Unmanned Aircraft Systems (UAS) Industry Study

Sponsored by:
The Kentucky Commission on Military Affairs
Office of the Governor

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Prepared by:

ALARIS
SOLUTIONS FOR UNMANNED SYSTEMS

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ACRONYM LIST

Acronym	Definition
AIA	Aerospace Industries Association
AMA	Academy of Model Aeronautics
AOPA	Aircraft Owners and Pilots Association
AUVSI	Association of Unmanned Vehicle Systems International
AV	Air Vehicles
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
COA	Certificate of Waiver or Authorization
CFI	Certified Flight Instructor
DHS	Department of Homeland Security
DOD	Department of Defense
FAA	Federal Aviation Administration
FMRA	FAA Modernization and Reform Act of 2012
GPS	Global Positioning System
KCMA	Kentucky Commission on Military Affairs
KRS	Kentucky Revised Statute
MRTFB	Major Range and Test Facility Base
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NAICS	North American Industry Classification System
NTIA	National Telecommunications and Information Administration
OMB	Office of Management and Budget
PBFA	Policy Board on Federal Aviation
PIC	Pilot in Command
RIMS II	Regional Input-Output Modeling System
SOC	Standard Occupational Classification System
STEM	Science, Technology, Engineering, and Mathematics
TAAC	Technical Analysis and Applications Center
UAS	Unmanned Aircraft System
USDA	United States Department of Agriculture
USGS	United States Geological Survey

1. EXECUTIVE SUMMARY

> *"While we project more than 100,000 new jobs by 2025, states that create favorable regulatory and business environments for the industry and the technology will likely siphon jobs away from states that do not."*
>
> *– March 2013, AUVSI "The Economic Impact of UAS integration in the United States"*

The Kentucky Commission on Military Affairs (KCMA), Office of the Governor sponsored this study of the Unmanned Aircraft System (UAS) Industry's potential in the Commonwealth of Kentucky. The study approach was to gather federal and state level data for UAS, utilize an accepted model for economic impact calculations, interview Kentucky companies utilizing UAS and conduct interviews of Kentucky government representatives. This study examined the UAS economic impact with respect to manufacturers, users (agriculture and non-agriculture), legislation landscape, education, and recommended strategic investments to take advantage of the emerging UAS industry. The key findings of the study are the following:

- The economic impact of UAS in Kentucky is estimated to be $4.6M in 2015 and projected to increase to $19.1M in 2025
- Only one company in Kentucky is considered a UAS manufacturer
- Multiple companies support aerospace sub-component work, but transition of these complex assembly lines are challenged to transition to UAS production
- Agriculture is currently the largest economic area that may benefit from UAS growth
- The economic impact of UAS users (agriculture and non-agriculture) may generate considerable revenue, however the funding impact is considered revenue-neutral since it comes from within existing budgets
- UAS legislation is dynamic and both federal and state rules are in great flux. Kentucky is currently reviewing proposed "anti-UAS" legislation that overlaps existing laws in the Commonwealth
- UAS Education is very active in Kentucky and will serve as a substantial building block for UAS growth in the state

The cornerstone recommendation of this study is for Kentucky to establish a Blue Ribbon Panel to enable a centralized forum for industry, small business, education, and government leaders to further develop and establish Kentucky's position in the UAS industry. The Panel charter would be to bring these key stakeholders together to develop a comprehensive plan to develop Kentucky's UAS industry, and to establish the Commonwealth as a "Pro-UAS" state. Specific actions for the panel would be to establish the appropriate strategic investments, incentives and legislation to capitalize on the emerging UAS industry and enable Kentucky companies (***Exhibit 1-1***).

Exhibit 1-1: Ben Shinabery of Kentucky-based Qk4 launching a sUAS.

2. INTRODUCTION

The Kentucky Commission on Military Affairs (KCMA), Office of the Governor, sponsored the study of the Unmanned Aircraft System (UAS) Industry's potential in the Commonwealth of Kentucky. The study's primary focus is to answer 11 key economic impact questions. While answering these questions, the study will emphasize infrastructure, legislation and workforce. Additionally, the study provides a high level, synchronized, and actionable plan to enable Kentucky to capitalize on the continued integration of UAS into the national airspace by the Federal Aviation Administration (FAA) (***Exhibit 2-1***).

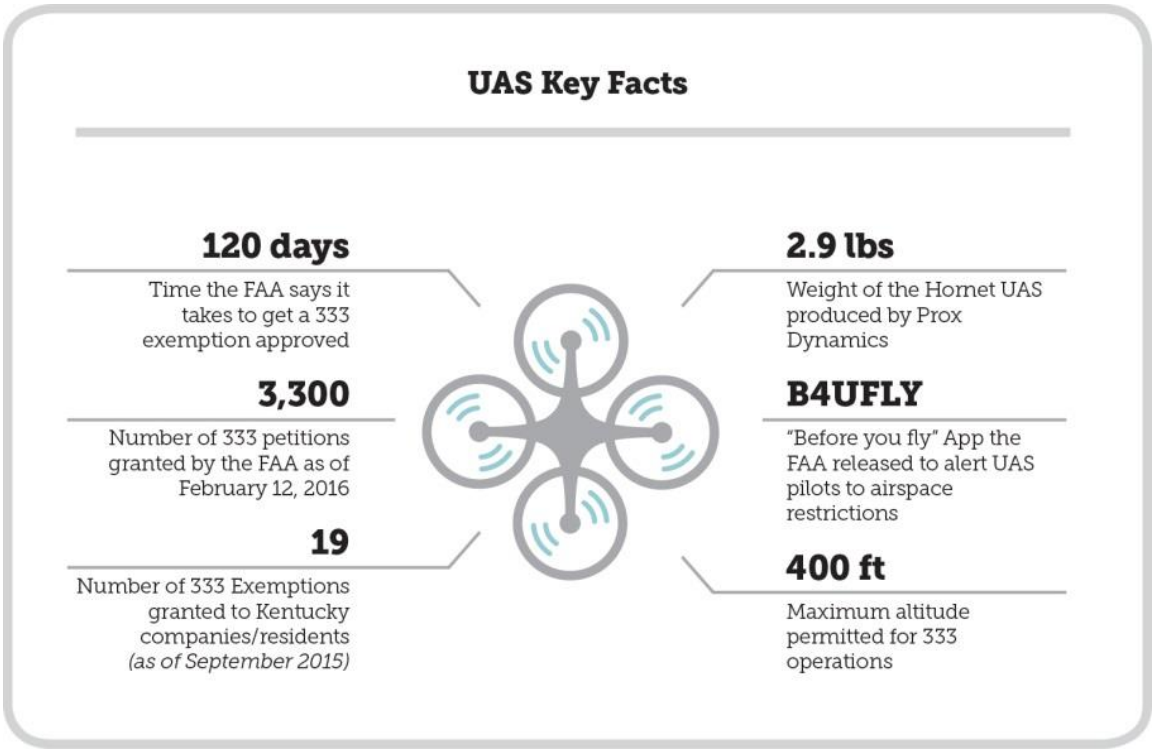

Exhibit 2-1: Key UAS Facts

The term UAS in this study refers to the wide range of unmanned aircraft systems currently manufactured and operated. While small (Class 1-3) UAS (sUAS) are presently the primary growth area for utilization in many new areas, this study refers to all classes (Class 1-5) as UAS.

3. EXISTING UAS MARKET DATA – AUVSI STUDY

The Association for Unmanned Vehicle Systems International (AUVSI) is a nonprofit organization focused on the advancement of the unmanned systems community. In March of 2013, AUVSI released a report titled "The Economic Impact of Unmanned Aircraft Systems Integration in the United States." The report is an instrumental resource in providing a state-by-state prediction of the economic gains possible from the growing UAS industry but has a decisively different focus than the questions addressed in this study. Despite the different objectives, there are two key assumptions in the AUVSI report which are equally assumed in this statewide study for Kentucky.

First, the AUVSI report generalizes that "there will be a net-zero impact of job creation in the application of these systems." The study agrees with this assumption and it is recognized as a

like assumption in this work. This assumption means regardless of the small or large number of UAS users in Kentucky, near term or long term, the projected job creation total sums that provide revenue will be neutral.

Second, the AUVSI report generalized that the "economic impact is based on the theory that a dollar flowing into a local economy from the outside is a benefit to the regional economy." This study aligns with this assumption and it is recognized as a like assumption in this work. This assumption means for Kentucky additional revenue (which primarily means manufacturing) "plus-ups" must come from outside the state. While the AUVSI study shows a substantial UAS revenue potential, it doesn't provide details for where that revenue will be specifically generated.

The AUVSI report used a national top-down approach primarily focused on revenue generated from manufacturers. This study uses a bottom-up approach specific to Kentucky and differentiates between 'manufacturers' and 'users.' Manufacturers are defined as companies and entities that produce products for the purpose of monetary sales. Users are defined as companies and entities that utilize UAS in conjunction with their statements of work and purpose.

4. STUDY APPROACH

4.1 KEY STUDY QUESTIONS AND ACTIONS

This Kentucky UAS Industry study is based on the 11 questions and actions from the state. These will be answered in summaries throughout the study:

Question/Action 1 - What is the economic impact if Kentucky does nothing or retains the status quo? What can the economic impact be if Kentucky enables this industry through legislation, incentives and other growth initiatives?

Question/Action 2 - What are the UAS jobs or career profiles and what are the compensation rates for occupations in this field?

Question/Action 3 - Fully develop and describe the enabling legislation needed at the state level to complement federal progress on UAS integration.

Question/Action 4 - Recommend state level economic growth incentives that will spur investment, business relocation to Kentucky, and entrepreneurial activity in the UAS sector.

Question/Action 5 - What strategic investments are required by the Commonwealth?

Question/Action 6 - How does Kentucky advance the development of this part of the economy while protecting the privacy of citizens?

Question/Action 7 - What are the infrastructure needs in Kentucky as related to the UAS industry? Do the military installations in the state have a role? If so, how is that potential developed? Fully analyze the military assets and infrastructure available in the Commonwealth of Kentucky and develop recommendations for leveraging these assets to grow the economic impact of UAS in Kentucky.

Question/Action 8 - Analyze the educational opportunities available in public institutions in Kentucky that enable graduates to participate in the UAS industry. Make recommendations for development of additional degree-granting programs and/or certifications.

Question/Action 9 - How can Kentucky impact workforce migration (gain) to the Commonwealth as this industry continues to develop?

Question/Action 10 - What are the specific uses of UAS that are best suited for Kentucky and why?

Question/Action 11 - Develop action steps and a timeline for growing the economic impact of the UAS industry in Kentucky. Include recommendations covering legislation, education and workforce, investment and infrastructure, licensing and regulation, military partnerships, economic incentives and any other recommendations developed in the course of the study.

The following sections describe the approach to data collection and analysis for the focus areas addressed and answer the study questions and actions. The study identifies *"Key Study Points"* to highlight important notes and issues. For the purposes of this study, the recommendations are focused at a 'high level' to assist Kentucky in deciding which areas merit further research and collaboration.

4.2 Overall Study Approach

The approach for this study was to group the questions into common focus areas as described in ***Exhibit 4-1***. The economic impact portion of the study is the largest focus area by weight and drives the recommendations and discussions in other focus areas.

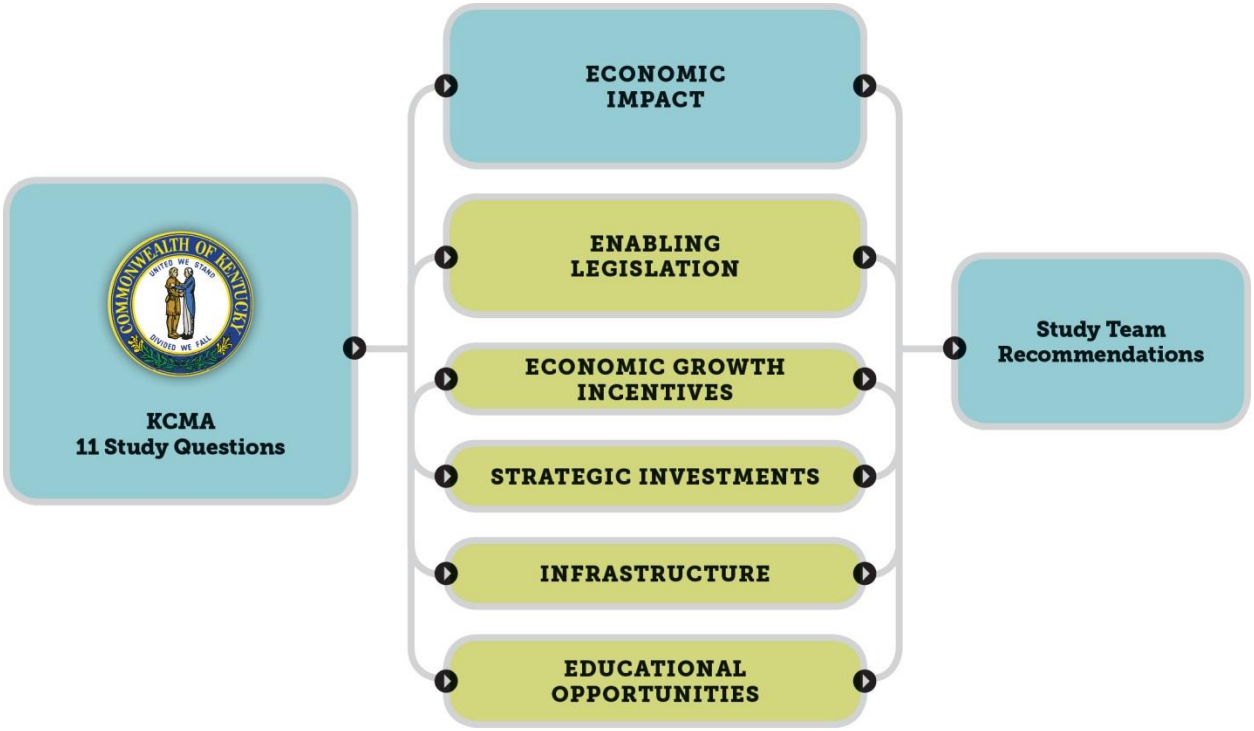

Exhibit 4-1: Kentucky UAS Study Approach

The study summarizes responses to Kentucky's questions after each focus area is fully addressed. This report also provides an overall recommendation that includes a 'high level' actionable plan for Kentucky to utilize. The specific approach for the economic impact analysis will be explained in more detail in the appropriate study section.

The study gathered data at the Federal and State level relating to industries which currently use (or may potentially use) UAS while reviewing other industry sources (such as AUVSI) where data was available. To ensure the study was accurately describing the UAS environment in the

Commonwealth, multiple Kentucky companies and various government representatives were interviewed.

4.3 Specific Approach and Methodology for Economic Impact Analysis

The economic impact analysis began by examining manufacturers and users of UAS in Kentucky. Both manufacturers and user data were structured utilizing the North American Industry Classification System (NAICS). Industries in the NAICS database are assigned codes to identify them as a specific industry or within an industry group. The NAICS system was developed under the direction and guidance of the Office of Management and Budget (OMB) and includes 21 primary industry groups (***Exhibit 4-2***).

Code Group	Industry Description
11	Agriculture, Forestry, Fishing and Hunting
21	Mining, Quarrying, and Oil and Gas Extraction
22	Utilities
23	Construction
31-33	Manufacturing
42	Wholesale Trade
44-45	Retail Trade
48-49	Transportation and Warehousing
51	Information
52	Finance and Insurance
53	Real Estate and Rental and Leasing
54	Professional, Scientific, and Technical Services
55	Management of Companies and Enterprises
56	Administrative and Support and Waste Management and Remediation Services
61	Educational Services
62	Health Care and Social Assistance
71	Arts, Entertainment, and Recreation
72	Accommodation and Food Services
81	Other Services (except Public Administration)
92	Public Administration

Exhibit 4-2: Primary NAICS Code Groups

The NAICS code groups are broken down further into four-number-codes as data becomes more specific. Also, several higher-level codes have been combined to represent a single industry: Manufacturing (codes 31-33), Retail Trade (codes 44-45), and Transportation and Warehousing (codes 48-49). A wide range of economic data is collected by the Federal Government and individual states using the NAICS system, which allows for a high degree of comparability between data collected by different agencies and organizations.

The challenge for new and emerging industries is the lack of specific NAICS industry codes, along with minimal economic data that relates directly to the industry. In some cases, data for a sector or subsector for which a code does exist is used as a proxy for the new industry. Another

method is to bundle the new industry into the definition of an existing code. For example, NAICS code 54151, Computer Systems Design and Related Services encompasses a wide band of activities ranging from web development to computer systems design.

In the context of analyzing economic data, the nascent technologies of unmanned systems are part of a very new industry and therefore burdened with the issues described for emerging industries. While it leverages skills and technologies deployed in the already-established aerospace industry, the UAS industry represents the packaging of these elements into new formats, platforms, and services for which there is no direct historical equivalent. As the industry matures in the upcoming years, the data will coalesce into natural groupings and be captured in discrete elements.

> ***KEY STUDY POINT: Even though the organizations and companies refer to unmanned systems as an "industry" the standard and accepted data structure under the NAICS system does not list new and emerging technologies as such. Just as there would be no NAICS code for "cell phones," even though it is clear that improved smart phone technology has a significant economic impact.***

The study determined that 12 areas (based upon the larger list of industries) would serve as the baseline for the analysis (Exhibit 4-3).

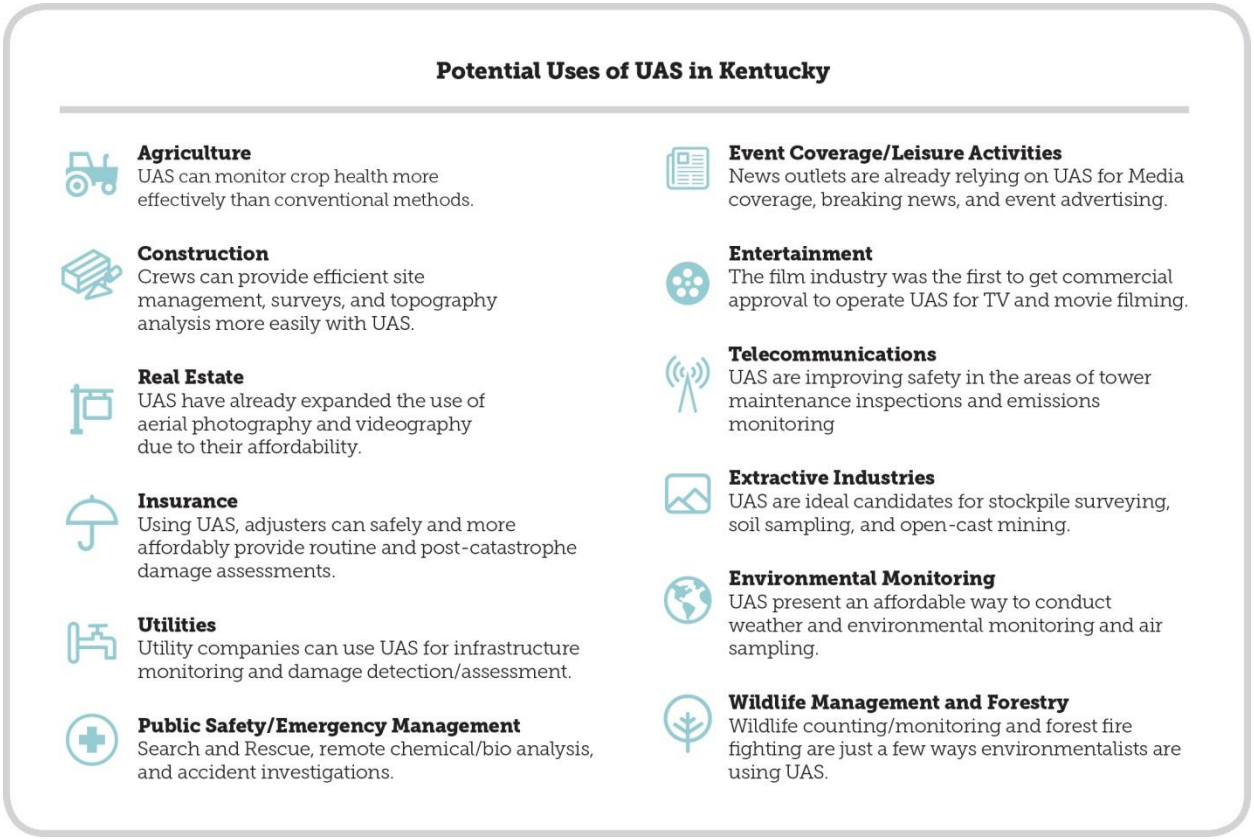

Exhibit 4-3: Potential Uses of UAS in Kentucky

4.3.1 Specific Approach and Methodology for Analyzing UAS Manufacturers

The study utilized two primary sources of data for Kentucky UAS manufacturers. The first set of data utilized was from the US Census Bureau from which data for NAICS codes specific to aerospace manufacturing was extracted. The most relevant NAICS code was considered to be code 3364 – designated as the code for 'Aerospace product and parts manufacturing.' The second set of data utilized was from the Kentucky Cabinet for Economic Development (www.thinkkentucky.com) which includes aerospace as a major industry. Additionally, some minor data was collected via online searches for Kentucky-based aerospace companies. After collection from these two sources the study compared results and analyzed the economic impact (***Exhibit 4-4***).

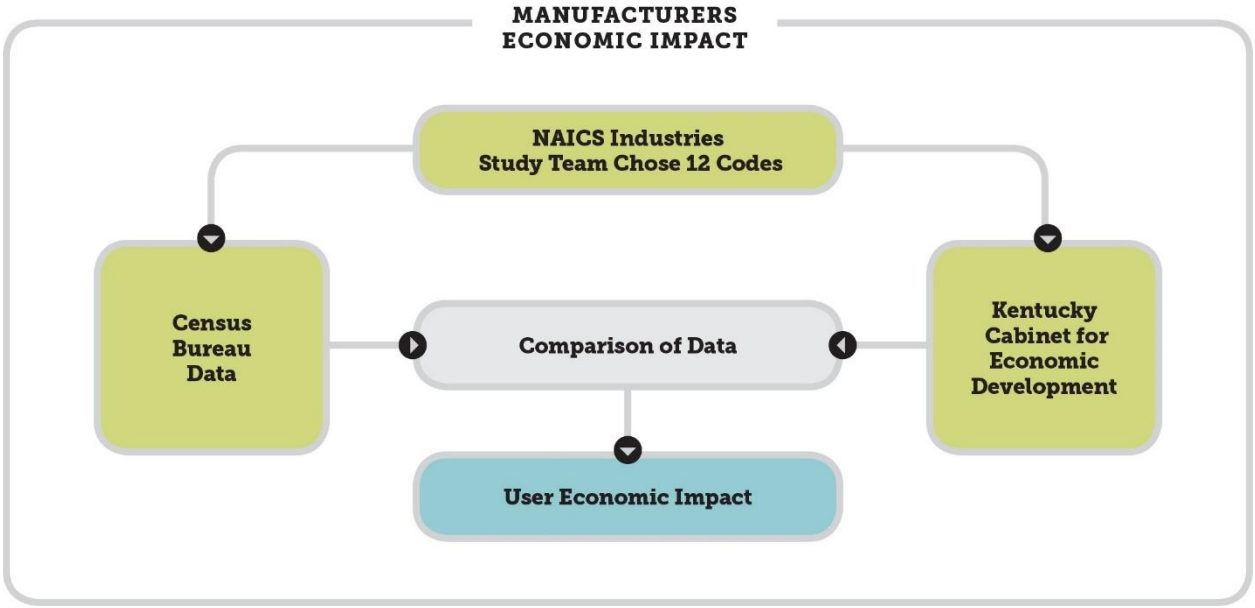

Exhibit 4-4: Manufacturers Economic Impact Study Flow

4.3.2 Specific Approach and Methodology for analyzing UAS Users

The study utilized three primary sources of data for Kentucky UAS users. The first data set was from the US Census Bureau, which looked at any industry that would be a user of UAS. The second data set was from the US Department of Agriculture (USDA), which focused on Kentucky farming. The third data set utilized was from the US Department of Labor via their Standard Occupational Classification (SOC) system, which focused on workers in Kentucky that could potentially be users of UAS. After collecting data from these three sources, the study compared data results and analyzed the economic impact using the methodology described in ***Exhibit 4-5*** on the next page.

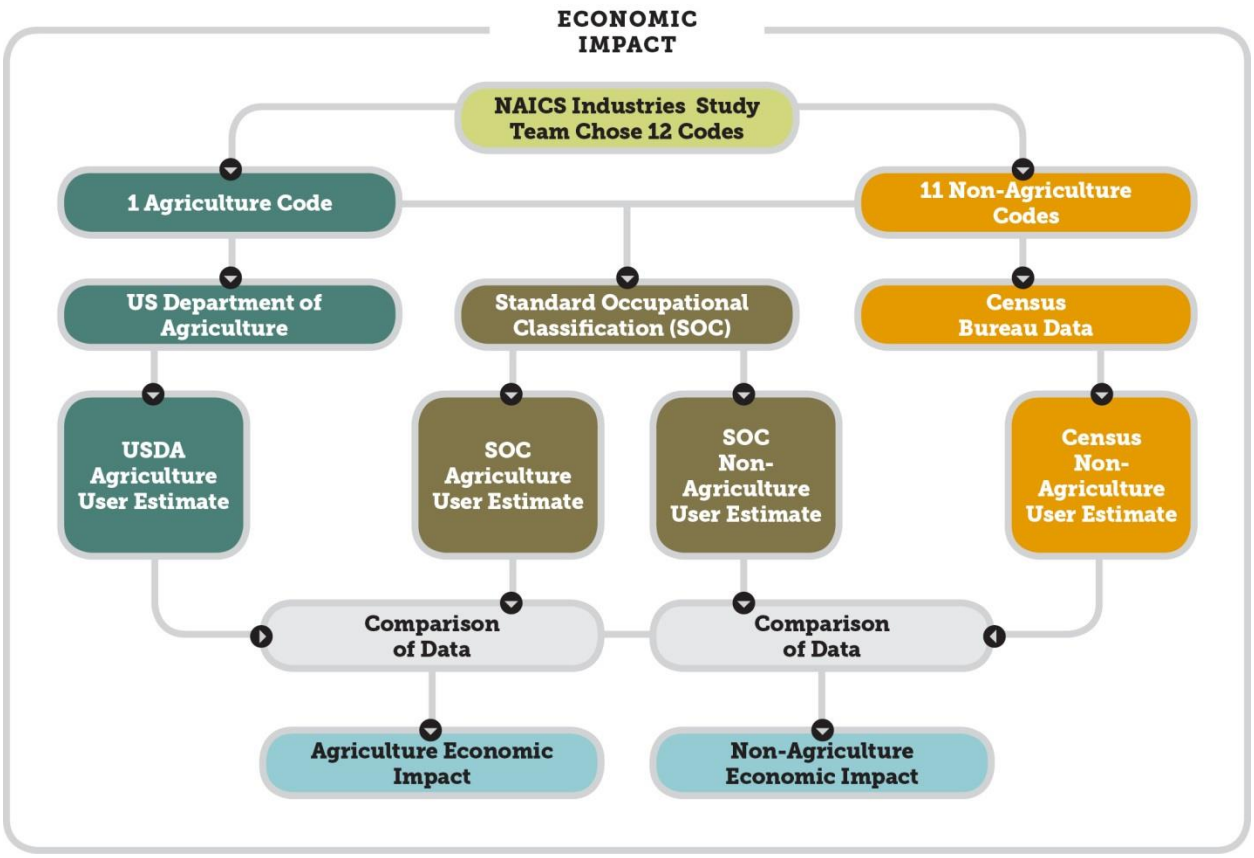

Exhibit 4-5: User of UAS Economic Impact Study Flow

After initial data collection, the study analyzed the current and potential users' economic impact by utilizing the Regional Input-Output Modeling System (RIMSII). This tool was approved by the KCMA for this high-level study since it is a widely-used cost effective model to estimate the impact on the overall regional economy. Due to the dynamic nature of the UAS market, the economic results are supplemented by reasonable assumption and expert summation by the study under close coordination with the KCMA.

5. UAS MANUFACTURERS ECONOMIC IMPACT IN KENTUCKY

Foreign companies currently dominate international commercial UAS sales, with the majority of the manufacturers located in Asia. In Kentucky, approximately 90% of the UAS users purchased foreign systems for their operations. For a manufacturer to compete in the highly-competitive UAS manufacturing market, considerable investment in production capability would be required to have a significant portion of the market. The infrastructure needed to successfully produce, market, sustain and sell UAS can require considerable investment even though many consider the basic UAS technology to be "low tech."

The study did not find a major commercial UAS manufacturer in Kentucky. The only known UAS manufacturer identified in Kentucky is ProxDynamics, which is focused on both military and commercial systems. ProxDynamics is a Norway-based company with a US headquarters in Alexandria, Virginia. All the advertised jobs with ProxDynamics are Norway-location based descriptions. Data does not show evidence of any large scale commercial or military contract yet for ProxDynamics.

KEY STUDY POINT: Currently the only known manufacturer of UAS in Kentucky is Norwegian-based ProxDynamics.

Even though only specific company data directly correlated to the manufacturing of UAS, data was collected on companies associated with the aerospace industry. The study identified 15 companies in the aerospace industry in Kentucky using the Census Bureau Data. These companies functioned in the aerospace specific areas identified by their NAICS codes. The specific names are not listed in the database:

- NAICS code 3364 - Aerospace Product and Parts Manufacturing

The study identified 51 companies involved in the aerospace industry in the state with the help of the Kentucky Cabinet of Economic Development. These companies were performing work in the following areas:

- Aircraft component manufacture
- General Engineering (primary focus not specifically aerospace)
- Aviation Maintenance
- Aviation Services

The study examined the likelihood of these existing aerospace companies converting to UAS manufacturing; these companies will have challenges converting to UAS assembly operations. The aircraft component manufacturers focus on very different products than UAS. These companies focus on larger, complex aircraft assembly, while the majority of UAS assembly is a less complex operation. Most UAS are not widely distributed operations with specialized part assembly and sub-contracting specialty requirements.

The 51 aerospace companies identified in Kentucky were provided to the KCMA for further discussion as required.

KEY STUDY POINT: Even though Kentucky has a robust components sector for commercial aircraft, there is no direct evidence that these assembly lines have a direct or economically feasible conversion to support small UAS manufacturing.

The study did not find major US Defense of Department (DoD) UAS manufacturers in Kentucky. The two largest UAS manufacturers in the United States defense industry are General Atomics Aeronautical Systems and Northrop Grumman Aerospace Systems (both based in California). Their primary UAS assembly lines are definitively established and currently funded. The 2013 Department of Defense Report "*Unmanned Systems Integrated Roadmap 2013-2038*" indicates that US defense budgets for UAS are likely to decline, with the focus being on the maintenance of existing fleets and development of high-end systems. The report also states that "a comparison of DoD funding plans versus industry predictions indicates the Department of Defense will not be the bulk user within [the UAS] market."

KEY STUDY POINT: Entrance into the US DoD UAS market will be a challenge due to already established weapon systems and decreasing budgets.

6. UAS USERS ECONOMIC IMPACT IN KENTUCKY

6.1 NON-AGRICULTURE USER DATA VIA US CENSUS BUREAU

The Study utilized the NAICS codes relevant to each of the potential fields of use. This data was initially cross-referenced with the US Census Bureau to identify the number of establishments

located in Kentucky for each code and the aggregate number of people employed by those establishments (***Exhibits 6-1 and 6-2***). If the data references to establishments showed no potential users of UAS, a reasonable percentage was estimated based on the team's broad review of those specific establishments.

The first data collection tallies 'potential users' which is defined as an occupation determined by the study that could be a UAS user. The second data collection tallies 'estimated users' which is defined as more realistic number of users actually utilizing UAS. Estimated users' numbers are used later for Non-Agriculture Economic Impact calculations.

Industry	Companies	Employees
Construction	4039	29,900
Real-Estate	1713	8,075
Insurance	1981	10,555
Telecommunications	565	8,005
Event Coverage / Leisure	464	7,332
Utilities	270	7,809
Extractive	212	3,304
Environmental Monitoring	101	736
Entertainment	88	1,481
Public Safety / Emergency	50	918
Wildlife and Forestry	71	564
Total	**9,554**	**78,679**

Exhibit 6-1: Summary of Companies and Employees for Potential Non-Agriculture UAS Users (US Census Bureau)

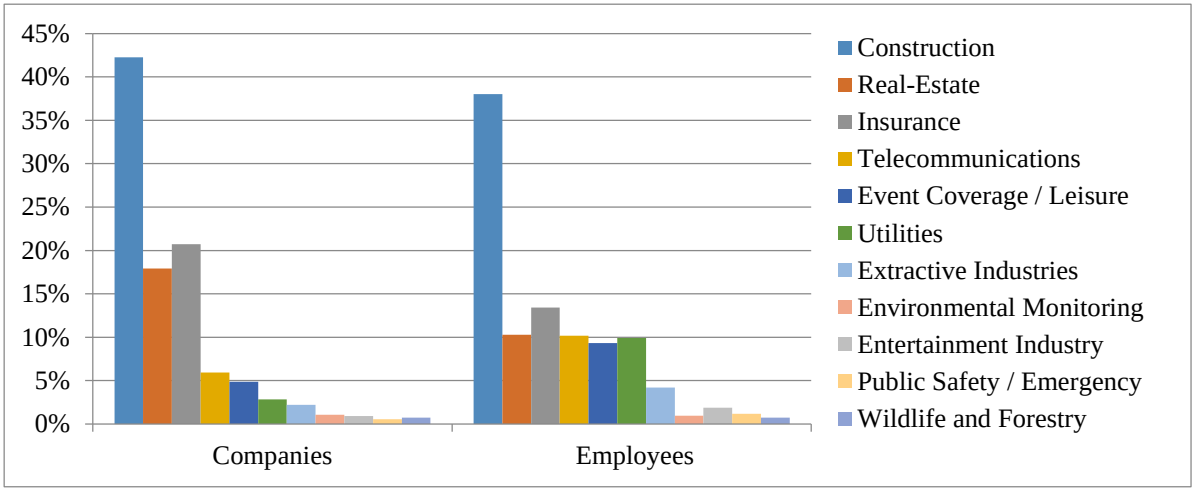

Exhibit 6-2: Percentage Summary of Companies and Employees for Potential Non-Agricultural UAS Users (US Census Bureau)

This data provides one measure of potential UAS users within Kentucky; however, few establishments will have every employee utilize a drone during business operations. The study did not find any data that can accurately calculate current UAS usage across the industries listed. Therefore, two assumptions were made to estimate employee usage for UAS. The first

assumption was to assume that 100% of listed companies will utilize UAS. The second assumption is that assigning a percentage of usage to each establishment area will account for the variability between establishments that have a large utilization versus establishments that have smaller and even no utilization. The study made a UAS utilization assessment for each specific NAICS code identified within each industry sector.

The study developed a scaling system (***Exhibit 6-3***) to apply to each specific NAICS Industry Sub-Sector.

Probability of UAS Use	% of Companies using UAS
Low	10%
Low-Medium	25%
Medium	50%
Medium-High	75%
High	95%

Exhibit 6-3: Five Point Estimation for Potential Levels of UAS Usage

The following example (***Exhibit 6-4***) for the construction sector illustrates process used in compiling the data for each sector:

- Starting with the Construction Sector, there are 15 Sub-Sectors the study determined would utilize UAS
- The sub-sector "Residential Building Construction" has 1,278 Kentucky firms listed per the study data
- The study assumed on average 10% of "Residential Building Construction" firms would utilize UAS
- This equated to 127 firms in the sub-sector that could potentially utilize UAS in Kentucky
- This methodology is applied to each sub-sector and summarized at the bottom of the table

Construction	Firms	Utilization	UAS
23611 Residential Building Construction	1,278	10%	127
23622 Commercial and Institutional Building Construction	487	25%	121
23711 Water and Sewer Line and Related Structures Construction	162	10%	16
23712 Oil and Gas Pipeline and Related Construction	23	90%	20
237103 Power and Communication Line and Related Structures Construction	98	90%	88
23721 Land Subdivision	56	50%	28
23731 Highway, Street, and Bridge Construction	134	50%	67
23799 Other Heavy and Civil Engineering Construction	44	50%	22
23891 Site Preparation Contractors	487	50%	243
54131 Architectural Services	142	25%	35
54132 Landscape Architectural Services	39	50%	19
54135 Building Inspection Services	47	75%	35
54136 Geophysical Surveying and Mapping Services	6	75%	4

Construction	Firms	Utilization	UAS
54137 Construction surveying services	122	75%	91
56173 Landscape contractors (except construction)	914	50%	457
	4,039		**1,373**

Exhibit 6-4: Estimates of UAS Users by Construction Industry Sub-Sector (US Census Bureau)

For a complete breakdown of all Industry Sub-Sectors, see ***Appendix B***. ***Exhibits 6-5*** and ***6-6*** show a summary of all the Sub-Sectors under their respective industries.

Industry	Companies	Estimated Users
Construction	4039	1,373
Real-Estate	1713	469
Insurance	1981	901
Telecommunications	565	220
Event Coverage / Leisure	464	256
Utilities	270	119
Extractive	212	52
Environmental Monitoring	101	25
Entertainment	88	72
Public Safety / Emergency	50	5
Wildlife and Forestry	71	18
Total	**9,554**	**3,510**

Exhibit 6-5: Summary of Companies and Employees for Estimated Non-Agricultural UAS Users (Census Bureau Data)

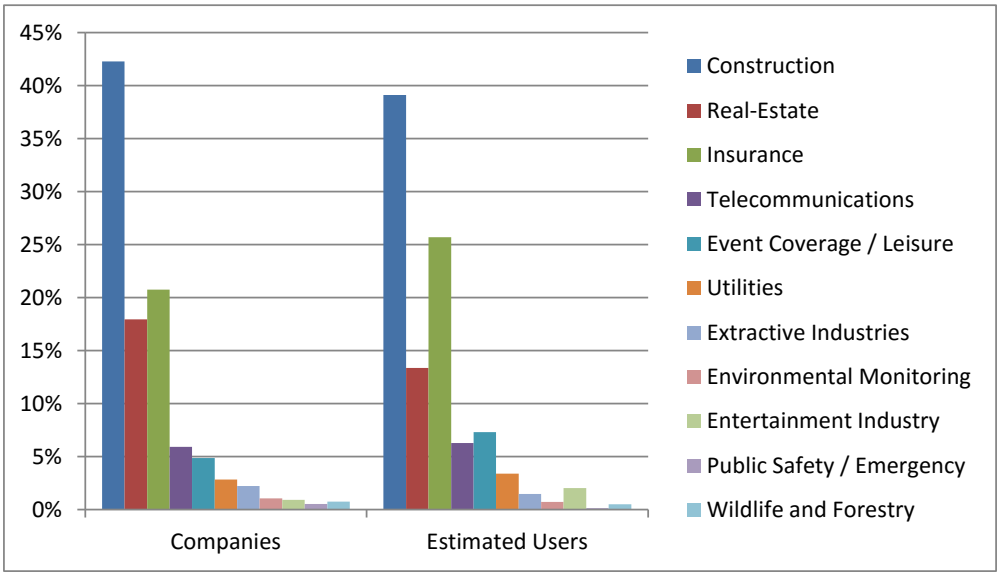

Exhibit 6-6: Percentage Summary of Companies and Employees for Estimated Non-Agricultural UAS Users (US Census Bureau)

KEY STUDY POINT: The numbers for potential utilization of UAS will most likely increase as access to airspace and decreased operating costs continue to improve.

KEY STUDY POINT: The estimated users' figures represent the number of companies. The number of actual aircraft systems purchased and utilized will be higher as firms require multiple aircraft purchases to sustain operations.

6.2 NON-AGRICULTURE DATA VIA US DEPARTMENT OF LABOR (STANDARD OCCUPATIONAL CLASSIFICATION)

The study utilized the Standard Occupation Classification (SOC) codes relevant to each of the potential field of users. Utilizing the SOC data, 48 occupations in 2014 (most recent data) were identified that represent potential users of UAS. ***Appendix A*** lists the 48 identified occupations. These occupations were then matched with the twelve NAICS industry groups to generate estimates (***Exhibit 6-7***) consistent with the Bureau Census Data in Section 6.1.

Industry	Companies	Employees
Construction	4,039	10,860
Real-Estate	1,713	2,060
Insurance	1,981	7,410
Telecommunications	565	6,610
Event Coverage / Leisure	464	1,570
Utilities	270	4,840
Extractive	212	670
Environmental Monitoring	88	1,340
Entertainment	88	420
Public Safety / Emergency	50	11,740
Wildlife and Forestry	71	4,560
Total	**9,541**	**52,080**

Exhibit 6-7: Summary of Companies and Employees for Potential Non-Agriculture UAS Users (SOC)

The study again utilized the same five-point estimation scale ***(Exhibit 6-3)*** to determine estimated users.

For a complete breakdown of all the Industry Sub-Sectors see ***Appendix C***. ***Exhibits 6-8*** and ***6-9*** show a summary of all the Sub-Sectors under their respective industries.

Industry	Companies	Estimated Users
Construction	4,039	3,157
Real-Estate	1,713	620
Insurance	1,981	2,513
Telecommunications	565	412
Event Coverage / Leisure	464	465
Utilities	270	484
Extractive	212	67
Environmental Monitoring	88	134
Entertainment	88	22
Public Safety / Emergency	50	1,120
Wildlife and Forestry	71	492
Total	**9,541**	**9,485**

Exhibit 6-8: Summary of Companies and Employees for Estimates of Non-Agricultural UAS Users (SOC)

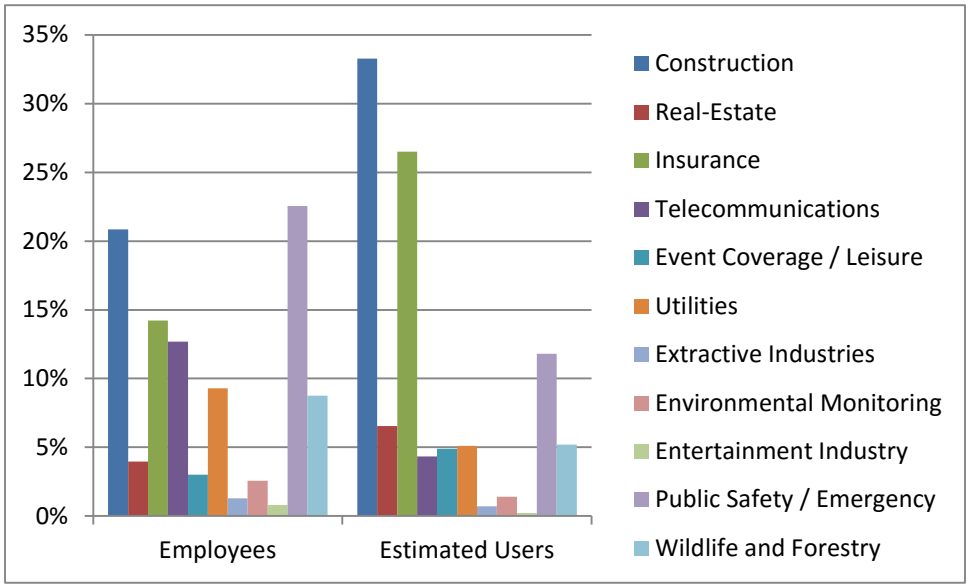

Exhibit 6-9: Percentage Summary of Companies and Employees for Estimated Non-Agricultural UAS Users (SOC)

KEY STUDY POINT: The SOC data shows a large percentage of potential users in public safety and emergency management but construction and insurance remain the largest potential users.

6.3 Comparison of Non-Agriculture User Economic Data

The study compared the estimated user total from both the Census Bureau data (Section 6.1) and SOC data (Section 6.2) for Non-Agricultural Users. The comparison is in ***Exhibit 6-10***.

Industry	Estimated Users		
	US Census Bureau Basis	BLS SOC Basis	Average
Construction	1,373	3,157	2,265
Real-Estate	469	620	545
Insurance	901	2,513	1,707
Telecommunications	220	412	316
Event Coverage / Leisure	256	465	361
Utilities	119	484	302
Extractive	52	67	59
Environmental Monitoring	25	134	80
Entertainment	22	22	22
Public Safety / Emergency	5	1,120	562
Wildlife and Forestry	18	492	255
Total	**3,461**	**9,485**	**6,473**

Exhibit 6-10: Comparison of Estimates for Non-Agriculture UAS Users

The study determined to use the average between the two estimates for the next portion of non-agriculture user economic impact.

6.4 Non-Agriculture Users Economic Impact

The study utilized the following information, multiplier and assumption utilizing the RIMS II model.

- Average estimated users (non-agriculture) from ***Exhibit 6-10***
- 10% conversion rate of estimated UAS users to full-time UAS operators
- Growth profile for UAS sales defined in the 2013 AUVSI study[1]
- Multipliers provided by the RIMS-II model
- Multipliers (local/state tax) available from Kentucky Cabinet for Economic Development

[1] 2013 AUVSI report anticipated a relatively rapid rise in UAS sales in the US from approximately 40,000 units in 2015 to 110,000 in 2017, followed by a more gradual increase from 2017 to a level of 160,000 units projected in 2025.

Exhibit 6-11 summarizes the economic impact assessment of estimated non-agriculture UAS users in Kentucky:

Direct Jobs Created

Industry	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Construction	57	106	156	166	176	186	196	206	216	226	237
Real-Estate	14	26	37	40	42	45	47	50	52	54	57
Insurance	43	80	117	125	133	140	148	155	163	171	178
Event Coverage / Leisure	9	17	25	26	28	30	31	33	34	36	38
Utilities	8	14	21	22	23	25	26	27	29	30	31
Extractive	1	3	4	4	5	5	5	5	6	6	6
Environmental Monitoring	2	4	5	6	6	7	7	7	8	8	8
Entertainment	1	1	2	2	2	2	2	2	2	2	2
Public Safety / Emergency	14	26	39	41	44	46	49	51	54	56	59
Wildlife and Forestry	6	12	18	19	20	21	22	23	24	25	27
Telecommunications	8	15	22	23	25	26	27	29	30	32	33
Total	**162**	**303**	**445**	**474**	**503**	**532**	**561**	**589**	**618**	**647**	**676**

Exhibit 6-11: Estimated Economic Impact of Non-Agriculture UAS Users

Indirect + Induced Jobs Created

Industry	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Construction	102	192	281	299	318	336	354	373	391	409	427
Real-Estate	29	55	81	86	91	96	102	107	112	117	123
Insurance	86	162	237	253	268	284	299	314	330	345	361
Event Coverage / Leisure	15	28	40	43	46	48	51	54	56	59	61
Utilities	16	31	45	48	51	54	57	60	62	65	68
Extractive	3	5	7	7	8	8	9	9	10	10	11
Environmental Monitoring	3	6	9	9	10	11	11	12	12	13	13
Entertainment	1	2	2	3	3	3	3	3	3	4	4
Public Safety / Emergency	25	47	69	74	78	83	87	92	96	101	105
Wildlife and Forestry	9	18	26	28	29	31	33	34	36	38	39
Telecommunications	15	27	40	43	45	48	50	53	56	58	61
Total	**305**	**571**	**838**	**892**	**947**	**1,001**	**1,056**	**1,110**	**1,164**	**1,219**	**1,273**

Exhibit 6-11: Estimated Economic Impact of Non-Agriculture UAS Users (continued)

Total Jobs Created

Industry	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Construction	159	298	437	465	494	522	550	579	607	636	664
Real-Estate	43	81	118	126	133	141	149	156	164	172	179
Insurance	129	242	355	378	401	424	447	470	493	516	539
Event Coverage / Leisure	24	44	65	69	74	78	82	86	91	95	99
Utilities	24	45	66	70	74	78	83	87	91	96	100
Extractive	4	8	11	12	12	13	14	15	15	16	17
Environmental Monitoring	5	10	14	15	16	17	18	19	20	21	22
Entertainment	1	3	4	4	4	5	5	5	6	6	6
Public Safety / Emergency	39	74	108	115	122	129	136	143	150	157	164
Wildlife and Forestry	16	30	43	46	49	52	55	58	60	63	66
Telecommunications	22	42	62	66	70	74	78	82	86	90	94
Total	**467**	**875**	**1,283**	**1,366**	**1,450**	**1,533**	**1,616**	**1,700**	**1,783**	**1,866**	**1,949**

Exhibit 6-11: Estimated Economic Impact of Non-Agriculture UAS Users (continued)

Total Value Added / $ (2015 – 2020)

Industry	2015	2016	2017	2018	2019	2020
Construction	9,949,704	18,655,696	27,361,687	29,138,420	30,915,153	32,691,886
Real-Estate	2,998,930	5,622,993	8,247,057	8,782,580	9,318,103	9,853,626
Insurance	13,125,743	24,610,768	36,095,792	38,439,675	40,783,558	43,127,440
Event Coverage / Leisure	916,056	1,717,604	2,519,153	2,682,734	2,846,315	3,009,897
Utilities	3,920,406	7,350,761	10,781,116	11,481,189	12,181,261	12,881,334
Extractive	352,734	661,377	970,020	1,033,008	1,095,996	1,158,985
Environmental Monitoring	319,992	599,984	879,977	937,118	994,260	1,051,401
Entertainment	55,904	104,819	153,735	163,717	173,700	183,683
Public Safety / Emergency	2,056,530	3,855,995	5,655,459	6,022,696	6,389,934	6,757,171
Wildlife and Forestry	497,626	933,049	1,368,472	1,457,334	1,546,195	1,635,057
Telecommunications	2,877,740	5,395,763	7,913,785	8,427,668	8,941,550	9,455,432
Total	**37,073,380**	**69,510,825**	**101,948,270**	**108,568,157**	**115,188,045**	**121,807,932**

Exhibit 6-11: Estimated Economic Impact of Non-Agriculture UAS Users (continued)

Total Value Added / $ (2021 – 2025)

Industry	2021	2022	2023	2024	2025
Construction	34,468,619	36,245,352	38,022,085	39,798,817	41,575,550
Real-Estate	10,389,150	10,924,673	11,460,196	11,995,719	12,531,242
Insurance	45,471,323	47,815,206	50,159,088	52,502,971	54,846,853
Event Coverage / Leisure	3,173,478	3,337,059	3,500,641	3,664,222	3,827,803
Utilities	13,581,406	14,281,478	14,981,551	15,681,623	16,381,696
Extractive	1,221,973	1,284,961	1,347,949	1,410,938	1,473,926
Environmental Monitoring	1,108,543	1,165,684	1,222,825	1,279,967	1,337,108
Entertainment	193,666	203,649	213,631	223,614	233,597
Public Safety / Emergency	7,124,409	7,491,647	7,858,884	8,226,122	8,593,359
Wildlife and Forestry	1,723,919	1,812,781	1,901,643	1,990,504	2,079,366
Telecommunications	9,969,314	10,483,196	10,997,079	11,510,961	12,024,843
Total	**128,427,820**	**135,047,707**	**141,667,595**	**148,287,482**	**154,907,370**

Exhibit 6-11: Estimated Economic Impact of Non-Agriculture UAS Users (continued)

State & Local Taxes / $ (2015 – 2020)

Industry	2015	2016	2017	2018	2019	2020
Construction	904,809	1,696,518	2,488,226	2,649,799	2,811,372	2,972,945
Real-Estate	277,132	519,623	762,114	811,601	861,089	910,577
Insurance	832,559	1,561,048	2,289,537	2,438,208	2,586,879	2,735,550
Event Coverage / Leisure	74,162	139,053	203,945	217,188	230,431	243,674
Utilities	571,218	1,071,034	1,570,850	1,672,854	1,774,857	1,876,860
Extractive	70,656	132,480	194,305	206,922	219,539	232,156
Environmental Monitoring	20,180	37,838	55,495	59,099	62,703	66,306
Entertainment	4,526	8,486	12,446	13,254	14,062	14,871
Public Safety / Emergency	155,445	291,460	427,474	455,232	482,990	510,749
Wildlife and Forestry	20,958	39,297	57,635	61,378	65,120	68,863
Telecommunications	536,959	1,006,799	1,476,638	1,572,524	1,668,409	1,764,295
Total	**3,470,621**	**6,505,651**	**9,540,682**	**10,160,077**	**10,779,472**	**11,398,867**

Exhibit 6-11: Estimated Economic Impact of Non-Agriculture UAS Users (continued)

State & Local Taxes / $ (2021 – 2025)

Industry	2021	2022	2023	2024	2025
Construction	3,134,519	3,296,092	3,457,665	3,619,238	3,780,811
Real-Estate	960,065	1,009,553	1,059,041	1,108,529	1,158,017
Insurance	2,884,222	3,032,893	3,181,564	3,330,235	3,478,906
Event Coverage / Leisure	256,918	270,161	283,404	296,647	309,890
Utilities	1,978,864	2,080,867	2,182,870	2,284,873	2,386,877
Extractive	244,773	257,390	270,008	282,625	295,242
Environmental Monitoring	69,910	73,513	77,117	80,721	84,324
Entertainment	15,679	16,487	17,295	18,103	18,911
Public Safety / Emergency	538,507	566,265	594,023	621,781	649,539
Wildlife and Forestry	72,605	76,348	80,090	83,833	87,576
Telecommunications	1,860,181	1,956,066	2,051,952	2,147,837	2,243,723
Total	**12,018,262**	**12,637,657**	**13,257,052**	**13,876,446**	**14,495,841**

Exhibit 6-11: Estimated Economic Impact of Non-Agriculture UAS Users (continued)

6.5 AGRICULTURE USER DATA VIA US DEPARTMENT OF AGRICULTURE (USDA)

The study utilized the USDA data to provide a summary of estimated users on farms in Kentucky (***Exhibit 6-12***). The USDA data states that the total farm receipts for Kentucky in 2012 averaged $5,237,000 with farms of 260 acres or more. These farms represent 15% of the total number of farms, accounting for 64% of total receipts. The average receipts per farm less than 260 acres of land is $78,708. Approximately three fourths of farms (77%) are less than 180 acres in size and generate average receipts of less than $49,000, with 47% in that group making a net loss on their operations.

The study assumed that larger farms would have more resources to invest in UAS operations. UAS platforms for agriculture use can cost $15,000 (average depending on sensor decision) and training which includes personnel obtaining a pilot's license as per the FAA. As the FAA loosens restriction on UAS operations and as UAS platforms decline in price, the accessibility of smaller farming operations should increase.

KEY STUDY POINT: Small farms may be challenged to utilize UAS due to required startup costs, training and operating within limited budgets.

Size	Number of farms	Potential UAS Use	Estimated Users
1 to 9 acres	4,337	0%	0
10 to 49 acres	23,776	0%	0
50 to 179 acres	31,151	10%	3,115
180 to 499 acres	13,024	25%	3,256
500 to 999 acres	2,848	75%	2,136
1,000 acres or more	1,928	95%	1,832
Total	**77,064**		**10,339**

Exhibit 6-12: Estimated Agriculture UAS Users Based on Farm Sizes (USDA)

6.6 AGRICULTURE USER DATA VIA US DEPARTMENT OF LABOR (STANDARD OCCUPATIONAL CLASSIFICATION)

The study used a utilized the BLS SOC data to pride a summary of estimated users on farms in Kentucky (***Exhibit 6-13***).

Size	Number of Operators	Potential UAS Use	Estimated Users
1 to 9 acres	6,487	0%	0
10 to 49 acres	35,035	0%	0
50 to 179 acres	45,521	10%	4,552
180 to 499 acres	19,512	25%	4,878
500 to 999 acres	4,406	50%	2,203
1,000 acres or more	3,249	75%	2,437
Total	**114,210**		**14,070**

Exhibit 6-13: Estimated Agriculture Users Based on Farm Sizes (SOC)

6.7 Comparison of Agriculture User Economic Data

The UAS Study compared the estimated user total from both the USDA data (Section 6.5) and SOC data (Section 6.6) for Agricultural Users. The comparison is in ***Exhibit 6-14***.

	Estimated Users		
Size	**Farm-based**	**Workforce-based**	**Average**
1 to 9 acres	0	0	0
10 to 49 acres	0	0	0
50 to 179 acres	3,115	4,552	3,834
180 to 499 acres	3,256	4,878	4,067
500 to 999 acres	2,136	2,203	2,170
1,000 acres or more	1,832	2,437	2,134
Total	**10,339**	**14,070**	**12,204**

Exhibit 6-14: Comparison of Estimated Agriculture UAS Users

The study used the average between the two estimates for the next portion of agriculture user economic impact.

6.8 Agriculture User Economic Impact

The study utilized the following information, multiplier and assumption utilizing the RIMS II model.

- Average agriculture estimated users (***Exhibit 6-14***)
- 10% conversion rate of estimated UAS users to full-time UAS operators
- Growth profile per AUVSI, as used for the non-agricultural industries
- Multipliers provided by the RIMS-II model
- Multipliers (local/state tax) available from Kentucky Cabinet for Economic Development

Exhibit 6-15 summarizes the economic impact assessment of estimated agriculture UAS users in Kentucky:

Direct Jobs Created

Farm Size	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1 to 9 acres	0	0	0	0	0	0	0	0	0	0	0
10 to 49 acres	0	0	0	0	0	0	0	0	0	0	0
50 to 179 acres	96	180	264	281	298	315	332	349	366	383	400
180 to 499 acres	102	191	280	298	316	334	352	370	389	407	425
500 to 999 acres	54	102	149	159	169	178	188	198	207	217	227
1,000 acres or more	53	100	147	156	166	175	185	194	204	213	223
Total	**305**	**572**	**839**	**894**	**948**	**1,002**	**1,057**	**1,111**	**1,166**	**1,220**	**1,275**

Exhibit 6-15: Estimated Economic Impact of Agricultural UAS Users

Indirect + Induced Jobs Created

Farm Size	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1 to 9 acres	0	0	0	0	0	0	0	0	0	0	0
10 to 49 acres	0	0	0	0	0	0	0	0	0	0	0
50 to 179 acres	223	419	614	654	694	734	774	814	853	893	933
180 to 499 acres	237	444	652	694	736	778	821	863	905	948	990
500 to 999 acres	126	237	348	370	393	415	438	460	483	506	528
1,000 acres or more	124	233	342	364	386	409	431	453	475	497	520
Total	**711**	**1,333**	**1,955**	**2,082**	**2,209**	**2,336**	**2,463**	**2,590**	**2,717**	**2,844**	**2,971**

Exhibit 6-15: Estimated Economic Impact of Agricultural UAS Users (continued)

Total Jobs Created (2015 – 2020)

Farm Size	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1 to 9 acres	0	0	0	0	0	0	0	0	0	0	0
10 to 49 acres	0	0	0	0	0	0	0	0	0	0	0
50 to 179 acres	319	598	878	935	992	1,049	1,106	1,163	1,220	1,277	1,334
180 to 499 acres	339	635	931	992	1,052	1,113	1,173	1,233	1,294	1,354	1,415
500 to 999 acres	181	339	497	529	561	593	626	658	690	722	755
1,000 acres or more	178	333	489	520	552	584	616	647	679	711	742
Total	**1,016**	**1,905**	**2,794**	**2,976**	**3,157**	**3,339**	**3,520**	**3,701**	**3,883**	**4,064**	**4,246**

Exhibit 6-15: Estimated Economic Impact of Agricultural UAS Users (continued)

Total Value Added / $ (2015 – 2020)

Farm Size	2015	2016	2017	2018	2019	2020
1 to 9 acres	0	0	0	0	0	0
10 to 49 acres	0	0	0	0	0	0
50 to 179 acres	18,928,481	35,490,902	52,053,323	55,433,409	58,813,495	62,193,580
180 to 499 acres	20,080,898	37,651,685	55,222,471	58,808,345	62,394,220	65,980,095
500 to 999 acres	10,711,952	20,084,910	29,457,868	31,370,717	33,283,565	35,196,414
1,000 acres or more	10,537,534	19,757,877	28,978,219	30,859,921	32,741,624	34,623,327
Total	**60,260,881**	**112,987,389**	**165,713,898**	**176,474,410**	**187,234,923**	**197,995,436**

Exhibit 6-15: Estimated Economic Impact of Agricultural UAS Users (continued)

Total Value Added / $ (2021 – 2025)

Farm Size	2021	2022	2023	2024	2025
1 to 9 acres	0	0	0	0	0
10 to 49 acres	0	0	0	0	0
50 to 179 acres	65,573,666	68,953,752	72,333,838	75,713,924	79,094,010
180 to 499 acres	69,565,970	73,151,844	76,737,719	80,323,594	83,909,468
500 to 999 acres	37,109,263	39,022,111	40,934,960	42,847,808	44,760,657
1,000 acres or more	36,505,029	38,386,732	40,268,434	42,150,137	44,031,839
Total	**208,755,948**	**219,516,461**	**230,276,974**	**241,037,487**	**251,797,999**

Exhibit 6-15: Estimated Economic Impact of Agricultural UAS Users (continued)

State and Local Taxes / $ (2015 – 2020)

Farm Size	2015	2016	2017	2018	2019	2020
1 to 9 acres	0	0	0	0	0	0
10 to 49 acres	0	0	0	0	0	0
50 to 179 acres	422,895	792,929	1,162,962	1,238,479	1,313,997	1,389,514
180 to 499 acres	448,642	841,205	1,233,767	1,313,881	1,393,996	1,474,111
500 to 999 acres	239,324	448,732	658,140	700,877	743,613	786,350
1,000 acres or more	235,427	441,426	647,424	689,465	731,505	773,546
Total	**1,112,877**	**2,084,882**	**3,056,887**	**3,255,256**	**3,453,625**	**3,651,994**

Exhibit 6-15: Estimated Economic Impact of Agricultural UAS Users (continued)

State and Local Taxes / $ (2021 – 2025)

Farm Size	2021	2022	2023	2024	2025
1 to 9 acres	0	0	0	0	0
10 to 49 acres	0	0	0	0	0
50 to 179 acres	1,465,031	1,540,548	1,616,065	1,691,582	1,767,099
180 to 499 acres	1,554,226	1,634,340	1,714,455	1,794,570	1,874,685
500 to 999 acres	829,086	871,822	914,559	957,295	1,000,032
1,000 acres or more	815,586	857,627	899,667	941,708	983,748
Total	**3,850,363**	**4,048,732**	**4,247,102**	**4,445,471**	**4,643,840**

Exhibit 6-15: Estimated Economic Impact of Agricultural UAS Users (continued)

Key Study Point: The potential economic impact of UAS in agriculture is significantly larger (more than 2x) than all of the non-agricultural industries put together. This is consistent with other industry analysts, including AUVSI.

6.9 Combine Non-Agriculture and Agriculture User Economic Impact

Exhibit 6-16 summarizes the economic impact for non-agriculture and agriculture UAS users in Kentucky:

Direct Jobs

Industry	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Agriculture	305	572	839	894	948	1,002	1,057	1,111	1,166	1,220	1,275
Non-Agriculture	162	303	445	474	503	532	561	589	618	647	676
	467	**875**	**1,284**	**1,367**	**1,451**	**1,534**	**1,618**	**1,701**	**1,784**	**1,868**	**1,951**

Exhibit 6-16: Estimated Economic Impact of Non-Agricultural and Agriculture UAS Users

Indirect and Induced Jobs

Industry	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Agriculture	711	1,333	1,955	2,082	2,209	2,336	2,463	2,590	2,717	2,844	2,971
Non-Agriculture	305	571	838	892	947	1,001	1,056	1,110	1,164	1,219	1,273
	1,016	**1,904**	**2,793**	**2,975**	**3,156**	**3,337**	**3,519**	**3,700**	**3,881**	**4,063**	**4,244**

Exhibit 6-16: Estimated Economic Impact of Non-Agricultural and Agriculture UAS Users (continued)

Total Jobs

Industry	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Agriculture	1,016	1,905	2,794	2,976	3,157	3,339	3,520	3,701	3,883	4,064	4,246
Non-Agriculture	467	875	1,283	1,366	1,450	1,533	1,616	1,700	1,783	1,866	1,949
	1,483	**2,780**	**4,077**	**4,342**	**4,607**	**4,871**	**5,136**	**5,401**	**5,666**	**5,930**	**6,195**

Exhibit 6-16: Estimated Economic Impact of Non-Agricultural and Agriculture UAS Users (continued)

Total Value Added / $ (2015 - 2020)

Industry	2015	2016	2017	2018	2019	2020
Agriculture	60,260,881	112,987,389	165,713,898	176,474,410	187,234,923	197,995,436
Non-Agriculture	37,073,380	69,510,825	101,948,270	108,568,157	115,188,045	121,807,932
	97,334,260	**182,498,214**	**267,662,167**	**285,042,567**	**302,422,968**	**319,803,368**

Exhibit 6-16: Estimated Economic Impact of Non-Agricultural and Agriculture UAS Users (continued)

Total Value Added / $ (2021 - 2025)

Industry	2021	2022	2023	2024	2025
Agriculture	208,755,948	219,516,461	230,276,974	241,037,487	251,797,999
Non-Agriculture	128,427,820	135,047,707	141,667,595	148,287,482	154,907,370
	337,183,768	**354,564,168**	**371,944,569**	**389,324,969**	**406,705,369**

Exhibit 6-16: Estimated Economic Impact of Non-Agricultural and Agriculture UAS Users (continued)

Total Local and State Taxes / $ (2015 - 2020)

Industry	2015	2016	2017	2018	2019	2020
Agriculture	1,112,877	2,084,882	3,056,887	3,255,256	3,453,625	3,651,994
Non-Agriculture	3,470,621	6,505,651	9,540,682	10,160,077	10,779,472	11,398,867
	4,583,497	**8,590,533**	**12,597,569**	**13,415,333**	**14,233,097**	**15,050,861**

Exhibit 6-16: Estimated Economic Impact of Non-Agricultural and Agriculture UAS Users (continued)

Total Local and State Taxes / $ (2021 - 2025)

Industry	2021	2022	2023	2024	2025
Agriculture	3,850,363	4,048,732	4,247,102	4,445,471	4,643,840
Non-Agriculture	12,018,262	12,637,657	13,257,052	13,876,446	14,495,841
	15,868,625	**16,686,389**	**17,504,153**	**18,321,917**	**19,139,681**

Exhibit 6-16: Estimated Economic Impact of Non-Agricultural and Agriculture UAS Users (continued)

6.10 KEY ECONOMIC IMPACT STUDY QUESTIONS

Question/Action 1—What is the economic impact if Kentucky does nothing or retains the status quo?

For manufacturers, the economic impact may be little to nothing unless definitive action is taken to attract additional manufacturers to Kentucky. The current aerospace companies may have some cross over to UAS platforms as more complex systems are developed that require specialized assembly, which is the main focus in Kentucky.

For agriculture and non-agriculture industries there will be a continued growing usage across the state regardless of action. A more likely detractor to UAS usage would be restrictions and anti-UAS legislation (which is addressed under the legislation questions).

Question/Action 2—What are the UAS jobs or career profiles and what are the compensation rates for occupations in this field?

This study found that very few specific jobs for UAS skills have been defined and advertised. It appears the primary utilization by UAS users is usually integration into a job profile that already exists (performing other duties for their specific company). As most UAS operations are integrated into current other job profiles, there is not a separate established salary base that is valid. As UAS usage expands and more UAS dedicated jobs are finalized, compensation rates will become established.

Question/Action 9—How can Kentucky impact workforce migration (gain) to the Commonwealth as this industry continues to develop?

As most UAS jobs are not specifically created in addition to current workforce numbers, but rather a re-tooling or training of internal personnel, there may be little action Kentucky can specifically take for users in this area. Kentucky's main objective should be to focus on becoming a 'pro-UAS' state that encourages all industry sectors to conduct UAS operations without legislative restrictions.

Question/Action 10—What are the specific uses for UAS that are best suited to Kentucky and why?

The study identified three "best uses" for UAS in Kentucky as agriculture, construction and insurance sectors. Each of these sectors has specific functions that can utilize services provided by UAS. These services have previously been performed by other tools and equipment. UAS integration may improve the efficiency and safety of operations. Additional revenue may be an indirect outcome but user data has primarily shown that improvement in operations and not specifically bottom-line revenue has been the primary objective.

7. ENABLING LEGISLATION

The study examined current and potential legislation implications. This included both Federal (FAA) and state legislation (current and in coordination). Privacy concerns were examined due to the large growth in UAS operations and usage.

As of February 12, 2016 there were over 3,300 Section 333 petitions granted by the FAA. The most popular categories for 333 exemptions are Aerial Photography, Real Estate, Aerial Survey, Aerial Inspection, and Agriculture.

Improvements in UAS technologies have made it easier than ever for inexperienced UAS pilots to operate systems with little-or-no training. Improvements in automation coupled with advancements in Global Positioning System (GPS) stabilized autopilots, miniaturized gyros, and Lithium Polymer (LiPo) batteries have created fertile ground for entrepreneurs and enthusiasts to enter into the UAS industry. To accommodate the resulting demand for UAS operations, the federal government permitted commercial UAS operations through the "333 Exemption process." This regulatory action was born from the FAA Modernization and Reform Act of 2012 (FMRA) and served to accelerate the expansion of the UAS commercial market. As of February 12, 2016 there were over 3,300 Section 333 petitions granted. The resulting surge saw some states enacting "pro UAS" legislation to attract businesses while other states created "anti-UAS" legislation aimed (for the most part) at restricting UAS operations in the name of privacy. In the paragraphs that follow, a summary of UAS regulations will be provided at the Federal Level, in other states, and within Kentucky.

7.1 FEDERAL UAS REGULATORY LANDSCAPE

The broader federal UAS regulatory environment can be partitioned into the categories of UAS operational regulations and those regulations aimed at protecting the privacy of non-participants. As standardized operational rules are formed and barriers to entry are lowered, one can assume that the number of UAS in any given airspace will increase. The resulting increase in the public's exposure to UAS will most likely put pressure on legislators and law enforcement to curb their use.

7.1.1 Federal UAS Operational Regulations

Prior to the FAA allowing "333 Exemptions," the only viable avenue for non-DoD UAS operations in the NAS was through the "special airworthiness certification" process. This is a lengthy, expensive, and complex process that few companies have the patience or budget to pursue. The resulting approval permitted limited commercial activities and had little value to most companies when compared to the level of effort expended to get the certificate. In contrast, the 333 Exemption process required little effort and resulted in most approvals be granted within four months (***Exhibit 7-1*** on the next page).

The pending small UAS (sUAS) rules expected to be released by the FAA later in 2016 will have a dramatic effect on the commercial UAS industry by lowering a significant barrier to entry for existing operations. Except for DoD operations, the minimum pilot requirements for all FAA UAS operations (effected through the COA process) require pilots to have passed the FAA Pilot Ground School written exam for pilots. This requires a course of documented study, a recommendation by a manned Certified Flight Instructor (CFI), and the administering (and passing) of a formal FAA test at a designated testing facility. This has been a bridge too far for

many UAS companies, who have chosen to take their chances with getting caught by the FAA by blending in with the mass of UAS operators.

In an effort to emphasize the FAA's authority to regulate UAS operations at the federal level, the FAA Office of the Chief Counsel released the "State and Local Regulation of Unmanned Aircraft Systems (UAS) Fact Sheet" in December of 2015. A summary of this document is included below since it clearly states the FAA's position on federal regulations and the ability of state and local governments to legislate UAS operations.

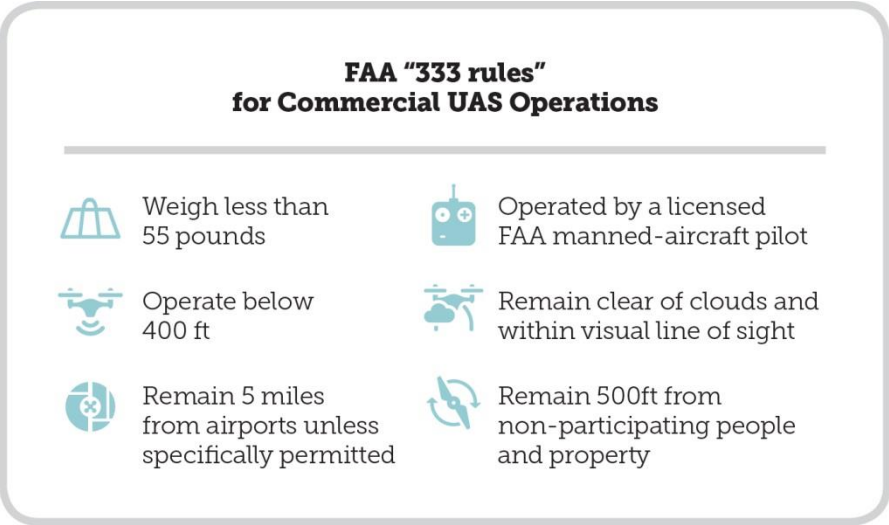

Exhibit 7-1: FAA "333 Rules"

The Fact Sheet advises that "state and local restrictions affecting UAS operations should be consistent with the extensive federal statutory and regulatory framework pertaining to control of airspace, flight management and efficiency, air traffic control, aviation safety, navigational facilities, and the regulation of aircraft noise at its source." The study further states the following:

- Congress has directed the FAA to "prescribe air traffic regulations on the flight of aircraft (including regulations on safe altitudes)" for navigating, protecting, and identifying aircraft; protecting individuals and property on the ground; using the navigable airspace efficiently; and preventing collision between aircraft, between aircraft and land or water vehicles, and between aircraft and airborne objects
- Cites the need for a consistent regulatory system for aircraft and the use of airspace to ensure a "safe and sound air transportation system" and states the agency's regulatory authority over aviation safety matters
- States that "no state or local government may impose an additional registration requirement on the operation of UAS in the navigable airspace without first obtaining FAA approval."
- Describes how state or local regulations could create a "patchwork quilt" of different regulations that could impact the FAA's ability to control "safety and efficient air traffic flow."
  - Operational restrictions on altitude, flight paths, operational bans, and any regulation related to the navigable airspace. Case law examples are provided to illustrate how the federal courts have ruled against state and local regulation of overflight.

  - Mandating UAS equipment or training related to aviation safety such as geo-fencing.[2]
- Provides examples of laws within state and local government police power that are "generally" not subject to federal regulation:
  - Land use, zoning, privacy, trespass, and law enforcement operations
  - Requirement for police to obtain a warrant prior to using a UAS for surveillance
  - Specifying that UAS may not be used for voyeurism
  - Prohibitions on using UAS for hunting or fishing, or to harass with individuals hunting or fishing
  - Prohibitions on attaching firearms or similar weapons to UAS

As described earlier, the pending sUAS rules expected to be released later this year will transform the UAS Industry by lowering current restrictions and thereby increasing the number of UAS operators.

KEY STUDY POINT: FAA rules are moving towards fewer federal limitations, which will increase the number of UAS operators. As restrictions are reduced, states will have increased pressure to take local actions.

7.1.2 Federal UAS Privacy Legislation

The study examined UAS privacy legislation. On February 15, 2015, a Presidential Memorandum was issued titled "Promoting Economic Competiveness While Safeguarding Privacy, Civil Rights, and Civil Liberties in Domestic Use of Unmanned Aircraft Systems." The Memorandum restricts the data collected by government agencies and details a process to "develop and communicate best practices for privacy, accountability, and transparency issues regarding commercial and private UAS use in the NAS." The process charters the National Telecommunications and Information Administration (NTIA) with initiating a stakeholder engagement process to "develop a framework regarding privacy, accountability, and transparency for commercial and private UAS use."

The NTIA convened four meetings in 2015 concerning privacy, transparency, and accountability issues regarding commercial and private use of unmanned aircraft systems. "Use cases" and voluntary best practices for Commercial and Private Use of Unmanned Aircraft Systems were produced as a result of these meetings. No future meetings are currently planned.

KEY STUDY POINT: Privacy concerns are being addressed nationally and definitive rulings are still being processed. States have a chance to influence state and federal policies and legislation.

7.2 UAS Regulatory Landscape in Other States

The Study examined examples of UAS legislation in other states. When considering the expanding use of UAS in their state, legislators often find themselves caught between two general categories of constituents; UAS industry stakeholders that desire expanded use of the systems to take advantage new opportunities, and citizens concerned about privacy issues and the potential nuisance of UAS. A few states have successfully navigated through this difficult issue by using key subject matter experts from the UAS and legal communities to educate legislators

[2] Geofencing as it relates to UAS is a means of creating a virtual flight barrier (or "fence") for the Air Vehicle (AV). Geofences can be advisory or forced. Advisory geofences provide the operator an alert if the AV penetrates the boundary. Forced geofences physically prevent the AV and operator from crossing the boundary.

and the public at large on existing rules for UAS and the applicability and effectiveness of existing laws in their state as they relate to prohibiting "bad players" from improperly using UAS. In many cases, existing privacy and nuisance laws in place at the state level prove sufficient to identify bad players and pursue them for improper use of UAS. Two examples of state successes in enacting "Pro UAS" legislation are listed below:

- ***Maryland SB70*** requires that only the *State* may enact a law or take other action to prohibit, restrict, or regulate the testing or operation of UAS in the *State*. The law preempts the authority of a county or municipality to restrict operations. This helped to establish Maryland as "Pro UAS" by telling UAS operators in Maryland that only federal and State laws apply and prevents operators from having to follow different rules as they operate in different locations within the state (referred to as a "patchwork quilt" by the FAA).
- ***Virginia Executive Order 43*** establishes an Unmanned Systems Commission with the expectation that it will help "leverage its unique resources" and "take the greatest advantage of the industry's development and reap benefits from it." It should be noted that Virginia also passed legislation that requires that law enforcement obtain a warrant before using a drone in all but limited circumstances.

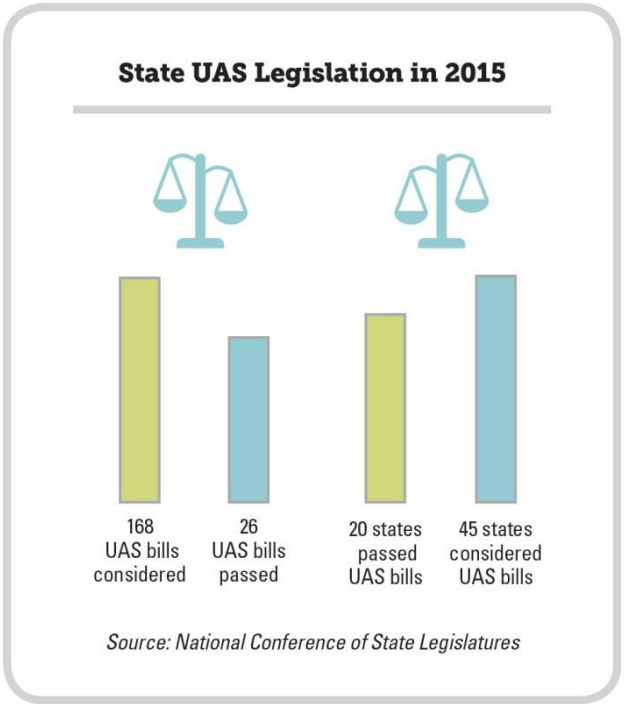

Exhibit 7-2: State UAS Legislation in 2015

These positive examples represent the minority of UAS legislation. Most states have passed laws to restrict operations with the majority of those laws being directed at protecting privacy. The National Conference of State Legislatures website states that in 2015, 45 states considered 168 bills related to drones. Twenty states passed 26 pieces of legislation."[3] ***(Exhibit 7-2)***.

7.3 KENTUCKY UAS REGULATORY LANDSCAPE

Earlier this year, the first lawsuit regarding the rights of UAS operators versus the rights of property owners was filed in a federal court in Kentucky. This stemmed from an earlier incident in which a property owner shot down a UAS that he believed was invading his privacy and trespassing on his property. This case clearly illustrates the current argument playing out across the US and raises the question – does the property owner have rights to the airspace above their property or is that airspace regulated by the FAA? The FAA's answer is clear. As described in section 2.1.1 above, the FAA has stated "no state or local government may impose an additional

[3] "Current unmanned aircraft state law landscape," www.ncsl.org, January 13, 2016.

registration requirement on the operation of UAS in the navigable airspace without first obtaining FAA approval." If a state, county, or municipality is permitted to establish restrictions on the airspace above property in their jurisdiction, the result would be what the FAA terms a "patchwork quilt" of different regulations that could ultimately impact the FAA's ability to control safety. The effect on UAS operations would be to stifle or even prevent UAS operations in the corresponding area all together. Additionally, operators would need to be cognizant of the imaginary lines in the sky that separate the airspace over various jurisdictions.

Existing laws to protect privacy in Kentucky: Kentucky's existing laws for nuisance, noise emission prohibitions, and voyeurism can protect citizens from misuses of unmanned systems.

> ***KEY STUDY POINT: Creating legislation to curb users of UAS in Kentucky has the possibility of being overturned by federal courts. Additionally, this legislation can create the negative affect of an "anti-UAS" culture within the state.***

Proposed legislation to limit UAS operations: Three bills were originally introduced in the 2016 legislative session. Since being introduced, HB 22 and HB 67 have subsequently been withdrawn and their issues added to HB 120. To highlight the focus areas that served as the source of the original proposed legislation, the two withdrawn bills are individually highlighted in the following section. A brief summary of the proposed bills is included below:

Kentucky HB22 (Drone Surveillance) Analysis:

1. HB22 restricts 'lethal payload' to primarily DoD and Homeland Defense. Dropping lethal payloads is prohibited in some COAs but surprisingly is not mentioned in the "blanket" COA administered for 333 operators. Many (but not all) public COAs have the following limitation:

   "The dropping or spraying of aircraft stores, or carrying of hazardous materials (including ordnance) outside of active Restricted, Prohibited, or Warning Areas approved for aviation activities is prohibited unless specifically authorized as a special provision."

   The FAA did not specifically call out the dropping of stores for 333 operations since a 333 exemption states that "UAS PIC and UAS operations must comply with all applicable parts of 14 CFR including but not limited to parts 45, 47, 61, and 91." FAR 91.15 states:

   "No pilot in command of a civil aircraft may allow any object to be dropped from that aircraft in flight that creates a hazard to persons or property. However, this section does not prohibit the dropping of any object if reasonable precautions are taken to avoid injury or damage to persons or property."

   The question for Kentucky legislators is – can Kentucky further restrict Federal Aviation Regulations? The authors of this study believe that this is possible for state employees but not for non-state employees.
2. HB22 states that 'higher education' may conduct operations for education/research. This clause achieves little since any operator (public or commercial) can obtain approval from the FAA to conduct education/research. Additionally, as stated throughout this study, the FAA has publicly stated (and has proven through case law) that the FAA is mandated by congress to "prescribe air traffic regulations."
3. HB22 requires law enforcement to obtain a search warrant and states usage for only targets of concern. On the surface, this seems reasonable but after longer consideration, begs the question – does Kentucky require this for general aviation aircraft used/leased by the state?

For street surveillance, or public areas? Based on FAA case law, the airspace is not Kentucky's to regulate. These types of bills that target UAS will need to be defeated if Kentucky Legislators want to attract more UAS businesses to the state.

Kentucky HB67 (Drone Harassment) Analysis:

1. HB67 Bill defined that utilization of a drone to harass is illegal. It also defines when someone can be found guilty of drone harassment. KRS 525.070 already defines harassment and the definition of guilt under the law. Some of the existing definitions under this law already cover misuse of UAS:
    - Attempts or threatens to strike, shove, kick, or otherwise subject the person to physical contact
    - Follows a person in or about a public place or places
    - Engages in a course of conduct or repeatedly commits acts which alarm or seriously annoy such other person and which serve no legitimate purpose. KRS 531.090 covers voyeurism and 531.100 covers video voyeurism. A person is guilty of video voyeurism when he or she intentionally:
    - Uses or causes the use of any camera, videotape, photo optical, photoelectric, or other image recording device for the purpose of observing, viewing, photographing, filming, or videotaping the sexual conduct, genitals, or nipple of the female breast of another person without that person's consent; and
    - Uses or divulges any image so obtained for consideration; or
    - Distributes any image so obtained by live or recorded visual medium, electronic mail, the Internet, or a commercial online service

For UAS, KRS 531.100 is most applicable since it would not involve "the unaided eye" as defined in KRS 531.090. The existing laws (525.070 and 531.100) cover the intent of the proposed bill. Like HB22, this targets UAS operations for behaviors already prohibited for similar operations. Consider similar bad behaviors such as using a pole to extend the camera. This misuse is not specifically covered since it's covered under the general use of the term "camera" or "videotape." In a similar way, UAS' are merely an extension of a camera no different than using a selfie stick or pole to gain access to areas normally considered private by citizens. All of these actions should be considered bad behaviors and illegal. However, this is redundant legislation targeting a specific use when it (and others like it) is already covered under the existing law as written. If approved, the bill does little to further protect Kentucky citizens but may have a negative impact on the state by causing pause for UAS businesses and those considering operations in the Kentucky.

Kentucky HB120 (drone definition) Analysis:

1. HB120 creates a new KRS section of 525 to provide a separate provision specifically targeted at drone unlawful purposes.
2. The Bill defines "drone" and the acts defining the illegal use of them.

This bill merely states what is proposed in the other bills and adds a class B misdemeanor. The analyses for the other bills listed above still apply in that UAS bad behaviors are already covered in existing laws. This proposed law however specifically targets the UAS industry by adding an additional charge (on top of the other laws already covering illegal use) specifically targeting UAS operations. Kentucky Legislators should consider that this will be received poorly by industry and promote an "anti UAS" environment in Kentucky.

7.4 LEGISLATION STUDY QUESTIONS

Question/Action 3 - What legislation can be developed at the state level to complement federal progress on unmanned systems integration?

To complement federal progress on unmanned systems integration, Kentucky should develop legislation which prevents counties and municipalities from creating rules that will antagonize UAS operations. Maryland's SB370 could serve as an initial framework to begin discussions and could be easily adapted to meet Kentucky's requirements. As shown earlier in this section, the FAA is mandated by congress to protect the safety of the airspace over Kentucky and has proven this point through years of case law in manned aviation. While restrictive state legislation would be considered non-binding by the FAA, it could serve to stifle the expansion of UAS operations in the state and send a negative message to prospective companies considering Kentucky as a location for their business.

Additionally, the Blue Ribbon Panel previously recommended should perform a detailed analysis of existing privacy, voyeurism and harassment laws to ensure that existing laws aimed at a general population of bad players are sufficient to address the inappropriate use of UAS. Once verified, the Blue Ribbon Panel assessment would serve as an information tool for legislators and would promote good will with Kentucky citizens concerned about the perceived lack of legislation covering the inappropriate use of UAS. Most UAS subject matter experts testifying in support of UAS in various states will say that education is the key to easing concerns over the increasing number of unmanned operations and the possibility of inappropriate use.

Question/Action 6 - How does Kentucky advance this part of the economy while protecting the privacy of its citizens?

Kentucky's existing laws for nuisance, noise emission prohibitions and voyeurism are already structured to protect Commonwealth citizens from the misuse of UAS. Adding specific laws targeting UAS will have minimal positive effect on further protecting citizens but will have a negative effect on promoting Kentucky's UAS industry by creating an antagonistic environment for current and potential UAS companies.

8. ECONOMIC GROWTH INCENTIVES

8.1 BASIC ECONOMIC INCENTIVE CONCEPTS

Different types of economic incentives have been developed to encourage and support the growth of new industries. Economic incentives generally fall into three categories:

- Those intended to encourage the attraction of existing businesses into the location of interest from other locations
- Those intended to support the creation of new businesses, which may also include incentives aimed at attracting entrepreneurs and strengthening other elements of the innovation ecosystem such as venture capital sources
- Those intended to strengthen or support the growth of existing businesses

8.2 POTENTIAL KENTUCKY INCENTIVE OPTIONS

Based upon the minimum amount of current manufacturers of UAS and the current aerospace companies in Kentucky, the following options should be considered:

- Tax incentives for established UAS manufacturers moving into Kentucky. While this is not the only consideration manufacturers will evaluate, it is a critical consideration which can negate other positives in any state.
- Tax incentives that include R&D credits (which could also be tied to educational and training opportunities).

Based upon the large number of agricultural and non-agricultural users of UAS the following incentive options can be considered:

- Tax incentives which encourage usage of UAS specifically. These incentives could have a wide range of agricultural usage, and should be a key item for evaluation by the recommended Blue Ribbon Panel.
- These incentives could include tradeable R&D tax credits that would enable larger companies to offset development costs, and small companies to generate essential funding through the sale of credits to which they were entitled.

8.3 ECONOMIC INCENTIVE STUDY QUESTIONS

Question/Action 1 - What can the economic impact be if Kentucky enables this industry through legislation, incentives and other growth initiatives?

Due to the minimum presence of manufacturers in Kentucky it is undetermined if short term initiatives will have any economic impact. For manufacturers, Kentucky may opt to focus on long term initiatives to attract new UAS businesses.

The study determined the economic impact for agriculture and non-agricultural users is revenue neutral. UAS are already considered a business expense, so utilization of them can already be written off for tax purposes. An incentive for a 'working tool' does not show an immediate economic impact while those expenses are already off set in most operations.

Question/Action 4 - What are the recommended state level economic growth incentives that will spur investment, business relocation to Kentucky, and entrepreneurial activity in the UAS sector?

The study determined that two key incentives could make an impact on state UAS activity. First, providing incentives via tax breaks for organizations utilizing UAS (manufacturers or users). This would be similar to companies that can get breaks for utilizing green technologies. Second, ensuring that users are not 'punished' for utilizing UAS via user fees in addition to current aviation charges. This would be similar to residents in Kentucky who register their aircraft legally in another state which has lower registration fees and taxes.

9. INFRASTRUCTURE

The study in coordination with the KCMA focused on airspace in this section. Other areas that are traditionally associated with infrastructure are covered in the previous economic impact sections.

9.1 AIRSPACE IN KENTUCKY

The airspace over Kentucky includes a substantial amount of uncontrolled airspace which, in the current regulatory environment, provides significant access to "333 Exemption" operators to perform commercial operations. While these same operators can file individual COAs for permission to operate closer to airports, the nationwide "333 blanket COA" requires that

operators remain outside of controlled airspace. Individual COAs for specific operational sites (e.g. close to airports) are processed by the FAA and the agency's regional offices. Kentucky falls under the FAA's Southern regional office, which is located in Georgia.

The congested airspace around Lexington, Louisville, and Cincinnati does have an impact on UAS operations. While Louisville's and Lexington's Class C airspace is significantly smaller than Cincinnati's Class B and "Mode C" veil, all of these areas serve to reduce operations in locations where UAS operators want to fly and where customers desire their services. Congested airspace is generally located near urban areas where construction, real estate and many other companies want to operate UAS. As the FAA reduces restrictions and develops procedures for UAS operations, it is expected that the airspace around these congested areas will begin to become more legally accessible.

A detailed airspace analysis of Kentucky is outside the scope of this study but it is recommended that one be completed as part of an educational program to improve safety and reduce violations by UAS operators in the Commonwealth.

9.2 USE OF MILITARY AIRSPACE BY COMMERCIAL UAS OPERATORS

The military installations of Fort Knox and Fort Campbell have special use airspace that UAS manufacturers and operators would like to access. However, the DoD has a different airspace rule set for UAS operations. On 30 January 2014, the Army sent an updated memorandum titled "Scheduling and Activating Army Delegated Special Use Airspace" (SUA). In this memo, the Army states that Army Special Use Airspace will be scheduled and activated in accordance with the references, which includes the interpretive guidance provided in DoD's Policy Board on Federal Aviation (PBFA) memorandum "Scheduling and Activating DoD Delegated Special Use Airspace," dated 22 January 2014.

The PBFA memo states that "The purpose of DOD-delegated SUA is to fulfill Armed Forces training, test and evaluation requirements for peacetime, contingency, and wartime operations. The volume and times of SUA use should be the minimum required to contain the intended activity." This means that allowing UAS access to commercial operators using Commercial Service Agreements (CSAs) is not permitted and may cause the FAA to re-evaluate the use of SUA. Ranges designated as Major Range and Test Facility Bases (MRTFBs) as defined in DOD 3200.11 are given provisions to allow for expanded use of the SUA; however, Fort Campbell and Fort Knox are not considered MRTFBs.

KEY STUDY POINT: Military airspace is NOT regularly accessible for civilian and commercial R&D, training and operations.

9.3 USE OF MILITARY AIRSPACE BY COMMERCIAL UAS OPERATORS

The study did not identify any airspace that is specifically dedicated for civil and commercial R&D, training and operations. Establishing areas that can be utilized for UAS operations can be a lengthy and complex project. There are challenges from privacy, landowners, environmental impact, public reviews, public perception, professional aviation reviews and comments.

KEY STUDY POINT: Development of a common UAS airspace for Kentucky can be a lengthy and complex process.

9.4 INFRASTRUCTURE STUDY QUESTIONS

Question/Action 7 - What are the infrastructure needs in Kentucky as related to the UAS industry?

Like many other states, Kentucky has a shortage of dedicated airspace for UAS R&D, training and operations. A single airspace volume does not necessarily provide UAS utilization for potential users and manufacturers. Most of these potential UAS operations may require local airspace. Consideration should be given to multiple airspace options that can accommodate local UAS operations to the maximum extent possible.

> ***KEY STUDY POINT: Development of airspace for civil UAS operations may be a lengthy process due to environmental impact, FAA procedures and public support.***

Question/Action 7 (continued) - Do military installations in the state have a role? If so, how is that potential developed? Fully analyze the military assets and infrastructure available in the Commonwealth of Kentucky and develop recommendations for leveraging these assets to grow the economic impact of UAS in Kentucky.

Fort Knox and Fort Campbell are actively involved in military UAS operations and training. Fort Knox has two airstrips to accommodate UAS operations and serves as a facilitator to other installations. Additionally, Fort Knox supplements Fort Campbell's overflow airspace needs for training the 101st and 160th Aviation Units as well as the Tennessee National Guard UAS units which replaced the unit's C-130 squadron.

Since 2012, Fort Campbell has fielded more than 43 UAS systems which resulted in $113M in Army-Military Construction and an additional $2.2M in minor construction. This expansion has provided conventional and special operation units with simultaneous real-time situational awareness and direct action capability.

Based on current FAA and military regulations, the study determined that military installations will have little impact on commercial UAS economic development in Kentucky. The study did not examine the economic impact of added UAS assets to Kentucky military installations. DoD UAS usage at Kentucky installations is developed under separate budgets with already specific predefined missions. The Blue Ribbon Panel should examine both short term and long term UAS airspace state needs. Additionally, the panel should consider expanded cooperation for state emergencies where Kentucky Guard units already play a major role.

10. EDUCATIONAL OPPORTUNITIES

Kentucky has the ability to make an impact on its workforce by using its current educational opportunities as well as looking to expand its educational pipeline. Educational opportunities begin with the K-8 Science, Technology, Engineering and Mathematics (STEM) programs to prepare students for Kentucky High School Science Standards. They also allow students to learn skills in the Kentucky Community and Technology System (KCTS) and embrace opportunities with programs at the university level.

Kentucky took a positive step forward when it began the Unmanned Systems Research Consortium spearheaded by the University of Kentucky. By partnering industry and academia, Kentucky has created an incubator of ideas that will greatly assist the state. Additionally, short courses available through the Kentucky Transportation Research Center Technology Transfer

Program on UAS demonstrate the positive impact of increasing educational and workshop opportunities.

Kentucky needs to create an educational environment capable of attracting this top talent. Offering a degree in UAS through engineering schools is just the beginning. Law schools need to address ethics, privacy, and accident concerns. Medical professionals must understand the technology to add it to their life saving tools. Criminal justice stakeholders should have a feedback loop for lessons learned for concept of operations and uses. Transportation specialists must learn to exploit the new opportunities presented with UAS.

In addition to traditional higher education courses and degrees, Kentucky must pursue paths into vocational education. Previous avenues developed for the aircraft industry can be augmented to address UAS concerns of telemetry, software, ground control stations and human factors. A state certification program would allow for the standardization of skills, while marketing the skill sets of Kentucky's workforce to UAS companies.

10.1 Assumptions and Methods

Educational opportunities were analyzed at all grade levels and divided into bands of P-12, community and vocational college, state universities and entrepreneurship programs. Analysis encompassed current programs in Kentucky, programs in competing states and trends for education in the UAS Industry. As opposed to providing an extensive list of all educational opportunities and initiatives in the United States, this study provides a summary of best practices and lessons learned from other states as well as recommendations on how to customize and expand them for the Commonwealth of Kentucky.

10.1.1 Kentucky Educational Initiatives

In the P-12 band, STEM programs, competitions and non-profit science initiatives were explored. Since the STEM Taskforce met and out-briefed in 2007, Kentucky has made great strides in supporting its students, teachers and parents in STEM education. The University of Kentucky (UK) has degrees in STEM Education and provides several initiatives to support students and teachers. The UK seeBlue STEM Camp and seeBlue Mathematics Clinic are two ways UK is advocating for STEM ready students. The seeBlue STEM Camp occurs in the summer and provides access to the University of Kentucky's Engineering Labs. Last year, the 5-8 graders engaged in a Lego Robotics Competition which could be expanded to include a UAS competition. The UK seeBlue Mathematics Clinic provides free outreach support for students struggling in mathematics and provides individualized assistance.

The University of Kentucky has also teamed with the nonprofit organization Battelle to support the STEMx Network of tying resources across Kentucky. "The STEMx program works by connecting preexisting Kentucky STEM education advocacy programs with one another. As a result, STEMx Kentucky is uniquely positioned to impact education at the ground-level," said UK College of Education Dean Mary John O'Hair.

Nonprofits such as the Kentucky Girls STEM Collaborative Project (http://kgsc.org/) attempt to steer female students to pursue careers in the traditionally underrepresented fields of Science, Technology, Engineering and Mathematics. Despite recent gains, women are less than 20 percent of the workforce in Computer Science, Engineering and Physics. All three areas directly support the UAS Industry and offer a unique opportunity to attract women to these professions.

For community and vocational education, opportunities provided by the Kentucky Community and Technical College System (KCTCS) (http://www.kctcs.edu) were captured. KCTCS provides education and workforce training for approximately 82 percent of Kentucky's Skilled Trades Workforce, with 70 campuses throughout the state. The 16 schools offer multiple training programs and degrees to prepare students in everything from EMT certification to the country's only accredited Jockey and Horseman Program. KCTCS is in a prime position to offer certificate programs and degrees for the UAS Workforce. The opportunity for partnership between KCTCS and Eastern Kentucky University will be discussed below.

At the state-sponsored post-secondary level, the University of Kentucky (UK) (http://www.uky.edu/) has taken a leading role by launching the Unmanned Systems Research Consortium (USRC). With several meetings per year, the consortium brings industry and academia together to create research opportunities as well as provide insight into the latest unmanned technologies. Consortium members have access to testing resources such as wind tunnels, precision machinery, and rapid prototyping.

The University of Kentucky also launched the Kentucky Research Center Technology Transfer Program (KRCTTP) (http://www.kyt2.com) which offers UAS short courses to busy professionals by providing information on the latest technologies and trends. About every six months, the KRCTTP offers a short course to provide businesses with needed information on how UAS can help their business. The course is centered around one full day of instruction, an extensive question period, and hands-on displays of UAS.

Also, Eastern Kentucky University (EKU) (http://www.eku.edu) was reviewed for this study to evaluate their Aviation Program and its synergy with the UAS Industry. EKU curriculum offers several BS degrees and minors in Aviation, Aviation Management and Flight. These students have the requisite skills for UAS Operations and Management. Adding a UAS degree would be relatively straight forward for the curriculum. Currently, EKU offers the nation's first FAA-approved 1,000-hour power, 2+2 degree pathway. EKU's partnerships with four institutions in the Kentucky Community and Technical College System (Ashland, Owensboro, Hazard and Middlesboro) allow students who completed their two-year studies in aviation related fields to complete a four-year degree at EKU.

For business assistance, the Commonwealth of Kentucky created the Kentucky Innovation Network (http://www.thinkkentucky.com/entrepreneurship/innnetwork.aspx) to assist innovative companies from thirteen locations across the Commonwealth. In a recent initiative, Morehead State University, the Kentucky Innovation Network and Unmanned Services Inc. have partnered to create a UAS flight training school that will begin offering classes in March of 2016. The flight school is designed to provide technical unmanned aircraft systems education and instruction to public and private entities at a low cost and help develop the UAS sector in Kentucky. The Kentucky Innovation Network will sponsor the training school with location, marketing, and scholarships. Students will learn about aircraft maintenance and flight operations programs.

Nonprofit organizations are also taking a full spectrum role in educating future business leaders to helping high school students. For example, the Kentucky Science and Technology Corporation (KSTC) "is a private, nonprofit corporation committed to the advancement of science, technology and innovative economic development founded on Kentucky know-how (http://www.kstc.com)." KSTC has three prevalent areas of interest to include; *AdvanceKentucky*

supporting Advanced Placement high school students, Laying the Foundation to support teachers in grades 3-12 and the Governor's School for Entrepreneurs to help creative teens develop new ideas.

Kentucky has many resources available for the education of its citizens and more opportunities are created every day. By educating the population on the multitude of resources available, Kentucky can create an educational pipeline that vectors students into the blossoming UAS Industry.

KEY STUDY POINT: Kentucky has a strong educational baseline structure to continue to grow with UAS manufacturers and users.

10.1.2 Other State Initiatives

National best practice initiatives are divided into educational bands as previously established for the Commonwealth. They include grades P-12, community and vocational college, state universities, and entrepreneurship programs. Looking across the nation for notable achievements and leading edge efforts, the information below is a sample of the current trends in the UAS Educational Fields:

In grades pre-school through twelve, STEM has taken a primary role in the introduction of UAS instruction and gaining student interests. In addition to standard course load, high schools are introducing UAS events for students to participate in friendly competition while learning how to operate in a team environment and developing new technology.

In 2015, high school STEM students in Maryland participated in the STEM4UAS Competition. The students spent three months taking a UAS Robotics Curriculum (Ground School) while designing and building a quadcopter for the competition. UAS kits were provided to each team from the STEM program to provide a level starting line. The competition culminated in a search and rescue event.

After this inaugural event, the program's format was adopted nationally by the Academy of Model Aeronautics (AMA) and was renamed UAS4STEM in August 2015. The AMA expanded the competition for eighth through twelfth grade and promoted teams across the United States to form their own local teams of four to eight members. These teams can begin competing in 2016.

Also, in Maryland, the Association for Unmanned Vehicle Systems International Seafarer Chapter has held an annual Student Unmanned Aircraft Vehicle (SUAS) competition since 2002. Various universities, colleges, and high schools from around the country and the world travel to this competition. With different skill levels, budgets, and sponsorships, the competition is guided towards rewarding individual team efforts while also acknowledging the best in multiple categories. While the flying events are the primary focus of the competition, technical papers, team presentations, systems engineering, and safety are graded just as highly. This event has become a convergence of the world's future UAS talent.

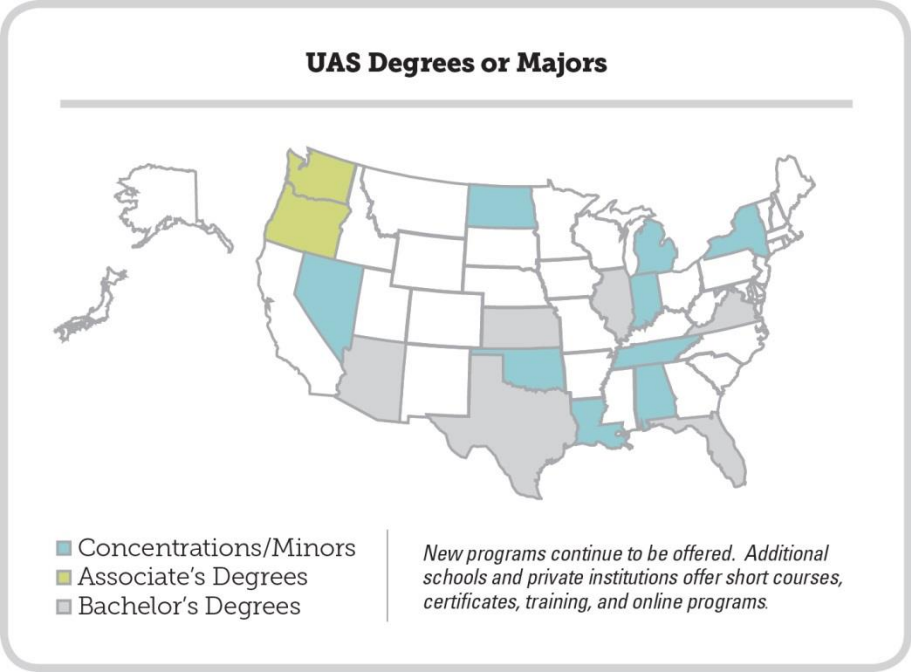

Exhibit 10-1: States with UAS Degrees or Major Courses of Study

Community colleges throughout the nation are also realizing the value of UAS (***Exhibit 10-1***). Sinclair Community College in Dayton Ohio is chartered for workforce development and provides skills to students in upcoming industries. Besides advanced manufacturing, IT and Cybersecurity; they also offer classes in UAS. As part of their community development efforts, they minimize tuition and increase availability by offering many online courses such as COA Smart, UAS First Responder Leadership, Introduction to UAS, UAS Precision Agriculture, UAS and the Law, Geospatial Information for UAS and Current State of UAS Standards and Regulations. In addition, they offer hands on skills with UAS and, while an urban school, provide an indoor flying range for students.

Many colleges with aviation programs now offer courses in unmanned systems, and several universities have added majors. The University of North Dakota was the first in 2009. In 2012, Kansas State University Salina graduated its first student with a Bachelor of Science in unmanned aircraft systems and Indiana State University offered a major in 2014. Even schools not affiliated with specific states, such as Embry-Riddle Aeronautical University, started offering the degree in 2011 at its Daytona Beach, Florida campus.

The University of North Dakota offers a Bachelor of Science Degree in Aeronautics with a major in UAS. To participate, students must be a US Citizen due to ITAR Considerations. Students must take five 300 level courses: UAS Flight Systems, UAS Ground Systems, UAS Remote Sensing, UAS Communications and Telemetry Systems and Survey of Unmanned Systems. These courses are part of the student's aeronautics degree that will also allow them to gain their commercial pilot's license.

Also under their Aeronautics Department, Kansas State Polytechnic: College of Technology and Aviation offers a Bachelor Degree in Unmanned Aircraft Systems Flight and Operations. This school was one of the first two in the country to offer a Bachelor of Science in Unmanned Operations with its 127 credit degree program.

Professional conferences have become a standard way to increase a company's business and entrepreneurial understanding of the UAS Industry. Each year, the University of New Mexico hosts the UAS TAAC (Unmanned Aerial Systems Technical Analysis and Applications Center) Conference to bring together Industry and Government to discuss the latest UAS challenges. With attendees from DoD, NASA, DHS, NOAA, BLM, USGS, AOPA, AIA, universities and private industry, classified and unclassified briefings are presented.

The largest conference for the unmanned industry is AUVSI's XPonential Conference. Hosted in a different city each year, it has more than 8,000 attendees from 55 countries. With numerous exhibitors and education tracks, attendees are presented with abundant opportunities to increase their understanding of the industry as well as network with other professionals. In 2016, XPonential is scheduled to have over 160 speakers present the latest information on this industry.

10.2 SUPPORTING INFORMATION AND DATA

The UAS industry study data was obtained through internet research, organizational document reviews, phone interviews and in-person interviews. In reviewing state trends, this study has captured leading national best practices. While many states have enacted the practices discussed, none are securing a full educational pipeline and helping to fuel the "UAS Ecosystem."

In reference to Kentucky, the primary means of collecting data was through in-person or phone interviews. From the responses gathered, Kentucky's educational leaders are passionate and dedicated to improving the quality of life for their citizens. They are adaptive and willing to use all tools made available to them and their teachers.

While researching other states, it became obvious that no educational opportunity began as a large single event. Instead, the programs in place were refined over the years and became the best of the best. Many of these efforts were aligned with a college and university's charter of providing workforce and technical skills under existing departments. STEM programs were expanded to take advantage of the latest technology. As a result, the declaration and pursuit of the UAS Industry provided a vision for existing programs to embrace.

10.3 EDUCATIONAL STUDY QUESTIONS

Question/Action 8 - Analyze the educational opportunities available in public institutions in Kentucky that enable graduates to participate in the UAS industry. Make recommendations for development of additional degree-granting programs and/or certifications.

The Kentucky Educational System is taking the initiative in the UAS Industry. If a Blue Ribbon Panel is sponsored, as recommended in this report, it has the opportunity to streamline the multitude of efforts and focus on a more robust educational pipeline with greater availability to the citizens of Kentucky. A summary of these efforts are as follows:

- Market current educational avenues with an "Education on UAS Education"
- Increase university and college opportunities
- Participate in STEM UAS Programs
- Create Kentucky-sponsored competitions
- Sponsor internships for students with Kentucky businesses
- Create a leadership program for rising Kentucky business people, politicians, and citizens
- Market and attract UAS Conferences to Kentucky

10.3.1 UAS Education

> *"Many students tend to leave Kentucky to follow work opportunities but then tend to return to Kentucky to raise their families and start or grow businesses here"*
>
> *— Dr. Susan Weaver Smith, UK Unmanned Systems Research Consortium*

The Blue Ribbon Panel should provide a strategic vision on the educational opportunities in Kentucky to increase workforce success in the emerging UAS Industry. The strategic vision would address all stages and opportunities of the educational pipeline from preschool to post-secondary education and workforce training. As part of its charter, the panel would sponsor and conduct town hall as well as community meetings to address UAS issues. These meetings would address the latest concerns and identify areas of opportunity for the citizens of Kentucky. Topics should include FAA Regulations, Industry Trends, and places to fly UAVs such as AMA designated parks.

10.3.2 Increase University and College Opportunities

The University of Kentucky (UK) and Eastern Kentucky University (EKU) have resources in place to offer a Bachelor of Science in Unmanned Aircraft Systems. The state universities have placed these degrees under their engineering and aeronautics departments. In addition to formal degree programs, UK and EKU could increase the number of short courses and provide lessons to other Kentucky schools on implementing this courseware and possibly expanding UAS degree programs to other schools.

There is also an opportunity for Kentucky colleges and universities to embrace UAS education on an ancillary path. As with any new industry, legislation lags behind technology. The quickly growing UAS industry is in a prime position to have new laws and regulations created (or defeated). Kentucky Law Schools have the opportunity to review the ethical uses of UAS and provide state as well as national guidance.

There is also a need within the field of medical administrators to understand how UAS technology can be used for medical supply delivery and use. First responders also need to understand the uses of UAS and should gain firsthand knowledge and experience through their educational pipeline.

A third avenue for university and college education is the cross link of different disciplines. Advanced manufacturing and software development are just two areas, of many, that directly impact the UAS industry. By acknowledging the relationship of these skills, offering courses from all three disciplines across each degree program would be beneficial.

10.3.3 STEM UAS Programs.

Through existing STEM programs, younger Kentucky Students have the opportunity to explore and understand UAS. Kentucky's STEM Program can either develop its own UAS curriculum or use existing programs from other states. For instance, the AMA approved STEM4UAS curriculum is available nationwide. With UAS Kits constantly decreasing in cost, an entire program can be executed for less than the cost of a textbook for each child, while providing real world experience.

10.3.4 Kentucky-Sponsored Competitions

Kentucky sponsored UAS competitions are an effective way to capture the imagination of Kentucky's youngest students. In addition, they identify those deserving of merit-based educational assistance. Awards can consist of scholarships to Kentucky universities as well as cash prizes. Other states have high-school and university competitions for this purpose. The annual AUVSI student UAS competition could serve as a model to conduct a similar event for high schools in the state.

Competitions should be tailored to the strengths of Kentucky's industries. Ideally, a competition would highlight Kentucky's agriculture or logistics infrastructure. With the growth of precision agriculture, the competitions can reveal the next "great idea" that will directly affect Kentucky's prosperity. Large logistics companies such as UPS, FEDEX, DHS, and more throughout Kentucky should sponsor and see the benefit from the logistics competitions. As Kentucky becomes a more fertile ground for UAS ideas, more companies and prosperity would stay local.

10.3.5 Internship Opportunities

The Blue Ribbon Panel can match promising students with leading companies. With extensive logistic, manufacturing, transportation and agriculture interests in Kentucky, providing internships will help the students gain valuable skills while increasing their ties to the Commonwealth. Kentucky companies can also gain valuable insight into their existing workforce. To offset the cost of the intern programs, tax breaks can be offered to participating businesses.

10.3.6 Leadership Program

Kentucky could benefit from adopting public-private partnerships for leadership program expansion. In other states, program members are sponsored by their organization to attend a one to two-day class each year. The training highlights a particular industry in their state, such as coal and energy, culminating in a behind the scenes facility tour. Another day is dedicated to government with a visit to the state capital and to watch legislation in progress.

10.3.7 UAS Conferences in Kentucky

Kentucky already hosts one of the largest indoor farm machinery conferences in America, the National Farm Machinery Show. Each year, thousands of people come to Kentucky to find out the latest information about farm machinery. Another function of the Blue Ribbon Panel would be to attract additional conferences to Kentucky. By hosting a conference such as XPonential, Kentucky would establish its position within the UAS Industry.

11. STRATEGIC INVESTMENTS AND RECOMMENDATIONS

Question/Action 5: What strategic investments are required by the Commonwealth?

> ***KEY STUDY POINT: This study estimates the economic impact of UAS in Kentucky to be $4.6M in 2015 and projects an increase to $19.1M in 2025.***

Strategic investment in UAS is a difficult decision in weighing the pros and cons of multiple courses of action. By focusing the Commonwealth's energy and resources, Kentucky is poised to guide its own path into this multi-billion-dollar industry ***(Exhibit 11-1***). After reviewing the overall industry and Kentucky's natural fit, the Governor's Office should form a Blue Ribbon Panel to focus and guide the Commonwealth's pursuit of this opportunity. The Panel should pursue legislative, educational, workforce, and infrastructure initiatives to allow the Commonwealth to embrace the emerging UAS industry. Membership should consist of leaders from government, education, manufacturing, public safety, agriculture, and infrastructure. Charting a course for Kentucky's future, the following recommendations are made to assist the Blue Ribbon Panel.

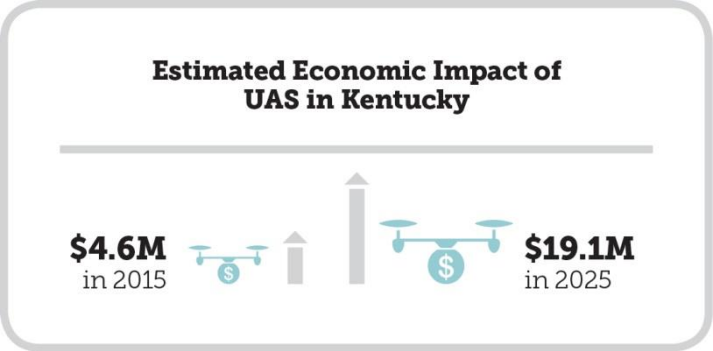

Exhibit 11-1: Estimate Economic Impact of UAS in Kentucky

11.1 KENTUCKY INDUSTRY GUIDANCE

With the largest UAS manufacturers currently in other states, opportunities still exist for sub-component and smaller UAS manufacturing in Kentucky. Under current acquisition rules, preferences are placed for socio-economic groups that the large businesses must use to compete in this market. With strong support of the aviation industry, Kentucky's manufacturing capabilities are already poised to provide the right components for the UAS Industry. Additionally, businesses already support aviation maintenance and services that can use their talents for UAS. By sponsoring Kentucky businesses with delegate-industry trips to these large businesses, the Commonwealth can demonstrate why Kentucky small businesses should support these larger efforts. With UAS as a means of collecting data for public safety and providing users with useful information, software development is a major component of this industry. Software, Engineering, Cybersecurity and Information Technology are critical disciplines needed for successful operations and creating meaningful data. By focusing on these areas, the Blue Ribbon Panel can grow sections of this industry that are not currently monopolized by large businesses in other states and countries.

11.2 UAS USERS ENVIRONMENT

Numerous interviews with Kentucky commercial companies participating in real estate, construction, insurance, entertainment and agriculture pursuits revealed that users are employing UAS as a means to improving their business efficiency. Many smaller businesses are still unsure of FAA rules and the requirements to legally employ this new tool for their profession. Providing readily available guidance will assist these companies in growing their livelihood.

11.3 LEGISLATIVE PURSUITS

With concern for their citizens, many states have attempted to pass additional laws for UAS that address privacy, nuisance, and hazard issues. These laws are already addressed by the state in previous legislation as it pertains to aircraft, public safety, and voyeurism. Legislative action is not required to duplicate existing laws. Instead, efforts should be directed towards embracing the

technology in a responsible and proactive way to make Kentucky UAS-friendly. Legislation prohibiting additional UAS restraints above and beyond the FAA's current rules has successfully become law in several states.

11.4 INFRASTRUCTURE ENABLER

The FAA sponsored National UAS Test Ranges in six states with specific charters and diverse environmental conditions. Other states have successfully created UAS Test Ranges through their university system or with military partnerships. Being a member of one of the six FAA-sanctioned test sites is not required to create an independent public Kentucky UAS Test Site. As a public entity, a Kentucky UAS Test Site would be able to obtain public COAs for UAS operations. With these COAs, the Test Site could then enter into agreements with commercial UAS companies to perform research, development, and services with UAS. By creating a Kentucky-sponsored Test Site as a focal point for research and concept exploration, the Commonwealth will create a nexus to enable this industry. By partnering with an institution such as the University of Kentucky, dedicated efforts will plant the seeds for future Kentucky innovation.

Many large companies use Kentucky's strategic physical location for logistics and transportation operations. As UAS gain greater importance to these hubs, Kentucky is in a prime location to capitalize on the business efficiencies. To become a leader in these fields, Kentucky should participate in FAA pilot programs to demonstrate and establish the best uses of UAS for its logistics and transportation companies.

11.5 EDUCATIONAL OPPORTUNITIES

As a means of enabling its citizens, the Blue Ribbon Panel should become the champion for the UAS Educational Pipeline. With many educational programs currently in place, small additions and guidance will prepare Kentucky citizens for the new technology. Best practices for Kentucky include:

- Increase awareness of current UAS educational avenues
- Increase university and college UAS Opportunities
- Participate in STEM UAS Programs
- Create Kentucky-sponsored UAS competitions
- Sponsor internships for students with Kentucky businesses
- Create a leadership program for rising Kentucky business people, politicians, and citizens
- Market and attract UAS Conferences to Kentucky

This study, sponsored by the Kentucky Commission on Military Affairs (KCMA), Office of the Governor, provides actionable steps to place Kentucky at the forefront of the UAS Industry's growth. By enabling Kentucky's vision of a profitable, safe, and civically responsible course, the Commonwealth is leading the nation in ways to assist its citizens towards a better future. With understanding of the effects of new technology and shepherding its implementation, Kentucky's economy is ready to grow into the future.

Appendix A: SOC Occupational Titles Utilized for Examining Potential UAS Users

SOC Code	Occupation Title
11-2011	Advertising and Promotions Managers
11-9013	Farmers, Ranchers, and Other Agricultural Managers
11-9021	Construction Managers
11-9141	Property, Real Estate, and Community Association Managers
11-9161	Emergency Management Directors
13-1121	Meeting, Convention, and Event Planners
13-2021	Appraisers and Assessors of Real Estate
13-1031	Claims Adjusters, Examiners, and Investigators
13-2053	Insurance Underwriters
17-1011	Architects, Except Landscape and Naval
17-1012	Landscape Architects
17-1021	Cartographers and Photogrammetrists
17-1022	Surveyors
17-2021	Agricultural Engineers
17-2051	Civil Engineers
17-2081	Environmental Engineers
17-2151	Mining and Geological Engineers, Including Mining Safety Engineers
17-3022	Civil Engineering Technicians
17-3031	Surveying and Mapping Technicians
19-1013	Soil and Plant Scientists
19-1023	Zoologists and Wildlife Biologists
19-1031	Conservation Scientists
19-1032	Foresters
19-4093	Forest and Conservation Technicians
27-3022	Reporters and Correspondents
27-4031	Camera Operators, Television, Video, and Motion Picture
27-4032	Film and Video Editors
27-4099	Media and Communication Equipment Workers, All Other
33-2011	Firefighters
33-2021	Fire Inspectors and Investigators
33-3041	Parking Enforcement Workers
33-3051	Police and Sheriff's Patrol Officers
33-9011	Animal Control Workers
33-9092	Lifeguards, Ski Patrol, and Other Recreational Protective Service Workers
37-2021	Pest Control Workers
37-3013	Tree Trimmers and Pruners
41-3021	Insurance Sales Agents
41-9021	Real Estate Brokers
41-9022	Real Estate Sales Agents
45-2011	Agricultural Inspectors

SOC Code	Occupation Title
45-4011	Forest and Conservation Workers
47-2181	Roofers
47-4011	Construction and Building Inspectors
47-4041	Hazardous Materials Removal Workers
47-5013	Service Unit Operators, Oil, Gas, and Mining
49-2021	Radio, Cellular, and Tower Equipment Installers and Repairers
49-2022	Telecommunications Equipment Installers / Repairers, Except Line Installers
49-9051	Electrical Power-Line Installers and Repairers
49-9052	Telecommunications Line Installers and Repairers

Appendix B: Industry Sub-Sector Non-Agriculture Estimated Users (US Census Bureau)

Real Estate

		Firms	Utilization	UAS
53112	Lessors of nonresidential buildings	333	25%	83
53121	Offices of Real Estate Agents and Brokers	775	25%	194
53131	Real Estate Property Managers	394	25%	99
53132	Offices of Real Estate Appraisers	182	50%	91
54185	Outdoor Advertising	29	10%	3
		1,713		**469**

Exhibit B-1: Estimates of UAS Users by Real Estate Sub-Sector

Insurance

		Firms	Utilization	UAS
52412	Direct Insurance (except Life, Health, and Medical) Carriers	165	10%	17
52421	Insurance Agencies and Brokerages	1,758	50%	879
524291	Claims Adjusting	58	10%	6
		1,981		**901**

Exhibit B-2: Estimates of UAS Users by Insurance Sub-Sector

Telecommunication

		Firms	Utilization	UAS
517110	Wired Telecommunications Carriers (except satellite)	409	50%	205
517210	Wireless Telecommunications Carriers (except satellite)	156	10%	16
		565		**220**

Exhibit B-3: Estimates of UAS Users by Telecommunications Sub-Sector

Event Coverage / Leisure

		Firms	Utilization	UAS
541921	Wedding photography services	16	95%	15
7112	Spectator Sports	129	95%	123
7113	Promoters of Performing Arts, Sports, and Similar Event	57	95%	54
71212	Historical Site	14	10%	1
71391	Golf Courses and Country Clubs	193	25%	48
71392	Skiing Facilities	1	95%	1
71393	Marinas	54	25%	14
		464		**256**

Exhibit B-4: Estimates of UAS Users by Event Coverage/Leisure Sub-Sector

Utilities

		Firms	Utilization	UAS
2211	**Electric Power Generation, Transmission and Distribution**	230	50%	115
56221	**Waste Treatment and Disposal**	40	10%	4
		270		**119**

Exhibit B-5: Estimates of UAS Users by Utilities Sub-Sector

Extractive Industries

		Firms	Utilization	UAS
21111	**Oil and Gas Extraction**	80	25%	20
212111	**Bituminous and Lignite Surface Mining**	2	25%	1
2123	**Nonmetallic Mineral Mining and Quarrying**	84	10%	8
48621	**Pipeline Transportation of Natural Gas**	46	50%	23
		212		**52**

Exhibit B-6: Estimates of UAS Users by Extractive Sub-Sector

Environmental

		Firms	Utilization	UAS
54162	**Environmental Consulting Services**	101	25%	25
		101		**25**

Exhibit B-7: Estimates of UAS Users by Environmental Monitoring Sub-Sector

Entertainment

		Firms	Utilization	UAS
51211	**Films, motion picture production**	53	95%	50
51512	**Television broadcasting stations**	21	95%	20
56152	**Tour Operators**	14	10%	1
		88		**72**

Exhibit B-8: Estimates of UAS Users by Entertainment Sub-Sector

Public Safety / Emergency

		Firms	Utilization	UAS
81293	**Parking Lots and Garages**	50	10%	5
		50		**5**

Exhibit B-9: Estimates of UAS Users by Public Safety/Emergency Sub-Sector

Wildlife and Forestry

		Firms	Utilization	UAS
813312	**Environment, Conservation, and Wildlife Organizations**	71	25%	18
		71		**18**

Exhibit B-10: Estimates of UAS Users by Wildlife and Forestry Sub-Sector

Appendix C: Industry Sub-Sector Non-Agriculture Estimated Users (SOC)

Construction

		Employees	Utilization	Estimated Users
17-1011	Architects, Except Landscape and Naval	550	25%	138
11-9021	Construction Managers	3,220	0%	0
17-1022	Surveyors	570	25%	143
17-3031	Surveying and Mapping Technicians	720	90%	648
17-1021	Cartographers and Photogrammetrists	250	90%	225
17-1012	Landscape Architects	120	25%	30
47-4011	Construction and Building Inspectors	970	75%	728
17-2051	Civil Engineers	2,460	10%	246
17-3022	Civil Engineering Technicians	1,190	50%	595
47-2181	Roofers	810	50%	405
		10,860		**3,157**

Exhibit C-1: Estimates of UAS Users by Construction Sub-Sector

Real Estate

		Employees	Utilization	Estimated Users
13-2021	Appraisers and Assessors of Real Estate	420	50%	210
41-9022	Real Estate Sales Agents	1,640	25%	410
		2,060		**620**

Exhibit C-2: Estimates of UAS Users by Real Estate Sub-Sector

Insurance

		Employees	Utilization	Estimated Users
13-1031	Claims Adjusters, Examiners, and Investigators	2,600	10%	260
13-2053	Insurance Underwriters	380	10%	38
41-3021	Insurance Sales Agents	4,430	50%	2,215
		7,410		**2,513**

Exhibit C-3: Estimates of UAS Users by Insurance Sub-Sector

Telecommunications

		Employees	Utilization	Estimated Users
49-2021	Radio, Cellular, and Tower Equipment Installers and Repairers	2,680	10%	268
49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers	2,490	0%	0
49-9052	Telecommunications Line Installers and Repairers	1,440	10%	144
		6,610		**412**

Exhibit C-4: Estimates of UAS Users by Telecommunications Sub-Sector

Events

		Employees	Utilization	Estimated Users
11-2011	Advertising and Promotions Managers	290	10%	29
13-1121	Meeting, Convention, and Event Planners	770	50%	385
27-3022	Reporters and Correspondents	510	10%	51
		1,570		**465**

Exhibit C-5: Estimates of UAS Users by Event Coverage/Leisure Sub-Sector

Utilities

		Employees	Utilization	Estimated Users
49-9051	Electrical Power-Line Installers and Repairers	2,490	10%	249
51-8031	Water and Wastewater Treatment Plant and System Operators	1,640	10%	164
51-8091	Chemical Plant and System Operators	420	10%	42
51-8092	Gas Plant Operators	290	10%	29
		4,840		**484**

Exhibit C-6: Estimates of UAS Users by Utilities Sub-Sector

Extractive Industries

		Employees	Utilization	Estimated Users
17-2151	Mining and Geological Engineers, Including Mining Safety Engineers	320	10%	32
17-2171	Petroleum Engineers	0	10%	0
47-5013	Service Unit Operators, Oil, Gas, and Mining	350	10%	35
		670		**67**

Exhibit C-7: Estimates of UAS Users by Extractive Sub-Sector

Environment

		Employees	Utilization	Estimated Users
17-2081	Environmental Engineers	350	10%	35
19-1013	Soil and Plant Scientists	130	10%	13
19-1023	Zoologists and Wildlife Biologists	220	10%	22
19-1031	Conservation Scientists	240	10%	24
19-1032	Foresters	150	10%	15
19-4093	Forest and Conservation Technicians	250	10%	25
		1,340		**134**

Exhibit C-8: Estimates of UAS Users by Environmental Sub-Sector

Entertainment

People		Employees	Utilization	Estimated Users
27-4031	Camera Operators, Television, Video, and Motion Picture	110	20%	22
27-4032	Film and Video Editors	120	0%	0
27-4099	Media and Communication Equipment Workers, All Other	190	0%	0
		420		**22**

Exhibit C-9: Estimates of UAS Users by Entertainment Sub-Sector

Public Safety/Emergency

		Employees	Utilization	Estimated Users
11-9161	Emergency Management Directors	150	10%	15
33-2011	Firefighters	3,190	10%	319
33-2021	Fire Inspectors and Investigators	110	25%	28
33-3041	Parking Enforcement Workers	40	0%	0
33-3051	Police and Sheriff's Patrol Officers	6,740	10%	674
33-3052	Transit and Railroad Police	0	0%	0
33-9011	Animal Control Workers	220	10%	22
33-9021	Private Detectives and Investigators	200	10%	20
33-9092	Lifeguards, Ski Patrol, and Other Recreational Protective Services	1,090	10%	42
		11,740		**1,120**

Exhibit C-10: Estimates of UAS Users by Public Safety/Emergency Sub-Sector

Wildlife and Forestry

		Employees	Utilization	Estimated Users
11-9141	**Property, Real Estate, and Community Association Managers**	1,800	10%	180
19-1023	**Zoologists and Wildlife Biologists**	220	10%	22
19-1031	**Conservation Scientists**	240	25%	60
19-1032	**Foresters**	150	10%	15
19-4093	**Forest and Conservation Technicians**	250	10%	25
33-2022	**Forest Fire Inspectors and Prevention Specialists**	0	25%	0
33-3031	**Fish and Game Wardens**	0	10%	0
37-3013	**Tree Trimmers and Pruners**	1,140	10%	114
37-2021	**Pest Control Workers**	760	10%	76
		4,560		**492**

Exhibit C-11 Estimates of UAS Users by Wildlife and Forestry Sub-Sector

Appendix D: FAA-Approved 333 Operators in Kentucky (www.suasnews.com, March 2, 2016)

Aerial State Media Company
Aerial Solutions LLC
Aerora Inc.
AIRLEX Intelligent Solutions LLC
Mike Johnson dba B.E.V. Roof Inspections
Bocook Engineering
Paul Campbell
Edford A. Coffey
Herbert F Collins
Consulting Services Incorporated LLC
Alan Core
Robert Augustine
Bryan Cherry
Commonwealth Productions
Donan Solutions, LLC
Andrew Dunn
EvoImagery LLC
George Tio
Mr. Philip Madison
James W McCord IV
Laurie L McCord
John Flower Productions
Kentucky Windage UAV LLC
Kentucky Transportation Cabinet
Lone Star Sky Solutions, LLC
Malibu Jacks LLC
Melissa Maxwell
Pics from the Sky LLC
Jeb Smith dba Post Time Productions
Qk4, Inc.
David A Senechal
Bob Sokoler
Richard W Moore dba Heavenly Pictures
Skyscape Aerial Photography
Sublime Media Group LLC
Stidham Reconstruction and Investigation LLC
Sustainment Solutions Inc.
United Dynamics AT Technologies Corp.
Unmanned Services
Vaughan Engineering Inc.
Mark Virg
Kevin Wainscott
Randal A Wiedemann