Finding New Technologies in the Pork Industry: Towards Precision Farming or just High-Tech Hype?

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Introduction

The Prairie Swine Centre is a non-profit research corporation affiliated with the University of Saskatchewan. Established in 1992, the Centre focuses on near-market research, knowledge transfer and graduate student training. Using the sciences of nutrition, engineering and ethology the Centre approaches industry issues with a multi-disciplinary approach, combining original research with the evaluation of other research conducted world-wide and assessing it for its application to the Canadian pork value chain. Economic evaluation, best management practices and communication are at the core of the Centre's ability to engage pork producers and other members of the pork value change in increasing the speed of adoption of technologies and management that will provide an economic and sustainability advantage to Canada's pork sector.

This short paper identifies several technologies, ranging from those providing promise as a research tool to those in the early stages of commercialization. Before we can evaluate promising pork-industry aids, it is important to note that one paper cannot touch on all the production, transport and processing

technologies that are currently in the development stage. This is a very active area of development given the improved access of barns to internet and Wi-Fi connections, and a multitude of developers that work to provide high-tech solutions to other industries that are now discovering the animal agriculture industry. At Prairie Swine Centre we use three areas of effort to uncover these technologies: 1) public grants for original research, 2) evaluation of new technologies developed world-wide that are in the early development through to pre-commercialization phases, and 3) regular interaction with innovators that want to share their ideas and seek feedback.

This paper will move along the path from research-ready to commercially-available products, and from outside the barn to production aids for use inside the barn. From my perspective, what will determine the success of any of these ideas will be their ability to use them in a barn environment (must be robust), and they must address a fundamental business need of collecting, analyzing and acting on aspects of production that have economic value. The term “Precision Farming” is used, especially in arable agriculture, to describe the collection of data in the field and the judicious use of expensive inputs to improve net income, reduce waste and impact on the environment (sustainability), and speed (even automate some) decisions.

The use of new Precision Farming technology is so prolific within arable farming that there are companies and newsletters devoted solely to this subject. The Top 10 Technologies are discussed in one

publication https://www.therobotreport.com/top-10-technologies-in-precision-agriculture. A review of the article reveals that most of the topics are not easily translated into animal agriculture: GPS; Mobile Devices; Robotics; Irrigation; Internet of Things; Sensors; Variable seeding rates; Weather modeling; Nitrogen modeling; Standardization. Some however, are important and relevant, such as mobile devices, Internet of Things, and standardization as they are at the heart of how we will assess what we need and what will become available to us in pork production.

Figure 1. Big Data & the Internet of Things

The source of advancement in Precision Farming is based on access to lower-cost data collection devices and the moving of this data through the Internet of Things network of devices and storage. To make these two themes useful for Canada's pork producers, we will explore individual projects that exist because of these two data phenomena. I will balance these advancements with other more 'tangible' technologies that will be moving out of the lab in the next few years.

Beginning Outside the Barn

Geofencing and syndromic health surveillance are now possible with satellite technology that allows the technology to draw a ‘fence’ around a building or property and link this through an app that can record the movement of people (or devices with the app) across the ‘fence’. As part of the biosecurity of the farm - Be Seen Be Safe, a Guelph, ON based company is using this technology to create notification to the farm manager, an alert to the person entering the property and a record of who entered and exited the farm. Testing of the technology started in 2016, primarily in poultry in Ontario. Issues include ‘drifting’ of the fence and applications not running on all phones (devices), but these are solvable. The platform has the advantage of being able to link with other subscribers and create a ‘network’ for communicating changing health status in a geographic area through daily health monitoring inputs from the production supervisor. With the veterinarian linked in, there could be early warning of changing health status in participating farms. Long-term applications include potential for linking traffic between farm-sites in case of a foreign animal disease outbreak. This first technology brings up the issues of privacy and ownership of data and therefore may have its greatest benefit within a company of related barns. At an estimated $300 per year subscription this is a low-cost addition to the biosecurity program.

The transport truck is the link between barns and markets and is also the most significant vector of disease after the live pig itself. The next technology is from the food and hospital industries; the ATP meter allows an instantaneous test of

'cleanliness' of trailers. A research project determined the likely areas that are not well-cleaned and the ATP meter swabs can be brushed on the metal and inserted into the reader for an instantaneous readout – ***clean***, "please back up to the barn", or ***dirty*** "please go back and rewash before approaching my barn". At $2,000 per handheld unit (reusable for years) and $150 per trailer in disposable swabs this is unlikely to be used for finisher hog shipments, but would make sense for the nucleus barn.

DrySist is a trademarked cleaning/baking process from Castene Trailer manufacturing in Spain. The process uses a site dedicated to completing the disinfection of washed trailers. When arriving at the site 'washed', the undercarriage is sprayed (automatically) with disinfectant. Backing into the baking station, a sliding wall moves up each side of the trailer enclosing it and forms a pinch-point behind the cab. This concentrates the heat that is supplied by a heat generator moved into place and directed into the rear of the trailer compartment. The trailer can be previously outfitted with heat sensors that connect wirelessly to a central computer. Hot air is blasted in the back until all sensors reach 72^{o}C. The advantage is that it would use about 40% less gas than the current method of heating a whole building. Also, it does not heat the tires and running gear, instead heating the trailer from the inside out. The beta site is now operational in Spain.

Lastly for trailers - tracking trailers as part of total traceability is now possible while also capturing environmental data from various compartments in the trailer in real time. The Raspberry PI microcomputer (from the UK) is the size of a credit card

and can have numerous sensors attached to it (humidity, temperature, cameras, etc). This information can be sent directly to the operator's tablet in the cab, ensuring driver oversite of the welfare of the animals in transit. A GPS chip adapter allows the trailer to be tracked. A commercial application (Trailer Genie) is now under development. I noted that this basic microcomputer is currently on Amazon for $55 Cdn each.

The next 'outside the barn' application is Hydrothermal Liquification (HTL) of biowaste. This University of Illinois project has identified swine manure as potentially the best source to feed algae which are harvested and put through the HTL process to extract oil. No longer just benchtop (1998), this project has attracted partners (Snapshot Energy) which have constructed small plants in South Carolina and Texas capable of 40-160 barrels a day of oil production. This is not commercially viable at today's oil prices but estimates breakeven at $80/barrel. When designing new barns, should we be altering the proposed building complex site and making provisions for the capture of manure and taking advantage of also adding food waste into the mix?

While we are considering siting of new barns maybe it is possible to be closer to populations, labour, utilities, services, etc. if we make our barns 'good neighbours'. Doing this requires managing exhaust air vented from the barn (and the gases and odours associated with this ventilation). A project between the Centre de développement du Québec and Prairie Swine Centre demonstrated that gases can be stripped from exhaust air and the nutrients captured, and remaining air 'cleaned'

before being exhausted beyond the building. The design confirmed in 2013 that ammonia, dust and odour can be reduced by 77%, 92%, and 75% respectively with a commercial-scale bio-trickling air filtration system. At the 2016 Eurotier show, there were two companies demonstrating biotrickling cubes for just such a use. Cost per pig was not determined.

Inside the Barn

This is where a proliferation of new devices will be introduced. From low-cost sensors to Bluetooth and Wi-Fi enabled technologies, the collection of data will be more frequent, and more complete. Thus, we *should* be able to make real-time decisions when conditions we determine are not optimal can be corrected before feed intake, growth or health is impacted.

For the purposes of this paper I will limit discussion to three in-barn innovations, all from Europe and all to be available within the next 2 years.

The use of Big Data is beginning to be understood and used by PigChamp Pro Europa. This Spanish company offers recordkeeping services which has lead them to begin mining the database for trends and the first Big Data output is a realization that most swine herds have ‘Super Sows’, and that these females can be identified as giving 15 liveborn in the first litter. Records on over a million matings identified that these females have a 6% higher farrowing rate and will produce 26 more live born pigs in their lifetime than their herd-mates. This detailed analysis lead to advanced management procedures that should be followed once

the ‘Super Sow’ is identified. Long-term strategies include selecting for more of these prolific, long lasting females in the herd and use of predictive analytics. The current estimate is that these high-performance sows reduce the cost of production by $6 USD per 20kg weaned pig produced.

This same group has taken the commercially-available digital pen and created software that allows a pen and paper solution in the barn (instead of expensive phones/PDA). A proprietary software application has been developed that allows the farm to determine the questions they want to ask and the measures they want to be taken in the barn. The special paper form creates links to the digital pen, and through Bluetooth and Wi-Fi, links in real-time to the home office. A screen that appears in the office, converts handwritten numbers and letters into digital, and allows for verification (sloppy writing) and saving of a digital file for later analysis. For example, this has been used to score foot problems in the herd and categorize individuals by 5 different problems and whether the problem is light, medium or severe. Whole herd shifts in hoof health can then easily be monitored and managed over time. Cost still to be determined.

The Vetic was developed by Optimal Pork Production (OPP) in Spain and manufactured by Henke Sass in Germany. This product will become available in 2018 and will provide complete traceability of injectables, by linking the pig/pen/room through RFID tags, by having a reader right on the syringe. This allows the quantity of product, with detail of the day and even lot number of the product injected to be recorded, and that record linked to that individual pig. Retail

price has not been set but, with changes in antibiotic regulations and RWA programs, this type of technology will likely become part of the future infrastructure of on-farm traceability.

The Bottom Line

The technologies identified here are proving to be robust, reliable and inexpensive. It is likely that an abundance of independent manufacturers from diverse industries will look at animal agriculture, and attempt to measure or monitor welfare, environmental pressures and food safety with their technologies. What will be needed is a method to evaluate systematically how well the products work, the data integrity and security and the link to decision support software and methodologies required to get value out of the technology. If this is done correctly there is value for the industry, otherwise we do not need 'High-Tech Hype' technology just for the sake of technology that isn't moving us in a strategic direction of making pork the prime choice of meat protein for consumers world-wide.