How Long Does it Typically Take before Farmers Adopt New Technologies?

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During 2015, KFMA economists began collecting information regarding KFMA members' adoption of precision agricultural technologies. By August 2017, 545 KFMA farms reported their respective adoption status (used or never used specific technologies). Of the 545 farms reporting, 399 (73%) reported using one or more precision technologies.

Duration, the length of time between being able to adopt and adopting technology

In a duration analysis, the 'duration' is the length of time (usually measured in years) between the farm adopting technology and when the farm could adopt the technology (which is the later of the technology being introduced for commercial purchase or the farm entered operation if after the commercialization of the technology). In the case of precision technology adoption, the year that the technology or service was first made locally available was identified for this analysis (Figure 1). The remaining variable of the year that the farm operation began was used from the KFMA Operator Database.

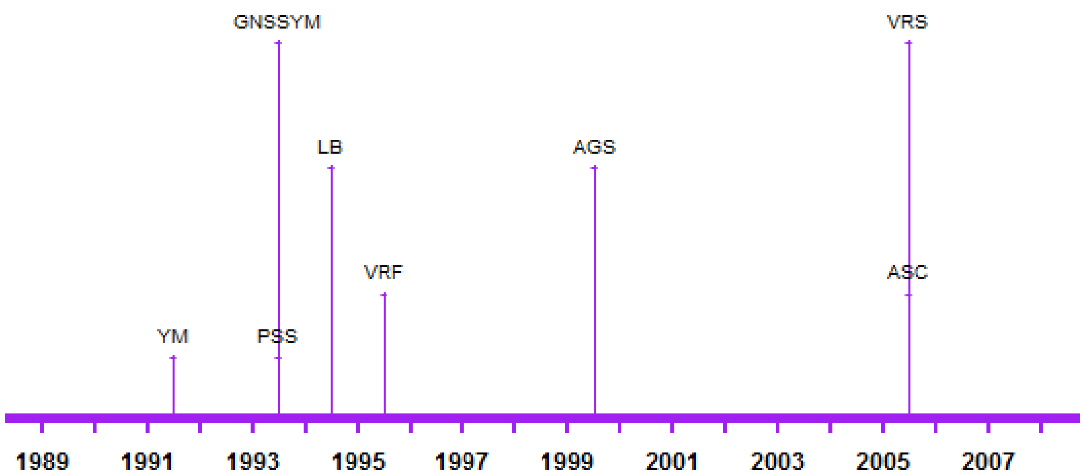

Figure 1. Timeline of commercialization of precision agricultural technology

YM is yield monitor, GNSSYM is yield monitor with GNSS, PSS is precision soil sampling, LB is lightbar, VRF is variable rate fertility, AGS is automated guidance, VRS is variable rate seeding, and ASC is automated section control. GNSS is global navigation satellite system formally known as GPS.

To graphically represent the relative response of Kansas farmers' adoption of each technology, "violin plots" were chosen (Figure 2). Only farms that had adopted specific technology were included, therefore the sample size was n=399. Violin plots were named given that they look similar to violins. Violin plots are a type of box plot that represent the relative size of the numbers, here the number of farms that adopted each technology in years, i.e. duration, after they could have adopted the technology. The wider the 'body of the violin' the more farmers adopted at that given level of duration. The purple dot represents the median duration year that KFMA farmers adopted the specific technology. The left side of the violin plot indicates when the first farmers adopted the technology and the right side represents the most recent adoption of the technology. The x-axis has negative years indicating some Kansas farms adopted individual technologies before being widely commercially available; in those cases the farms likely sought out those technologies outside of their geography region, potentially as beta users direct with the manufacturer, and can be considered the very earliest adopters.

Relatively newer technologies such as variable rate seeding (VRS) and automated section control (ASC) that have only been on the market for a few years, have shorter violins (as measured from left to right). Other technologies that were introduced to the marketplace earlier and remained on the farm for longer periods of time have longer violin shapes. In this case yield monitors (YM) and lightbar guidance (LB) have longer violin shapes than the other technology.

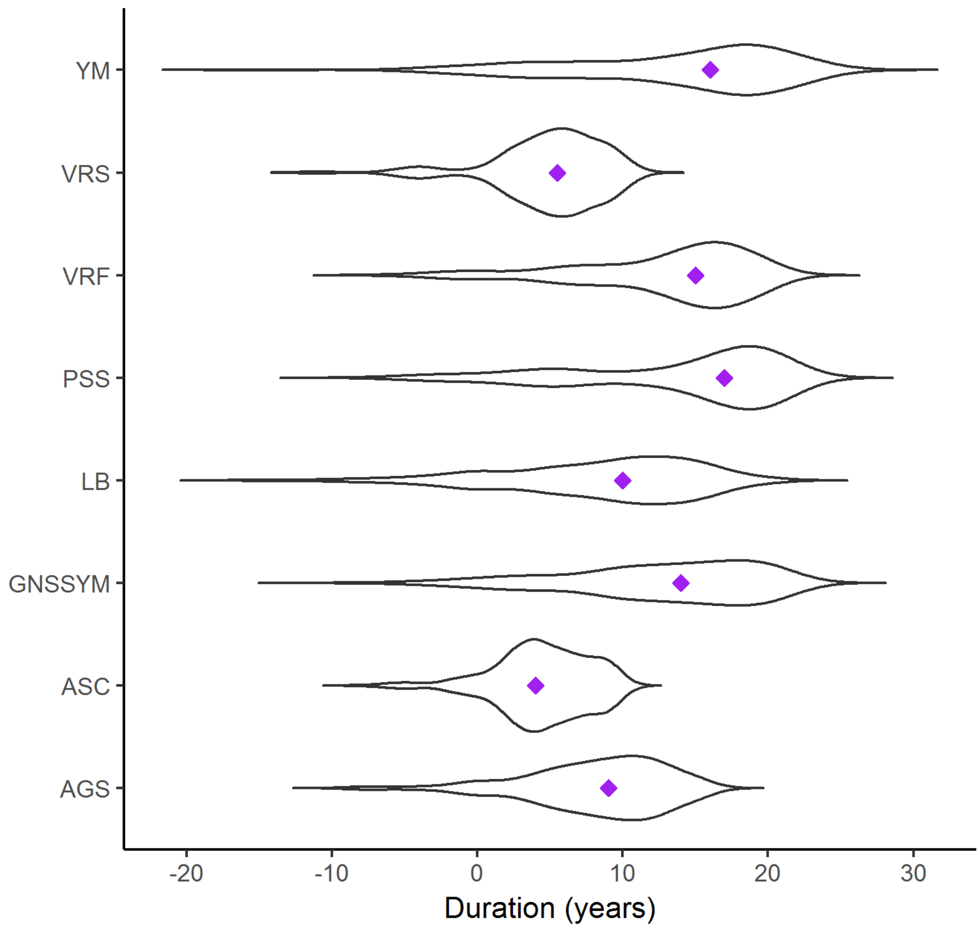

Figure 2. Violin plot of precision agriculture adoption (n=399)

Results of Duration Analysis

Statistical tests were conducted to determine if technology adoption were significantly different from each other. Duration results can loosely be interpreted to reveal whether one technology has been adopted at a faster rate than another.

Embodied-knowledge technology

The duration for automated guidance were compared to duration for lightbar; results indicated that adoption rates of these technologies were statistically different. Automated section control was adopted in relatively shorter amount of time than automated guidance.

Information-intensive technology

Duration for yield monitors with and without GNSS were compared. No statistical difference were detected between the two types of yield monitors. Precision soil sampling and GNSS-equipped yield monitors were not adopted at statistically different rates.

Embodied-knowledge versus information-intensive technology

Automated guidance was compared to all yield monitors (regardless of the yield monitor having a GNSS). The duration for automated guidance was statistically different than yield monitors, indicating that farmers did in fact adopt automated guidance 'quicker' than yield monitors.

Summary

It was expected that duration of similar technologies grouped as either embodied-knowledge or information intensive would not substantially differ and duration across these two broad categories of technology would significantly differ. Specifically, it was expected that automated technologies such as guidance and section control would be adopted at much higher rates than data technologies like yield monitors due to differences in human capital costs to use these technologies. These results may indicate that although lightbar was considered an embodied-knowledge technology, it provided information which equipment operators used as a visual aid without automating anything; therefore it could be argued that even though substantial technology was embodied into the lightbar, it was analogous to information-intensive given that the user must make use of the information from the lightbar. For embodied knowledge technologies, automated section control was adopted quicker than automated guidance and automated guidance was adopted quicker than lightbar.

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