Lawyers and Engineers Can Speak the Same Robot Language

Forthcoming as: Bryant Walker Smith, Lawyers and Engineers Can Speak the Same Robot Language, in Robot Law (2014)

Engineering and law have much in common. Both require careful assessment of system boundaries to compare costs with benefits and to identify causal relationships. Both engage similar concepts and similar terms, although some of these are the monoglot equivalent of a false friend. Both are ultimately concerned with the actual use of the products that they create or regulate. And both recognize that the use depends in large part on the human user. This forthcoming book chapter emphasizes the importance of these four concepts—systems, language, use, and users—to the development and regulation of robots. Although the chapter applies broadly to robotics, motor vehicle automation provides the primary example.

Key Reference Documents

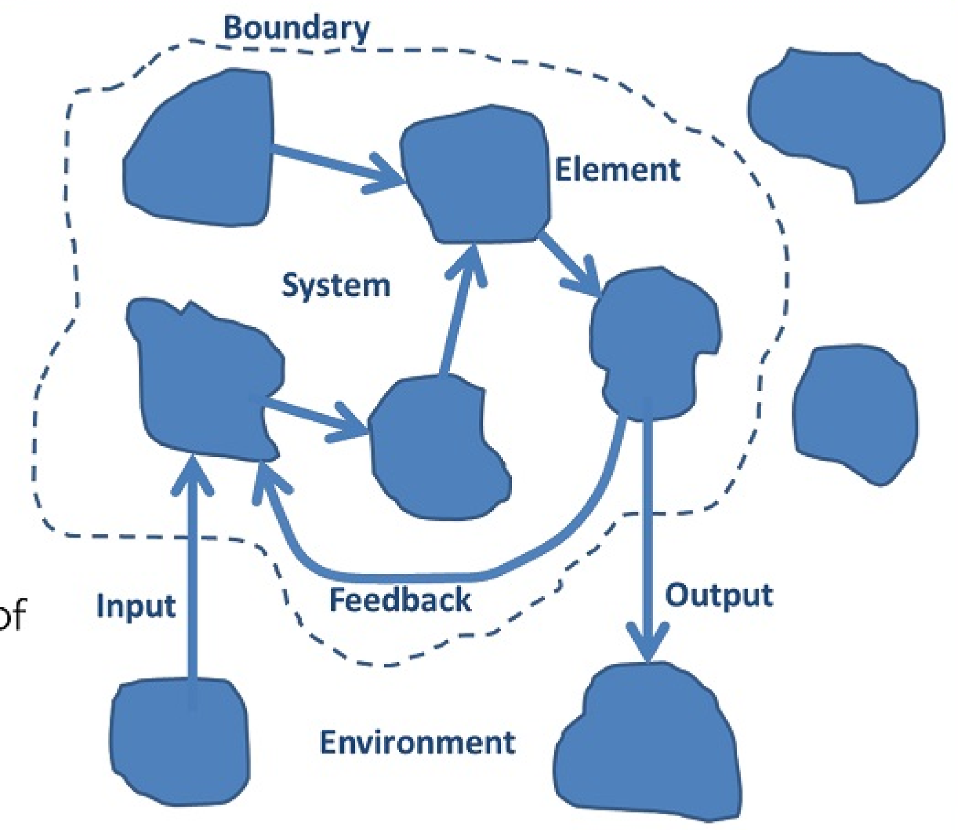
- SAE J3016 Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems,
- ISO 26262 Road vehicles – Functional safety.
- ISO/IEC 15288 Systems and software engineering – System life cycle processes,

Systems

Rising automation and connectivity will demand increasingly thoughtful systems analysis:

1) M2M networks, OTA updates, 3D printing, and other developments may lead to products that complicate traditional legal distinctions
2) Human enhancement/augmentation will blur human/machine boundary
3) More analysis may review previuosly unrecognized causal relationships

The concept of systems is essential to all parts of this chapter.



Language

Control

Control theory is only useful when the pertinent control system is clearly defined. Because they obscure rather than clarify the system, casual references to "control" or "under control" are particularly unhelpful.

- -Engineer: Control Loop?
- -Lawyer: Principal-agent relationship?
- -Public: Killer Robots?

Most automatic control systems can be defined broadly enough that they involve a human and narrowly enough that they do not.
Rather than attempt to define control (as well as particular control systems), SAE J3016 deliberately eschews most standalone uses of the term. Instead, for each level of vehicle automation, it specifies whether the "human driver" or the "automated driving system" performs the "dynamic driving task."
Ultimately, control is more useful as a structure than as a standalone term. Those who would deploy it should first describe the control system they actually intend.

Risk

The risk of a particular harm is the product of the probability of that harm and the severity of that harm; the risk of an act or omission is the sum of the risks of the particular associated harms. Different domains are concerned about different harms.

The secondary risk to actors who may have created the primary risk must not be conflated with the primary risk itself: a given risk to life or limb cannot be "transferred" to another party or "reduced" by a grant of tort immunity.

Safety, Reasonableness, and Efficiency

Engineering and law both struggle to define reasonable safety. Meaningful cost-benefit analysis requires an appropriate system. Excluding certain decisions (like driving too fast or selling a categorically unsafe product) could affect whether a behavior is deemed reasonable (like crashing unavoidably or selling the safest possible product).

Responsibility

Responsibility can be used in a legal, technical, or moral sense. SAE J3016 avoids the potential conflation of these domains by speaking of performance rather than responsibility.

Even within the legal domain, responsibility requires careful definition:

- -Legal Obligation
- -Civil Liability
- -Criminal Liability

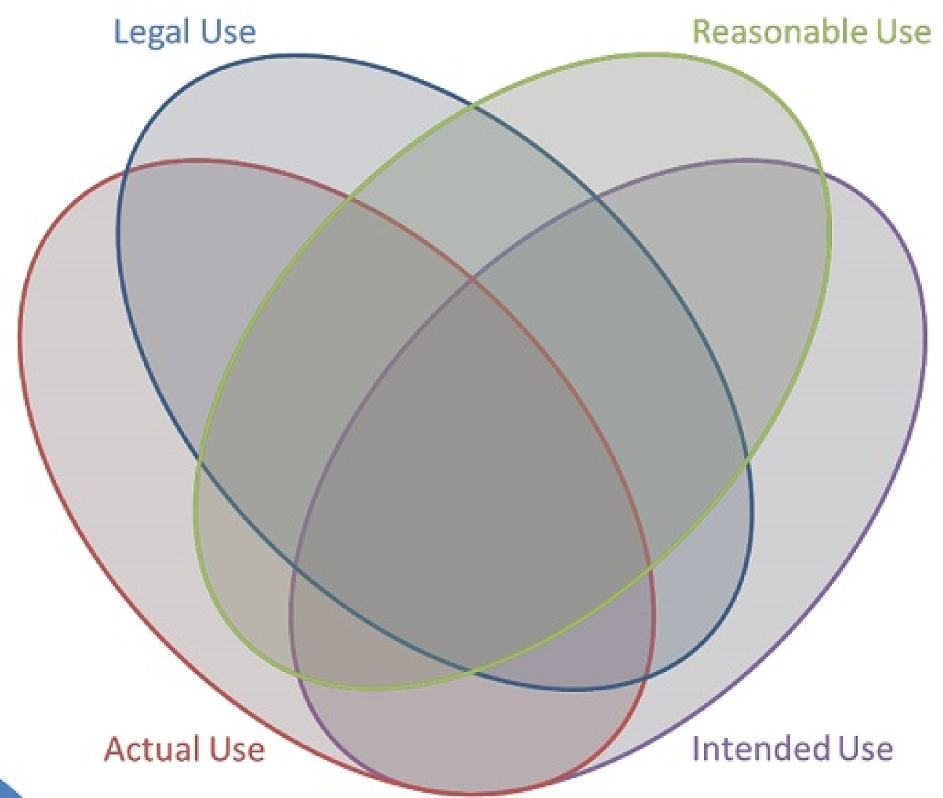
Liability is not an either/or proposition: Depending on the facts and the jurisdiction, the vehicle owner, operator, seller, manufacturer as well as upstream providers of parts and services may all be civilly and in some cases even criminally liable.

Use

Engineered systems are used. This actual use (including misuse and abuse) may or may not be an intended use, a legal use, or even a reasonable use.

1) Intended Use
2) Legal Use
3) Reasonable Use
4) Actual Use

Tensions among the actual, intended, legal, and reasonable uses suggest particular structural failures. An open question is the extent to which product design should attempt to confine actual uses to those that are legal, reasonable, or intended (e.g., Speed regulators and ignition interlocks).



The expanding ability of manufacturers to monitor and update their products in the field may increase their obligations to also facilitate reasonable use of those products.
See: Bryant Walker Smith, *Proximity-Driven Liability*
http://ssrn.com/abstract=2336234

Poster credit: Sien Rivera

An Example of Use: Traffic Speed

1) Legal Speed
- -Statutory Speeds
- -Posted Regulatory Speed
- -Posted Advisory Speed
- -Basic Speed

2) Actual Speed
3) Design Speed

Legal speed affects design speed, which affects reasonable speed, which affects actual speed, which affects legal speed, which affects actual speed, which affects reasonable speed. Automated systems face a similar dilemma, in part because they still depend in part on human judgment or performance:

Users

In the words of the Defense Science Board (DSB), "all autonomous systems are joint human-machine cognitive systems." Human factors scholars have long recognized that circumscribing the human role in a human-machine system does not necessarily make that system less susceptible to human failure.

-ISO 26262 recognizes that both the safety technology and the human driver can be part of a larger safety system.
-SAE J3016's levels of driving automation which reveal this complexity are summarized in the chart below, reveal some of this complexity.

Summary of Levels of Driving Automation for On-Road Vehicles

This table summarizes SAE International's levels of driving automation for on-road vehicles. Information Report J3016 provides full definitions for these levels and for the italicized terms used therein. The levels are descriptive rather than normative and technical rather than legal. Elements indicate minimum rather than maximum capabilities for each level. "System" refers to the driver assistance system, combination of driver assistance systems, or *automated driving system*, as appropriate.

Level	Definition	Execution of steering and acceleration/ deceleration	Monitoring of driving environment	Fallback performance of *dynamic driving task*	System capability (*driving modes*)
0 No Automation	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1 Driver Assistance	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2 Partial Automation	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
3 Conditional Automation	the *driving mode*-specific performance by an *automated driving system* of all aspects of the *dynamic driving task* with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4 High Automation	the *driving mode*-specific performance by an *automated driving system* of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5 Full Automation	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

Select Questions

-Does the human driver or the automation system exercise ultimate authority over steering, acceleration, and deceleration?

-Can this apply to automated emergency intervention systems?

-What if human oversight further increases an automated system's overall safety?

-SAE J3016 specifies the intended use on the assumption that this use is reasonable, and it does not specify the actual or legal use. When is the legalor reasonable use actually attainable?).

Safety assessments necessarily involve assumptions about scale, timeline, and causation—classic issues related to system boundaries.

The systems analysis introduced in this chapter reveals the conceptual, linguistic, and practical difficulties that developers and regulators will confront on the path toward increasing automation. The safety of these automated systems will be determined both by their design and by their use. Because humans will remain a key part of both design and use, they are best understood as part of the systems themselves.