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Lesson 5 Glossary

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abide (verb)*:* to tolerate, to stand.

agile (adjective): to be quick or responsive. (Note: There is a school of “agile management” that is a defined process, but that is not the specific meaning used in this Lesson.)

allowances (plural noun): provisional room to change or update information, processes, content, technical features, etc. (as used in the document excerpt; there are other definitions of this word for other uses)

calibrate (verb): to determine exactly; also, to correlate the measurements of an instrument with a reading to check an instrument’s accuracy.

charter (noun): a document that formally outlines the function, purpose, structure, rights, and responsibilities of a boyd or organization.

codified (past tense verb): to collect and systemitize; to reduce to a set of code or rules.

critical (adjective): of great importance; imperative in nature (as used in the document excerpt; there are other definitions of this word for other uses).

dedicated (verb, adjective): to be loyal to, or for the exclusive use of.

deployment (noun): the onset of an action, or implementation of a plan.

embedded (verb, past tense): place into a surface or substance.

ever-changing (adjective): continuously changing; always morphing.

horizon (noun): the limit of knowledge or function (as used in the document excerpt; there are other definitions of this word for other uses)

feat (noun): a noted accomplishment; an important achievement

incremental (adjective): relating to a fixed addition or increase, often in small amounts.

infrastructure (noun): the basic built services, utilitics, and facilities that serve human purposes such as roads, bridges, water lines, electricity, schools, hospitals, and the like.

lidar (noun; also, liDAR or LIDAR or LiDAR): a surveying method that measures distance to a target by illuminating it with pulsed laser light and measuring the reflected pulses with a sensor. Short for light detection and ranging.

mandate (verb, noun): to require; to order/a requirement or order.

meager (adjective): a small, modest or inadequate amount.

onset (noun): beginning, launching point.

protocol (noun): a set of established rules or regulations that allow work to proceed with some predictability.

provisions (plural noun): allowances. (as used in the document excerpt; there are other definitions of this word for other uses)

real-world (adjective): not theoretical.

reconfigure (verb): to realign; to redesign; to rework.

reflect (verb): to cast back; to show.

threefold (adjective): three times as much.

undoubtedly (adjective): undisputed; reliably.

ushered in (past tense verb): brought in; began.

V2V (acronym): short for “vehicle to vehicle.” In this specialized case the “2” has replaced the word “to” because it is an English sound-alike word that shortened the acronym by one keystroke.

V2I (acronym): short for “vehicle to infrastructure.” In this specialized case the “2” has replaced the word “to” because it is an English sound-alike word that shortened the acronym by one keystroke.

V2X (false acronym): short for “vehicle to anything with an antennae.” In this specialized case the “2” has replaced the word “to” because it is an English sound-alike word that shortened the acronym by one keystroke.

wifi (noun): a common word for the capability of electronics to connect to the Internet or other devices wirelessly within a defined geographic area.

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Lesson 5, Grammar: Adjective Use

Speaking

Sequence of individual, unrelated adjectives

In English, adjectives precede nouns. It is possible to build strings of 2, 3, 4 and more adjectives to modify the noun, with each adding a specific characteristic. Adding more than 3 is not recommended, especially in spoken English, since too many adjectives can impede listening comprehension and obscure the noun that is being described. In any case, the following is the proscribed sequence, also called the Royal Order of Adjectives:

opinion < size <temperature < age < shape < color < origin < material < purpose

An example of a relevant—but unusual—sentence that accurately describes this sequence would be:

An excellent, large, hot, new, rectangular, black, English metal container

Hyphenation in related adjectives

Hyphens between adjectives imply that there is a relationship between adjacent terms. In some cases, the relationship consists of the fact that all the terms are components of the noun that is being modified. Examples include: carbon-monoxide detector; hydro-electric dam; lithium-oxide battery.

Hyphens are a useful tool for combining two or more terms that, together, form a single unit of meaning. A chemical that is sensitive to heat becomes a heat-sensitive chemical, for example. Also: the phrase *an excavation machine that is 6 years old* can be more briefly and elegantly expressed *as: a 6-year-old excavation machine*. Notice that when numbers are used, plural forms are changed to singular forms (6-year-old; not 6-years-old). This means that a tunnel of 1,000 *feet* becomes *a 1,000-foot tunnel*. Likewise, a job for ten men *becomes a 10-man job*.

Hyphens are not used with an adverb precedes the group of adjectives. Often, you'll recognize adverb use through the word ending -ly. For example, material that is extremely fire resistant is: *extremely fire-resistant material*. Metal that is very prone to corrosion is: *very corrosion-prone metal*.

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Lesson 5: Common Prepositions in English

The following is a list of the 50 most common prepositions in English, listed in order of frequency. That is, the word of is by far the most frequent. Many of these words are used to indicate a specific time or location: that is, they have a true preposition function. However, some also function as adverbs or adjectives. Some prepositions have relatively little meaning, but are used in idioms. Common examples of use follow each preposition.

Of	It's 10 of 5, or 4:50 pm.
With	Come with me; we're start on it together.
At	The project begins at 9 o'clock exactly.
From	The collaboration will last from May until September.
Into	Two goes into twenty ten times.
During	A loud drilling noise occurred during the operation.
Including	We'll need to have a discussion including both the planning and the accounting departments.
Until	I'll be there late—that is, until 10 pm.
Against	To make sure that the adhesive is effective, push the plank up firmly against the wood.
Among	He is just one engineer among 20 qualified staff in the company.
Throughout	Intermittent safety checks took place throughout the entire summer.
Despite	Despite our slow progress, the manager was pleased with the quality of our effort.
Towards	Don't give up on finding a solution; together, we should work towards solving the problem.
Upon	Upon finally reaching the West Coast, he began to look for new opportunities.
Concerning	They wrote a note concerning the need for more resources as soon as possible.

To The letter is addressed to the forensics lab that we are working with.

In Put the new batteries in a cold place for long and effective storage.

For We asked for an accounting of how the money was used.

On When they arrived, the new pipes were sitting on frozen soil.

By The report was written by a new standards organization.

About I don't know the exact distance, but I would say it's about 12 kilometers.

Like Iron, like certain other metals, tends to corrode when exposed to moisture.

Through By pushing a pipette through the tunnel, we were able to clear the channel.

Over The bridge over the Thames river is solidly constructed.

Before Before you begin using the slurry on the road, check its consistency.

Between. Between noon and 1, I will be traveling and unavailable for a conference call.

After After a hard rain, be sure to dry off all the components that were lying in the open.

Since I have conducted research on this topic since I was hired.

Without. They refused to deliver the materials without prior payment.

Under Put the perishable items under a tarp to protect them from the elements.

Within Within our company, we have trained seismologists.

Along They discovered hairline cracks along the side of the road.

Following As he was following the instructions, he realized that something was missing.

Across Two hundreds years ago, it was only possible to travel across the ocean by ship.

Behind The deadline was Friday. It's Monday, so we are running behind schedule.

Beyond He doesn't have training as a chemical engineer. Giving a suitable recommendation is beyond him.

Plus Twelve plus thirteen equals twenty-five.

Except We'll provide all of the equipment except for our new drill, which must stay here.

But I understand the need for haste, but it's more important to be accurate than to be fast.

Up When we looked up, we realized that inclement bad weather was going to be a problem.

Out My clock is out of synch with yours: we will need to coordinate to make sure they agree.

Round The round of selections continued until there were no choices left to anyone.

Down	You may set the gauge down: it must be heavy.
Off	Please take the tie-downs off: we are ready to unload the girders from the truck.
Above	The CEO in our company has authority that is above that of our business manager.
Near	When the researchers got near the site, they began to show special interest.

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Lesson 5 Reading Excerpt 1

For explanation of words in bold, see the Glossary.
White Paper: *Sensors for Autonomous Vehicle Development: A History and An Update, "Introduction and Background to the Growing Demand for Sensors and Antennae for Autonomous Vehicle Development."*

With the United States being our initial target for autonomous vehicle **deployment**, it is **critical** to understand the need for the wide array of sensors that will be used within the industry.

As early as 1997, the concept of an automatic highway system (AHS) was regarded as a revolutionary idea. At that time, an eager industry saw its potential by witnessing "Demo 97," which was a project based on the idea that the roads themselves would be part of the self-driving car environment. For testing and demonstration purposes, Demo 97 engineers and road experts **embedded** over 93,000 magnets into an eight-mile stretch of road; the magnets contributed to the vehicles' navigation and speed. Part of the persuasive argument for creating such automated systems for vehicles was traffic flow. Assuming consistent traffic speed with fewer or no accidents, high volume roads would experience up to a **three-fold** decrease in traffic jams. The event, which took place on a San Diego highway with 20 fully automated vehicles, took place without a hitch.

However, politics and economies have interfered with the Demo 97 vision. With the United States reporting that it is approximately US$504 billion behind in basic road and bridge maintenance, new high-tech roads embedded with magnets or other guidance tools are not on the **horizon**. In fact, as of 2019, the working **charter** of the US Department of Transportation doesn't contain any wording or language that addresses autonomous vehicles. At this point, if car manufacturers want to move towards autonomous vehicles, the entire guidance package must be within the vehicle itself. In contrast to updating any nation's entire transportation **infrastructure**, it is apparent that the move to autonomous vehicles will be from the manufacturers of these vehicles. It is infinitely more cost effective to make light, cheap cars than to **reconfigure** a nation's entire road system.

Getting to a Level 5 autonomous vehicle is no small **feat**. There are different kinds or levels of communication systems that must be in place and fully functional for them to work:

- Vehicle to Vehicle (**V2V**)
- Vehicle to Infrastructure (**V2I**)
- Vehicle to Anything with an Antenna (**V2X**)

The industry is currently pursuing a combination approach to creating a sensor network within each vehicle that will allow it to operate and be safe. Any of the above three communications systems will have to work with existing data **protocols,** including GPS, Wi-Fi, and the open-source dedicated short-range communication (DSRC) radio-frequency protocol.

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Lesson 5 Reading Excerpt

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White Paper: *Sensors for Autonomous Vehicle Development: A History and An Update*, "Vehicle to Vehicle (V2V) Communication."

The three Vs (V2V, V2I, and V2X) **undoubtedly** will have to be used together for any autonomous vehicles to be safe and functional. Vehicle manufacturers should **abide** by the US Federal Motor Vehicle Safety Standard (FMVSS) No. 150 of 2016. It states that all new light vehicles should be able to communicate with each other by the year 2023. The scope of FMVSS 150 is that all vehicles in the "light" category can send and receive basic safety messages (BSMs) to each other. The main **objective** for any V2V effort should and will be increased safe operation of the vehicle. Advances in sensors, antennas, wireless, and cloud systems working together will allow a new era of safety to be **ushered in**.

The entry level for these advances is with the vehicles themselves. Industry leaders and government agencies must create a set of standards by which V2V can operate. To begin, there are several steps. First, all systems and standards must assume that cars must talk to other cars. Currently, it is assumed that this will initially be accomplished by using dedicated short range communication (DSRC) technologies for any BSM. Second, mandates must be **codified** which control uses of DSRC, including who will monitor and protect the secure messaging environment for all manufacturers. Third, such efforts would be combined with performance requirements, architecture specifications, and test procedures for verification of sending and receiving BSMs.

As of this writing, the NHTSA anticipates that any mandates for V2V and/or DSRC will be written to allow **provisions** for future technologies that may take its place.

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Lesson 5 Reading Excerpt 3

Despite the use of lidar technology by competitors such as Uber and Waymo, developers at Tesla will be avoiding the use of lidar for their vehicles. Instead, the engineers and AI specialists at Tesla insist that cameras will be the technology that allows self-driving cars to gain enough reliability to reach Level 4 or Level 5 autonomy without risking passenger safety. Tesla engineers claim that lidar is not a safe option for fully autonomous vehicles because lidar cannot tell “a plastic bag from a rubber tire.” Tesla will be investing its efforts into camera technology which will be fine tuned through massive AI inputs via a neural network fed by other Tesla vehicles.

However, experts challenge Tesla’s exclusive reliance on cameras. Camera technology, they argue, is nothing more than replicating the limitations of the human eye: both cameras and eyes are challenged to see well at night or when there is a storm, for example. Using cameras alone is building a mechanical analog to human capability only, with all the associated limitations.

Lidar holds promise because it can function in ways far beyond human (or camera) capabilities. Lidar can effectively process the active roadway surroundings in ways that cameras simply cannot. As of this writing, advanced environmental sensing lidar technologies are still important to autonomous vehicle development, complimenting the functionality of cameras for self-driving cars.

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Lesson 5: Complete Sentences Transcript

1. Many advancements that deal with unanticipated circumstances have been made.
2. Menendez is looking for sensors that are able to classify obstacles.
3. Internal prototypes that we have been using can't predict all hazards.
4. The multiple sensing devices that an autonomous vehicle needs are a challenge for mass production.
5. Pedestrian detection is one of the most important challenges that we face.
6. The assumption that pedestrians are always in standing mode is not completely true.
7. Fish-eye lenses that we're familiar with produce optical distortions.
8. Robert plans to consult with traffic engineers who are very knowledgeable about traffic management systems.
9. Engineers who have experience in robotics may have extra insights on the best sensors.
10. A golf cart that was deployed on a university campus recently used digital image processing technology.

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Lesson 5: Speaking Transcript

Myra: So, Roberto, how is your research coming?

Roberto: Well, by degrees, I feel I'm really coming up to speed. I have ten evaluation criteria for sensors that I know by heart, that I can produce at a moment's notice.

Myra: Really? I'm impressed. What are some of them?

Roberto: Well, there is cost, illumination, noise, range, resolution, weather, velocity tracking, height tracking, distance tracking, and classification.

Myra: And what are the sensors that you're evaluating with these criteria?

Roberto: In short, I'm basically looking at camera, lidar, and radar. But in my opinion, none of them are perfect. Cameras fall down on distance tracking and in the dark, Lidar is expensive, and radar has resolution issues.

Myra: On balance, which type has the most to offer, would you say?

Roberto: I can't say for certain just yet. It's hard to come to any solid conclusions, although lidar has real advantages by far in terms of tracking.

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Lesson 5 Transcript

For explanation of words in bold, see Glossary

Listening Practice 5, Part One

Good morning, students. As you may remember, I've been mentioning from time to time the contributions made by Expo 97 to development of autonomous vehicles. But it seems helpful to expand on that history a little bit so that we can about what the Expo was expected to accomplish, and what in fact it did accomplish, pointing the way to developments in the field today.

To meet its legislative **mandate** from Congress, the NAHSC decided to create Demo 1997. In actual fact, the event took place in year 3 of a planned 7-year study. By then, the core issues had become reasonably clear. A key discussion point was whether a prototype highway system needs fully **dedicated** lanes, occupied only by vehicles **calibrated** to communicate with each other, or whether automated vehicles can be equipped with enough internal sensors that they can safely navigate on regular highways, mixed with manually driven models. Undertaken by Carnegie Mellon University, and presented in detail at an IEEE conference in September of 1997, this question is an extremely complex one, and I'll address just a few of the factors today.

So, certainly, mixed-use highways was one concern, and another was the use of so-called "free agents." Free agent vehicles are actually surrounded by sensors and free of infrastructure.

Listening Practice 5, Part Two

Now, here's how the concept of free agents was described at the **onset** of Demo 1997. Free agents can be used for driver assistance even when not driven autonomously. The vision system warns drivers when they begin to drift off the road: if your car has been manufactured in the last five years, you're quite familiar with the lane recognition warning alarms, for example. Radar warns drivers of others stopped on the road immediately ahead.

But one of the most useful design features is the use of **incremental deployment** of automation. Consider this: you live in a relatively rural area. You leave home in your vehicle, but rather than actively driving, you are reading a technical article and sipping coffee while your free agent takes you, in sparse traffic, to a busier metropolitan center without any involvement from you. You're now in a zone that features a traffic control center that sends speed signals to all entering vehicles based on an analysis of current traffic patterns; you hear a recorded alert about that change. As a privately owned vehicle, your car gets to ramp up its speed so that it passes public busses safely. Sounds ideal, right?

In actual fact, all runs of free agents at Demo 1997 were successful. But as you might expect, there were some bugs. For example, radios that worked well in less congested cities like Pittsburgh did not work well in San Diego, and substitutes were needed. Also, unexpectedly, radars picked up overpasses as obstacles, making for unnecessary slowdowns. We'll go into other challenges after a short break.