The Farm Data Ecosystem

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CNH INDUSTRIAL

1. Introduction

CNH Industrial is a global leader in the capital goods sector that, through its various businesses, designs, produces and sells agricultural and construction equipment, trucks, commercial vehicles, buses and specialty vehicles, in addition to a broad portfolio of powertrain applications. Present in all major markets worldwide, CNH Industrial is focused on expanding its presence in high-growth markets, including through joint ventures.

The roots of CNH Industrial date back more than 175 years. During this period, the companies making up CNH Industrial went through radical technological evolutions, often being involved in the birth and development of new innovative solutions.

2. History of Agricultural Technology

Historically, most people were farmers providing their own food and food for the local community. In the 18th century, new practices in agriculture, such as the utilisation of the swing plough and new crop rotation systems, lead to better living conditions. It was the age of the Enlightenment. The seedbed was created for new technologies in manufacturing. At the heart of the revolution was steam power. It meant manual work could be replaced by automation. After the invention of the wheel, this was the biggest technological miracle the world had seen so far.

Although steam powered implements and tractors existed in the 19th century, they were far from practical and only available for the lucky few. We had to wait for a more convenient power source in the form of an internal combustion engine. Henry Ford came to the market with the Fordson in 1917, the first mass produced and affordable tractor. The Fordson represented for agriculture what the Model T did for transport. Convenient machinery replaced horses. Large-scale mechanisation in agriculture started.

The next big jump in productivity gains in agriculture happened with chemical and biological technology halfway the 20th century. Mineral fertiliser, crop protection products and better seed varieties boosted output to new highs. This is known as the Green Revolution.

GPS signals became available for public use in the 80s. The 100-year old dream to steer a tractor automatically became a reality halfway through the 90s. In parallel, yield monitors were born. It was the dawn of precision farming. Yield measurements are mapped on the field through GPS-positioning. Using geo-located information it is possible to treat each square meter (and even centimetre) of a field with different applications, to give the plant exactly what it needs to become a healthy crop.

3. Digital Farming

In the beginning of the 21st century, new technologies for data communication and processing introduced us to "industry 4.0". Sensors and computing power have become cheap and available to a wider audience. Data is captured in unprecedented quantities and analysed through big data analytics. GPUs (Graphic Processing Units) support artificial intelligence and deep learning.

Farmers make decisions leveraging algorithms optimised through aggregated data and quantified knowledge. Data eco-systems emerge, where data is accessible by value chain participants, but still controlled by the farmer. This opens new possibilities to create services based on the data (Figures 1-2).

Many farm input providers start by using data to improve their products. E.g. Seed companies get a better understanding on the performance of their seeds, and can make recommendations (a.k.a. prescriptions) to improve yield. Chemical companies provide recommendations for the optimal use of their fertiliser. Business models change. Where the product used to be agrochemicals, it is now crop protection in the most complete sense, which could as well be based on data rather than chemicals.

4. Opportunities for Equipment Manufacturers

Machinery manufacturers are also looking for data. And in this scenario, there are several implications for OEMs (Original Equipment Manufacturers): most importantly, manufacturers are compelled to redefine their strategy and consequently their business, moving from "selling iron" to a complete service and data-driven solution for customers, in order to enter into the so called 'Digital Farming revolution'.

Especially with precision farming, agricultural machines are the biggest data generators and consumers in agriculture. Yield monitors capture ton-loads of data; and data is required to operate the machines in the field efficiently. Through the installation of telematics systems, the data from the vehicle is now available on the cloud. It is easily accessible by the farmer, who can grant access to 3rd parties including the manufacturer. Historically, machinery dealers have a good relationship with their customer. Machinery manufacturers are one of the preferred partners to handle the data from the farmer.

Second generation telematics connections feature bi-directional communication for getting data out of the machine, and also sending information into the machine. This infrastructure allows for new functionality, including remote diagnostics and over-the-air software updates. Dealers also have visibility on the machines, such as updates on issues during operations. This allows for pro-active intervention, enhancing the customer experience.

Machine manufacturers may use data from the vehicles to improve products and processes. Processes are either directly linked to the vehicle such as vehicle service or automatic warranty registrations, or indirectly based on aggregated information for example spare parts operations.

But the ultimate goal is to build the perfect vehicle. By analysing how a vehicle is used in the field, we can better define requirements, resulting in products which better match the needs of the farmer. Over-engineered features can be avoided. Error messages from the vehicles are captured in real time, allowing faster detection of issues. More contextal information is available, again leading to faster problem resolution. Product fixes are implemented faster, resulting in better vehicles and a higher customer satisfaction. For the customer it means a lower TCO (total cost of ownership), for the manufacturer it means lower warranty costs.

Many innovative ways of using data are possible. We are only on the brink of the digital breakthrough. During the last 175 years, CNH Industrial actively engaged in technological revolutions. We have no choice but to embrace the digital paradigm shift to better serve our customers.

5. A Model for an Agricultural Control Room

CNH Industrial produces combines, forage harvesters and large square balers under the New Holland Agriculture and the Case IH brands (Figures 3-4). Combines are a flagship product with a lot of customisation. Although they are all yellow and red, no two identical combines leave the factory.

Combine harvesters have become more digital, being equipped with automatic steering solutions and various crop sensors for measuring yield, moisture and nutritional crop content. Recently, combines have also been equipped with a modem on board, which allows the vehicle to be monitored in real time. The connectivity platform stores the data that can be transferred to 3rd party suppliers for services related to farm management, agronomy, food traceability and many other applications.

CNH Industrial intends to use the data from the vehicles – with the farmer's permission – to further improve the efficiency and reliability of its products. This is especially important for harvesting equipment, as the harvesting window is limited. The hidden cost of a non-operational or inefficient machine is very high.

A combine harvester is a complex machine with many settings, posing a risk for inexperienced operators not to use the machine to its full capacity. For repair and maintenance the goal is to switch from a re-active approach (fixing the machine when it breaks down) to a pro-active approach (planning the intervention before the breakdown happens). The data from the vehicles will allow engineers to learn how the machines are used and behave, so they can develop better products that are more reliable and cheaper to maintain.

The "control room" is the heart of this process. It is a monitoring centre to assist farmers with the usage of the vehicle. The support centre will pro-actively engage dealers when a breakdown is imminent, and they will report back to the engineering department to develop long-term solutions.

The control room concept is new in the agricultural business segment of CNH Industrial. The company already has a successful control room for the support of trucks based in Turin, Italy (Figures 5-6). This provides a template and experience to further build on. That said, the products are very different. Although data is agnostic, the way services are provided is tailored to the business needs.

6. Strategy

The dealer is our main partner to provide support to the customer, although we don't see the dealer as the main actor for data analysis. This requires specific knowledge that goes beyond their scope and capabilities. The dealer is involved in providing service and communication with the customer. CNH Industrial provides the tools to help the dealer provide better support, for troubleshooting and knowledge. The tools require specific dealer training.

CNH Industrial is bringing all its competencies together in the control room. From a commercial point of view, the control room is a product designed by CNH Industrial, not by the dealer. The goal is to create win-win situations for everybody: the customer, the dealer, and last but not least CNH Industrial and the departments within the company.

There is no strategy for reaching out to the customer directly. Ultimately we want to get as close to the customer as possible with the right competencies. In the worst case breakdown scenario we envision a central flying doctor to solve the issue, however the dealer remains a strong partner throughout the process.

7. Operation

Large combines are equipped with telematics by default. The modem taps data from the CAN-bus. The CAN-bus is the artery of the machine. It connects all sensors, actuators and user interfaces of the machine in a digital way. The data lands on the telematics platform, and is forwarded to a cloud environment. The control room's activity starts when data is available for analysis.

Data is combined with other sources of information such as product configuration, maintenance and repair data, and warranty information.

The control room is manned with a dedicated engineer who receives support from a cross-functional group of tech specialists from the data scientist team, training organisation, technical support and product development engineers. The control room uses reports and dashboards to monitor the machines. The team meets once a day to discuss cases, alleviate damage and define structural solutions. The control room engineer involves the right people from the right departments dependent on the case. The type of support depends heavily on the product use case and the stage of the solution identification and development.

8. Dealer Support

The control room has a positive impact on the dealer tech support process. The strategy is (and always has been) to have good dealer technicians that can solve issues themselves, with a central CNH Industrial team to support these technicians only in case of need.

We see today that too many interventions requiring customer visits from dealer support technicians are badly prepared. Through pro-active analysis of the vehicle behaviour remotely, we can ensure efficient field trips. With the control room we already have a better understanding of vehicle performance, conditions, usage, etc. The challenge is to reduce the uncertainty in identifying the root cause of the problem. This should lead to faster issue resolution.

Secondly there are the indirect benefits. The control room works pro-actively, where dealer support only gets involved at the final stage of the issue resolution. Combine harvesters will be better engineered thanks to the utilisation of vehicle data in the design process. In general, less issues should lead to less dealer support interventions.

If the dealer has problems with remotely diagnosing the vehicles, they can get in contact with customer care who will assist them with the operation and interpretation of the result. Having the right diagnosis before going to the field ensures the right parts are taken to the vehicle. In parallel the control room engineer will alert the dealer of pending interventions and pro-actively order the parts.

9. Product Development Support

Early issue identification helps dramatically in reducing the time to implement structural solutions. As such the warranty costs can be reduced significantly, while concurrently improving customer satisfaction.

The incidents are grouped and ranked according to prevalence and criticality by the control room engineer, and reported back to engineering. Engineering can further investigate (or post requests for investigation or data extracts) the incidents to define the root-cause of the issues. It depends what the engineer wants to do. The request can either go to the control room or they can work directly with data scientists and analysts. In some cases engineering has specific requests that require more details (e.g. higher frequency, other parameters…) that go beyond the scope of the control room.

10. Conclusions

In the new era of digital transformation (Agriculture 4.0), agricultural data is a key element which is transforming competition and reshaping strategy among stakeholders, OEMs and technology/services providers.

In this context, CNH Industrial is also facing this technological challenge, developing a complete new infrastructure where data, flowing from vehicles, are transmitted through a telecom network to a Cloud storage and are made available for elaboration and statistical/historical analysis, enabling 3rd party services integration.

To conclude, a data-driven approach is nowadays a major factor of competitive advantage for enterprises, and especially a support for remote maintenance applications. As a matter of fact, CNH Industrial's architecture allows to connect a skilled operator in a control room where thousands readings from several sensors embedded in the machine are captured and analyzed to identify specific patterns, showing, on one side, how performance can be correlated with machine's engineering specifications and, on the other hand, how a root cause of a failure can be unveiled combining those readings with the recurrence of problems.

References

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Figures

Figure 1 – 2_ The Farm Data Ecosystem

Figure 3 – 4_ New Holland Agriculture and Case IH Combines

Figure 5 – 6_ CNH Industrial Control Room