

## Final Project Summary

<b>Project title</b>	Hands Free Hectare 2: Autonomous farming machinery for cereals production		
<b>Project number</b>	21140006	<b>Final Project Report</b>	PR609
<b>Start date</b>	October 2017	<b>End date</b>	September 2018
<b>AHDB Cereals &amp; Oilseeds funding</b>	£45,000	<b>Total cost</b>	£45,000

### What was the challenge/demand for the work?

Hands Free Hectare first ran during the 2016 to 2017 cropping year. It was a 'world-first' project run by Harper Adams University and Precision Decisions. Funded by Innovate UK, it aimed to drill, tend and harvest a barley crop without operators on the machine or agronomists in the field.

In year one, the project looked to prove the feasibility of using open source global navigation satellite systems (GNSS) within field agriculture to autonomously till, plant, grow and harvest a spring barley crop.

The systems used have been developed by the open-source community and utilised within the small-scale unmanned aerial vehicle (UAV)/drone market, which has expanded rapidly in agriculture in the past four years.

There is a need to build on lessons in year one to increase the accuracy of the machinery and to improve remote agronomy. There is also a need to inspire new talent to enter the industry to develop such technologies.

### How did the project address this?

Hands Free Hectare 2 built on the experiences during the 2016 to 2017 cropping season to farm a one hectare of winter wheat autonomously.

Improvements to the tractor's systems were made. This included the addition of an auto-start function that allowed it to be turned on remotely.

In November 2017, wheat was drilled with an enhanced auto-pilot function. This led to improved driving accuracy and increased field coverage. Drilling misses fell from 2.82% (autumn 2016) to 0.35% (autumn 2017).

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The wheat was harvested with an autonomous combine harvester. For the first time, the team unloaded grain from the combine on the move. This was achieved through improvements to the control system on the tractor. This level of accuracy achieved allowed the tractor and trailer to run alongside the combine, making harvest more efficient. Some manual intervention was required to ensure the tractor started on the right line. Once it was there, it drove itself to within a 5cm accuracy. The combine ran autonomously throughout the cutting and completed the headland turns without a problem. In this crop, compared with the last, the combine header cut was adjusted from 1.5 m to 1.75 m. It is important to note that smaller machines (running in fleets), like used within this project, are probably the key to autonomous success.

The project also aimed to maintain the high profile of Hands Free Hectare. The project received extensive coverage in the farming press. The project has gained worldwide attention, with articles, blogs and broadcast items appearing in 85 countries. The team has also been invited to talk at conferences and events in various countries, including the 2018 Oxford Farming Conference, and has received prestigious awards (e.g. the BBC Food and Farming Awards 'Future Food Award' for 2018). The project has also issued regular, engaging updates through its dedicated website – [handsfreehectare.com](http://handsfreehectare.com) – and social media channels (e.g. [Twitter](#) and [YouTube](#)). Hands Free Hectare was also present at key industry events. At Cereals 2018, for example, four live demonstrations of the autonomous harvesting systems were delivered.

Half of the crop was harvested in early August 2018. This allowed systems to be refined. The harvested wheat was also milled and the flour used to make pizzas on the official harvest day (14 August 2018). [A video of the harvest has been published on YouTube](#). Despite the late drilling and technological challenges of growing an autonomous crop, the winter wheat crop achieved a respectable overall yield of 6.5 t/ha.

During the third cropping year (2018/19) the team has established a cover crop and will further refine all aspects of the autonomous cropping process. The team will look to develop infrastructure to facilitate the hands-off process. For the tractor to drive itself from the shed to the field, for example, the team will develop a gate that opens and closes when the tractor enters the hectare.

<b>Lead partner</b>	Agri EPI
<b>Scientific partners</b>	Harper Adams University (staff operate on behalf of Agri EPI)
<b>Industry partners</b>	KWS Soil Essentials
<b>Government sponsor</b>	Precision Decisions Limited

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