regulatory initiatives.

Technical:

Technical advancement over the past decade was the root of the recent rise in CAD activities and progress and is naturally also the key indicator for future developments. Amongst others, the hurdles established by the group of experts address the needs to further improve vehicle environment perception and event prediction, to achieve integration in traffic management systems, to ensure failsafe operation in mixed traffic, privacy and cybersecurity and to provide means to interact with other road users. The central areas for improvement and the hurdles identified in the workshop can be attributed to the following three action fields:

- *Function development*: four key actions were identified to advance function development in a staggered approach spanning the short- and mid-term. In order these cover the development of a model sensor and control suite based on standards that are to be established (input link to legal layer), the implementation of the necessary infrastructure intelligence, the provision of a fail-operational and safe vehicle control architecture and, finally, a the development of comprehensive and flexible concepts for cybersecurity.
- *Integration*: with respect to the integration in mixed traffic systems, short-term actions for the development of collective traffic and incident management systems and for the scenario definition for control frameworks should be complemented by mid-term actions relating to the updating and adaptation of the connectivity infrastructure, the evolution of the management concept to account for new use cases and the creation and subsequent utilization of global and open centralised maps.
- *Validation*: the well-established validation procedures for current automotive technology and functionality must be replaced by new validation methods that account for the lack of traceability of the decision-making process based on artificial intelligence. Given the central importance for vehicle deployment, this action possesses a high priority and also requires further actions concerning scenario simulation and field testing. These methods will serve as the foundation for new

certification procedures (link to legal layer), while current legislation defines the conditions for field testing and should also be adapted in the future to expand testing capacities.

1.1.3 Links between layers

For the links between individual layers, workshop participants had the possibility to indicate whether a certain action required input from other actions/layers (link designated at the beginning of the action), whether the conclusions derived from that action serve as input to another action/layer (link at the end of the action) or whether a continuous interaction between actions and layers is required. As already pointed out as part of the discussion of the action fields in the previous sections, a large number of links was identified, often underlining key dependencies in which a certain action could not be executed, and specific hurdles could not be overcome, before an action in a different layer was completed or at least advanced. In particular, the human factors layer exhibits many links in both inputs and outputs to technical actions, primarily function development, and a strong linkage was also established between the technical and legal layers. Furthermore, the ethics action field from the societal layer was identified as a critical input to the liability and data security action fields in the legal layer, while the actions in the economic layer build on input from all other layers and are expected to create a need for an adaptation of legislation as a result of the creation of new business models and investment incentives. The full set of links identified by the experts can be examined in the appendix of this document, which includes the individual posters.

1.2 Roadmap validation workshop

The roadmap was subsequently validated as part of the "Interactive Symposium on Research & Innovation for Connected and Automated Driving" in Vienna on April 20th, 2018. The session was attended by 30 experts, including members of the SCOUT consortium as well as participants from the sister project CARTRE, from directorates of the European Commission and from transport ministries from the U.S., Japan and from EU member states.
After an introduction to the session and a summary of the SCOUT project results from Jörg Dubbert and Benjamin Wilsch from the project coordinator VDI/VDE-IT, the workshop participants were invited to group around the poster of their expertise, where they could subsequently view and validate the roadmap content resulting from the roadmap creation workshop, correct or add relevant hurdles or actions and check the consistency of the content and, in particular the links. After an initial validation session, the participants also had the opportunity to move around and contribute to other posters and to ensure once again that both ends of important links were included consistently. The workshop setting, groups and some of the results are depicted in **Figure 4**.

Figure 4: Photos showing the five expert groups at the poster panels (from left to right: legal, societal, economic, technical and human factors layers) and the result for the technical and economic layers of CAD development.

1.2.1 Validation workshop results

New content added to the roadmap on all five layers is included in the posters in the appendix of this document. Additional hurdles or actions are marked with a red frame, while red rectangles contain general comments by workshop participants. For the hurdles, the largest number of additions concerns the technical layer poster, but this can in part be attributed to the fact that this poster had by far the most participants. It is noticeable that only in once case the added hurdles could not be categorized within the existing action fields so that the experts on the legal layer poster decided to add a new action field titled "Public planning". This should arguably be grouped with the action fields of the societal layer, but it is also representative for a key comment echoed by many workshop participants: even after defining a vision and creating a roadmap marked by hurdles and necessary actions for advancement, there is still a lack of agreement amongst stakeholders which in turn causes a lack of goal orientation and harmonisation in approaching CAD development. The participants thus called for test and simulations that can prove the potential benefits of CAD (e.g. with respect to road safety, social inclusion and traffic flow), followed by a promotion of these benefits across society and the provision of an appropriate legal framework that serves to ensure these benefits are reached, e.g. by establishing regulations and countermeasures to adverse effects. The associated actions were thus placed at the very beginning of the timeline and marked with necessary links to the legal layer. On the societal layer this conclusion is further underlined by comments stating that technology development will inevitably take place but must be guided by framework to guarantee beneficial implementation. The creation of this framework should also be shaped by ethics principles for CAD (e.g. programming of vehicle behaviour in case of accidents) that must accordingly also be defined in the short-term. Besides minor adjustments to the relative timing of individual actions in various action fields, workshop participants also added additional links and repeatedly stressed that using only input and output links to actions is insufficient since many actions require a continuous exchange between layers to foster coordinated and accelerated advancement instead of bottleneck effects. For example, on the legal layer a constant back and forth between regulative actions and function development on the technical layer or between data protection laws and ethical standard development on the societal layer were indicated. Another recurring comment concerned the difficulty to coordinate an general approach to CAD development in view of the wide variety of use cases and potential development paths, which is especially relevant when considering high level automation and consequently a vision for the long-term future. Overall, the discussions were strongly marked by an the complexity of CAD development with the multitude of actions and action fields, the large variety of links highlighting fundamental dependencies between actions and by an uncertainty concerning the best approach to resolve issues involving diverse stakeholders.

1.3 Conclusion

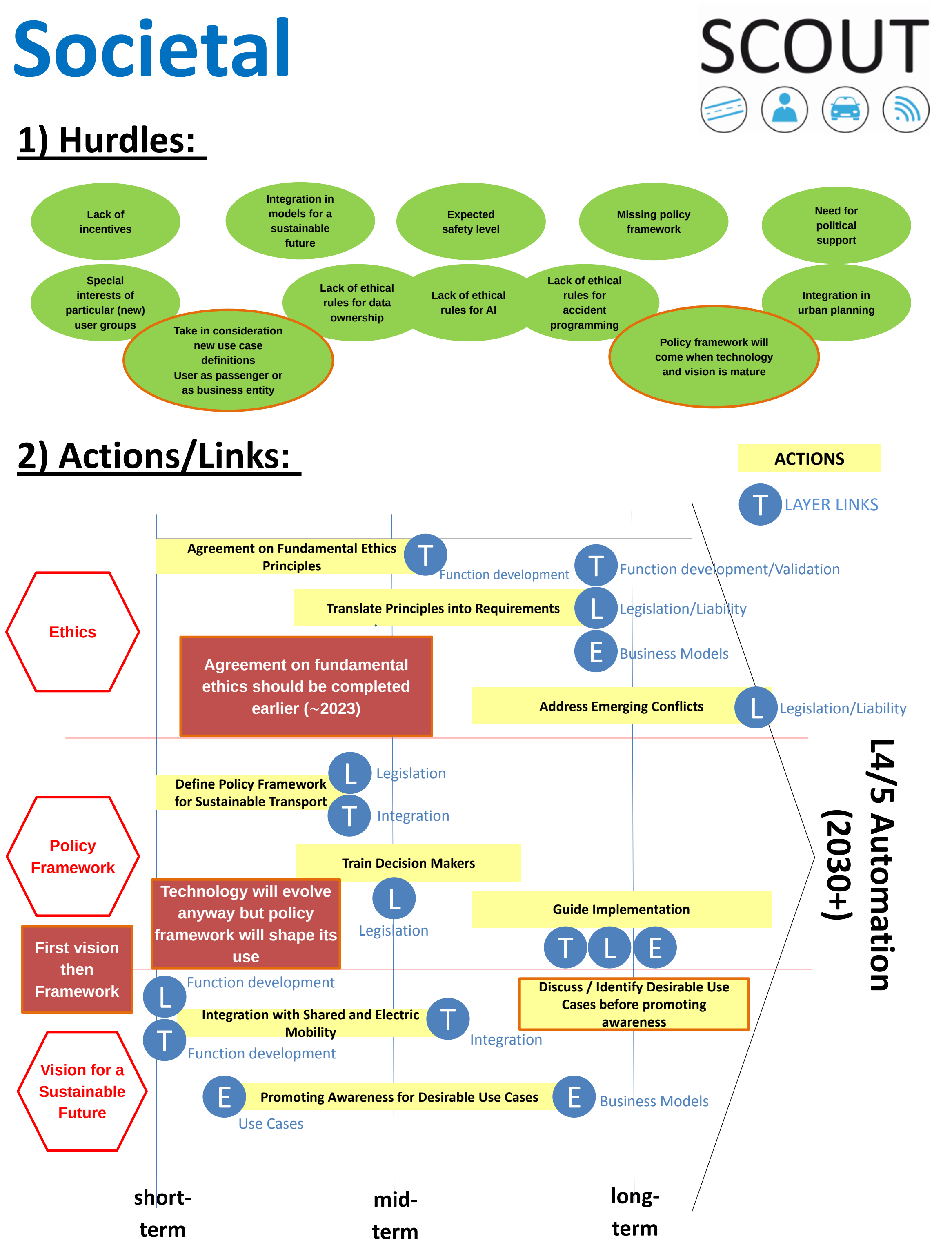
In conclusion, both the creation and the validation of the roadmap on the five technical and non-technical layers of level 4/5 CAD, under the involvement of experts from various organisations and fields, showed that a large number and variety of hurdles still have to be overcome, in order to establish high-level automation over the next two decades, but also proved that specific short-, mid- and long-term actions can be conceived and subsequently orchestrated to enable a stepwise approach to reducing the complexity of and ultimately eliminating the hurdles. For all five layers, it was possible to group the actions derived by the experts into three to four categories, thus creating distinct action fields that define focus areas on each layer. The results show that the effective deployment of level 4/5 CAD is a very complex task, which requires a comprehensive and coordinated approach of experts in different fields (technical, legal, societal, economic and human factors).

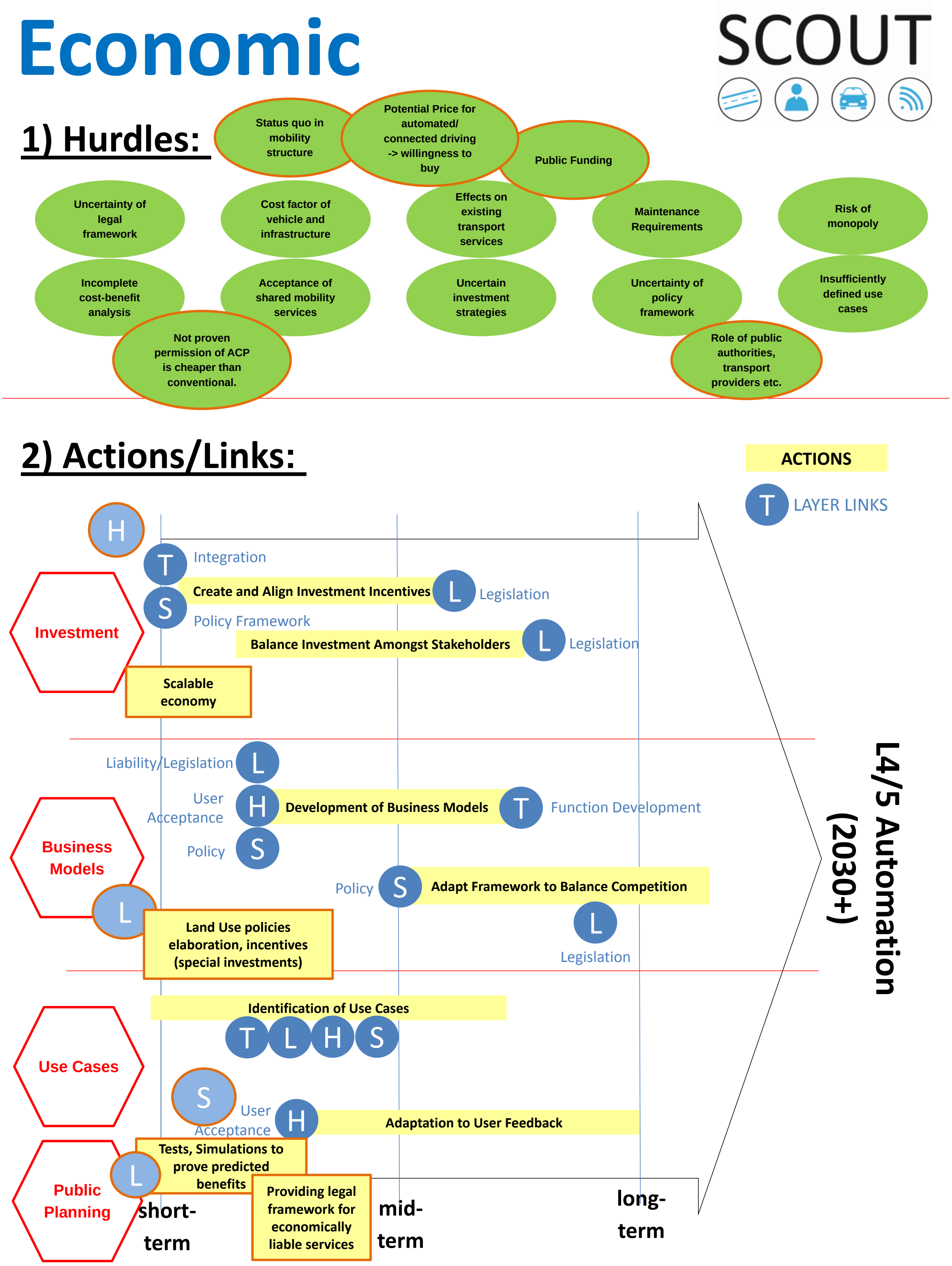
The success depends strongly on the cooperation of these different fields, as underlined by the many links identified between the individual layers, which highlight dependencies that can cause significant hold-ups for deployment. The discussion between experts can be guided by the use of the five-layer model, which proved to be an ideal framework to cover all relevant issues as well the relations between them. The validation process showed that although the list of hurdles is seemingly endless and it is always possible to find new (potential) hurdles, the action fields defined during roadmap creation can be considered complete to the degree that they adequately summarize the foci and priorities of CAD development. The experts also agreed on the main actions in each field although it proved more difficult to agree on the cross-field and cross-layer timing and order of actions. Most noticeably, the majority of stakeholders asserted a difficulty to define a coordinated and harmonized approach across all layers from the very generally and broad perspective of a roadmap for level 4/5 CAD. They attributed this primarily to the large variety of use cases, the large variety of application environments and the uncertainty associated with developing a roadmap for CAD in 2030 and beyond. On this general level, a kind of Gordian knot results from the different actions on all layers and in particular from the links (dependencies) between them and it is unclear at which point and how this should be tackled. Both the roadmap creation and validation process with stakeholder involvement thus led to the conclusion, that, although these general roadmaps provide a very good understanding of the CAD field and the factors that influence its development, a detailed roadmap that may serve as a kind of action plan for coordinated and accelerated CAD development **should address specific use cases**, in order to lift the complexity that characterizes the broad perspective. The translation of the established roadmaps on all five layers on to the use case level, e.g. for high-level CAD applications such as on-demand shuttles or valet parking, will thus be the final step of the roadmap creation process and will be the basis for roadmap visualisations. This process has been done by the SCOUT project partners for five selected use cases together with the roadmap visualizations in Deliverable D5.4 based on all experience made so far.

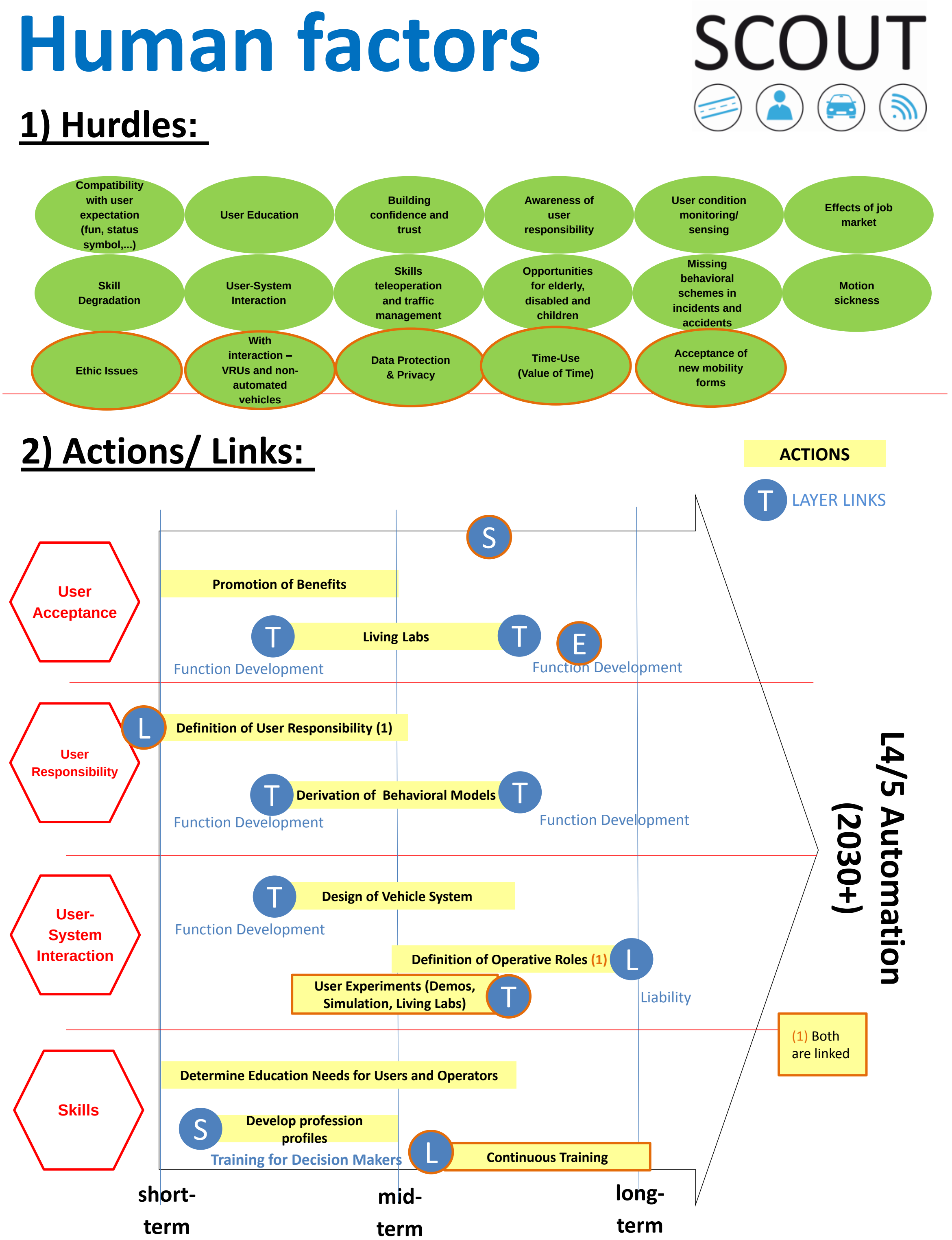
1.4 Policy Recommendations

Together with the visualizations of roadmaps, recommendations for policies and actions to drive the harmonised installation of regulatory frameworks and standardisation complementing the technology-focused advise and proposing actions for the accelerate deployment of infrastructure as well as advise for handling of critical issues like e.g. gathering of big data vs. cybersecurity and privacy are provided in D5.4 which result from the experience in the roadmap development work in SCOUT. They refer to both the selected five use cases and the general CAD development. The recommendations will suggest the essential next actions and instruments for the further development.

2 Appendix

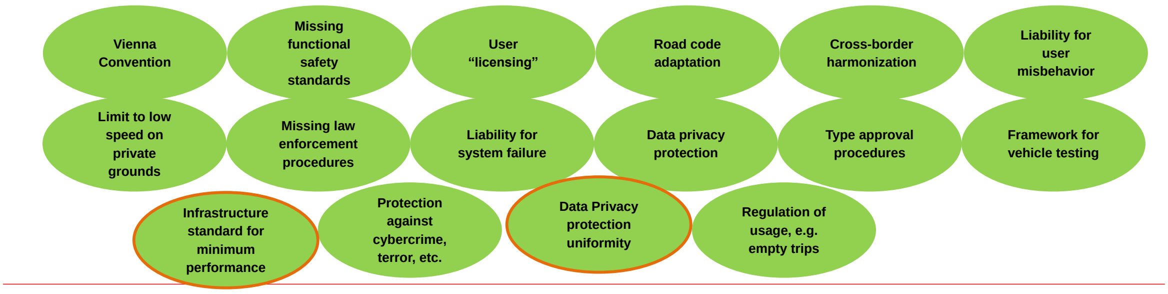

Societal
SCOUT
1) Hurdles:
Lack of incentives
Integration in models for a sustainable future
Expected safety level
Missing policy framework
Need for political support
Special interests of particular (new) user groups
Lack of ethical rules for data ownership
Lack of ethical rules for AI
Lack of ethical rules for accident programming
Integration in urban planning
Take in consideration new use case definitions User as passenger or as business entity
Policy framework will come when technology and vision is mature
2) Actions/Links:
ACTIONS
LAYER LINKS
Ethics
Agreement on Fundamental Ethics Principles
Function development
Function development/Validation
Translate Principles into Requirements
Legislation/Liability
Business Models
Agreement on fundamental ethics should be completed earlier (~2023)
Address Emerging Conflicts
Legislation/Liability
Policy Framework
Define Policy Framework for Sustainable Transport
Legislation
Integration
Train Decision Makers
Technology will evolve anyway but policy framework will shape its use
Legislation
Guide Implementation
First vision then Framework
Function development
Integration with Shared and Electric Mobility
Function development
Integration
Discuss / Identify Desirable Use Cases before promoting awareness
Vision for a Sustainable Future
Promoting Awareness for Desirable Use Cases
Use Cases
Business Models
short-term
mid-term
long-term
L4/5 Automation (2030+)


Economic
SCOUT
1) Hurdles:
Status quo in mobility structure
Potential Price for automated/ connected driving -> willingness to buy
Public Funding
Uncertainty of legal framework
Cost factor of vehicle and infrastructure
Effects on existing transport services
Maintenance Requirements
Risk of monopoly
Incomplete cost-benefit analysis
Acceptance of shared mobility services
Uncertain investment strategies
Uncertainty of policy framework
Insufficiently defined use cases
Not proven permission of ACP is cheaper than conventional.
Role of public authorities, transport providers etc.
2) Actions/Links:
ACTIONS
T LAYER LINKS
Investment
H
T Integration
Create and Align Investment Incentives
L Legislation
S Policy Framework
Balance Investment Amongst Stakeholders
L Legislation
Scalable economy
Business Models
Liability/Legislation L
User Acceptance H
Development of Business Models
T Function Development
Policy S
Policy S
Adapt Framework to Balance Competition
L Legislation
L
Land Use policies elaboration, incentives (special investments)
Use Cases
Identification of Use Cases
T L H S
S
User Acceptance H
Adaptation to User Feedback
Public Planning
L
Tests, Simulations to prove predicted benefits
Providing legal framework for economically liable services
short-term
mid-term
long-term
L4/5 Automation (2030+)

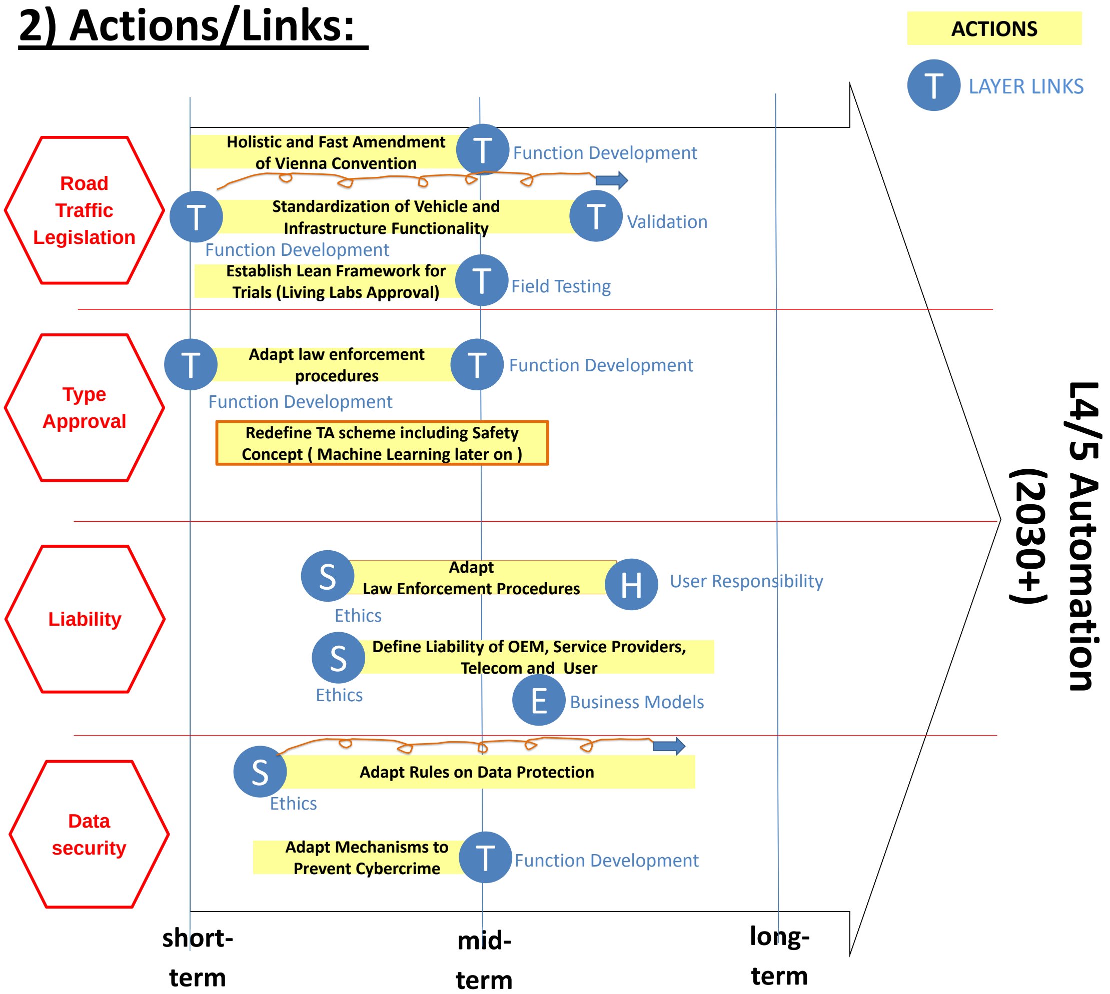

Human factors
SCOUT
1) Hurdles:
Compatibility with user expectation (fun, status symbol,...)
User Education
Building confidence and trust
Awareness of user responsibility
User condition monitoring/ sensing
Effects of job market
Skill Degradation
User-System Interaction
Skills teleoperation and traffic management
Opportunities for elderly, disabled and children
Missing behavioral schemes in incidents and accidents
Motion sickness
Ethic Issues
With interaction – VRUs and non-automated vehicles
Data Protection & Privacy
Time-Use (Value of Time)
Acceptance of new mobility forms
2) Actions/ Links:
ACTIONS
T LAYER LINKS
User Acceptance
S
Promotion of Benefits
T Living Labs T
E
Function Development
Function Development
User Responsibility
L Definition of User Responsibility (1)
T Derivation of Behavioral Models T
Function Development
Function Development
User-System Interaction
T Design of Vehicle System
Function Development
Definition of Operative Roles (1) L
User Experiments (Demos, Simulation, Living Labs) T
Liability
(1) Both are linked
Skills
Determine Education Needs for Users and Operators
S Develop profession profiles
Training for Decision Makers
L Continuous Training
short-term
mid-term
long-term
L4/5 Automation (2030+)

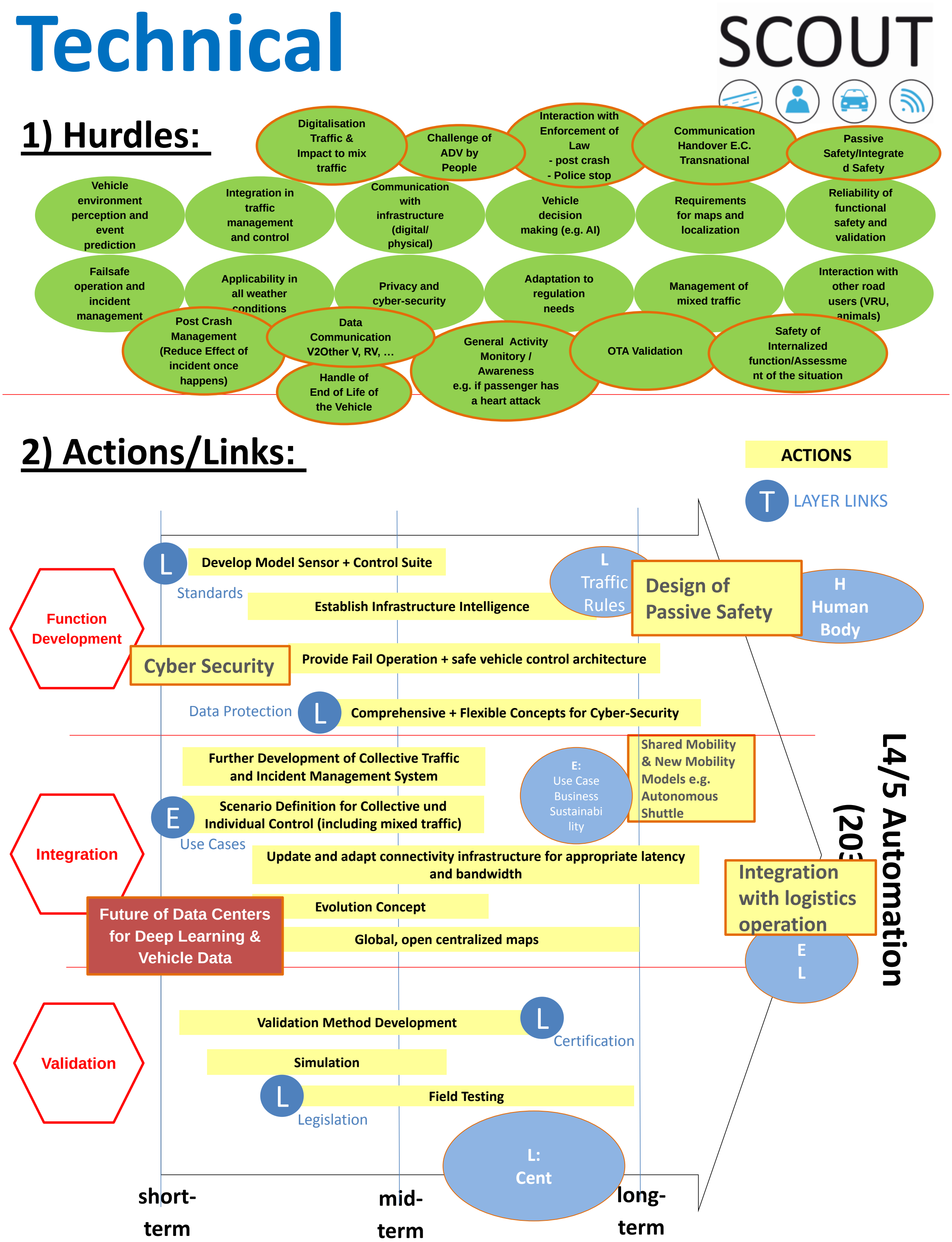
Legal

1) Hurdles:



2) Actions/Links:




Technical
SCOUT
1) Hurdles:
Digitalisation Traffic & Impact to mix traffic
Challenge of ADV by People
Interaction with Enforcement of Law - post crash - Police stop
Communication Handover E.C. Transnational
Passive Safety/Integrated Safety
Vehicle environment perception and event prediction
Integration in traffic management and control
Communication with infrastructure (digital/ physical)
Vehicle decision making (e.g. AI)
Requirements for maps and localization
Reliability of functional safety and validation
Failsafe operation and incident management
Applicability in all weather conditions
Privacy and cyber-security
Adaptation to regulation needs
Management of mixed traffic
Interaction with other road users (VRU, animals)
Post Crash Management (Reduce Effect of incident once happens)
Data Communication V2Other V, RV, …
Handle of End of Life of the Vehicle
General Activity Monitory / Awareness e.g. if passenger has a heart attack
OTA Validation
Safety of Internalized function/Assessment of the situation
2) Actions/Links:
ACTIONS
T LAYER LINKS
Function Development
L Standards
Develop Model Sensor + Control Suite
Establish Infrastructure Intelligence
L Traffic Rules
Design of Passive Safety
H Human Body
Cyber Security
Provide Fail Operation + safe vehicle control architecture
Data Protection L
Comprehensive + Flexible Concepts for Cyber-Security
Integration
Further Development of Collective Traffic and Incident Management System
E: Use Case Business Sustainability
Shared Mobility & New Mobility Models e.g. Autonomous Shuttle
E Use Cases
Scenario Definition for Collective und Individual Control (including mixed traffic)
Update and adapt connectivity infrastructure for appropriate latency and bandwidth
Integration with logistics operation
E L
Future of Data Centers for Deep Learning & Vehicle Data
Evolution Concept
Global, open centralized maps
Validation
Validation Method Development
L Certification
Simulation
L Legislation
Field Testing
L: Cent
short-term
mid-term
long-term
L4/5 Automation (203