Digital Transformation of Animal Husbandry

White Paper

Why do future farms need a good data scientist?
- Agricultural robots and AI help to reshape animal husbandry

Sveaverken Agri AB
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In recent years, in the context of technological development, social aging and economic globalization, the animal husbandry industry is undergoing structural changes that have impacted the husbandry ecosystem.

This white paper will initially describe how to use agricultural robots and big data technologies to realize the digitalization of animal husbandry and enable modern automated farms to accurately plan and execute, thereby increasing profits and reducing risks. It will also explain how a good data scientist can use big data to effectively analyze farm operations and digital solutions to optimize operations without the need for years of experience in the livestock industry.

Digitalization can help bridge the communication gap between traditional farmers and bankers. It not only simplifies communication, but also points a clear and visible path for the mutual benefit of both parties, maximizing the benefits of the farm.

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1. Data analysis is the best solution for animal husbandry financing risk control

Animal husbandry, an important branch of agriculture, is the main way that farmers make a living in the most countries worldwide. Promoting the development of this industry is often the priority for national and local governments. Therefore, governments usually support the development of the industry through granting subsidies, as well as encourage state-owned and private banks to provide loans to farmers in this field. However, these financial institutions cannot avoid the risk management.

Compared with the systematic risk assessment methods commonly used by customers in the industrial field, the traditional animal husbandry business has greater volatility and it is susceptible to natural disasters, animal diseases, food price fluctuations and other factors. On one hand, based on the profit-oriented nature of financial institutions, they are not charitable organizations, naturally are unwilling to issue loans to farms with low profitability or even loss. Furthermore, it is never easy to assess the profitability of a farm without having a large amount of raw data, unless auditors are provided with the data, but often it is contrary to expectations. And the asset evaluation of a ranch is different from a plant. Depreciation of the assets of factory equipment is easy to calculate, but the value of the farmed animals cannot be accurately calculated by counting the number. A farm with 50 cows that manages a fine and healthy herd, will usually bring more lasting returns and lower levels of risk to investors, than a farm with 100 cows that are extensive management with disease-ridden. But to assess whether the management of the ranch is scientific, the health status of the herd, and the resistance to the epidemic are very challenging and difficult to quantify for bankers.

In recent years, driven by the development of science and technology, social aging and economic globalization, the animal husbandry industry is undergoing a structural change, which will have a significant impact on the animal husbandry ecosystem. A noteworthy phenomenon is that more and more small and medium-sized farms are going bankrupt due to the inability to keep up with new equipment upgrades, rising labor costs and stricter environmental regulations. To enable the animal husbandry to achieve sustainable development and profitability in a rapidly changing market, effective and sufficient capital expenditure is the key. Farms, who can provide financial institutions with a good cost structure and risk management based on quantitative data, will have a greater opportunity to obtain sufficient growth capital to gain a competitive advantage over other farms in the market. At the same time, financial institutions that can evaluate customer farms based on quantitative data, are able to significantly reduce their non-performing loan risk, which will give them a competitive advantage over other financial institutions that do not have similar data channels. In summary, the Matthew effect will cause the decrease in number of companies and financial institutions to engage in this husbandry business, only highly competitive companies can survive and thrive.
Here come the questions: what kind of farm can survive and thrive? People would say that it must be a digitally capable farm. What is digital? Gartner believes that “Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business.” (1)

In our understanding, this means digitizing each step of the operating process allows us to use a large amount of data to quantitatively track the operating process. In this way, analysis can be performed based on these data, and then with the results of analysis, countermeasures can be accurately used to optimize the operating process and obtain better returns. In traditional farms, work is done manually, so it causes the difficulty in quantitative analysis; in another word, the huge differences between people lead to the possibility of inaccuracy and invalidity in data collecting. For example, a farmer and a banker often communicate about the income and profits for the past few years. But once the banker asks the farmer about the reasons of these digital fluctuations, he or she may think about a few factors, but it is basically impossible to provide quantitative data for the banker to make any reliable judgment. Especially when asked about the prediction for the next few years, the farmer would probably not say anything because he/she is not capable of coping with the internal and external changing environment. In this white paper, we are going to tell you that solving this problem through our digital and automation solutions will enable a good data scientist to effectively analyze farm even without years of livestock experience. The result is an optimized farm operation plan. As you can see, digitization can help close the communication gap between traditional farmers and bankers. It not only simplifies communication, but also points out a clear and mutually beneficial path for both parties, which is to maximize the profitability of the farm.

2. Application of data analysis in modern animal husbandry industry

Big data can provide functions such as data integration, data storage, data calculation, data management, and data analysis. It has the ability to expand horizontally as the data scale expands. There are many types of modern animal husbandry data including husbandry and poultry data, market fluctuations, epidemic information, etc., making full use of such data, and uploading the information to the cloud, farmers can effectively avoid market risks, costs reduction, and increase breeding income by analyzing with big data platform and AI algorithms.

2.1 Decision management

According to the Principles of Economics (People Respond to Incentives) (2), people usually make decisions after comparing costs and benefits. When costs and benefits change, people’s decisions and behaviors will be changed. By using the big data platform of animal husbandry, people can predict the changes of costs and benefits in advance, optimize the production and sales behavior, and guide them to make right business decisions.

The market price of animal products is decided by the supply and demand of feed costs, raw materials, and labor, etc., which can easily trigger the cobweb effect, affecting the market prices of agricultural and sideline products as well as consumers’ confidence. In traditional animal husbandry, farmers often are helpless to such fluctuations that result in huge economic losses. Using the big data platform of animal husbandry to carry out visual analysis of charts, according to changes in market conditions, the farm can determine the current aquaculture income situation, and improve the level of forecast and early warning of animal product market

conditions. Farmers can be guided to adjust production and sales behaviors, thereby avoiding farming risks and economic losses. In the content later in this white paper, we will combine actual cases to analyze in details of how big data predicts the development of animal husbandry, and accurately apply it to enterprise management.

2.2 Epidemic forecast

The big data platform for animal husbandry can predict the epidemic trend of animal diseases, and scientifically carry out disease prevention and epidemic control.

The management level of animal husbandry and breeding varies from farm to farm in the world. The sanitary and environmental conditions are so different. In the era when transportation and logistics industry are so developed, epidemic risks such as zoonotic diseases and animal diseases are easily spread through human-animal circulation or environmental exposure. In the big data platform of animal husbandry, environmental information, policies and regulations, epidemic prevention technology, expert opinions, and epidemic prevention materials can be integrated to analyze the epidemic situation and trend of farm epidemic, eventually to obtain accurate early warning information, and strengthen animal epidemic prevention. The initiative and enthusiasm for the prevention and control of animal epidemics will be further enhanced.

3. How traditional animal husbandry industry goes digital

There are so many advantages to the digitalization of animal husbandry. How can traditional animal husbandry achieve digitalization? The first thing to do is to liberate the workforce, that is, to achieve driverless driving. Due to the differences between individuals, the consistency of operations cannot be guaranteed, and quantitative observation and quantitative implementation cannot be performed. However, unmanned driving can achieve a high degree of consistency in operations and reduce human-induced errors. Through the digital modeling, digital monitoring and digital operation of the ranch, the transformation of agriculture to industrial standardization will be realized. In other words, the digitalization of farms that have been widely discussed in the industry in the past few decades, but failed to achieve, is really carried forward with the achievements of low-cost driverless.

Realizing digitalization requires farm management through a variety of smart devices and solutions. Continuous analyzing data, verifying breeding, and mining of key indicators that offer the most comfortable environment for animal fast growth and high-quality agricultural products producing, and make the management of the breeding process simpler. And the variety of smart devices not only refer to the IoT system for real-time monitoring, but also provide data and solutions from multiple dimensions. This is what we call animal husbandry in the era of big data.
AI technology is also an important tool for digitalization. Big data and AI technology are being deeply integrated in multiple dimensions. Big data technologies emphasize the collection, storage, processing, and display of data. AI can mine the width and depth of big data at all stages, and continuously expand the application value and application scenarios of big data in the animal husbandry industry.

<table>
<thead>
<tr>
<th>Big Data</th>
<th>Collection</th>
<th>Storage</th>
<th>Process</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image identification, voiceprint recognition, thermal infrared monitoring, physical sensors, etc.</td>
<td>Data label, data classification, etc.</td>
<td>Intelligent deep learning, machine learning, knowledge graph, edge computing, etc.</td>
<td>Visual cloud screen, PC, mobile phone, etc.</td>
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With the continuous application of these smart devices and solutions, the cloud computing, IoT, AI, and Blockchain technology have been deeply applied. Digitalization is becoming an important driving force for self-worth reconstruction of agricultural and husbandry enterprises.

4. The meaning of data analysis in animal husbandry for financial practitioners

4.1 Risk Control

The core of finance is risk control. The risk control level of financial institutions directly affects the bad debt rate, revenue and profits. Risk control is data-oriented. The application level of big data in risk control is becoming the core competitiveness of financial companies.

The methods of traditional bank and enterprise risk assessment is mostly based on static data such as historical credit data and transaction data. The biggest drawback of this method is the lack of foresight, because the important factors affecting farm defaults are not only the company’s historical data, but also the overall development of the industry and real-time management conditions.

The animal husbandry big data platform can firstly collect farm information through system log collection, network data collection and database access, etc. Next, perform data modeling, establish data assumptions, determine modeling goals, and then use big data technology to perform agricultural portraits, classify objects. Using AI to simulate the operation of the farm in the future repayment cycle tens of thousands of times under various uncertain environments, the big data platform will output analysis reports on farm investment returns, open risk pricing, and assist banks in accurately lending.

Compared with traditional risk control methods, the risk control methods using animal husbandry big data platform, have a wider range of risk data sources. In addition to structured financial data, they also contain semi-structured or unstructured data including user behavior, social attributes, industry forecasts, and etc. In terms of data application logic, compared with the traditional analysis method that emphasizes causality, big data risk control focuses on mining the correlation between data, and has a stronger ability in association logic and defining cross-risk factors.
5. Smart farming solution for animal husbandry and case studies

Currently, for example, a cow farm with 1,000 lactating cows, for each 1% increase in milk production, it can increase income by at least 140 euros per day, and make more than 40,000 euros per year. All these improvements in profit depend on a smart data management system based on animal husbandry big data. The system can be remotely controlled through the PC and APP, using sensors to automatically collect real-time information, and automatically give the optimal solution after analysis. Without manual intervention, it can cover lighting, ventilation, feeding, manure cleaning, and data collection in all aspects of the ranch, which can reduce costs, reduce waste of resource, increase ranch productivity, and protect animal welfare.

4.2 Precision marketing

Big data platforms for animal husbandry can help banks achieve precise marketing. There are three processes to achieve it: first, use the big data platform to find target customers and accurately locate the marketing target; second, after obtaining the customers’ data mining results, provide a set of intelligent decision-making solutions for specific customers; finally, use the model of the animal husbandry big data platform to analyze the results, identify potential customers and achieve a sustainable marketing plan.

4.3 Monitoring and warning

Animal husbandry big data platform can accurately cover existing customers and partially high-quality potential customers. Real-time monitoring and early warning can timely detect abnormal behaviors of farm management or abnormal performance of financial products, and make stop-loss responses to help bands build proactive, efficient and intelligent marketing.(3)

5.1 Feeding analysis

Feeding level is the most critical factor affecting cow’s growth and milk production. For lactating dairy cows, the daily dry matter intake needs to reach 15-30kg, which makes feed expenditure the most important cost (more than 50%) of pasture operation.

Through the TMR feeding station, you can clearly know the daily feed intake of various types of feeds, and then calculate the daily feeding cost based on the purchase price. Wisdom pasture management system by feeding dry conversion parameters, combining milk production data and body condition score data, determines whether the feeding and feeding formula of each herd is appropriate, and adjust it to achieve accurate feeding.
In addition, the timely return to the trough of scattered feed cannot only meet the nutritional needs of the cattle to ensure the output, but also improve the feed utilization of the cattle farm, reduce feed waste and costs. The traditional manual pushing method is relatively inefficient, and the mechanical noise of tractors and other equipment is relatively large. However, the AI-driven pushing robots can provide a closed-loop pushing feed services for the ranch. The whole process without manual intervention, liberates manpower, improves efficiency, and reduces time and labor costs. It helps increase cow feed intake and reduce leftovers, thereby increasing milk production.

If the lighting time of the cowshed is extended, the milk production and feed intake of the cows will increase. Studies have shown that when the light time is 16 to 18 hours per day and the light intensity is at least 160-200 lux, the milk production is the highest. During the dry period, the situation is exactly opposite. At this stage, 8 hours lighting and 16 hours dark light are recommended.

5.2 Lighting analysis

According to Phil Elkins, director of the Westpoint Veterinary Group in the UK,(4) prolonged lighting is thought to increase the release of prolactin, which is the hormone responsible for milk production." Research has shown that during breastfeeding, especially in the early stage, a 16-hour photoperiod plus 8 hours of dim lighting can increase milk production by 2 liters per day compared to a herd with only 13 hours of light per day”. That is to say, if the ranch lighting is properly designed, it can increase milk production by 6%-10%.

To achieve this, high-quality and consistent lighting is required. For high lighting hours, dairy farmers should evenly level the light in the cowshed to 180-200lux. During periods of low lighting, the light may drop to 50lux or less.(5)

The intelligent ranch management system can automatically control the cowshed environment through the light sensor. Collecting real-time brightness information of the cowshed, with the combination of the current lighting requirements, as well as automatic adjustment of the current optimal lighting scheme through big data analysis, dairy cows will be provided with the most comfortable living environment, thereby increase milk production.

5.3 Cow health

As it is known that activity pedometers are the core smart wearable product for the dairy cattle. Through the data, the traditional inefficiency, effort, and inaccuracy of the traditional manual disclosure of estrus cow have been completely changed. The accurate disclose of cattle’s estrus directly increases from uncertainty to 95%, thereby shortening the breeding time and calving interval, and maximizing the performance of dairy cows as much as possible, which is for high-activity cows. Similarly, low-activity cows also need to be taken seriously. The big data platform can also accurately find abnormal dairy cows based on activity data and historical information, to check whether the cows have hoof disease or other diseases, and promptly remind relevant personnel to check.

5.5 Business strategy

In response to growing dairy demand and the pressures of climate changing, ranches are seeking the help of revolutionary new technologies. In this process, the big data system of animal husbandry collects data such as milking, feeding, estrus, breeding, environment, cow health, etc., and locates each cow through cattle identification, to realize group farms and even the entire industry's interconnection through the platform. The animal husbandry big data platform integrates the information available in the cloud and even other cross-industry information (such as weather data and pricing models), analyzing human, insurance, plumbing, communications, diesel, maintenance costs, lease and other consumption costs, etc. to establish a model to analyze the output improvement plan to determine the optimal operation mode of the ranch. For example, it can predict that if the market demand is about to be excessive by the big data, and the pasture can moderately reduce the feeding amount or adjust the formula to reduce milk production and avoid waste caused by excessive milk production. These models help reduce costs and increase efficiency, and make valuable early warnings.

5.6 Manure cleaning

A clean and stable barn environment is especially important for cow comfort and health, especially for lactating cows who often walk and lie in the fecal tract. The piled fecal dirt can cause a variety of cow diseases such as mastitis and laminitis. Therefore, timely and effective manure removal is the basic requirement of every high-yielding pasture. Traditional manual cleaning and traditional decontaminating vehicles often leads to piles of feces, breeding of germs. The loud operating noise will disturb cattle herds to rest, and rumination causes stress. People frequently in and out of the barn to clean up the manure will also increase the risk of zoonotic transmission. Without scientific manure disposal methods, environmental pollution and carbon emissions will also increase.

5.4 Milking data

Through real-time monitoring of milking flow data, 0 - 15s, 15 - 30s, 30 - 60s, 60 - 90s, milking data can help the dairy farm manage the milking process. Judging from the data, it can tell whether the operation of milkmaid is correct or not. When the flow value of 15 - 30s is less than 0 - 15s, a double-peak milking phenomenon will occur, which will affect the cow nipple health and increase the risk of keratinization. The big data platform alarm can inform relevant personnel about which milking point has problem in real time, and even can determine which milkmaid’s operation has problems. Is the problem caused by milkmaid’s operation or the milking process? With the help of big data platform, the historical milking flow curve of the cow can be analyzed, and whether there is a problem with the cow, the equipment itself, and the milking process can be determined too. By practically solving the thorny problems of the ranch with minimum marginal cost such as time and effort, and ranch profit maximization will be gained. The world’s leading milking equipment companies De Laval and Lely, applying the big data platform technology, have launched milking robots with automatic milking, disinfection, and milk analysis functions for precise cow management.

Low activity, low milk production, lactation days more than 200 days, body condition score less than 3 (1 point means very lean cows, 5 points means overweight cows, these two numbers are extreme scores; generally, the ideal average score is 3 points, which is also the most ideal score for most dairy herds) and other data combined with analysis, the intelligent separation door can automatically separate the cows to the designated area to be treated, while the veterinarian only needs to bring tools to the designated area and treatment. The more precise the data is, the simpler the job will be.
In the digital era, the ranch manure cleaning system consists of manure removal robot and a manure scraper board equipped with high-precision sensor. After identifying the manure in the fecal tract, it intelligently calculates the cleaning path without manual intervention. Emancipating manpower and improving efficiency can not only free the workers from the "dirty and stinky", but also effectively improve the environment of the cowshed and the welfare of people and animals. Moreover, with high efficiency, low consumption, low noise, and no pollution features, intelligent manure cleaning system, through solar energy and biogas power generation, will realize renewable energy in animal husbandry. Finally, the fertilizer is returned to the field to form a closed loop.

5.7 Other applications

The government and farms can also complement with each other. The government can clearly obtain the real-time dynamics of the national dairy industry through big data, and better manage the macro-control and investment of the industry. The ranch will also know the price logistics of imported production materials through government import and export information, such as alfalfa, and make timely reserves or plans to prevent the impact of international raw milk price fluctuations or corn and soybean meal influence on the cost of milk. For example, in 2012-2013, New Zealand, the world's largest exporter of milk powder, has suffered severe drought, reducing the output of raw milk by 1.8%, which directly led to a shortage of raw milk in the global market. The early warning mechanism of big data is particularly important at this time. Knowing in advance through big data, it will help the expansion of cattle farms and even build new ranches, hence milk production capacity will be enhanced and obtain timely profit margins. The government lowers tariffs in advance and purchases raw milk to curb market price fluctuations. Dairy companies also sign more dairy farms in advance to take advantage of market opportunities. Of course, during the period, the above three parties can work together to formulate a more reasonable and comprehensive plan.

Scientific research institutions use the animal husbandry big data to deeply analyze the actual needs of the ranch, and to increase the research of advanced technology applies to dairy cows. If the pasture suffers from mastitis for a long time, the milk production will be affected toughly, resulting the decline of dairy cows' performance and elimination, even the milk quality SCC will be severely affected too. Through in-depth research on infrared technology, scientific research institutions have found that infrared technology can monitor hidden mastitis through data on the temperature of the breast, so that early warning can be achieved, and technology can be converted into products and applied for mastitis monitoring. With this product, the ranch can find and treat the hidden mastitis cows, to avoid clinical morbidity. According to the historical husbandry data, mastitis has a greater impact on cows with more than two babies, which brings a loss about 1,200 kg of milk production. The use of technology, the recovery for direct losses and hidden costs of ranch are considerable.
6. Smart farming solution for pig farm and case analysis

Everything on the pig farm can be digitized. Digitization can achieve the effect of 1+1>2. From the manual era of manual feeding and decontamination, to the automatic era of automatic feeding lines and automatic manure scraping, to the era of the information era of pig farm management, and to the era of the Internet of Things (IoT) of various sensors, with the rise of technology, the pig industry is also constantly changing. No matter what kind of changes the transformation made, it will allow farmers to raise healthier pigs with a lower cost. At the same time, it also helps us to have a better control of the health status of the pig. Like other industries, the pig industry is also undergoing changes from extensive management to refined management. Today, driven by technologies such as big data, Blockchain, AI, robotics and 5G, the pig farm will usher in a brand-new era. This new era is called the “Smart Age”, will combine the characteristics of all previous eras and sublimate them.

Let’s experience the time changes from a pig farm owner’s perspective. John is the general manager of a pig breeding group. The group owns 900,000 basic sows in more than one province in China. There are more than 30 large-scale pig farms ranging from 1,000 basic sows to 10,000 basic sow. Before applying the big data, the company gathered operation data monthly through Excel reports and various pig farm management software. It took one week from the time the data is received to the time when John got the production data summary. The financial statement was available after one month. During this period, finance department had to complete the consolidation of various reports and data analysis, and the workload is huge. That is to say, after the production report at the end of March, John would know whether the group made a profit or a loss in March until April.

As a business man, the delay in financial checkout is not what John most worried about, but the timing of selling pigs is. China is a vast country, and the price of pigs varies from province to province, even city to city. The most essential question for John is how to ensure that each pig farm can sell out the pigs at the best timing. If a 1000-head pig farm is produced in batches per week and the market weight is 110 kg, then if the price of pigs falls by 0.2 yuan / kg tomorrow, then he will sell nearly 10,000 RMB less. If all his farms are in the same situation, he will earn 9 million RMB less per week, almost 468 million yuan less in one year.

African swine fever made the situation even worse for John. The virus has swept mainland China since the outbreak in 2018. Numerous pig farms bankrupted as a result. If one pig in the farm contracted the virus, the only way to survive was to kill the entire herd. The rehabilitation can only be started 6 months after the culling, while the probability of success in rehabilitation is indeed frightening. Biosecurity is the only one solution to the problem of African swine fever. John took a lot of effort on this, including recruiting special personnel to be responsible for biosafety. However, personnel and materials come in and out. It is not realistic for a human to guard 24 hours every day!

Feed is the top 1 cost for pig farms, and usually account for 60%~70% out of all costs on a farm. One cent saved from one pig; more profit will be gained for the whole farm. Let’s say, if John could save 10kg of pig feed from one hog, he can save at least 20 RMB each hog, which means 360 million RMB a year. If the herd is healthy, the housing environment is properly controlled, death and the feed-to-meat ratio will be decreased. This 360 million RMB goal can be easily achieved.
After several visits to the pig farm, John found that sows were either fat or thin. If a sow is too thin, it means it does not have enough feed, so its piglets were few and weak. After the lactation period, the sow will become thinner, and will not even be able to estrus normally and enter the next production cycle. Its piglets, because of the inherent weakness, grew slower than their peers. It is hard for the weak piglets to fight for food with normal pigs. Conversely, fat pigs ate too much feed, resulting in wasted feed and ultimately difficult delivery.

Eating a log makes hogs grow faster than other kinds of pigs, so feed for hogs runs out quickly. The breeder needs to climb the steel ladder of the feed tower frequently to check if there is enough remaining pig feed. If no, he can order from the feed mills in time. When it was raining or snowing, accidents would possibly happen, like falling off the ladder and breaking the leg.

There are many examples like this.

Later, John met Sveaverken and used the big data platform of animal husbandry. Things became like this:

Sveaverken has deployed sensors, automated control system, robots and management system in each farm. Within the group, the existing systems was connected to integrated management system of Sveaverken pig farm. By this way, the farm group can have access to all platforms via just one system. All authorized managers can implement functions such as receiving reminders and viewing reports through mobile phones, tablets PC and computers. Sveaverken even set up a war room at John’s office in headquarter. The big screen displays the production status, financial data and daily reminders in real time.

With this system, decision making becomes timely and accurate. All production and financial data can be reported daily. Once reports received, the system will automatically generate daily reports, monthly reports, annual reports and other kinds of reports based on preset templates. All data no longer need manual analysis for days or even weeks before getting the report. Each report can be automatically generated and sent to managers in real time. Nor does Headquarters need so many data analysts too. Undoubtedly, the time for strategic decision-making not only has been significantly reduced, some subjective errors also has been avoided. In this situation, even if specialized reports are required, it could also be generated within an hour, which is unimaginable in the past.

With this system, the farm knows when the profit peak is to sell pigs. With real-time production and financial data, owner could know about the real-time cost and predict future cost of each batch of pigs. Combining with the market price trend, the best sales timing and sales plans could be automatically made. After reviewing by the officer, sales plan will be directly issued to each pig farm for implementation.
With this system, security and biosecurity are greatly ensured. AI cameras are installed inside and outside each pig farm to monitor personnel and materials. Any entering needs to be reported in advance through the system and approved by the headquarters. For example, an employee is going to return to the pig farm after vacation. After quarantine, he can pass the pig farm staff entrance by face ID. If he has reported his back in advance and got approved, the door controlled by the system will open automatically for him. His belongings will be passed through the disinfection window to the disinfection room. Employees enter pig farm have to pass through Sveaverken patented disinfection and shower system, to ensure no virus would be carried into farm. The entire process requires no guard on duty. If an unexpected visitor appears at the gate or fence, the camera will automatically sound an alarm to it. In the meantime, the alert will be sent to both the pig farm and its headquarters. In the pig farm, the smart access control system separates pigs from the farm staff in the breeding, nursery and fattening area. So, the spreading of disease can be prevented in the farm. In the vehicle decontamination center, the system identifies the staying time by recognizing the plate of vehicle. Combining the human recognition camera, water sensor, and sewage pipe water quality sensor in the workshop, the system will determine whether the car is carefully washed. In the drying workshop, the camera and multiple temperature sensors are used to determine whether the vehicle drying time and drying temperature meet the standards, in order that vehicle is free of any pathogens when approaching the farm.

In the pig farm, Sveaverken offers intelligent feeding solutions. Load cells are mounted above each tower. Each feeding time and feeding weight will be recorded. When the feed is consumed, the system will automatically send a feed order to the feed mill. At the same time, the system will also calculate the daily weight gain, feed intake and meat-to-meat ratio of each pig per day based on the number and weight of pigs measured by the intelligent camera in the farm. If any of the parameters is abnormal, an early warning will be issued to the pig farm and the group headquarters. The feeding system will also control the automatic feed line to feed automatically according to the remaining material sensors of each feed tank. In the pig farm, Sveaverken provides intelligent environmental control systems. The AI camera is suspended above the pigsty to identify the rest and movement behavior of the pigs. The pig’s somatosensory temperature is directly judged by the pig’s behavior. Then the control of fans, water curtains, ventilation windows, heaters, floor heating, etc. provides the most suitable environment for the pigs, allowing pigs to eat more, grow faster, and live a healthy and happy life. The manure scarpering system will automatically operate after the peak of excretion of pigs under the guidance of behavior analysis cameras to ensure fresh air in the pigsty.

In the pig farm, Sveaverken provides intelligent health analysis systems. The camera combines with sound recognition technology to continuously analyze the images and sounds in the pig house every day. If the pigs with abnormal eating, drinking, and moving behaviors, whose house number and pigpen number will be sent to veterinary’s phone. After receiving the information, the veterinarian can bring the equipment to find the sick pigs immediately and treat them at once. By monitoring the cough sound, the system can predict outbreaks of respiratory diseases several days in advance of humans, and promptly notify the veterinarians for treatment. By monitoring the compressed sound of the piglets, the system can dispatch the intervention robot in the delivery room to pick up the sows and rescue the crushed piglets.
In the pig farm, Sveaverken offers smart robot system. The cleaning robot can replace humans to complete high-pressure rinsing of the pigsty, spraying cleaning agents and disinfectants, which doubles the efficiency of manual cleaning. The monitoring robot can realize automatic unmanned inspection of pig houses by using zoom optical cameras, thermal imagers, microphones, and water guns. It is also able to detect and mark activities, temperature abnormalities, coughing pigs in time and notify the veterinarian. Simultaneously, it also stores the condition of each pregnant pig, and adjust the feeding amount of the feeder to achieve accurate feeding, promising that the pregnant sow is not overweight or lean and presents best reproductive performance in the farrowing house.

In the pig farm, Sveaverken offers environmentally friendly solutions. After the biogas fermentation of pig manure, the differences between biogas slurry nutrition and the nutritional requirements of crops can be determined by measuring the content of nitrogen, phosphorus, and potassium in biogas slurry and farmland soil. Then the water and biogas slurry are automatically matched by the intelligent water and fertilizer machine, and are automatically transferred to the farmland through the pipeline, to ensure that animal husbandry and agriculture form an ecological recycling industry chain and minimize environmental pollution.

For branded meat sales companies, Sveaverken provides a full chain traceability system for pig breeding. After purchasing pork, consumers can query the related information such as the split time of pork, transportation route, slaughter time, pig farms, breeders, feeds eaten during growth, immunization records, antibiotic injection records, surveillance videos. Consumers are provided with environmentally friendly, healthy and antibiotic-free pork.

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Imaging a day that all farmers and their livestock farms are on Sveaverken’s smart farming solution, daily operations are automatically done by AI robots, operation analytics are digitalized and visualized by the IoT system. Farmers have no need to work from early morning to late night, nor need to bear smelly working environment. They will win more time with family and friends. The word ‘FARMERS’ will no longer represent the man working all time on farms, but the man controlling the farms remotely. With Sveaverken’s smart farming solution, a free-farm life, is the kind of lifestyle that the new farmers will have.
7. Prospects of data analysis for animal husbandry

“The cost of something is what you give up to get it.”(6)
The animal husbandry big data platform allows the farm to use the least effort in exchange for the greatest benefit.

At present, the Internet has fully entered the "DT" (Data Technology) era. The integration and development of big data, 5G, AI, and Blockchain are becoming increasingly tight. The technologies used to serve the public and stimulate productivity have become increasingly mature. If the animal husbandry industry wants to break through the constraints of resources and environment, it is necessary to use big data to improve the precision and intelligence of animal husbandry production, promote the transformation of agricultural resource utilization methods, guide the production and management decisions of animal husbandry producers, and increase profit margins. Strengthening cooperation with banks will reduce capital pressure on livestock industry practitioner, guarantee cash flow for livestock farmers, and enable animal husbandry practitioners and bankers to share the rich harvest of digitization. The full application of big data in animal husbandry will trigger a new round of revolution in animal husbandry production, operation and management.

In the future, as the proportion of animal husbandry in food will continues to increase, with the effective help of big data, supporting the development of the animal husbandry industry is not only a stable and promising investment, but also provides an important guarantee for the survival, health and safety of all humankind.

References


