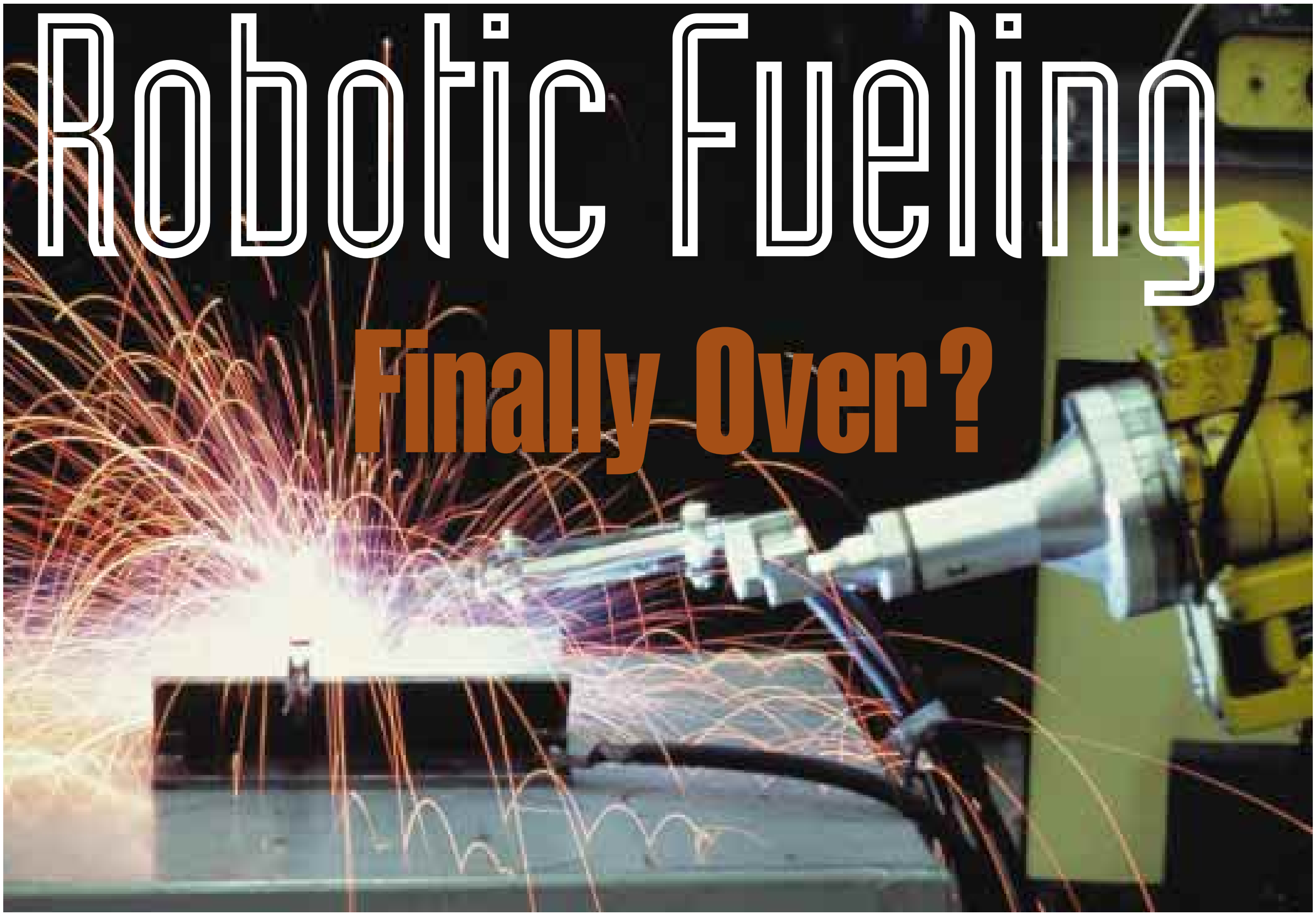
Is The Long Wait for Robotic Fueling Finally Over?



by Wolf H. Koch, Ph.D.

Why is it just a matter of time for robotic fueling to become a reality for the consumer?

In my experience over the last 35 years—first as a service station attendant, then as a consumer, and later as someone working in the industry to increase customer satisfaction—I have only met a few individuals who seem to have enjoyed the rather mindless activity of pumping gas. They were outside consultants who wanted to make the experience "exhilaratingly exciting." Typically, after several years of working on the problem and collecting significant fees, the consultants were fired and the project ended.

While I would not describe the experience of robotic fueling as exciting, it certainly provides significant advantages: the customer remains in the car and has a choice of entertainment options, including potential targeted advertising; he/she will be protected from the elements; and the fueling process may be quicker. For the oil company, the benefits may include increased customer satisfaction and loyalty, targeted advertising, increased throughput, lower labor cost and increased margins. In addition, robotic fueling complies with the Americans with Disabilities Act (ADA).

Nearly 25 years ago, in 1973, *National Petroleum News* had an article on robotic fueling.[1] The article concluded that (1) while the technology for automatic fueling existed, the economics were not clear; and (2) implementation depended on automakers standardizing fill-pipe design and locations. At that time, the only major oil company actively considering robotic fueling was Amoco.

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Figure 1 (above) *Amoco model for fueling unmodified cars.*
Figure 2 (below) *Amoco model for under-car fueling.*

Figure 3 *Nozzle and fuel receiver for fender and under-car fueling.*

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Let's fast forward to 1997. Two companies have announced their plans to introduce robotic fueling equipment for the first quarter of 1998: Shell Oil Company and Trans Robotics Inc. Other companies are working on robotic fueling concepts and may bring additional technology into the marketplace.

Robotic beginning

During the mid '60s, as oil companies began contemplating the use of self-serve stations, the idea of robotic fueling appears to have arisen as a way to minimize labor costs. The patent literature starts modestly with two 1963 patents issued to Charles Mays and Lee Darwin. Between 1968 and 1970, Irwin Ginsburgh of Amoco obtained seven patents on various aspects of robotic fueling and an eighth in 1972.

All systems described by these patents were mechanical and required extensive changes in the vehicle tank fill pipe. *Figures 1* and *2* depict these early systems and show that precise positioning of the vehicle and the fill pipe was necessary; this is no longer the case. In addition, automated point-of-sales (POS) technology that could capture and store a transaction had not yet matured.

A position paper published by Amoco in 1971[2] indicates that the company had studied the following alternative designs: fueling unmodified current-model cars; retrofitting cars with a uniquely positioned filler pipe; and factory standardized fill pipes having a machine-operable closure.

For the first design, Amoco considered storing the fill-pipe position in a central database or on an identification card that was to initiate the transaction. At the time, equipment capable of locating a random fill-pipe location had not been developed and this design was abandoned because of excessive development costs.

The second design was tested extensively and eventually abandoned, again for economic reasons. It abandoned the earlier use of a gantry (now in use by Shell) in favor of, initially, a fender-mounted and later, a bottom-mounted receiver for the tank and a matching fueling arm. *Figure 3* shows equipment that was developed for this second design. It is reminiscent of aircraft midair refueling devices, scaled down for automotive use.

The third alternative, having the automakers provide standardized fill-pipes, was never realized, and led to the abandonment of the project in the early 1970s. During the late '60s and early '70s, Amoco had not yet built an integrated system, although the company had evaluated all components, including card readers, receipt printers and automated billing on a stand-alone basis. Safety devices such as sensors to ensure engine shut-off, interlocks to ensure nozzle latching and barriers to prevent drive-offs during fueling had also been designed. Between 1972 and the late '80s, the patent literature describes an advancing POS technology, ancillary advances in robotics and significant improvements in instrumentation and sensors.

The next wave of patents in automated vehicle fueling were issued to Ronald Horvath (1987) and James Hollerback (1989). Like the Amoco developments, the Horvath patents describe a mechanical robot that fuels from the bottom of the vehicle tank and requires extensive tank modifications; it appears to be best suited for fleet applications. The Hollerback design includes provisions for windshield cleaning and describes the first use of hydraulic and solenoid switches and a credit card reader, all linked to and controlled by a computer.

Double exposure

My first exposure to robotic fueling was in 1991. I attended a demonstration of Trans Robotics equipment (Trans Robotics International) at an international engineering conference hosted by Wayne-

Dresser as part of the company's 100-year anniversary celebration. A year later, I observed demonstrations of the same unit at the Automechanika in Frankfurt, Germany. Following the Frankfurt show, I visited Trans Robotics in Sweden and witnessed actual fueling of several cars at a fleet fueling location, where the robot was being tested.

Upon returning from this European trip, I frequently discussed automated fueling with people of varied backgrounds. The usual objection I heard was that it would be extremely difficult to determine the fill pipe location. I usually replied that the world's air forces have been using mid-air refueling of high performance jets for many years and that fueling a stationary object on the ground should be relatively simple in comparison.

Since 1990, the patent literature indicates a significant renewed interest in automated refueling. Our patent database now includes more than 120 US, European and World patents covering automated fueling and related robotics, instrumentation and POS topics. About 70 of the 120 patents have been issued since 1990, covering all facets of robotic fueling, vehicle interface, instrumentation and safety. Judging the current wealth of patents, it appears that most difficulties of the past have been overcome.

Current developments

A number of domestic and international development efforts by the following companies are currently underway.

Shell Oil Company Shell's current internal effort in robotic fueling began in 1991 when a Shell employee, Bill Ramsey (now retired), approached corporate management with a proposal to purchase or develop appropriate technology. Shell initially worked with Trans Robotics. In 1993, Shell's management authorized an internal development effort to commercialize robotic fueling instead of purchasing externally. The current Shell effort started in 1994 with International Submarine Engineering (ISE), Gilbarco, HR Textron and Stant as partners.

The first robotic station was built earlier this year in Sacramento, California, and is currently being tested. Large scale customer tests with a 500 vehicle fleet are to start in mid-September. Work with Underwriters Laboratory (UL) is almost completed and certification testing with the California Air Resources Board (CARB) will begin soon. A nationwide roll-out is scheduled for early 1998.

The Shell Smart Pump Sacramento installation, shown in *Figures 4* and *5,* is quite similar to *PE&T's* previous artistic renderings based on the patent drawings (March/April 1997, p. 40). The robot's fuel arm travels in an overhead gantry that allows travel around the vehicle to reach the fill pipe. The vehicle must have a credit card size transponder mounted in the windshield, providing information about the customer and the vehicle to the controller. The fill-pipe must also have a replacement fuel cap with a spring loaded slot, eliminating the need for cap removal during refueling.

There are some vehicles which the Smart Pump cannot fuel. While most of them are exotic imports, they do include Chevrolet Corvette, Honda Civic Del Sol and the Mazda Miata.

Since the hydraulics, point-of-sales and vapor recovery components of the Shell robot are manufactured and integrated by Gilbarco, the system will eventually be available to the industry as a Gilbarco system. Future marketing plans have not yet been released.

Trans Robotic Inc. The Swedish company Trans Robotics International was reorganized in 1992. The Company now operates as Trans Robotics Inc. domestically and as Autofill Europe AB in Sweden and Europe. The Company's products have been tested commercially for a number of years. Trans

Figure 4 *Shell's Smart Pump Installation in Sacramento, CA*

Figure 5 *Fueling arm detail of Shell's Smart Pump*

Figure 6 *Trans Robotic's Swedish testing facility*

Robotics president, Claes Holm, expects availability of robots in early 1998. UL certification is almost completed and CARB testing is to start soon.

The Trans Robotics unit is less complex than Shell's Smart Pump. Instead of an overhead gantry, the robot is positioned on the island. It has a capability of fueling on one side of a vehicle only; two robots are needed to fuel a mix of left and right fueled cars and the system cannot accommodate rear fueling. Mr. Holm suggests that his robot will be more cost effective: since the distribution of left and right fueled vehicles is about even, two of his robots will handle twice the vehicle throughput at a cost that, while not yet announced, is claimed to be lower than a gantry system.

Figure 6 shows a typical Trans Robotics installation. A small round transponder button is mounted to the upper rear corner of the fuel door and the vehicle fuel cap is replaced with one having a spring-loaded slot. The robot locates the fuel door, opens it, and connects through the fill cap to dispense fuel and return vapors.

Figure 7 *Tokheim's FlowMark V prototype*

Tokheim/Robosoft Tokheim Corp. has formed an alliance with Robosoft of France to bring existing fleet fueling technology to the North American market. Robosoft developed two generations of fleet robots and has fueled several municipal fleets of more than 400 vehicles for about five years. Their current models, the OSCAR Mk4 and 5, are available to commercial fleets today. Of all automated fueling equipment vendors, Robosoft has the most experience.

Figure 8 *Salzkotten robot prototype*

Tokheim's joint development with Robosoft has resulted in the FloMark V, first shown at Convex '96. The unit, shown in *Figure 7,* can be added to an existing island dispenser. The vehicle to be fueled has a compact transponder attached to the undercarriage and its filler cap replaced with one containing a spring-operated trap.

The robot uses a standard nozzle and hose to fuel vehicles and may be used in combination with Tokheim's Fuel Point system for establishing information exchange between the vehicle and the station. While the system is now ready for fleet fueling, Tokheim is looking for an oil company partner to move it to the retail arena.

Tankanlangen Salzkotten/Mercedes/BMW The German publication announced a robotic fueling research project in late 1995[3]. The joint project among the Fraunhof-Institut, Mercedes, BMW, Tankanlangen Salzkotten, Albert Hiby, Reis Robotics and Lengyel Industrial Design was budgeted at about $10 million (DM 15 Million). The first prototype was shown in Frankfurt at the Automechanika in September 1996 (see *Figure 8*).

A news release in November stated that Reis Robotics will bring the unit to North America in about five years.[4] Recent communications with Salzkotten indicate that the first commercial units are planned for 1999, and that Salzkotten has all marketing rights.

Future automotons

With current development efforts, it is quite certain that robotic fueling will become a reality. "When?" is another question. It is doubtful that systems already announced will be ready for retail operations by early next year.

While Shell and Trans Robotics claim to be close to satisfying UL listing requirements, the CARB certification process has not yet started. To meet current certification requirements, the testing protocol must be modified. Regulations governing the Weights and Measures requirements must also be changed. Both tests require human intervention and need to be changed to reflect automated robotic equipment.

On the positive side, Shell expects vapor recovery to exceed 100 percent when using current testing standards. All robots will make a tight seal with the vehicle fill cap and capture the initial vapor release currently experienced when motorists open the fill cap.

Will robotic fueling someday be profitable? Shell's project manager Bob Gates would only say that Shell expects the robot to be profitable, and that the company spent less than the German consortium.

The *Sacramento Bee* newspaper had a recent article on the findings of some Shell focus group marketing studies; apparently, the system is particularly popular with women, parents traveling with children, and business people[5]. Shell has not announced how much it will charge for a Smart Pump fill.

In New Jersey and Oregon, two states where self serve is not legal, robots might replace pump attendants. For the rest of the US, automated fueling might

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replace full service pumps at service stations that still offer it, or add a new level of automated service at high volume pumpers that are not currently offering full service.

Margins for full service are in the range of 15 to 60 cents per gallon, and average about 30 cents per gallon. Northern and Midwestern area stations offering full service may average 10 percent of station volume through the full service islands. Since full service is generally only offered at smaller, traditional service stations, full service volumes may someday be displaced by automated fueling at a lower incremental cost at high volume pumpers.

References:

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3. *Tankstellen Markt,* September/October 1995, p. 100.
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5. Mark Glover, "Robots Man Gas Station," *Sacramento Bee,* April 10, 1997.

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