The Diagnostic Process -- It's about *what* you know

There are many approaches to diagnosing *any* problem with a vehicle. Most (if not all) manufacturers have a published diagnostic method -- or routine -- that they want you to follow, which will systematically guide the technician to find the failure in as little time as possible. I'm not referring to diagnostic trouble code routines. I'm referring to the overall diagnostic process, which is in all reality generic and relies mostly on common sense. But because of the diverse levels of knowledge and experience found within the total population of technicians, manufacturers had to develop a process that all technicians can follow that will hopefully lead to them to the root cause of the problem.

Take for example the Ford process, which instills the SSCC -- Symptom to System to Component to Cause. The SSCC concept makes great sense when you think about it. Take the symptom and determine which vehicle systems could cause that symptom. Vehicle systems could include engine mechanical, engine electronics, computerized engine controls, transmission, driveline, body electrical, etc. Once the systems are identified, determine what components could cause the symptom and then test them. If a problem is found, make sure it isn't the result of a greater issue, which would be the root-cause.

Let's take for example a 2000 Ford Windstar with a 3.8L engine comes in with a surging at cruise symptom without any stored diagnostic trouble codes. What systems could cause a surge at cruise?

Transmission: Torque converter engaging/disengaging
Fuel System: Lean running cylinder(s)
Ignition System: Misfire
Emission System: Purge, EGR
Body Electronics: Charging system, A/C cycling

This is just a rough listing of systems that would relate to the surging symptom, but it shows some important points.

1. Many vehicle systems can cause the same symptom
2. Technicians need to be verse in many technical areas
3. Wearing blinders during diagnostics can seriously limit your diagnostic skills. It's important to look at the whole picture, and don't get short sighted.
4. A solid understanding of a system is essential to determine if it's operating correctly, which is essential to proper diagnosis.

With the possible systems identified, it's time to narrow them down to determine which one is most likely causing the problem. Visual inspections, TSBs, published service manual diagnostics, scan tool interpretation are the likely tools used to determine the system at fault. Individual component tests will then lead you to find the actual failed part, but let's not forget about the root-cause. Sometimes, if you're lucky, the component failure is the root cause, but it's not worth taking a chance.

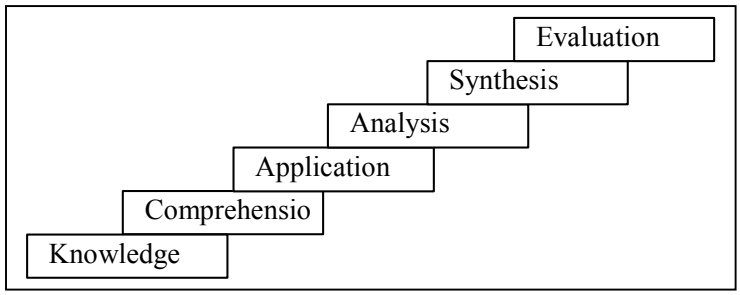
In the case if the vehicle surge in the provided example, the transmission was eliminated as a source by reviewing scan data. The TCC remained engaged, which was determined by reviewing the scan data. The ISS and engine RPM did not differ, which provided strong evidence that the TCC was staying locked. While diagnosing the engine control system (fuel, ign, emission) with a scan tool, the tech noticed that the fuel trims increased during the surge and the HO2S shifted lean. This all occurred at the same time the EGR was commanded ON. Through inspection, the tech determined that the EGR system was not flowing adequate exhaust gas, which the PCM was expecting to enter the cylinder. With the absence of the metered recirculated exhaust gas, the cylinder took a larger charge of fresh air, which drove the fuel mixture lean. This resulted in the lean misfire under slight load at cruise. The greatest clue was the scan data.

This example shows how important it is for technicians to be proficient in all areas of the vehicle to make sound diagnostics on vehicle systems. It all drives home the important point #4 mentioned above: "A solid understanding of a system is essential to determine if it's operating correctly, which is essential to proper diagnosis." It not practical for every technician to know every piece of technology on a vehicle, but it should be expected that every technician be able to learn about the systems and how they work on a vehicle, even if it's while you're diagnosing it for the first time.

The Process of Learning: Logical and Efficient

The process of learning technology is much different than the diagnostic process. It starts with the fundamentals and works up. It involves a hierarchy, which requires you to complete one step, before attempting the next step. The following learning hierarchy is modified from "Bloom's Taxonomy," which identifies the way people achieve different intellectual levels. The following description uses transmission diagnostics as an example, but it could apply to learning virtually any concept.

Knowledge: Focuses on learning the names of components and identifying parts. For example, learning the parts of a planetary gearset: Sun, Internal, and Carrier. It's simple memorization, but it's a necessary step, because it becomes impossible to discuss a transmission or review a service manual without being able to identify the parts and components.



Comprehension: Focuses on learning how the parts fit together and connect. Think of this as assembling a transmission. Do you really need to know what a clutch does to successfully put it together? Do you really need to know what every valve does in the valve body to assemble it? Understanding how parts fit together is essential to understanding how the parts actually work together.

Application: learning how the parts work in their different modes of operation. What happens to the clutches when the transmission is in reverse? What does the pressure

regulator valve do in order to regulate line pressure? To answer these questions, the technician needs to know the names of the parts and how they interact together. For that reason, when learning new technology, it's important to take a little time to learn the technology following this logical process, especially for complicated systems.
Analysis: This is the diagnostic step: the ability to analyze a system when things aren't working as intended. Take for example a transmission that's slipping only in second gear. What could cause this hydraulically? Mechanically? Electrically? If the tech knows and understands how each of these sub-systems work, diagnostics just got a whole bunch easier.
Evaluation and Synthesis: Levels that go beyond diagnostics to find solutions to problems, like redesigning a hydraulic circuit to cure valve body wear, or reinforcing an input drum to cure breakage issues. These steps go above the diagnostic level in attempt to provide long term solutions to known problems.

It's not uncommon to hear stories of techs that throw parts a vehicle to solve a problem. When you feel confident on how a system works, sometimes it's hard to understand why a tech would try changing shift solenoid A on a 4L60E to cure a skipping 2nd gear problem, when you know it couldn't operate in 3rd or 4th without shift solenoid A and the 1-2 shift valve working properly. But the difference is "what you know" vs. "what they know."