PMM TROUBLE SHOOTER/THE RAMIFICATIONS OF CAUSE AND EFFECT.

This month's topic will focus on the ramifications of cause and effect.
It begins with the vehicle a 2Ltr Cavalier using the Ecotec engine with Simtec 56.1 control.

The background as explained by the owner, poor starting especially when cold getting progressively worse and intermittent displays of the MIL lamp and eventually presented to us as a non-runner.

Our approach, attach a serial tool to the ADAL socket, (NSR bulkhead) and attempt to read any DTC's however the tool failed to power up, a quick check at the socket confirmed no power supply. We supplemented the supply to the tool via an alternative power lead and established serial coms. Confirming the control system as Simtec 56.1. The logged DTC's indicated errors with the crank and Cam sensor. A clear plausible reason for the vehicle condition. Our initial reaction was not to trust the DTC's without first checking both components with a scope.

The 56.0 and the 56.1 variants of Simtec control utilise a reluctive inductive signal generator for both crank and camshaft.

This method of signal generation uses oscillator input from the ECU with a modulated return; both signals are present static, therefore reasonably easy to check. However without the use of a competent high performance scope the signal sampled may suffer aliasing or in plain English mimic the actual signal leading to a totally inaccurate and false display. The oscilloscope may then display the waveform at a lower frequency than the actual input signal.
Waveform 1) is however an accurate sample taken from our vehicle and contains no errors. Note the different amplitude in the signals and draw your attention to the time base.

The Oscillator channel **a**) has amplitude in excess of 2.5v and the modulated return channel b) approximately 1vboth quotations are of course peak to peak values, the frequency is approximately 104,000Hz.

So the DTC's were not correct but we measured the signals at the engine, not at the PCM located in the drivers A post. Attaching a Break out Box allowed us complete and quick access to all inputs and outputs.

A further check confirmed both generators in perfect working order. The logic at the present time was to deal with the known errors before seeking new ones.
We decided to check the timing belt and discovered a small error in the position of inlet and exhaust camshafts. Relaying this information to the customer we agreed to replace the belt, pulleys and tensioner.

On completion we removed the plugs which were wet and checked the cylinder compressions which indicated a good 180-200 PSI.
Replacing the plugs with new and washing the HT leads to ensure good insulation we then attempted to start the engine.

At first it seemed as if the engine was prepared to start however after several backfires into the inlet we decided to look at other electronic data.

Through the Break out box (BOB) we checked the ignition primary profile and current flow whilst cranking waveform **2**.

The profile although unusual is correct for Siemens Systems, the current peaking at 4 amps (100mv/amp) would be acceptable during cranking where general system voltage drop is to be expected. The spiking effect is due to PWM control (pulse width modulation) ensuring the coil is not overcharged during the extended dwell period whilst cranking. The burn time channel **1)** far right is approx. 2 m/s with a firing line threshold of 35-40 volts all of which is correct, so we have a good spark, onward and upward, the injector pulse and current were also correct 40ms and approx. 1amp peak current flow. Our next check was to inspect a sparkplug which indicated incomplete combustion, not wet and not sooty just dirty? We then considered the possibility of a blocked exhaust. Moving around to the rear of the vehicle the gas pressure appeared OK with regular beats from the compression/exhaust strokes.

Our conclusions at this point seemed to rule out mechanical or electronic error, however, because of the popping back through the inlet we decided to check the ignition and the injector pulse over a longer period, thus confirming a satisfactory pulse chain. In plain language, a symmetrical triggering would confirm the PCM is operating its prime functionality correctly. Following our own procedures, as often discussed in our training sessions, we decided to look at the fuel supply and pressure, both were excellent despite a near empty tank level indicator. We did however become suspicious of its contents; it smelt like petrol but had a greasy texture, which did not readily evaporate. We chose to flush the tank empty through the pump and relay. Refilling the tank with known good fuel we further flushed the system and fuel rail before reassembling the vehicle.

Pushing the vehicle outside prior to cranking was a good decision, the vehicle started promptly emitting severe amounts of smoke from the exhaust which eventually disappeared as the engine warmed up and displayed a very smooth idle.
We checked the lambda sensor, which remarkably was switching normally and the manifold vacuum at 20inHg confirming no mechanical irregularities.

The conclusion is of course always easy once all the facts are known; the customer was unaware of the diesel/petrol mix in the tank? The likely sequence of events suggest an inadequate fuel/air mix causing the engine to preignite or backfire producing erratic timing belt tension on a worn belt/tensioner hence it jumped the sprockets thus causing DTC's to be displayed confirming incorrect crank/cam relationship. Bringing us back to the beginning of our story, the correct diagnostic procedure will **always** identify the cause and the effect of any error no matter how obscure it may be.