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Planning for Financial Risks Associated with Using sUAS in Agriculture

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There is no doubt that small unmanned aircraft systems (sUAS)[1] are envisioned as an emerging technology to help agricultural users reduce their management risks. The technology currently allows at least five broad applications for agricultural users including but not limited to: 1) crop or animal monitoring, 2) chemical applications, 3) asset tracking and management (e.g. monitoring fences, irrigation systems), 4) crop or animal inventory and crop insurance, and 5) marketing and sales. Since there are so many options to achieve the respective application, sUAS users face tough decisions on which option is best. This Fact Sheet is designed to help agricultural sUAS users understand the costs involved and present a decision-making process to evaluate the least costly option for their respective application.

All sUAS users have an objective or reason (e.g. RGB images; crop vegetation index; plant inventory; spraying) for using this technology and they realize there are several options available for meeting their business needs. The key driver in the process is to carefully understand what services are provided under each option and determine what those decisions imply about the corresponding costs. Once those costs are understood, then potential users need a framework to evaluate the options based on the best decision from a business standpoint – improving the bottom line.

For the purpose of this publication, we will define the parameters of our specific example for an agricultural sUAS user and then provide three scenarios to accomplish the objective. Remember that this is simply an example, but hopefully the framework presented and discussed will help reduce your financial risk when adopting this emerging technology.

Parameters used in our example:

- Objective: vegetation index (e.g. NDVI)
- Area of interest: 3 acres
- Frequency of image collection: 2 times/month over 5 months (May – September)
- Estimated # images/sortie: 32
- Estimated flight time/sortie: actual flight time 5 min but will assume 0.5 hr/sortie (dependant on the flight time of the sUAS)
- Estimated image processing time to create vegetation index: 1 hr/sortie

Table 1 summarizes three scenarios that will help us start our cost analysis:

In **Scenario #1**, the agricultural users choose to purchase all of the equipment and software needed to

Table 1. sUAS User Strategies

SCENARIO COMPARISONS[2]
BUSINESS/USERS:
#1: Owns/purchases all equipment/ software/licenses.
#2: Owns/purchases the aircraft & sensor but uses outside image processing service.
#3: Hires outside service to collect images and process images.

[2]Each scenario uses the same task objective, which in this example, is to generate a crop vegetation index.

accomplish the objective. Advantages include the ability to fly on an 'as needed' basis and the fact that the business retains all rights to the information produced. Disadvantages include the in-house cost of providing all of the resources (labor & equipment) to process images as well as acquiring the knowledge to use the technology for enhancing business management decisions. Since sUAS is an emerging technology the hardware and software are changing rapidly, thus, an investment may become outdated quickly and maintaining knowledge may be on-going and challenging against other on-farm demands. Business will have to maintain the internal expertise to collect and process images.

In **Scenario #2**[3], the agricultural users choose to purchase all of the equipment but hire an outside provider to process the images needed to accomplish the objective. As was the case with Scenario #1, this allows the agricultural user the ability to collect images on their own timeframe. Using an outside image processing service to process your images means you do not need to invest in that software and you can rely on the remote sensing expertise of the outside provider. You should make sure the outside provider can provide interpretation of the image output – otherwise you have nothing but a 'pretty picture'. An issue to consider when outsourcing your image processing is whether you still **retain exclusive rights to image data** and derived information.

In **Scenario #3**, the agricultural users hire outside services for collection and processing of images needed to accomplish the objective. An advantage of outsourcing both the collection of imagery and the processing is you minimize your capital investment in a technology that is rapidly changing. A clear disadvantage is whether access to the services meets your schedule.

Table 2 details cost components and estimates for using the three outlined scenarios in the first year (Y1). All of the scenarios used crop vegetation index (e.g. NDVI) as the application. A similar structured analysis would need to be conducted if the objective was different (e.g. plant inventory, spraying, etc.). Remember that this is simply a framework that allows users to insert their own inputs (e.g. size of

Table 2. Estimated Y1 Costs Comparing UAS Options.

COST CATEGORIES	Scenario #1	Scenario #2	Scenario #3
AIRCRAFT			
Aircraft	*$1,729*	*$1,729*	–
Spare aircraft parts (e.g., battery, propellers)	*$465*	*$465*	–
Flight navigation software	*$98*	*$98*	–
LICENSING/INSURANCE			
Liability insurance (annual)	*$500*	*$500*	–
Aircraft insurance (annual)	*$169*	*$169*	–
Remote pilot training/test	*$300*	*$300*	–
SENSOR			
Liability insurance (annual)	*$400*	*$400*	–
Aircraft insurance (annual)	*$3,500*	*$3,500*	–
OR AIRCRAFT + SENSOR			
Aircraft bundle (aircraft. Modified RGB sensor, batteries, propellers, RC)	*$3,500*	*$3,500*	–
IMAGE[4] COLLECTION			
Service: 5 mo x 2X/mo x 1 hr min./sortie x $300/hr	–	–	*$3,000*
Labor: 5 mo x 2X/mo x 0.5hr/sortie x $10/hr	*$50*	*$50*	–
IMAGE PROCESSING			
Image processing software	*$1,750*	–	–
Dedicated computer/monitor	*$2,000*	–	
Service to process images ($120/month x 5 mo)	–	*$600*	*$600*
Labor: 5 mo x 2X/mo x 1hr/sortie x $15/hr	*150*	–	–
TOTAL COST	*$7,611*	*$4,311*	*$3,600*

[4]Processing of vegetation index only; does not include time to stitch images.

Table 3. Five Year Projected Costs for each Scenario.[5]

	Year 1			Year 2			Year 3			Year 4			Year 5			Year 5 Total		
	Scenario			Scenario			Scenario			Scenario			Scenario			Scenario		
Cost Categories	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Aircraft	2292	2292	0	0	0	0	0	0	0	0	0	0	0	0	0			
Licensing/Insurance	969	969	0	669	669	0	969	669	0	669	669	0	969	669	0			
Sensor	400	400	0	0	0	0	0	0	0	0	0	0	0	0	0			
Image Collection	50	50	3000	50	50	3000	50	50	3000	50	50	3000	50	50	3000			
Image Processing	3900	600	600	150	600	600	150	600	600	150	600	600	150	600	600	11687	9587	18000
ANNUAL TOTAL	**7611**	**4311**	**3600**	**869**	**1319**	**3600**	**1169**	**1319**	**3600**	**869**	**1319**	**3600**	**1169**	**1319**	**3600**	**1169**	**1319**	**3600**

[5]The cost of services, equipment, insurance, licensing or labor rate were market quotes at the time of this publication and could change over time.

area of interest, number and frequency of images needed, hourly rate).

Based on the estimated input costs during the first year to generate a crop vegetation index under these specific circumstances, it appears the most cost-effective option is Scenario #3 which involves hiring an outside business to collect and process images. However, when we project these cash outlays out over a five year period (Table 3) the analysis shows the cost impacts over a period of time (5-years). Assuming the equipment lasts five years, the total cash outlays suggest Scenario #2 is a better decision solely from a cost standpoint.

Remember that the purpose of this Fact Sheet is to lay out a framework for a business to start the decision analysis required to evaluate whether or not to adopt this technology under differing scenarios. The specifics of your situation will be used to develop a decision tree framework. It is also important to note that we have not included an analysis of potential returns or tax impacts associated with adopting sUAS. For example, if we use a sUAS to generate a vegetation index and this is intended to partially replace crop scouting from the ground, is there potential savings? Is the equipment purchased tax deductible? Other considerations include evaluation of other types of risk (i.e. regulatory, liability, labor, etc.) that impact business decisions.

[1]Note that flying sUAS for this purpose is considered commercial use and therefore requires a license from the FAA. Drone operators are required to obtain a Part 107 or Remote Pilot Certificate under the FAA's sUAS rule. Please refer to this fact sheet on pilot certification and aircraft registration for more information (FSA6150: https://www.uaex.uada.edu/publications/pdf/FSA-6150.pdf).

[3]Scenario #2 remains the same even when considering the "time value of money", discounting annual cash outflows. The cumulative discounted flows were $11,130, $9,130 and $17,143 for scenarios 1 - 3 respectively using a 5 percent interest rate for the valuation.

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