Self-Driving Cars –
what, when, why and why not

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In March 2012, Google published a video showing a blind man behind the wheel of a car, driving on public roads, going about his everyday errands. How was the blind man able to drive the car? By use of self-driving technology.

Today there are many major car producers that are developing their own self-driving car (SDC) prototypes, including Volvo, Toyota, Audi, Nissan, Mercedes-Benz, General Motors, Honda and Tesla Motors (EY, 2014) (Shimizu, 2014). As of April, 2014, Google’s SDCs have traveled more than a million kilometers on public roads, without ever causing an accident (Google, 2014). Volvo are currently testing their self-driven cars on public roads in Gothenburg, and the company plans to have made SDCs available for purchase by 2017 (Stevens, 2014). Volvo envisions all its new cars to be virtually uncrashable by the year 2020, much as a consequence of self-driving technologies.

The self-driving car, long a subject restricted to science fiction, theoretical discussion and contained laboratory experiments, is now becoming a reality. One of the technology’s many prominent proponents is Catharina Emsäter-Svärd, Sweden’s Minister for Transportation during the Reinfeldt government 2010-2014. She has named the technology as key to increase traffic efficiency (Persson, 2014, p. 10).

As recently as November 2015, the current Swedish government announced that they are actively working on ways of practically introducing SDCs on public roads (Tibell, 2015).

So, why are so many so enthusiastic about self-driving cars? There are several reasons, the most important of which are increased traffic safety, decreased environmental harm and urban planning.
Traffic safety: As is discussed in the paper ‘Self-Driving Cars: Diffusion of Radical Innovations and Technology Acceptance’, the number one cause of traffic accidents is human error. By taking humans out of the equation, traffic safety is thus expected to increase significantly.

Decreased environmental harm: By optimizing traffic flow and by use of effective driving algorithms, emissions from traffic are expected to decrease.

Urban planning: Optimization of traffic flows would not benefit the environment; it would also lessen the need of ever-bigger roads to accommodate increasing traffic. Computer-driven cars would also be much more effective at parking. They would be able to park much closer to one another, and some people envision that SDCs would drive their passengers to the desired location and then drive off to park themselves somewhere outside city centers. These factors would reduce the need for parking lots and car parks, freeing up space for residential, industrial or recreational areas.

There are five levels of automation. They are defined as follows:

- **Level 0: No Automation**, where the vehicle operation solely depends on the driver with no automated input. This includes situations where the driver is assisted by passive systems such as a GPS-transmitter or parking sensors. At this level, the driver is fully responsible for navigating the car.

- **Level 1: Function-Specific Automation**, when the vehicle automatically performs one specific control function. Examples include cruise control, where the vehicle maintains the speed set by the driver; and lane centering. These functions may allow the driver to let go of either the pedals or the steering wheel, but not both. At this level, the driver is fully responsible for navigating the car.

- **Level 2: Combined Function automation**. At this level, the vehicle carries out two or more simultaneous functions automatically, for example both cruise control and lane centering. (This has been used in automatic congestion driving.) This differs significantly from Level 1, since it involves situations where the driver can let go of both steering and accelerating/braking. The driver is still fully responsible for navigating the car, and must be prepared to take over full control at all times.

- **Level 3: Limited Self-Driving Automation**. This level entails situations where the car is able to fully drive itself, without the driver’s assistance, under specific conditions. These conditions may relate to weather conditions or the traffic situation around the car. Cars equipped with active security products, such as automatic emergency brake systems, typically fall into level 2 or level 3.

- **Level 4: Full Self-Driving Automation**. This is when the car is able to make any journey all by itself, regardless of external conditions. Google’s prototype, unveiled in May, 2014, is planned to have Level 4-automation. With a market release planned for some time between 2017 and 2020, the car will have no controls to enable manual driving such as a steering wheel or gas / brake pedals – just one single on/off switch (Urmson, 2014).
Most industry experts agree that the technology is no longer a problem. Rather, the barrier to overcome is the technology acceptance of car drivers. In the paper ‘Self-Driving Cars: Diffusion of Radical Innovations and Technology Acceptance’, a new framework to measure and assess drivers’ technology acceptance was therefore developed. The framework is dubbed ROCAM (Robotic Car Acceptance Model), and has its roots in several classic acceptance models, such as the TAM frameworks.

The ROCAM illustrates that the base for driverless technology acceptance is technology readiness. Technology readiness is the foundation for the three factors Perceived Risk, Perceived Usefulness and Perceived Ease of Use. For a more detailed introduction to ROCAM, refer to the paper ‘Self-Driving Cars: Diffusion of Radical Innovations and Technology Acceptance’.

To increase acceptance of driverless technology, the full paper explains that SDCs need to provide their passengers a lot of information. In essence, acceptance would increase if the car continually communicates its reasoning and its calculated next moves to the passenger. Another way of increasing trust in an SDC might be to give it human characteristics, such as gender and name.

Some research into artificially intelligent robots suggests that acceptance rises if the user perceives that the machine is capable of making human-like mistakes, such as stumbling or misremembering something from time to time. However, it is highly questionable whether this applies to robotic cars!

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