The Changing Role of Technology in Golf Course Equipment

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Predicting the future has proved to be a perilous profession - at best. There are many examples of 'sure things' that have not panned out or unexpected successes that seem to come out of nowhere. The future, by its very nature, is dynamic and ever-changing and a myriad of influences can affect its outcome.

The same rule applies when predicting technological advances. Simply having technology available does not ensure it will be broadly implemented - it has to be desirable and functional. Technology always has and will continue to be driven by people's needs. Often, new emerging technology is a different (yet better) way to solve an old problem.

A Golf Course Manager's basic needs, include understanding plant health, better management of water resources, improving productivity, managing labour and being a responsible steward of the environment. If new technological applications address these needs better than an existing approach, then technology has a good chance of success. If the application is simply different or if it introduces other problems that are more time-consuming, it is likely to fail.

Rarely does technology burst on the scene overnight - it is usually a gradual process, which occurs after the initial invention. For example, while the computer was invented in the 1940s, its use has only recently become widespread. This is often the case with new technology - once created, it quickly evolves into a functional form used by a small group of customers categorised as early adopters. Then, it is refined and improved until it is accepted (or in demand) by a much larger group.

Often, new technology evolves and is used to solve problems other than its original intent.

When it comes to assisting professional turf managers in their day-to-day tasks, there are many technologies being pursued. This article will touch on just a few of them.

WATER MANAGEMENT

Water continues to become a more valuable resource. In many parts of the world, watering restrictions limit the timing and amount of water that can be used to irrigate a golf course. Generally, water quality is diminishing. For example, effluents, which increase salinity, are being used for irrigation. Consequently, the cost, availability and water quality are becoming a major factor to deal with.

Managing water is a critical job for the Course Manager, and, for the most part, irrigation water is not managed precisely. Traditionally, water schedules are set via minutes of run-time versus dispensing only what the plant needs. (This is comparable to running your home heating or air conditioning for ten minutes every hour, regardless of the outside temperature.) If a golf course were flat, had homogenous soil throughout and micro-climates did not exist, this method would be suitable. However, this is not the case.

Today's irrigation control systems, frequently incorporate digital maps of the golf course to help control individual sprinkler heads. Evaporation-transpiration (ET) devices are currently available to assist in calculating how much water is lost on a daily basis due to current weather conditions (eg, sunlight, humidity, wind, etc.) While these tools help manage water over a broad area, more precise technologies are being pursued.

The future of turf irrigation is likely to revolve around precision turf management, a closed-loop or supervisory-based method of identifying what a small area of turf requires and being able to precisely supply the amount of water, nutrients or chemicals needed to that area. Some of the technology used to accomplish this will include: more sophisticated irrigation heads and controllers; accurate digital maps of the golf course; global positioning systems (GPS); remote sensing and in-ground moisture sensors. For example, soil moisture probes, which measure moisture content at varying depths, could be deployed at multiple sites around the golf course to report on a specific area's moisture state.

Evapotranspiration (ET) weather station

Another new technology, called remote sensing, uses near-infrared (NIR) spectroscopy, which can detect plant stress before the human eye can. For example, NIR sensors mounted on a fairway mower with a GPS could monitor plant health while mowing and report via wireless radio to a central computer. The greenkeeper would receive a colour-contour picture of the turf on each of the fairways. The central computer would then assimilate this data and provide the Course Manager with improved information to make watering and disease-treatment decisions, which are tailored to each specific area on the golf course.

ELECTRIC MACHINES

Course Managers are attracted to electric machines because of two key qualities: they are quiet and do not leak. They also have other desirable attributes, such as low or zero emissions, fewer wearing parts, higher efficiency and the potential (through electronics) for better diagnostics and precise control to improve productivity.

However, electric machines have made limited inroads into the turf maintenance market (golf carts are notable exceptions) due to the following restrictions:

- Weight
- Range
- Cost

New technology cannot be successful if it introduces new problems in order to remedy an existing one.

Turf equipment needs to be gentle on the turf and battery-electric machines are hampered by weight. For example, the work obtained from just 3.8 litres (1 gallon) of petrol is roughly equivalent to 300 to 400kg (661 to 882lb) of lead-acid batteries. This weight issue can restrict the daily range

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By Jack Gust

of operation and has limited battery-electrics to the lower power applications on a golf course, such as small utility vehicles, golf carts and, to a certain degree, greensmowers and bunker rakes.

Further, unlike petrol/diesel machines that can be quickly refueled, batteries also need a long time to recharge and cannot be deployed for unscheduled tasks (eg, replacing a machine in repair) or occasional tasks, which require higher energy (eg, Verticutting).

Fortunately, new technology, such as advanced batteries, hybrid electrics and fuel cells, are becoming available to address these limitations.

ADVANCED BATTERIES

Advanced battery chemistries, such as nickel-metal hydride (NiMH) and lithium polymer, can significantly extend the runtime of battery-electric machines to make them more viable. NiMH batteries are extremely durable (potentially lasting the life of the machine), and can deliver up to twice the runtime of an equivalent weight of lead-acid batteries. Lithium batteries, commonly used in cell phones and digital cameras, are capable of delivering up to three times the range of lead-acid batteries and are relatively inexpensive. Either of these advanced battery technologies could vastly improve battery-electric products, such as electric greensmowers or bunker rakes.

Currently, both of these battery technologies are prohibitively expensive in larger sizes, but their costs should come down as they are gradually applied to other industries. Unfortunately, the turf industry itself is not large enough to drive the commercialisation of these advanced batteries. Their use will need to become prevalent in other higher-volume applications, such as forklifts or automobiles before they become affordable for turf products. It is difficult to predict how rapidly this will occur.

HYBRIDS

Hybrid-electric vehicles, particularly hybrid-electric automobiles, which combine electric motor and engine-based power sources, are frequently in the news.

There are two categories of hybrids: parallel and series. Parallel-hybrids, which are most common in the automotive industry, use sophisticated electronic transmissions that decide whether to use the engine, electric motor or both to drive the wheels. On the other hand, series-electric hybrids act more like a battery-electric machine with an engine powered on-board battery charger. Common to both types of hybrids is a smaller engine sized to deliver enough power for the average load with a battery pack (or ultra-capacitors) sufficient enough to handle any intermittent peak loads the machine might encounter.

Hybrids allow the creation of machines offering many of the attributes of battery-electric devices, but without their inherent range and weight limitations.

FUEL CELLS

Fuel cells are an interesting technology, also frequently in the news. Fuel cells can be thought of as a battery with an external fuel tank. (This is not an accurate depiction of a fuel cell, but it is a suitable analogy for the purpose of this discussion.) The fuel for this 'battery' is hydrogen, and it is typically carried on-board as a compressed gas. As long as the hydrogen tank has fuel, the fuel cell can continue to produce electricity at full power.

Electricity is produced by a fuel cell when hydrogen passes through a special membrane to encounter oxygen on the other side. As a hydrogen atom passes through this cell, its electron is stripped off and collected, which is used for power. This hydrogen ion proceeds through the membrane and encounters oxygen on the other side. Here, it combines to produce water, which flows out of the exhaust as a mist. Simply increasing the oxygen flow to the membrane via an air pump produces greater electric power output.

Hybrid riding greensmower prototype

While a fuel cell appears to operate much like a battery, in many ways it is similar to engine-powered equipment. A fuel cell requires a radiator for cooling, a fuel tank for the hydrogen, as well as hoses and pumps, etc.

ELECTRONICS

It doesn't take a psychic to predict the use of electronics will proliferate on the golf course much as it has done in the rest of modern society. However, it is more difficult to predict just how it will be used.

Electronics are critical in achieving water management control and electric-machine technologies previously described. It is integral to the sensors, displays, wireless and GPS technology envisioned for precision turf management. Electric machines require microprocessor-based controllers to distribute power to the drive wheels and cutting units.

Electronics will allow the design of 'smart' equipment - machines offering enhanced performance and diagnostics through the use of on-board electronics. This technology, often dubbed 'drive by wire', uses a computer to help the operator more effectively operate the equipment. For example, it could sense the speed of the machine and automatically adjust the optimum reel revolutions per minute (RPM).

It's not too far-fetched to combine drive-by-wire technology with GPS positioning to create an autonomous machine (ie, a robot). These machines are able to accurately mow straight lines to within a few centimeters and are even capable of mowing at night.

Electronics can also assist in maintaining turf care machines. Wireless hour meters can automatically radio the machine's hours to a central computer in the service bay, whenever the machine is near the maintenance shed. This information will save time and help plan routine care. Upon reading the machine's ID with a scanner, a touch screen at the technician's workbench can allow immediate, fingertip access to the parts look-up and maintenance instructions.

These are just a few of the advanced and exciting technology in the works for future golf course equipment. While it is difficult to predict when and which ones will ultimately become commonplace, it is safe to say maintaining the golf course of tomorrow will be different from today.

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