U.S. Department of Transportation

FEDERAL AVIATION ADMINISTRATION

INTERIM FINAL RULE REGULATORY EVALUATION

Registration and Marking Requirements for Small Unmanned Aircraft

RIN 2120-AK82

OFFICE OF AVIATION POLICY AND PLANS
ECONOMIC ANALYSIS DIVISION

Ralph Morris
George Thurston

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LISTS OF ABBREVIATIONS

AMA	Academy of Model Aeronautics
ARC	Aviation Rulemaking Committee
DOT	Department of Transportation
FAA	Federal Aviation Administration
FR	Federal Register
NAS	National Airspace System
NPRM	Notice of proposed rulemaking
OMB	Office of Management and Budget
Pub. L.	Public Law
sUAS	Small Unmanned Aircraft System
UAS	Unmanned Aircraft System
U.S.C.	United States Code

I. INTRODUCTION/BACKGROUND

In the FAA Modernization and Reform Act of 2012 (Pub. L. 112-95) (the Act), Congress mandated that the Department of Transportation (Department), in consultation with other government partners and industry stakeholders, develop a comprehensive plan to safely accelerate the integration of civil unmanned aircraft systems (UAS) in the national airspace system (NAS). Since 2012, the Department and the Federal Aviation Administration (FAA) have made progress in enabling small unmanned aircraft systems (sUAS) operations, by issuing exemptions under section 333 of the Act to permit commercial operations[1]; creating a UAS test site program to encourage further research and testing of UAS operations in real-world environments; and developing a Pathfinder program to encourage research and innovation that will enable advanced UAS operations. To date, for each of these integration programs, the Department and the FAA have required unmanned aircraft owners to comply with the statutory requirement for aircraft registration using the existing paper-based process under 14 CFR part 47. [2] Aircraft registration and marking is a foundational statutory and regulatory requirement. It helps the Department and the FAA ensure that operators are not only aware of the system in which they are operating, but that we also have a means to identify and track the aircraft to its owner and operator. As an exercise of discretion, historically, we have not required model aircraft to be registered under this system.

On February 23, 2015, the Secretary of the Department of Transportation and the FAA Administrator issued a notice of proposed rulemaking (NPRM), "Operation and Certification of Small Unmanned Aircraft Systems" (80 FR 9544 (Feb. 23, 2015)) (sUAS Operation and

[1] For purposes of this economic analysis, the term "commercial operations" means operations conducted for purposes other than as model aircraft.

[2] Clarification of the Applicability of Aircraft Registration Requirements for Unmanned Aircraft Systems (sUAS) and Request for Information

Certification NPRM), that proposed a framework for integrating sUAS operations in the NAS. Specifically, the proposal would require sUAS owners who are conducting operations other than model aircraft to register the sUAS aircraft under the paper-based system in 14 C.F.R. part 47 and mark the aircraft in accordance with the requirements of 14 C.F.R. part 45. We proposed to continue exercising discretion with respect to sUAS intended to be exclusively used as model aircraft and did not propose extending the registration and marking requirements to this population.

The Secretary and the Administrator recently affirmed that all unmanned aircraft, including model aircraft, are aircraft consistent with congressional direction in Title III, Subtitle B of Public Law 112-95 and the existing definition of aircraft in title 49 of the United States Code. 49 U.S.C. 40102. As such, in accordance with 49 U.S.C 44101(a) and as further prescribed in 14 CFR part 47, registration is required prior to operation. See 80 FR 63912, 63913 (October 22, 2015). Aircraft registration is necessary to ensure personal accountability among all users of the NAS. See id. With the unprecedented proliferation of new sUAS, registration allows the FAA a direct and immediate opportunity to educate sUAS owners. Aircraft registration also allows the FAA and law enforcement agencies to address non-compliance by providing the means by which to identify an aircraft's owner and operator.

The FAA estimates that in calendar year 2014, 200,000 small unmanned aircraft were operated in the NAS in model aircraft operations. During this period, the FAA received 238 reports of potentially unsafe UAS operations. The estimate for 2015 sales indicates that 1.6 million small unmanned aircraft intended to be used as model aircraft are expected to be sold this year (including approximately 50 percent of that total during the fourth quarter of 2015).

Since February 2015, reports of potentially unsafe UAS operations have more than doubled, and many of these reports indicated that the risk to manned aviation or people and property on the ground was immediate. For example, the agency has received reports of unmanned aircraft at high altitudes in congested airspace, unmanned aircraft operations near passenger-carrying aircraft or major airports,[3] and interfering with emergency response operations such as efforts to combat wildfires.[4] As recently as August 2015, the FAA investigated reports by four pilots who spotted an unmanned aircraft flying between eight and thirteen miles from the approach to Newark Liberty International Airport.[5] The FAA also investigated a similar incident at John F. Kennedy International Airport in August.[6] The risk of unsafe operation will increase as more small unmanned aircraft enter the NAS, and are flown by individuals who have little to no knowledge of airspace restrictions or safety implications.

Over the past several months, the reports of unauthorized and potentially unsafe UAS operations have escalated at an increasing rate. The following tables show the number of reports received during 2014 and 2015.

Table 2: Unmanned Aircraft Reports, 2014

2014	**Unmanned Aircraft Reports**												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Count	0	1	2	5	11	16	36	30	41	41	33	22	238

[3] *See, e.g.*, Keith Laing, *Feds investigating drone sighting near Newark airport*, The Hill, Aug. 10, 2015, http://thehill.com/policy/transportation/250731-feds-investigating-drone-sighting-near-newark-airport; *FAA Investigating Close Calls with Drones Near JFK Airport*, Albany Business Review, Nov. 20, 2014, *available at* 2014 WLNR 32783307.

[4] *See, e.g.*, Associated Press, *Drones Interfering with Emergency Wildfire Responders*, CBSNEWS.com, Aug. 10, 2015, http://www.cbsnews.com/news/drones-interfering-with-emergency-wildfire-responders ("The U.S. Forest Service has tallied 13 wildfires in which suspected drones interfered with firefighting aircraft this year . . . up from four fires last year . . . .); Polly Mosendz, *Drones Interfere With Firefighters Battling California Wildfire*, Newsweek, June 26, 2015, http://www.newsweek.com/drones-interfere-firefighters-battling-california-wildfire-347774.

[5] *See* Keith Laing, *Feds investigating drone sighting near Newark airport*, The Hill, Aug. 10, 2015, http://thehill.com/policy/transportation/250731-feds-investigating-drone-sighting-near-newark-airport.

[6] *See FAA Investigating Close Calls with Drones Near JFK Airport*, Albany Business Review, Nov. 20, 2014, *available at* 2014 WLNR 32783307.

Table 3: Unmanned Aircraft Reports, 2015

2015	Unmanned Aircraft Reports											
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov*	Total
Count	26	50	85	64	95	132	128	193	127	137	96	1133

* As of December 9, 2015.

Specific examples of UAS events include:

- June 17, 2015: Near the surrounding area of Big Bear City, CA, a fire erupted, quickly spreading and causing significant damage. By June 24, 2015, all surrounding affected areas were evacuated, 20,875 acres of land had been destroyed, and the fire was only 26% contained. Although the FAA issued a temporary flight restriction for the area surrounding the fire, unmanned aircraft penetrated the airspace and grounded all airborne firefighting efforts in support of continued fire containment. This event resulted in two reported evasive-action events, and forced the grounding of 4 responding aircraft over a period of two and a half hours before airborne firefighting efforts could resume. Before landing, a DC-10 tanker plane diverted to a separate fire in Nevada to drop its fire retardant, while the remaining smaller planes were forced to dump fire retardant around the immediate area due to landing weight restrictions.[7] Officials said the failed mission cost between $10,000 and $15,000.
- July 17, 2015: A fire began in California near Interstate 15, a highway that runs between Los Angeles and Las Vegas. Due to hot, 40 mile per hour winds, the fire spread at a rapid pace. The Air Attack Officer, upon arrival, observed small unmanned aircraft activity operating contrary to a temporary flight restriction in the area. This resulted in aircraft being removed from the area for a period of twenty minutes. The delay of 20 minutes in aircraft response was critical in the growth of the fire. With the heavy aviation response on the scene of the fire, Air Attack Officers estimate this fire could have been stopped at less than 100 acres if the small unmanned aircraft had not interfered by penetrating the airspace.[8] A total of eighteen vehicles and two trucks were destroyed by fire.
- September 3, 2015: An unmanned aircraft was flown into Louis Armstrong Stadium, which is located within 5 miles of LaGuardia Airport, during a U.S. Open tennis match. The unmanned aircraft crashed in an empty section of the stands.[9]
- October 26, 2015: An unmanned aircraft flew into primary conductors bringing down one span of power line in West Hollywood, California. The incident report from Southern California Edison indicates that initially 640 customers were impacted.[10]

[7] *Lake Fire Grew After Private Drone Flight Disrupted Air Flights*, LOS ANGELES TIMES, June 25, 2015, *available at* http://www.latimes.com/local/lanow/la-me-ln-wildfires-southern-california-20150625-story.html.

[8] SAFECOM (2015, July 18). Incident Report. Retrieved November 13, 2015 from https://www.safecom.gov/searchone.asp?ID=19694.

[9] *Drone Crash at U.S. Open, New York City Teacher Arrested*, NPR, September 4, 2015, *available at* http://www.npr.org/sections/thetwo-way/2015/09/04/437539727/drone-crash-at-u-s-open-new-york-city-teacher-arrested.

[10] Incident report from Robert Laffoon-Villegas, media relations, Southern California Edison, provided November 13, 2015.

- January 26, 2015: An unmanned aircraft operator crashed his unmanned aircraft on the grounds of the White House. The flight occurred in the White House prohibited flight zone, P56.[11]
- September 5, 2015: A University of Kentucky student flew an unmanned aircraft directly into the campus' stadium during the school's season-opening football game.[12] No injuries were reported. The unmanned aircraft, which had hovered near parachuting military skydivers, crashed in the suite level of Commonwealth Stadium. The Kentucky campus police chief told a news conference that the same student operated an unmanned aircraft over a soccer match the previous week.
- September 12, 2015: Debris from an unmanned aircraft that had fallen near bystanders cut and bruised an 11-month-old girl in a stroller during an outdoor movie screening in Pasadena, California. The Pasadena Police Department said a 24-year-old man lost control of his small unmanned aircraft, causing it to crash to the ground. The 11-month-old received injuries to her head. She was treated at Huntington Memorial Hospital and then released.[13]

During the last quarter of this calendar year, approximately 800,000 new sUAS are expected to enter the system and begin operating. In 2016, the FAA expects sales of an additional 1.9 million small unmanned aircraft used as model aircraft. The FAA also expects sales of 600,000 aircraft used for other than model purposes, after the Operation and Certification of Small Unmanned Aircraft Systems notice of proposed rulemaking (the "sUAS Operation and Certification NPRM") is finalized.[14] Model aircraft sales alone are expected to grow by 23 percent each year for the next 5 years.[15] Sales for sUAS used for commercial applications will rapidly accelerate as well, with different growth rates in different applications. Sales are forecast to grow from very few sUAS employed commercially today, to nearly 11 million units by 2020 (about 40% of total units sold that year).

[11] *A Drone, Too Small for Radar to Detect, Rattles the White House.* NEW YORK TIMES, Jan. 26, 2015, *available at* http://www.nytimes.com/2015/01/27/us/white-house-drone.html.
[12] *Student Charged with Endangerment After Drone Crashes into Stadium,* ARS TECHNICA, September 11, 2015, *available at* http://arstechnica.com/tech-policy/2015/09/student-charged-with-endangerment-after-drone-crashes-into-football-stadium/.
[13] *Fallen Drone Injures 11-mointh old near Pasadena City Hall*, PASADENA STAR NEWS, September 15, 2015 *available at* http://www.pasadenastarnews.com/general-news/20150915/falling-drone-injures-11-month-old-near-pasadena-city-hall
[14] 80 FR 9544 (Feb. 23, 2015).
[15] Sales estimates provided by McKinsey & Company. The McKinsey & Company forecast report can be found in the docket for this rulemaking.

Many of the owners of these new sUAS may have no prior aviation experience and have little or no understanding of the NAS, let alone knowledge of the safe operating requirements. Aircraft registration provides an immediate and direct opportunity for the agency to engage and educate these new users prior to operating their unmanned aircraft, thus helping to mitigate the risk associated with the influx of operations.

The risk of unsafe operation will increase as more small unmanned aircraft enter the NAS. Registration will provide a means by which to quickly identify these small unmanned aircraft in the event of an incident or accident involving the sUAS. Registration of small unmanned aircraft also provides an immediate and direct opportunity for the agency to educate sUAS owners on safety requirements before they begin operating.

As discussed earlier, sUAS owners authorized to operate in the NAS must register their aircraft in accordance with part 47. The Secretary and the Administrator issued a notice in the Federal Register clarifying the applicability of the statutory requirements for aircraft registration to sUAS (the Clarification/Request for Information) (80 FR 63912, October 22, 2015), to now extend to all small unmanned aircraft, including those intended for use exclusively as model aircraft under section 336 of Pub. L. 112-95. In that notice, we acknowledged the challenges associated with requiring all small unmanned aircraft to be registered using the paper-based system and determined that that system would be too onerous. This determination was based on the high costs to the FAA and expected delays in processing through the paper-based system, as well as the high time and effort that would have been imposed on registrants to use the paper-based system. (An analysis of the costs of using the paper-based system is presented in the "Costs" section below.)

The Secretary and the Administrator determined it was necessary to offer an alternative, stream-lined, web-based process for sUAS registration. The Administrator formed a UAS registration task force (RTF) to explore and develop recommendations to streamline the registration process for sUAS to ease the burden associated with the existing aircraft registration process. [16] To facilitate the work of the RTF, the Secretary and the Administrator sought information and data from the public through a number of questions identified in the Federal Register notice. The UAS RTF completed its work and submitted its recommendations on November 21, 2015. In developing this interim final rule (IFR), we considered the RTF's recommendations, as well as the public comments received in response to the aircraft registration proposal in the Operation and Certification of sUAS NPRM, and comments received in response to petitions for exemptions to allow certain sUAS operations to occur under the Secretary's authority in section 333 of Public Law 112-95.

Given the costs associated with the existing system as described above, and the expected proliferation of sUAS entering the system in the next year alone, this IFR provides an alternative, streamlined web-based aircraft registration process so that the agency can accommodate these aircraft registrations. Given easy consumer access to sUAS and the wide range of recreational and non-recreational uses, a streamlined registration process is necessary to provide relief from the existing registration process while still achieving the goal of identifying sUAS owners.

[16] Unmanned Aircraft Systems (UAS) Registration Task Force Aviation Rulemaking Committee (ARC) Task Force Recommendations Final Report November 21, 2015.

I. ASSUMPTIONS AND DATA

The benefit and cost analysis for the regulatory evaluation is based on the following factors/assumptions. Technology, markets, and uses for small unmanned aircraft are evolving rapidly and there is a high degree of uncertainty how the future will unfold and so the FAA requests comments (supported with data) on these assumptions.

- The period of the regulatory impact analysis begins in 2015 (denoted Year 0) and ends in 2020 (denoted Year 5).
- This analysis considers the benefits and costs of requiring the registrations of sUAS weighing less than 55 pounds and more than 0.55 pounds on takeoff.
- We use a seven percent discount rate for the benefits as prescribed by OMB in Circular A-4.

Population and Forecast

- Most of these assumptions, unless otherwise noted, were based on interviews with manufacturers, retailers, and other industry experts.
- Estimates of small unmanned aircraft registrations are based on projections of sUAS sales for the period of analysis. A sales forecast was developed based on use cases and likely adoption rates by commercial application and consumer electronic s-curve analysis for non-commercial applications. This forecast was then adjusted to obtain the number of modelers and the number of non-modeler sUAS units.
- Two basic populations are estimated: (1) model aircraft owners and their sUAS units and (2) the number of commercial / public owners and their sUAS units. In this document, the term “modeler” means the owner of a small unmanned aircraft that satisfies the statutory definition of “model aircraft” now codified in 14 CFR 1.1. The term

"commercial owner" or "non-modeler" means the owner of a small unmanned aircraft used for non-model aircraft purposes.

- For non-modelers, we assume that on average, all sUAS fail within a year and are replaced in the next year. For modelers we use the assumption that an average of ten percent of the modelers' sUAS survive into a second year, because they are used less intensively. These assumptions are based on manufacturers' information.
- Unmanned aircraft under the 0.55 pound weight limit are excluded from the registrations forecast. We assume 20 percent of the sales forecast will be unmanned aircraft below the 0.55 pound cutoff. This analysis is based on an examination of the current unit size distribution. While there may be some incentive for manufacturers to increase the number of aircraft produced below the registration size cut-off, the FAA believes the inherent limitations of the weight and available technology will not drive large shifts during the analysis period. SUAS flown exclusively indoors need not be registered. FAA assumes most sUAS over 0.55 pounds will be flown outdoors and must be registered.
- The entire existing fleet of model aircraft and 2015 fourth quarter sales are assumed to be registered in Period 0 or 2015.
- Most non-modelers will register their aircraft after the FAA has completed rulemaking to establish new Part 107, anticipated to go into effect in June 2016.
- On average, model aircraft owners are assumed to own a fleet size of 1.5 sUAS.
- 80 percent of model aircraft owners replace each aircraft as it is destroyed. (In other words, 20 percent of modelers drop out of the hobby each year).

- On average, non-model sUAS owners are assumed to own 2 aircraft at a time. This is based on an analysis of current registered sUAS aircraft. Every year all of the non-model sUAS owners go through the registration system replacing their two aircraft.

Time

- The estimated time to register an aircraft via the Part 47 (paper-based system) system is 30 minutes[17].
- The estimated time for a model aircraft owner to establish an online account and register an aircraft, under this rulemaking, is estimated to take 5 minutes; a registration renewal for these owners is also estimated to take 5 minutes. The bulk of this time includes reading and acknowledging basic safety information presented during the registration process.[18]
- The estimated time for a non-modeler registrant to establish an online account and register two small unmanned aircraft is 7 minutes; 5 minutes to establish an account plus 1 minute per small unmanned aircraft.
- The estimated time for a non-modeler registrant to de-register each aircraft is three minutes.
- The time for an owner to mark an aircraft with its registration number is de minimis.

[17] See SUPPORTING STATEMENT, OMB 2120-0042 Aircraft Registration Including Assignment and Cancellation of U.S. Identification Marks

[18] At this time, the FAA will not be accepting manufacturer name, model name, and serial number from individuals registering small unmanned aircraft intended to be used exclusively as model aircraft. However, as discussed in the preamble discussion on registration marking, the Administrator will continue to evaluate whether serial number can serve the purpose of aircraft identification and in the future, may require use of serial number for aircraft marking purposes in place of an FAA-issued registration number. In that case, this information would be acquired at point of sale by a manufacturer. FAA estimates this process would reduce the burden on the sUAS owners.

- The analysis assumes that all sUAS owners will comply with the registration processes considered in the regulatory analysis (Part 47 baseline system and the web-based systems resulting from this Part 48 rulemaking).

Costs

- The FAA assigns an hourly value of $19.13 per hour for the value of time for model aircraft registrants and $24.89 per hour for the value of time for non-modeler registrants in 2015. These hourly values are in 2013 dollars adjusted to reflect the growth of real changes in median household income over the analysis interval. [19]
- FAA estimates that its costs are $22 for the registration of an aircraft in the current paper-based system. This estimate is based on an internal cost model developed by FAA's Civil Aviation Registry for managerial purposes.
- FAA cost information for the streamlined, web-based registrations was developed based on cost models and FAA data. Costs for the web-based system include startup costs, costs to provide interfaces for retailers and manufacturers, the cost of providing for public search function based on the unique identifier, the cost of providing for law enforcement access, and maintenance costs, whether incurred by FAA personnel or FAA's contractors. We do not include costs for manufacturers or retailers to provide information to the registration system or to change packaging as those are voluntary actions. FAA expects that retailers will make point-of-sale interfaces available in the future.
- As is standard practice, FAA does not include costs of enforcing this rule.

[19] The hourly opportunity cost for modelers is based on the mid-point estimate of the range values as specified in Section 1.2.3 of FAA's Treatment of Time: Economic Values for Evaluation of FAA Investment and Regulatory Decisions (http://www.faa.gov/regulations_policies/policy_guidance/benefit_cost/). The hourly opportunity cost for non-modelers is estimated as the median gross compensation which is the sum of median hourly wage and an estimate of hourly benefits. This estimate is reported in DOT guidance titled Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis (Washington DC, 2015).

Safety

- We assume this regulation does not affect the levels of FAA manpower or resources expended on UAS safety education and outreach but it will allow the FAA to target those efforts, making those on-going efforts more effective.
- We do not attempt to quantify any safety benefit from this regulation. (See "Qualitative Benefits" section in the Regulatory Evaluation for further discussion).

Fees

- The fee to register an aircraft under Part 48, as well as in the current paper-based system in part 47, is $5. This fee is required by statute and is based on an estimate of the costs of the system and services associated with aircraft registration. If actual costs for the web-based system are known before a final rule is issued, we will adjust the fee accordingly in the final rule. If not, we will continue to monitor and determine the actual costs and adjust the fee in a subsequent rulemaking. FAA notes that under part 47, the registration fee using the paper-based system is $5 per aircraft. FAA has begun a rulemaking to update this fee based on current costs. (Aircraft Registration and Airmen Certification Fees, RIN 2120-AK37).
- We have estimated the registration fee for the new web-based system to be $5, based on the projected costs to build and maintain the system and provide the registration service. Model aircraft owners will pay $5 to register and will be assigned a unique identifier that can be marked on the owner's entire fleet of model aircraft. Model aircraft owners will be required to renew their registration every 3 years and pay a $5 fee. There would be no charge for de-registration.

- Non-modeler aircraft owners will also pay a $5 fee to establish an online account and register an initial aircraft in the new web-based system. They will also pay a $5 fee to add each additional sUAS to their existing account. Aircraft must be re-registered after three years, but as noted above, FAA expects very few, if any, sUAS to last that long. Non-modeler aircraft owners will not pay a fee to de-register a sUAS.
- Government fees and taxes are considered transfers and, by Office of Management and Budget guidance, transfers are not considered a societal cost. These transfers are estimated separately from the costs and benefits of this IFR. The FAA acknowledges fees and transfers can create incentives for behavior change.

III. sUAS REGULATORY FLEET FORECAST

This section describes the estimated number of sUAS aircraft to be registered and number of sUAS owners who will register their aircraft with the FAA. The forecast is based on a forecast of units sold developed by a contractor in November 2015. This forecast was based on conversations with manufacturers and retailers and potential and existing owners of sUAS, and expert judgment. For the regulatory evaluation, it is necessary to convert the forecast into both the number of owners (modelers and non-modelers) and the number of sUAS units, in order to calculate the time and impact of required actions by registrants. More details on the forecast and its conversion to registration activity drivers are in Appendix A.

Sales Forecast

Table 1 summarizes results from the sales forecast.

Table 1: Sales Forecast Summary
Million sUAS units

	2015	2016	2017	2018	2019	2020
Hobbyist (model aircraft)	1.6	1.9	2.3	2.9	3.5	4.3
Commercial (non-model aircraft)	0.0	0.6	2.5	2.6	2.6	2.7
Total	**1.6**	**2.5**	**4.8**	**5.4**	**6.1**	**7.1**

Note: numbers may not add due to rounding

Following are the key assumptions in the forecast. The FAA acknowledges there is significant uncertainty around the forecast and welcomes comments with supporting data.

- The forecast is based on interviews with market participants; an effort has been made to collect expert opinions on many applications to size the forecast from the bottom up.

- All sUAS aircraft in the forecast are less than 55 pounds.
- Twenty percent of unmanned aircraft purchased by modelers are estimated to be 0.55 pounds or less and will not be registered.
- Prior to 2015, there were 200,000 modelers' sUAS aircraft owned and operated, based on estimates of existing members of modelers' associations.
- In 2015, 1.6 million modelers' aircraft will be sold (including about 50 percent in the fourth quarter).
- Non-exempt non-modeler operations will commence in 2016. This forecast is roughly constrained to correspond with the expected regulatory environment through 2020.
- In 2016, 1.9 million modelers' units will be sold and approximately 600,000 non-modelers' units.
- The forecast then continues to grow through 2020, with intermediate years interpolated for the purpose of this regulatory evaluation.
    - The modeler's annual growth rate is 23 percent.
    - Non-modelers applications were developed by business category with separate growth rates.
    - Growth rates incorporate real GDP growth.

Life Span Assumption

A very important assumption in the forecast is that the life span of all sUAS less than 55 pounds is one year or less. FAA assumes that 10 percent of modelers' units last into a second year but are then retired. Interviewees indicate that under-55 pound sUAS have very short life spans because they are damaged, destroyed, or reach the end of their serviceable lives through use. Due to the life span assumption there will be no aircraft renewed after two years and no

transfers to different owners (the units are not assumed to last long enough to be transferred.) The forecast assumes the majority of the units sold are at the lower end of the weight range, consistent with the use cases identified. The FAA requests comment on this assumption.

Estimating the Number of Owners

Some additional assumptions are required to convert sUAS units to owners. They are summarized immediately below, with more details in Appendix A:

- **Average Number of Active sUAS units per Owner**: The forecast estimates that the average hobbyist will own 1.5 sUAS. Instead of assuming a homogeneous population of hobbyists owning 1.5 sUAS each, the FAA created a population of three types: 80 percent of hobbyists own one sUAS, 15 percent own three and 5 percent own five. This produces an average fleet size of 1.5 sUAS per hobbyist. This population distribution determines how many hobbyists must register their aircraft. FAA has determined that 20 percent of small unmanned aircraft sold will weigh 0.55 pounds or less and be exempted from registration. A hobbyist who owns only exempt small unmanned aircraft units need not register the aircraft with FAA.
- Two aircraft are assumed to be owned by non-model owners on average, based on the average number of sUAS units per certificate of waiver under section 333.
- **Attrition Rate**: Some owners will begin using sUAS but then cease operations in the future; FAA assumes that the annual attrition rate is 20 percent. We assume that owners that quit flying sUAS's are replaced by new owners (with identical characteristics) whose purchases are included in the sales forecast the following year. As little hard data is available, FAA requests comments on this assumption.

- **Percent of Sales to Hobbyists Owning only Lightweight sUAS**: FAA assumes that 20 percent of all hobbyist sUAS units sold include small unmanned aircraft that are 0.55 pounds or less and thus are not required to be registered. A slightly smaller percentage of modelers (16.1 percent) are assumed to be in this category, because some modelers are assumed to own only lightweight small unmanned aircraft (and thus do not need to register) but others own some lightweight unmanned aircraft and some above the weight (and thus need to register).

sUAS Subject to Registration

The following tables summarize these results. The number of sUAS units and owners estimated to be affected will be used in the following cost and cost savings analysis.

Table 2: Number of Registration Activities (000)

	2015	2016	2017	2018	2019	2020
Baseline: Paper-based Registrations for non-modelers						
Modeler	-	-	-	-	-	-
Non-Modeler	-	617	2,492	2,555	2,620	2,686
IFR Requirements: Web-Based Registrations						
Modeler	979	271	399	478	590	725
Non-Modeler	-	617	2,492	2,555	2,620	2,686
De-Registration						
Modeler	0	0	0	0	0	0
Non-Modeler	-	-	617	2,492	2,555	2,620
Renewals (owners)						
Modeler	0	0	0	501	174	255

Non-Modeler	0	0	0	0	0	0
Rejected alternative: Paper-based Registrations for modelers and non-modelers						
Modeler	1,400	1,384	1,704	2,096	2,578	3,171
Non-Modeler	-	617	2,492	2,555	2,620	2,686

Note: Appendix A contains the intermediate steps needed to convert from the sales forecast to the registry activities summarized here. Rows may not add due to rounding

The FAA notes that modelers would not be required to de-register their small unmanned aircraft as each aircraft is not individually registered. Some modelers may choose to deregister their aircraft themselves; the FAA assumes this would be a very small number. The FAA also notes that non-modelers will not have to renew their registration for a small unmanned aircraft for this analysis because the expected life span of non-modeler sUAS less than 55 pounds is one year or less; even if some survive longer than one year, essentially none are expected to last beyond three years.

IV. COSTS

In evaluating the impact of this proposed rule, we compare the costs and benefits of the IFR to a baseline consistent with existing practices: for modelers, the exercise of discretion by FAA (not requiring registration), and for non-modelers, registration via Part 47 in the paper-based system. We also calculate the costs of the rejected alternative: requiring modelers and non-modelers alike to register aircraft via the paper-based system.

In order to compare the costs of this rule to this baseline, the FAA estimated the costs of registering sUAS aircraft under the web-based registration system resulting from this Part 48 rulemaking (The IFR). The two populations, modelers and non-modelers, have slightly different processes as noted in this evaluation. In all of these scenarios, sUAS that are 0.55 pounds or less are excluded from registration. In these analyses, we estimate the private-sector compliance costs and government costs for each scenario.

FAA notes that any aircraft registration fees imposed will not result in a net gain (benefit) or loss (cost) from a societal perspective. Government fees and taxes are considered transfers and, by Office of Management and Budget guidance, transfers are not considered a societal cost.[20] The FAA is required by law to set the fee in regulation based on estimated costs of providing the service, and is also required to adjust the fee based on the actual costs of the service provided.[21] The current estimated fee for aircraft registration under part 48 is $5. Thus, this fee could be adjusted in the final rule if we have sufficient data to determine the actual costs of the system at that time. If not, we will continue to monitor and determine the actual costs and will adjust the fee accordingly via future rulemaking.

[20] See "Transfer Costs" section below
[21] See 49 U.S.C. 45305

Baseline: Registering sUAS aircraft operated as other than model aircraft under the baseline registration system

The baseline that we analyzed was a framework in which the population of sUAS requiring aircraft registration is those operated for non-modeler purposes and that these registrations would be made with the current paper-based baseline registration process. This baseline analysis requires non-modelers to register aircraft in the current paper-based system as they do today under the Section 333 exemption process. Notably, model sUAS aircraft are not registered, per historical discretionary practice, and the agency relies on its broad, general public outreach campaign, the Know Before you Fly initiative, as the primary opportunity to educate these new users.

The current paper-based registration process is codified in 14 CFR Part 47. To register an aircraft under the paper-based process, a sUAS registrant must send by mail the following to the FAA Aircraft Registration Branch: a completed aircraft registration application, evidence of ownership (such as one or more bills of sale), and a $5 aircraft registration fee.[22] We also include additional information such as date of manufacture and aircraft type (i.e., make/model). The application includes information on the manufacturer, model and, serial number, among other data fields. Evidence of ownership may include, but is not limited to, a traditional bill of sale, a contract of conditional sale, a lease with purchase option, or an heir-at-law affidavit. Many applicants are required to provide additional documentation for aircraft imported from a foreign country, built from a kit, or that qualify as amateur built aircraft. Additional documentation may include a certification from the builder as to the type of aircraft and a complete description, to include information such as make, model, serial number, engine manufacturer, type of engine,

[22] The required form is an Aircraft Registration Application (AC Form 8050-1). The fee for an application for a Certificate of Aircraft Registration for sUAS aircraft registered under Part 48 is $5, as is required for all Certificates of Aircraft Registration issued at this time.

number of engines, maximum takeoff weight, and number of seats. An applicant who applies as a limited liability corporation, a trustee, a non-citizen corporation, or submits documentation signed by "authorized signers," must submit additional documentation to support registration. For amateur built aircraft, the owner or builder designates the aircraft model name and serial number. An applicant pertaining to an imported aircraft must provide evidence showing the aircraft has been removed from a foreign registry. The FAA estimates that for this registration method it takes registrants 30 minutes to complete and submit forms for the registration process for each aircraft registered.

Once registered, the Registry issues a Certificate of Aircraft Registration (AC Form 8050-3) to the aircraft owner and mails it to the address on record. The Registry experiences a range in the amount of time required to issue a Certificate. While it typically takes 12-15 business days for the registry to issue a Certificate after an owner submits an application, due to an increase in registration applications, it currently takes approximately 22 business days for the registry to issue the certificate. The aircraft owner will typically receive a Certificate approximately 4 days after it is issued as a result of the time required for printing and mailing the certificate. The estimated times are extended if the application is rejected for document correction.

Registrants' costs reflect the time (estimated at 30 minutes) to fill out and submit the application form required by the current paper-based system for aircraft registration; because time is a valuable economic resource. The FAA notes that registrants' costs are the opportunity costs for their time used and are not out-of-pocket costs. For sUAS aircraft registration costs, we multiply the annual number of sUAS aircraft registrations (from Table 2) by the time it would

take to complete each registration form, and then by the hourly value of time from the "Assumptions and Data" section.

Table 3
Baseline: Non-Modeler Registrants' Costs
for SUAS Aircraft Registrations Using Paper-Based System

Year	Calendar Year	Number of sUAS registrations (millions)	Applicant Time (hours)	Hourly Opportunity Cost (Non-modeler Value of Time)	Total Costs ($M)	7percent P.V. ($M)
0	2015	0.000	0.5	$24.89	$ 0.0	$ 0.0
1	2016	0.617	0.5	$25.14	$ 7.8	$ 7.2
2	2017	2.492	0.5	$25.39	$ 31.6	$ 27.6
3	2018	2.555	0.5	$25.64	$ 32.8	$ 26.7
4	2019	2.620	0.5	$25.90	$ 33.9	$ 25.9
5	2020	2.686	0.5	$26.16	$ 35.1	$ 25.0
Total					**$141.2**	**$112.6**

Note: numbers may not add due to rounding

The following analysis provides estimates of the FAA's costs for sUAS registrations for non-modelers using the paper-based system. FAA estimates that its costs are $22 for the registration of an aircraft in this paper-based system. These costs reflect both the direct and indirect costs for these activities for Fiscal Year (FY) 2012. For aircraft registrations, direct costs are obtained from the FAA's Cost Accounting System (CAS) by project code and the associated tasks under each project code. Overhead is applied to the activities separately for direct labor and direct non-labor costs according to the FAA's reimbursable agreements methodology to ensure full cost measurement. The total costs for each of these activities are then divided by FY 2012 registration activity volumes to determine the cost for each activity. We multiply the yearly data in the number of initial registrations column by the FAA cost to register an aircraft in order to estimate the FAA cost of registering an aircraft. Table 4 shows the estimated registration costs, in millions of dollars, over the period of analysis.

Table 4
Baseline: FAA Costs for sUAS Aircraft Registrations for Non-modelers' Aircraft using Paper-Based System

Year	Calendar Year	Number of sUAS registrations (millions)	Registration processing Cost per sUAS	Total Costs ($M)	7 % P.V. ($M)
0	2015	0.000	$22	$ 0.0	$ 0.0
1	2016	0.617	$22	$ 13.6	$ 12.7
2	2017	2.492	$22	$ 54.8	$ 47.9
3	2018	2.555	$22	$ 56.2	$ 45.9
4	2019	2.620	$22	$ 57.6	$ 44.0
5	2020	2.686	$22	$ 59.1	$ 42.1
Total				**$241.3**	**$192.6**

Note: numbers may not add due to rounding

Therefore, the baseline cost estimate is shown in Table 5 below. This is the estimate of the total registrant and FAA cost to register all non-model sUAS aircraft using the paper-based system.

Table 5
Baseline: Paper-Based Registration for Non-modelers
Costs Summary
($M)

Year	Calendar Year	Costs			Costs 7% P.V.		
		Non-modelers cost	FAA Costs	Total Costs	Non-modelers cost	FAA Costs	Total Costs
0	2015	$ 0.0	$ 0.0	$ 0.0	$ 0.0	$ 0.0	$ 0.0
1	2016	$ 7.8	$ 13.6	$ 21.3	$ 7.2	$ 12.7	$ 19.9
2	2017	$ 31.6	$ 54.8	$ 86.5	$ 27.6	$ 47.9	$ 75.5
3	2018	$ 32.8	$ 56.2	$ 89.0	$ 26.7	$ 45.9	$ 72.6
4	2019	$ 33.9	$ 57.6	$ 91.6	$ 25.9	$ 44.0	$ 69.9
5	2020	$ 35.1	$ 59.1	$ 94.2	$ 25.0	$ 42.1	$ 67.2
Total		**$141.2**	**$241.3**	**$382.5**	**$112.6**	**$192.6**	**$305.1**

Note: numbers may not add due to rounding

Web-based Registration System resulting from this Part 48 rulemaking

Via this IFR, the FAA will establish a streamlined, web-based registration process for sUAS. In this section, we discuss the estimated costs of this web-based registration process to the owners of sUAS. The process is slightly different depending on whether the sUAS is operated by a modeler for hobby or recreational purposes or by a non-modeler for corporate, commercial, or public service purposes.

Modelers will be required to register aircraft with the FAA and mark their aircraft prior to operation. Modelers will be required to enter their name, their physical address (and if the applicant does not receive mail at their physical address, a mailing address must be provided), and their email address. In addition, basic safety information will be presented and must be acknowledged during the registration process. These registrants will pay a registration fee of $5 and receive a single unique registration number that they must use to identify all unmanned aircraft that they operate.[23] Every three years thereafter, modelers must renew their registration with the FAA and pay a registration renewal fee of $5.[24]

Based on the web system design and the information to be collected, the FAA estimates that it will take 5 minutes for a registrant to complete the initial registration process; again, these costs are time-resource opportunity costs. This time estimate includes the time necessary to read the education materials that will be provided through the online registration system. We multiply the number of annual number of registrations by the estimated time it would take to complete a registration session and then by the hourly value for personal time from the "Assumptions and Data" section. In Table 6 we provide estimates of registrants' costs to complete the registrations requirements based on the estimated number of applicants, the

[23] As noted throughout this regulatory evaluation these registration and registration renewal fees are transfers.
[24] Ibid.

applicants' time, and the value of the applicants' time, over the period of analysis. Every three years thereafter, modelers must renew their registrations with the FAA. The FAA estimated these costs using the sUAS owners and renewals discussed in the "sUAS Registration Fleet Forecast" section. Table 6 shows the estimated registration and renewal costs over the analysis period.

Table 6
Modelers Registrations and Renewals
Web-based Process Registration Costs

Year	Calendar Year	# of Modelers		Applicant Time (minutes)	Hourly Opportunity cost (Personal Value of Time)	Total Costs ($M)	7 % P.V. ($M)
		New (M)	Renewals (M)				
0	2015	0.979	0.000	5	$19.13	$1.6	$1.6
1	2016	0.271	0.000	5	$19.32	$0.4	$0.4
2	2017	0.399	0.000	5	$19.51	$0.6	$0.6
3	2018	0.478	0.501	5	$19.71	$1.6	$1.3
4	2019	0.590	0.174	5	$19.90	$1.3	$1.0
5	2020	0.725	0.255	5	$20.10	$1.6	$1.2
Total						**$7.2**	**$6.0**

Note: numbers may not add due to rounding

Non-modelers will be required to establish an account in order to register their sUAS aircraft with the FAA. The sUAS aircraft registration website will present registrants with a short set of questions required for registration. In addition, basic safety information will be presented and must be acknowledged. In this web-based Part 48 registration process, these registrants will be required to provide the name of their authorized representative, the name of the company (if applicable), physical address, mailing address (if different from their physical address), and email address to the FAA. Non-modelers owning sUAS must also provide the make, model, and serial number of each sUAS being registered. These registrants will pay a registration fee of $5 per aircraft registered. The FAA will provide those persons with a Certificate of Registration for each aircraft registered; a unique identifier will be provided by the

registry for each aircraft. This analysis assumes that sUAS aircraft have a one-year life and would therefore not have to be de-registered. There is no fee associated with de-registering a non-modeler sUAS aircraft but there is a 3 minute time associated with de-registering a sUAS aircraft. The FAA assumes after the first year all non-modelers will have to annually register their aircraft in the current year and de-register the aircraft from the previous year.

The FAA estimates that it would take 7 minutes for non-modelers to complete this registration process of new aircraft for that year and 6 minutes (3 minutes per sUAS aircraft)[25] to deregister the aircraft from the previous year. We multiply the number of annual number of these registrations and de-registrations by the time it would take to complete each session and then by the hourly value for personal time from the "Assumptions and Data" section. The FAA estimated these costs using the sUAS estimated in the "sUAS Registration Fleet Forecast" section. (In 2015 there are no non-modeler aircraft registrations using the part 48 process.) In 2016 non-modelers register aircraft for the first time, for a total of 7 minutes per registration. In 2017 – 2020 non-modelers spend 13 minutes registering their current year aircraft and de-registering the aircraft from the previous year. In Table 7 we provide estimates of the non-modeler registrants' costs to register and de-register their sUAS aircraft for each year of analysis interval.

[25] From the "Assumption and Data" section, on average, non-model sUAS owners are assumed to own 2 aircraft at a time.

Table 7
Non-Modelers sUAS Aircraft Registration Costs
Web-based Registration System

Year	Calendar Year	# of sUAS Actions		Cost ($M)		Total Costs ($M)	7 % P.V. ($M)
		Register (M)	De-register (M)	Register	De-register		
0	2015	0.000	0.000	$ 0.0	$ 0.0	$ 0.0	$ 0.0
1	2016	0.617	0.000	$ 0.9	$ 0.0	$ 0.9	$ 0.8
2	2017	2.492	0.617	$ 3.7	$ 0.8	$ 4.5	$ 3.9
3	2018	2.555	2.492	$ 3.8	$ 3.2	$ 7.0	$ 5.7
4	2019	2.620	2.555	$ 4.0	$ 3.3	$ 7.3	$ 5.5
5	2020	2.686	2.620	$ 4.1	$ 3.4	$ 7.5	$ 5.4
Total				**$16.5**	**$10.7**	**$27.2**	**$21.4**

Note: numbers may not add due to rounding

Costs to develop and implement the web-based registration system for the FAA

An external contractor assisted the FAA in estimating the government costs to develop and maintain the web-based registration system for the FAA. This section describes these costs and provides an estimate, over the analysis interval, of the costs. The FAA notes the system is being developed in phases that continue through 2016, and so costs remain uncertain.[26]

The FAA would incur business operation, IT program management, and other costs. Business operation costs include program analysts and managers. IT program management costs include costs to manage and maintain the web-based system. Other costs include educational costs and contract support. FAA contractors would also incur costs. These costs include the initial build and the long-term sustainment and support of the web-based registration system.

Table 8 shows estimate of these costs.

[26] Consistent with benefit-cost analysis practice, all government costs are accounted for in the year in which they occur.

Table 8
FAA Web-Based Registration System Costs
$M

Year	Calendar Year	FAA Cost	Contractor Costs	Total Costs	7 % P.V.
0	2015	$ 3.0	$ 0.9	$ 3.9	$ 3.9
1	2016	$ 1.8	$ 3.2	$ 5.0	$ 4.7
2	2017	$ 1.3	$ 1.9	$ 3.2	$ 2.8
3	2018	$ 1.3	$ 2.1	$ 3.4	$ 2.8
4	2019	$ 1.3	$ 1.7	$ 3.0	$ 2.3
5	2020	$ 1.3	$ 1.3	$ 2.6	$ 1.9
Total		**$10.2**	**$11.0**	**$21.2**	**$18.4**

Note: numbers may not add due to rounding

The following summary table shows total costs for modelers, non-modelers and FAA.

Table 9
Web-Based Registration Costs Summary
($M)

Year	Calendar Year	Modelers Costs	Non-Modelers Costs	FAA Costs	Total Costs	7% P.V.
0	2015	$1.6	$ 0.0	$ 3.9	$ 5.5	$ 5.5
1	2016	$0.4	$ 0.9	$ 5.0	$ 6.3	$ 5.9
2	2017	$0.6	$ 4.5	$ 3.2	$ 8.3	$ 7.3
3	2018	$1.6	$ 7.0	$ 3.4	$12.1	$ 9.9
4	2019	$1.3	$ 7.3	$ 3.0	$11.6	$ 8.8
5	2020	$1.6	$ 7.5	$ 2.6	$11.8	$ 8.4
Total		**$7.2**	**$27.2**	**$21.2**	**$55.6**	**$45.7**

Note: numbers may not add due to rounding

sUAS identification marking

Each sUAS aircraft registered in accordance with this IFR must display a unique identifier which must be marked on the aircraft or affixed by any other means ensuring a similar degree of permanence. Registrants' costs to complete the identification marking as required in the IFR are de minimis. While marking by a pen is sufficient, the FAA is aware some modelers

will adopt other means to preserve or enhance the appearance of their aircraft. The FAA will facilitate efforts by industry to permit the use of the serial number as the identification number, which would entirely relieve this requirement.

Rejected Alternative: Paper-Based Registration System Cost for Modelers and Non-Modelers

As noted above in the "baseline" discussion, the current paper-based registration process is codified in 14 CFR Part 47. As reflected in the October 22, 2015, clarification and request for information, the Department considered requiring all owners, modelers and non-modelers, to register under this existing process in part 47. Based on the following analysis, the Department has determined it is necessary to provide regulatory relief from this process and has developed the stream-lined web-based system in this IFR.

In this rejected alternative, non-modelers' costs remain the same as Table 4 above.

Similarly, the FAA estimated costs for modelers. We note the two populations are estimated separately as, by assumption, each group's value of time is different. Table 10 shows the estimated registration costs for modelers under the paper-based system over the period of analysis.

Table 10
Modeler (Recreational) Registrants Costs for sUAS Aircraft Registrations Using the Paper-Based System

Year	Calendar Year	Number of sUAS registrations (millions)	Applicant Time (hours)	Hourly Opportunity Cost (Personal Value of Time)	Total Costs ($M)	7 % P.V. ($M)
0	2015	1.400	0.5	$19.13	$ 13.4	$13.4
1	2016	1.384	0.5	$19.32	$ 13.4	$12.5
2	2017	1.704	0.5	$19.51	$ 16.6	$14.5
3	2018	2.096	0.5	$19.71	$ 20.7	$16.9
4	2019	2.578	0.5	$19.90	$ 25.7	$19.6
5	2020	3.171	0.5	$20.10	$ 31.9	$22.7
Total					**$121.6**	**$99.6**

Note: numbers may not add due to rounding

The costs to the FAA for non-modelers using the paper-based system are the same as those shown in Table 4 above. The process and cost elements for modelers would be the same. Table 11 shows FAA estimated costs if modelers were to register their aircraft using the paper-based system. FAA notes that the estimate of $22 per registration is a full-cost estimate, including allocations for overhead, as described in the baseline system. However, it is possible the FAA's costs would not increase in a linear fashion for this vast increase in number of registrations. The FAA did not attempt to develop a more detailed cost estimate for this rejected alternative.

Table 11
FAA's Costs for Paper-Based Registrations of Model Aircraft

Year	Calendar Year	Number of sUAS registrations (millions)	Registration processing Cost per sUAS	Total Costs ($M)	7 % P.V. ($M)
0	2015	1.400	$22	$ 30.8	$ 30.8
1	2016	1.384	$22	$ 30.4	$ 28.5
2	2017	1.704	$22	$ 37.5	$ 32.7
3	2018	2.096	$22	$ 46.1	$ 37.6
4	2019	2.578	$22	$ 56.7	$ 43.3
5	2020	3.171	$22	$ 69.8	$ 49.7
Total				**$271.3**	**$222.6**

Note: numbers may not add due to rounding

Table 12 below summarizes the total cost to FAA and registrants of registering model aircraft through the paper-based system.

Table 12
Paper-Based Registration for Modelers; Modeler and FAA Costs
(Rejected Alternative)
($M)

Year	Calendar Year	Modelers Costs	FAA Costs	Total Costs	7% P.V.
0	2015	$ 13.4	$30.8	$44.2	$44.2
1	2016	$ 13.4	$30.4	$43.8	$41.0
2	2017	$ 16.6	$37.5	$54.1	$47.3
3	2018	$ 20.7	$46.1	$66.8	$54.5
4	2019	$ 25.7	$56.7	$82.4	$62.8
5	2020	$ 31.9	$69.8	$101.6	$72.5
Total		**$121.6**	**$271.3**	**$392.9**	**$322.2**

Note: numbers may not add due to rounding

Table 13 below summarizes the total cost to FAA and registrants of registering modelers' and non-modeler's aircraft in the paper-based system (rejected alternative).

Table 13
Total Paper-Based Registration Costs Summary
(Rejected Alternative)
($M)

Year	Calendar Year	Modelers Costs	Non-Modelers Costs	FAA Costs	Total Costs	7% P.V.
0	2015	$ 13.4	$ 0.0	$30.8	$44.2	$44.2
1	2016	$ 13.4	$ 7.8	$44.0	$65.1	$60.9
2	2017	$ 16.6	$ 31.6	$92.3	$140.6	$122.8
3	2018	$ 20.7	$ 32.8	$102.3	$155.7	$127.1
4	2019	$ 25.7	$ 33.9	$114.4	$173.9	$132.7
5	2020	$ 31.9	$ 35.1	$128.9	$195.9	$139.6
Total		**$121.6**	**$141.2**	**$512.7**	**$775.4**	**$627.3**

Note: numbers may not add due to rounding

Cost Summary

Table 14 summarizes our estimates for the costs discussed in this section for all three scenarios: The baseline, the IFR solution, and the rejected alternative. The details for the calculations can be found in Appendix A.

Table 14
Cost Summary
($M)

		Modelers' Costs	Non-Modelers' Costs	FAA Costs	Total Costs
Baseline	Total	$0.0	$141.2	$241.3	**$382.5**
	7% P.V.	$0.0	$112.6	$192.6	**$305.1**
Interim Final Rule (IFR)	Total	$7.2	$27.2	$21.2	**$55.6**
	7% P.V.	$6.0	$21.4	$18.4	**$45.7**
Rejected Alternative	Total	$121.6	$141.2	$512.7	**$775.4**
	7% P.V.	$99.6	$112.6	$415.2	**$627.3**

Note: numbers may not add due to rounding

IV. BENEFITS

Quantitative Benefits

In this section, we discuss beneficial impacts to the non-modeler from the cost savings of this rule over registering sUAS aircraft using the baseline system. The cost savings to non-modelers from the option of not using the paper-based system exceed the costs to modelers and the government of establishing and using the web-based system.

The baseline column shows the total costs for the baseline from Table 5, non-modelers register their aircraft using the paper-based system, while modelers do not register their aircraft. The IFR column shows the total costs from Table 9, the costs to FAA and registrants (modelers and non-modelers) of the new web-based system. Table 15 below shows the significant cost savings of subtracting the costs of registration between the baseline system from the registration costs imposed by this rulemaking.

Table 15
Cost Savings of the Baseline versus the Part 48 Rulemaking
($M)

Year	Calendar Year	Total Cost		Difference	7 % P.V.
		Baseline	IFR		
0	2015	$ 0.0	$ 5.5	-$ 5.5	-$ 5.5
1	2016	$ 21.3	$ 6.3	$ 15.0	$ 14.0
2	2017	$ 86.5	$ 8.3	$ 78.1	$ 68.3
3	2018	$ 89.0	$12.1	$ 76.9	$ 62.8
4	2019	$ 91.6	$11.6	$ 80.0	$ 61.0
5	2020	$ 94.2	$11.8	$ 82.5	$ 58.9
Total		**$382.5**	**$55.6**	**$327.0**	**$259.4**

Note: numbers may not add due to rounding

Qualitative Benefits

In this section, we discuss beneficial impacts from this rule that cannot yet be quantified. We discuss how the sUAS market has failed to accomplish the goals of sUAS education, and

accountability. We also cite additional potential savings flowing to local law enforcement agencies from this IFR.

Sources of Market Failure

In this section of the regulatory evaluation, we highlight the economic rationale for government intervention by identifying the market failure this rule addresses. Then, we discuss how the selected regulatory intervention (this IFR requiring registration) addresses that market failure, drawing on examples from other industries to provide support for its likely effectiveness.

As established in the preamble to this IFR, there are problems arising from the rapid proliferation of sUAS models, and these concerns are arising more frequently. Further, sales of sUAS are projected to continue to increase, with over 500,000 new users projected in the fourth quarter of calendar year 2015 alone, which makes addressing this problem more urgent. Many of these users are new to aviation and are unaware of the system in which they will operate, let alone the safety requirements that must be met when operating their unmanned aircraft. There is an immediate need to educate this new user population before they begin operating and the new streamlined web-based aircraft registration system will provide that opportunity in a cost-effective manner. In this discussion, we characterize the problems in operating sUAS as "mistakes" on the part of their operators. There may be many kinds of mistakes, such as errors

in operators' judgment, not fully understanding the rules that determine where sUAS can fly, technical failures of sUAS or their control systems, etc.[27]

In some markets, tort liability and insurance systems exist to address these possible consequences of mistakes in use. However, establishing liability and effectively compensating those adversely affected depends upon at least two necessary conditions: (1) identifying the responsible party, which is difficult without some registration system, and (2) a rational basis for suing and collecting from the responsible party, some of whom will be consumers who may be judgment proof.[28] In such circumstances, Shavel argues that regulation and liability may be more effective if used together.[29] Further, insurance companies have also indicated that registration and robust regulation will be necessary conditions for the creation of insurance for UAS operations, which will be critical to their full development particularly in the commercial sector.[30]

Lacking information, new users may be unaware of when and where it is appropriate to operate their sUAS. For example, it is inappropriate to operate a sUAS within five miles of an airport without giving notice to the airport operator and to the air traffic control tower, if one is present at the airport. Such information failures may occur for a variety of reasons. First, if the new sUAS operator is an infrequent user he/she may not recognize mistakes as they occur,

[27] This section builds on the behavioral economics literature as described by Barr-Gill and others cited blow, as well as other literature on UAS's and the rapid adoption of new technologies. O. Barr-Gill: *The Behavioral Economics of Consumer Contracts in* **Minnesota Law Review (2008).**

[28] See S.Shavell: "A Model of the Optimal Use of Liability and Safety Regulation" *Rand Journal of Economics (Vol 15 No 2, Summer 1984) pp 270-280* and R. Golaszewski and A. Gellman: "Tort Liability and Government Regulation as a means to Promote Safety: Application to the Aircraft Replacement Parts Manufacturing Industry" *Proceedings of the Transportation Research Forum 1985) pp 395-400*

[29] Shavell op cit

[30] Lloyds: *Drones Take Flight* (Emerging Risk Report -2015)

especially if mistakes occur without consequence. Second, geographical diversity amongst users may limit learning opportunities. Hobbyist and other new users may not have access to expert advice on the proper use of these aircraft and the rules governing their use.

It is unlikely that efforts by sUAS manufacturers or sellers acting alone, in their own best interest will be sufficient to mitigate these market failures. Although the FAA and DOT had earlier initiated the "Know Before You Fly" campaign to educate sUAS operators about their responsibilities for conducting safe operations, the continued increase in reported incidents, along with the increase in new modelers indicates that a more immediate and targeted effort is warranted. Disclosure of the inherent risks associated with inappropriate use of such a product via labeling or inserts to packaging may not be heeded or even understood by its users., While research in this area reaches mixed conclusions,[31] it appears to be commonplace and widely-accepted for companies to build and offer products that are potentially unsafe when used improperly, as long as the risks of doing so are comprehensively disclosed.[32] Furthermore, education and other information provisions can only be effective if the market failure is inadequate or asymmetric information. Here we also have the market failure of potential external consequences to others rather than the operator.

Nevertheless, we have seen that the sUAS industry has recently recognized the problem of proliferating mistakes by operators, and developed mechanisms to fund general education efforts in cooperation with the FAA. The "Know Before You Fly" website is the most visible

[31] Jolls, Christine; Cass Sunstein and Richard Thaler (1998). "A Behavioral Approach to Law and Economics," *Stanford Law Review*, 50(5): 1471-1550.
[32] Bar-Gill, Oren (2007). *Informing Consumers About Themselves*. New York University Law School. (New York University Law and Economics Working Paper 111) page 49.

effort in this area.[33] While these efforts are important first steps toward reducing user mistakes, the expanding number of manufacturers, the proliferation of retailers, and a rapidly evolving set of uses, has meant that communities of interest have not yet coalesced to provide effective voluntary channels to reach and educate new users. Growth in the number and uses of sUAS will need to stabilize before these voluntary education measures can realize their full potential to promote safe sUAS operation.

Given that the market for sUAS insurance is also in its early stages of development, it cannot be relied upon to provide adequate incentives for responsible behavior by sUAS operators. Liability for the consequences of unsafe operation of sUAS has not yet been well established. Furthermore, given the growth in the sUAS hobby market, many sUAS are consumer products for which their typical modeler purchasers may not seek separate insurance coverage.

Correcting for Market Failure

One way to address this market failure is to encourage "internalization" of the externalities resulting from unsafe operation of sUAS, by adopting policies that make operators responsible for the adverse consequences of incidents (which is the basis for liability law). Registration will 1) make it easier to identify the owners of the aircraft which has been involved in an "incident;" 2) facilitate compliance and education, and when appropriate, enforcement action; 3) encourage accountability by holding owner's responsible for use and 4) establish a

[33] **"**Know Before You Fly**"** is an education campaign founded by the Association for Unmanned Vehicle Systems International (AUVSI) and the Academy of Model Aeronautics (AMA) in partnership with the Federal Aviation Administration (FAA) to educate prospective users about the safe and responsible operation of unmanned aircraft systems (UAS).

future basis for FAA to engage in immediate and targeted education activities which might not otherwise occur.

At present, there are multiple efforts by government to address the problem of increasing mistakes by sUAS operators:

- First, operators of model aircraft (small UASs flown for hobby or recreation) are required to comply with community-based safety guidelines within the program of a nationwide community-based organization. This maximizes users' opportunities to learn from one another about proper uses of the products, and about how to anticipate and avoid mistakes as new uses are discovered. It also creates the opportunity for individual communities to define locally appropriate uses and enforce local rules.[34]
- Second, as discussed previously, FAA and industry have joined together to promote safe operations of sUAS via their joint "Know Before You Fly," "B4UFLy APP," and "Drone Free Zone" initiatives.
- Third, FAA has issued the sUAS Operation and Certification NPRM (Part 107), which proposes operating requirements to allow small unmanned aircraft systems (small UAS) to operate for non-hobby or non-recreational purposes; FAA expects to finalize this rule during 2016.

[34] Public Law 112–95 specifically prohibits the FAA from promulgating operating rules regarding model aircraft that meet all of the following statutory criteria:

- The aircraft is flown strictly for hobby or recreational use
- The aircraft is operated in accordance with a community-based set of safety guidelines and within the programming of a nationwide community-based organization
- The aircraft is limited to 55 pounds or less unless otherwise certified through a design, construction, inspection, flight test, and operational safety program administered by a community-based organization
- The aircraft is operated in a manner that does not interfere with and gives way to any manned aircraft, and
- When flown within five miles of an airport, the operator of the aircraft provides the airport operator and the airport air traffic control tower (when an air traffic facility is located at the airport) with prior notice of the operation.

Aircraft registration and marking serve as the primary foundation blocks in the regulatory structure that provides for safe and orderly aircraft activity within the NAS because registration provides accountability among its users. The registration number provides a link to information about the aircraft and the owner responsible for its operations. Compliance with the aircraft registration and identification requirements will assist the FAA and law enforcement agencies in identifying owners of sUAS operated in an unsafe manner. With registration the FAA can more efficiently educate these users, and when appropriate, take enforcement action. Aircraft registration provides the FAA and law enforcement agencies an invaluable tool during inspections and investigations of inappropriate or prohibited behavior, during emergency situations and for purposes of sharing safety information.

As of October 7, 2015, the FAA has taken 20 actions of enforcement against individuals for unsafe or unauthorized sUAS operations. Taking enforcement action requires identifying an individual or entity responsible for the operation. That is often difficult due to the nature of sUAS operations. An operator can fly an unmanned aircraft from miles away, generally with no way to trace the aircraft back to its operator. Locating violators is also a challenge, as very few of these aircraft are registered in any federal database and rarely will they have identifiable markings such as those used for conventional manned aircraft.

Examples of Registration from Other Industries

As discussed previously, the primary objectives of this rule are to improve the education of sUAS buyers and users about safe operating practices, and increase their accountability for potential consequences of operating sUAS unsafely. Economic research, as well and examples from other industries, suggest that the preferred regulatory intervention of requiring sUAS

aircraft to be registered, can help address all of these objectives. Summaries of the experience with government registration requirements for other products that also entail potential safety consequences are reported below. Complete descriptions and sources are included in Appendix B.

Registration of products enables monitoring of their proper use, and also facilitates identification of those misusing them. For example, consumer mistakes are prevalent in the use of pesticides, which are registered with the U.S. Environmental Protection Agency (EPA). As part of the registration process, EPA disseminates guidance about permitted uses of specific pesticide products, and also exercises control over their quality, usage rates, claims, labeling, packaging, and advertising, thus ensuring that the interests of both pesticide users and the environment are well-protected.

The Food Safety Modernization Act (FSMA) requires food facilities to register, submit to inspections by the U.S. Food and Drug Administration (FDA), and renew their registrations annually. The FMSA and these new rules made it possible to better protect public health by adopting a modern, preventive, and risk-based approach to food safety regulation. These new rules allow the FDA to take a more preventive rather than reactive approach to food safety.

Surgical joint replacement registries have also proven to be beneficial in reducing rates of revision. Many countries, such as Sweden, Norway, Finland and the Netherlands have established arthroplasty (or joint-replacement) registries, which have improved the quality of joint replacements by enabling inferior results of implants or replacements to be detected as early as possible. The registry is a key component of establishing exposure data, monitoring adverse incidents and providing a means to conduct risk based safety analysis.

A final example is widespread registration and licensing of both commercial and recreational fishing, two of the many legal and regulatory measures available to control overfishing. A centerpiece of commercial licensing is the establishment of Annual Catch Limits (ACLs). One of the key benefits of these laws and regulations is to address adverse incentives for fishermen to collectively over-fish particular areas and exhaust fish populations; this occurs because individual fishermen face no incentive to consider the implications of their collective decisions about where and how intensively to fish, and together their individual decisions can reduce fish populations below replacement levels. Thus licensing and registration serves the important function of limiting individual participants' activity – in this case, fishing – to levels that guarantee preservation of a vital common resource that otherwise would be threatened by their individual actions. While registering sUAS aircraft is not meant to limit their use, it is meant to address an externality that may be caused by inappropriate behavior. Just as in fishing, inappropriate use of sUAS could result in adverse consequences including further restrictions on their use if they threaten other important activities.

Benefits to owners

This IFR also has the potential to benefit sUAS owners. In the event of a mistake where the aircraft flies away from the owner, the registration marking provides a means for the aircraft to be returned to its owner.

Education efforts

One benefit of this rulemaking will be to improve the opportunity to educate recreational sUAS owners and operators by making them aware of the regulatory and safety requirements affecting their activities. At the same time, it will provide essential educational tools to the legions of new and current flyers that are taking to the skies, so that they can use their unmanned

aircraft safely. Registration also provides a means to target educational efforts to new sUAS operators, in order to help them to avoid proliferation of the unauthorized and unsafe behavior that has been reported in recent press accounts.

The agency expects to accomplish its sUAS education goals by providing information to aircraft owners during the registration process. Each registrant will need to acknowledge having read, and state their intent to follow, guidance presented on a single screen of information before completing their registration process.[35] Registration will also enable the agency to engage in follow-up e-mail communication with sUAS owners in the future, thereby reducing its reliance on regular mail and providing important cost savings. E-mail also allows for a less burdensome and a more reliable method of delivering educational and other safety-related materials to sUAS owners.[36]

The FAA is already devoting resources to education and outreach by promoting safe sUAS flying via its "Know Before you Fly" and "Drone Free Zone" initiatives. While the FAA will continue to devote resources to outreach after this sUAS registration rule is published, these resources will be more effectively targeted on the audience of drone users who have registered their aircraft. This will improve the efficiency of the agency's efforts at educational outreach, thus enabling more effective use of resources compared to its current, less targeted approaches for communication and outreach.

[35] Time to read and acknowledge is included in the user registration time estimate in the "cost" section.
[36] No time or cost estimates for these future voluntary efforts are included, nor are quantified estimates of safety benefits derived from these voluntary efforts. The number and volume of these future communications is highly uncertain. Model aircraft operators are already required by law to be operating within the bounds of community programming, which does assume ongoing education. Costs associated with future mandatory education, such as for commercial operators, will be addressed in future regulations such as the final Part 107 rule.

Benefits for Enforcement

As more sUAS enter the NAS, the risk of unsafe operations will increase without a corresponding improvement in the means to identify sUAS operators for purposes of further education and enforcement action, when appropriate. An operator can fly a sUAS from miles away, generally with no way to trace the aircraft back to its operator. Locating violators of aviation safety regulations is also challenging, as very few of these aircraft are registered in any federal database, and they rarely have identifiable markings such as those used for conventional manned aircraft.

Requiring aircraft registration and display of marking information often has a direct and immediate impact on safety-related issues. For example, aircraft registration and marking provides the FAA and law enforcement agencies an invaluable tool during inspections and investigations of inappropriate or prohibited behavior, as well as during emergency situations. One of the FAA's goals is to provide the FAA and local law enforcement agencies the immediate ability to quickly connect individuals to their aircraft with the fewest number of steps possible.

In the process of developing this proposed rule, FAA queried various law enforcement agencies (LEA) who have worked with us on investigations involving UAS. The question we asked was "On average, how much time is spent helping the FAA investigating sUAS violations, to include subject identification, witness interviews and case processing?" Although the majority of agencies responded that they do not keep this type of statistic, several agencies did provide estimates that ranged from 30 minutes to 18 hours. We compiled the information provided by LEA and determined the average time spent on a sUAS investigation is approximately 3 1/2 hours.

We received feedback that the majority of incidents do not require extensive amounts of time to track down sUAS owners, as they are normally with the sUAS or self-identify if the device crashes. There have been a very limited number of incidents involving crashed sUASs in which the owner did not attempt to retrieve them. For these incidents, a registration database would save time by assisting the FAA and law enforcement in identifying a sUAS owner.

VI. TRANSFERS

Aircraft registration and registration renewal fees will be paid by registrants of sUAS. The fee for application for a Certificate of Aircraft Registration for sUAS and for renewing a certificate of aircraft registration is $5.00; these fees are transfers from the registrants to the Federal Government. Government fees and taxes are considered transfers and, by OMB guidance, transfers are not considered a societal cost. OMB Circular A-4 requires the FAA to report estimated transfers and defines a transfer payment as monetary payments from one group to another that do not affect total resources available to society. Fees to government agencies for goods or services provided by the agency should not be considered a cost or benefit because the goods and services are already counted as government costs, and including them as private costs would entail double counting. See Regulatory Impact Analysis: Frequently Asked Questions (FAQs) at pg. 12 available at

https://www.whitehouse.gov/sites/default/files/omb/assets/OMB/circulars/a004/a-4_FAQ.pdf Estimates of the total transfers from the baseline, and the web-based system resulting from this Part 48 rulemaking are presented in the following tables.

Table 16
Registration and Re-registration Fees - Transfer Amounts
For the Baseline and the IFR
For Modelers
($M)

Year	Calendar Year	Total Cost			7 % P.V.		
			Baseline	IFR Rulemaking		Baseline	IFR Rulemaking
0	2015		$0.0	$ 4.9		$0.0	$ 4.9
1	2016		$0.0	$ 1.4		$0.0	$ 1.3
2	2017		$0.0	$ 2.0		$0.0	$ 1.7
3	2018		$0.0	$ 4.9		$0.0	$ 4.0
4	2019		$0.0	$ 3.8		$0.0	$ 2.9
5	2020		$0.0	$ 4.9		$0.0	$ 3.5
Total			**$0.0**	**$21.9**		**$0.0**	**$18.3**

Note: numbers may not add due to rounding

Table 17
Registration Fee - Transfer Amounts
For the Baseline and the IFR
For Non-Modelers
($M)

Year	Calendar Year	Total Cost			7 % P.V.		
		Rejected Alternative	Baseline	IFR Rulemaking	Rejected Alternative	Historical System	IFR Rulemaking
0	2015	$ 0.0	$ 0.0	$ 0.0	$ 0.0	$ 0.0	$ 0.0
1	2016	$ 3.1	$ 3.1	$ 3.1	$ 2.9	$ 2.9	$ 2.9
2	2017	$ 12.5	$ 12.5	$ 12.5	$10.9	$10.9	$10.9
3	2018	$ 12.8	$ 12.8	$ 12.8	$10.4	$10.4	$10.4
4	2019	$ 13.1	$ 13.1	$ 13.1	$10.0	$10.0	$10.0
5	2020	$ 13.4	$ 13.4	$ 13.4	$ 9.6	$ 9.6	$ 9.6
Total		**$54.9**	**$54.9**	**$54.9**	**$43.8**	**$43.8**	**$43.8**

Note: numbers may not add due to rounding

VII. BENEFIT-COST SUMMARY

There are problems arising from the rapid proliferation of sUAS, the problems are occurring more frequently, sales projections are for the number of sUAS to continue to increase, and thus addressing the problem is urgent.

Over the past several months, the FAA has received increasing reports of unauthorized and unsafe use of sUAS. Pilot reports of unmanned aircraft sightings have increased significantly. For example, the agency has received reports of unmanned aircraft at high altitudes in congested airspace, unmanned aircraft operations near passenger-carrying aircraft or major airports,[37] and interfering with emergency response operations such as efforts to combat wildfires.[38]

As evidenced by the recent reports of unsafe sUAS operations, the lack of awareness of operators regarding what must be done to operate sUAS safely in the national airspace, and the lack of identification of sUAS and their operators pose significant challenges in ensuring accountability for responsible use. Without increased awareness and knowledge of the statutory and regulatory requirements for safe operation, the risk of unsafe sUAS operations will continue. This risk is escalated by the expected rapid increase in sUAS operating in the national airspace.

One benefit of this rulemaking is to improve the education of recreational sUAS owners and operators to make them aware of the regulatory and safety requirements affecting their operations by providing essential educational tools to the legions of new and current flyers taking

[37] *See, e.g.*, Keith Laing, *Feds investigating drone sighting near Newark airport*, The Hill, Aug. 10, 2015, http://thehill.com/policy/transportation/250731-feds-investigating-drone-sighting-near-newark-airport; *FAA Investigating Close Calls with Drones Near JFK Airport*, Albany Business Review, Nov. 20, 2014, *available at* 2014 WLNR 32783307.

[38] *See, e.g.*, Associated Press, *Drones Interfering with Emergency Wildfire Responders*, CBSNEWS.com, Aug. 10, 2015, http://www.cbsnews.com/news/drones-interfering-with-emergency-wildfire-responders ("The U.S. Forest Service has tallied 13 wildfires in which suspected drones interfered with firefighting aircraft this year . . . up from four fires last year . . . .); Polly Mosendz, *Drones Interfere With Firefighters Battling California Wildfire*, Newsweek, June 26, 2015, http://www.newsweek.com/drones-interfere-firefighters-battling-california-wildfire-347774.

to the skies so they can use their unmanned aircraft safely. Registration also provides a means for targeting sUAS operators and educating them in order to change their behavior that has resulted in unsafe and unauthorized events. Currently aircraft registration is a paper-based process defined in Part 47. Under current statutory and regulatory policy, the FAA could require sUAS model owners, at a significant cost, to register their sUAS aircraft under the legacy paper-based system, but as discussed above, this alternative was rejected. Non-modelers currently have to register their aircraft under part 47, and, without this IFR, would continue to as outlined in the notice of proposed rulemaking, "Operation and Certification of Small Unmanned Aircraft Systems" (80 FR 9544 (Feb. 23, 2015)).

Due to the rapid increase in sUAS use by modelers and expected growth in sUAS by non-modelers, the FAA has created a web-based registration to significantly reduce the time to register. In addition, to ease the burden to modelers this regulation will allow model owners to register their first sUAS aircraft, not each of their subsequent sUAS aircraft. While these owners will have the option to use either registration system, because of this benefit, we assume that most modelers will opt to register under the new streamlined, web-based part 48 registration system.

Given the time to register aircraft under the paper-based system and the projected number of sUAS aircraft, the FAA estimates the cost to the government and non-modelers would be about $383 million. Due to the increase in sUAS aircraft used by hobbyists to date and the expected rapid increase, the FAA has decided that both modelers and non-modelers need to register their aircraft and have developed this IFR to provide a less costly, stream-lined alternative for registering. The estimated cost of this IFR is about $56 million. The resulting cost savings to the society from this IFR equals the cost of the baseline policy ($383 million)

minus the cost of this IFR ($56 million), or about $327 million ($259 million in present value at a 7 percent discount rate). These cost savings are the net quantified benefits of this IFR.

VIII. APPENDICES

APPENDIX A: Forecast of sUAS Aircraft and Registration Activities

This appendix describes how the number of sUAS aircraft and number of sUAS owners registering with the FAA were estimated for the regulatory evaluation. The methodology is based on a forecast of units sold developed by FAA and its contractors, informed by discussions with industry and subject matter experts. For the regulatory evaluation, it is necessary to convert the sales forecast into both the number of owners (modelers and non-modelers) and the number of sUAS (both in the fleet and registered).

UAS Sales Forecast

Exhibit 1 summarizes FAA's sUAS forecast divided between model and non-model populations. The forecast is based on discussions with retailers, manufacturers and subject matter experts. Given the relatively sudden appearance of the technology in mass consumer markets and the fast developing non-model sector, the forecast represents a combination of expertise and judgment informed by information on sUAS that have been produced for the consumer market, and various exemption applications made by non-model owners in the U.S.. This forecast assumes that Beyond Visual Line of Sight (BVLOS) operations will not be approved in substantial numbers through 2020, meaning that most e-commerce, mapping and new/media applications are excluded and 50% of emergency response, agriculture and oil rig applications are also excluded.

Exhibit 1: FAA sUAS Unit Forecast Summary

Units (000)	2015	2016	2017	2018	2019	2020	Cumulative
Modeler	1,550	1,885	2,319	2,852	3,508	4,315	16,428
Non Modeler							
Aerial Photography	-	12	50	51	54	56	222
Agriculture**	-	280	1,142	1,165	1,189	1,212	4,988
E-Commerce*	-	-	-	-	-	-	-
Emergency Response**	-	6	25	25	25	25	107
Industrial Inspection**	-	274	1,094	1,127	1,161	1,196	4,852
Insurance	-	45	180	185	191	197	798
Mapping*	-	-	-	-	-	-	-
News/Media*	-	-	-	-	-	-	-
Wildlife	-	0	0	0	0	0	1
Total Non-Modeler	-	617	2,492	2,555	2,620	2,686	10,969
Total Sales	1,550	2,502	4,810	5,407	6,127	7,001	27,397

* Most projected applications are BVLOS and so are excluded.

** Fifty percent of agricultural and emergency projected applications are BVLOS dependent and so are excluded; 50% of oil rig projected applications included in industrial inspection at BVLOS and are excluded.

Following are key features of the forecast.

- All sUAS in the forecast are less than 55 pounds.
- Prior to 2015, FAA estimates that there were approximately 200,000 civilian sUAS in the U.S.
- All of sUAS costing less than approximately $65 are hobbyist aircraft that are generally .55 pounds or less and will not be registered; this is estimated to be 20% of hobbyist units[39])
- FAA estimates that in the first three quarters of calendar year (CY) 2015, between 0.6 and 0.8 million hobbyist units were sold.
- Discussions with industry suggest that another 0.8 to 1.0 million model units will be sold in the fourth quarter of 2015.
- FAA projects that in 2015, 1.55 million model units will be sold.
- In 2016, FAA projects that 1.9 million model units will be sold, with annual growth thereafter averaging 23%. By 2020, FAA projects model sales will reach 4.3 million units.
- Non-model operations will commence in mid-2016 once Part 107 is finalized.
- Non-model sales for the second half of 2016 are forecast to be 50% of the forecast rate afterwards, reflecting the tendency of a market to build over time. This translates into 2016 sales of 617,000 non-model units or 25% of 2017 sales.
- The forecast for non-model units sold is based on an evaluation of specific applications. The key assumptions for each of the applications are shown in Exhibit 2, which also shows the estimated units sold in 2017. It is important to note that e-commerce, mapping and news/media applications depend importantly on the ability to operate the aircraft beyond the visual line of sight (BVLOS) of the owner. The FAA assumes that civilian BVLOS applications will not be approved in substantial numbers within the regulatory analysis period, so they are set to zero in Exhibit 1.
- Each of the non-model applications grow through 2020 at the growth rates indicated in Exhibit 2; for the regulatory evaluation, BVLOS applications are excluded.

Life Span Assumption

A very important assumption in the forecast is that the life span of all model sUAS less than 55 pounds is one year or less, with the exception that 10% of modeler units last into a second year but are then retired. Interviewees indicate that under-55 pound-sUAS have very short life spans because they are damaged, destroyed or reach the end of their serviceable lives through use, generally within one year. This assumption drives unit sales, especially in the non-model sector where owners replace units each year.

The life span assumption also means that there are no aircraft renewed after three years and no transfers (the units are not assumed to last long enough to be sold or transferred.)[40]

[39] This conclusion is based on an evaluation of sUAS by sales rank, weight and price on Amazon November 18-20, 2015.

Uncertainty

The FAA recognizes that the forecast is subject to considerable uncertainty because this is a nascent market, the regulatory environment is evolving, and the pace of technology development is unknown. For the purposes of this analysis, it is desirable that the forecast be relatively conservative. The benefit cost evaluation of the IFR depends on saving time-related and processing costs in registering users and aircraft sufficient to offset the cost of investing in a robust new registration system.

Exhibit 2 illustrates the method used to project the number of units put to specific applications; later in the analysis we estimate the number of sUAS owned by the average modeler and non-model owners.

[40] An informal analysis suggests that used sUAS account for between 1.5% and 2.5% of the total market today. A search on Amazon on November 20,2015 for "DJI" found 35,070 "new" condition models and 614 "used" condition models for sale indicating used and potentially transferrable units make up 1.7% of the total. A similar search on EBay checked by condition revealed that there are 41,575 "new" listings, 1,008 "used" listings, and 234 "not specified" listings. Ignoring the “not specified” units, used and potentially transferrable units make up 2.4% of the total

Exhibit 2: Forecast Non-model Units by Application

A	B	C		AxBxC
Aerial Photography				
Photographers	Adoption Rate	sUAS/Photog	Growth Rate	2017 Value
165,000	20%	1.5	4%	49,500
Agriculture			Growth Rate	50% BVLOS
Sensing			2%	
Sensing firms	Adoption Rate	sUAS/Firm		2017 Value
6,000	80%	1		4,800
Farms	Adoption Rate	sUAS/Farm		2017 Value
5,700,000	40%	1		2,280,000
E-Commerce				BVLOS Dependent
Fleet			Growth Rate	2017 Value
450,000			10.0%	450,000
Emergency Response				50% BVLOS
Departments	Adoption Rate	sUAS/Firm		2017 Value
48,037	70%	1.5		50,439
Industrial Inspection			Growth Rate	
Oil Rigs	Adoption Rate	sUAS/Rig	3%	2017 Value:50% BVLOS
1,000	90%	1.5		1,350
Construction Companies	Adoption Rate	sUAS/Firm		2017 Value
729,000	100%	1.5		1,093,500
DOTs	Adoption Rate	sUAS/DOT		2017 Value
51	100%	5		255
Insurance				
Adjustors	Adoption Rate		Growth Rate	2017 Value
360,000	50%		3%	180,000
Mapping				BVLOS Dependent
Acres	Acres/sUAS/Day	Mappings/Yr		2017 Value
2,400,000,000	1,000	4		26,301
News/Media				BVLOS Dependent
Helicopters	Adoption Rate			2017 Value
11,000	5%			550
Wildlife				
National Parks	Adoption Rate	sUAS/Park		2017 Value
59	90%	5		266

Note: BVLOS operations are excluded in the regulatory evaluation because they are unlikely to be approved in substantial numbers during the analysis period.

Units Sold Subject to Registration

The Base Case for this regulatory evaluation is the "historic" Part 47 paper –based registration system, which would apply to non-model owners only. A non-model owner in the Base Case would register and renew their aircraft every three years, and would register each sUAS aircraft individually. Thus both non-modelers and their individual sUAS aircraft must be tracked in the Base Case.

In the Scenario Case (the IFR), both model and non-model owners would register using a robust computerized registration system. As in the Base Case, non-model owners would register and renew their aircraft every three years and would register each sUAS aircraft individually. Owners of at least one model aircraft above 0.55 pounds would register and renew every three years. (In the future, it is anticipated that model aircraft would be registered at the point of sale via systems linked directly to the FAA, but the regulatory evaluation assumes individual actions by the owner for the entire period).

Exhibit 3 summarizes the number of sUAS aircraft potentially subject to registration, depending on details in the rule.[41] The chart starts with the summary sales forecast from Exhibit 1, and shows how sales were converted to sUAS aircraft subject to registration. Following are the key assumptions made in this process:

- **sUAS Subject to Registration**: In the Scenario Case, all sUAS aircraft over 0.55 pounds are required to register and 100% comply. This assumption maximizes the estimated costs incurred by users and the FAA in the Scenario Case.
- **Underweight sUAS**: 20% of model sales are assumed to be 0.55 pounds or less, and thus not subject to registration.
- **Surviving Fleet**: 10% of the previous year's model fleet subject to registration is assumed to survive a second year.
- **Pre-2015 Fleet:** 200,000 model units are assumed to be in the fleet prior to 2015 of which 160,000 are heavier than 250 grams and subject to registration

[41] No individual units are assumed to be registered in 2015 .

Exhibit 3: sUAS Aircraft Potentially Subject to Registration

Units (000)	2015	2016	2017	2018	2019	2020	Cumulative
Modeler Sales Units	1,550	1,885	2,319	2,852	3,508	4,315	16,428
Non Modeler Sales Units	-	617	2,492	2,555	2,620	2,686	10,969
Total Sales	1,550	2,502	4,810	5,407	6,127	7,001	27,397
Modeler Registration Adjustments							
sUAS under weight limit	(310)	(377)	(464)	(570)	(702)	(863)	(3,286)
Surviving fleet from previous year	-	(124)	(151)	(185)	(228)	(281)	(969)
Pre-2015 fleet to register (> 250g)	160	-	-	-	-	-	160
Model sUAS Aircraft Covered by Registration	1,400	1,384	1,704	2,096	2,578	3,171	12,333
Total sUAS Aircraft Covered by Registration	1,400	2,001	4,196	4,651	5,198	5,857	23,302

Applying the Forecast to the Regulation

In order to evaluate the impacts of the rule, it is important to identify the volume of sUAS owners and and the aircraft that they will register. It is also important to recognize that users subject to registration in the Base and Scenario cases will incur time costs to register the first time in the system and to renew their registration.

- In the Base Case, only non-model owners would register via the paper based system; they would register each aircraft as it comes into the fleet.
- In the Scenario Case modelers will register once for all their aircraft (and renew every three years thereafter) while non-model owners will incur the initial time costs for their first registration and will register each sUAS aircraft. Thus, there are combinations of owners and sUAS units that drive the registration activities as summarized in Exhibit 4.

Exhibit 4: Activities Tracked in Base and Scenario Cases

		Activities Tracked	
		Modeler	**Non Modeler**
Base Case	Paper-Based System	NA	Owners and sUAS
Scenario Case (IFR)	Automated System	Owners only	Owners and sUAS

Estimating the Number of Owners

Exhibit 3 above provides estimates of the new sUAS that may need to be registered each year (depending on the case). To complete the regulatory evaluation, it is also important to count the

number of owners that may register each year. Some additional assumptions are required to convert sUAS units to owners. They are summarized immediately below:

- **Average Number of Active sUAS units per Owner**: Discussions with experts suggest that 1.5 sUAS will be owned by the typical modeler and 2.0 aircraft will be owned by the typical non-model owner[42]
- **Attrition Rate**: Some owners will begin using sUAS but then cease operations in the future; FAA assumes that the annual attrition rate is 20% for both model and non-model users; this means that of the new owners registering for the first time in any year, only 51% will still be operating three years later when it is time to renew their registration.
- **Percent of Sales to Modelers Owning only Lightweight sUAS**: FAA assumes that 20% of all model sUAS units sold are 0.55 pounds or less and thus are not required to register. A slightly smaller percentage of modelers (16.1%) are assumed to be exempt from registration, because some modelers own more than one aircraft.

Number of Modelers

Exhibit 5 reports the annual number of model aircraft being registered, and the number of modelers paying registration fees (in the Scenario Case). These two numbers are identical because modelers only pay when they register and renew registration as owners. They do not pay fees when they register individual sUAS (beginning in 2016).

[42] These average ownership figures are used to estimate the number of owners. In Exhibit 2, we used an average number of sUAS needed to accomplish work by someone adopting the technology; but not all adopters will choose to operate their own sUAS. For example, not all farmers will choose to operate their own sUAS.

Exhibit 5: Number of Model Owners

	2015	2016	2017	2018	2019	2020	Cumulative
Modeler Sales Units (000)	1,550	1,885	2,319	2,852	3,508	4,315	16,428
Sales to Modelers owning only lightweight sUAS Units (000)[43]	(250)	(304)	(374)	(460)	(566)	(696)	(2,648)
Sales to Modelers owning 1+ sUAS requiring registration Units (000)	1,300	1,581	1,945	2,392	2,942	3,619	13,779
Total Modelers (000)	867	1,054	1,297	1,595	1,961	2,413	9,186
Modelers with Pre-2015 Fleets requiring registration (000)	112	-	-	-	-	-	112
New Hobbyists from Transfers	-	-	-	-	-	-	-
Modelers previously registered (000) [44]	-	(783)	(897)	(1,117)	(1,371)	(1,687)	
New Modelers to register (000)	979	271	399	478	590	725	3,442
Renewal Registrations (000)	-	-	-	501	174	255	930
Total Number of Modeler Registrations (000)	979	271	399	979	764	981	4,372
Modelers dropping out (000)	196	157	179	223	274	337	
Modelers continuing to next year (000)	783	897	1,117	1,371	1,687	2,075	
Modelers continuing to next year-2015	783	626	501	401	321	257	
Modelers continuing to next year-2016		271	217	174	139	111	
Modelers continuing to next year-2017			399	319	255	204	
Modelers continuing to next year-2018				478	382	306	
Modelers continuing to next year-2019					590	472	
Modelers continuing to next year-2020						725	

The first row of Exhibit 5 above reports the FAA forecast of annual model unit sales. Subtract off the number of sales to modelers operating lightweight sUAS to estimate the new units that need to be registered. Because the average modeler owns 1.5 active sUAS, the total number of modelers to whom sUAS are sold in a year is simply total sUAS >0.55 pounds divided by 1.5. Add to this any modelers with sUAS prior to 2015 and subtract off any modelers who have previously registered their aircraft, to estimate the number of new model registrants. Add to this the number of renewals to obtain total registering in a year. Notice that at the bottom of the Exhibit, the analysis keeps track of modelers dropping out due to attrition each year, and the number remaining three years after initial registration who must renew.

Number of Non-model Owners

Exhibit 6 reports the annual number of non-model owners registering in both the Base and Scenario Cases. Note that these owners register each non-model sUAS. The format and logic of

[43] The difference between this row, and the corresponding row in Exhibit 3, reflects the fact that some lightweight sUAS are being sold to owners whose fleet is composed of both above and below the weight cut-off for the IFR.
[44] We assume that owners that quit flying sUAS's are replaced by new owners (with identical characteristics) whose purchases are included in the sales forecast the following year.

the analysis are identical to Exhibit 5, except that no non-model sUAS are assumed to be 0.55 pounds or less. The first row of the exhibit reports the FAA forecast unit sales. Divide this by the average number of units per non-model owner (2) to derive total owners. Subtract off non-model owners that have already registered and remain active (net of attrition) to derive new non-model owners. Then add any renewal registrations to derive total annual registrations by non-model owners.

Exhibit 6: Number of Non-model Owners

	2015	2016	2017	2018	2019	2020	Cumulative
Non-Modeler Sales Units (000)	-	617	2,492	2,555	2,620	2,686	10,969
Total Non-Modeler Owners (000)	-	308	1,246	1,277	1,310	1,343	5,485
New Non-Modeler Owners from Transfers	-	-	-	-	-	-	-
Non-Modeler Owners Already Registered [45]	-	-	(308)	(1,184)	(1,041)	(1,102)	(3,635)
New Non-Modeler Owners to register	-	308	938	93	269	241	1,850
Renewal Registrations	-	-	-	-	197	600	797
Total Registrations	-	308	938	93	467	841	2,647
Non-Modeler Owners dropping out	-	-	62	237	208	220	
Non-Modeler Owners continuing to next year	-	308	1,184	1,041	1,102	1,123	
Non-Modeler Owners continuing to next year-2015	-	-	-	-	-	-	
Non-Modeler Owners continuing to next year-2016		308	247	197	158	126	
Non-Modeler Owners continuing to next year-2017			938	750	600	480	
Non-Modeler Owners continuing to next year-2018				93	75	60	
Non-Modeler Owners continuing to next year-2019					269	215	
Non-Modeler Owners continuing to next year-2020						241	

Estimating the Key Activities for Each Case in the Regulatory Evaluation

The estimates of sUAS and owners in Exhibits 3, 5 and 6 can be used to summarize the activities that drive costs incurred by government, and users as well as the fees paid in each year for both the Base and Scenario Cases. These drivers are summarized in Exhibit 7.

[45] We assume that owners that quit flying sUAS's are replaced by new owners (with identical characteristics) whose purchases are included in the sales forecast the following year.

Exhibit 7: Registrations in the Base and Scenario Cases

		Activity	Owner Type	2015	2016	2017	2018	2019	2020
		Units	(000)						
Base Case	Paper-Based System	sUAS Aircraft	Non-Modeler	-	617	2,492	2,555	2,620	2,686
Scenario Case: (IFR)	Automated System	Owners	Modeler	979	271	399	979	764	981
		Owners	Non-Modeler	0	308	938	93	269	241
		sUAS Aircraft	Non-Modeler	-	617	2,492	2,555	2,620	2,686

APPENDIX B: Registration Analogies

Pesticide Registration

The EPA regulates pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Federal Food, Drug, and Cosmetic Act (FFDCA), and the Food Quality Protection Act, of 1996. The Federal Insecticide, Fungicide, and Rodenticide Act requires all pesticides sold or distributed in the United States (including imported pesticides) to be registered by the EPA.[46] Registration is based on evaluation of scientific data and assessment of risks and benefits of a product's use. Under this act, the EPA can authorize limited use of unregistered pesticides or pesticides registered for other uses to address emergencies and special local needs. The EPA can also suspend or cancel a product's registration. The FFDCA requires the EPA to set pesticide tolerances for all pesticides used in or on food or in a manner that will result in a residue in or on food or animal feed. The Food Quality Protection Act amends FIFRA and FFDCA, and states the EPA must find that a pesticide poses a "reasonable certainty of no harm" before it can be registered for use on food or feed. Also, the EPA must review each pesticide registration at least once every 15 years.

Under these laws, companies submit an application for a registration action, such as to register a new pesticide active ingredient, new product for an existing pesticide, or adding a new use to an existing product. The pathway for the registration of a pesticide is: (1) research conducted by the manufacturer prior to its decision to pursue registration; (2) submission of a data report by the manufacturer to the registration authority; (3) review of the data by the registration authority; and (4) a decision by the registration authority either to register the pesticide, based on the merits of the submitted data, or to deny registration.[47]

When reviewing a pesticide, the EPA considers harm to humans, wildlife, fish, and plants, including endangered species and non-target organisms, contamination of surface water or ground water from leaching, runoff, and spray drift. Potential human risks range from short-term toxicity to long-term effects such as cancer and reproductive system disorders.

The following quotations about the risks of pesticides from a recent paper, *Pesticide Exposure, Safety Issues, and Risk Assessment Indicators*, could very well be applicable to sUAS: "Many end users have poor knowledge of the risks associated to the use of pesticides, including the essential role of the correct application and the necessary precautions," and "Even though the development of toxicity reference levels for pesticides incorporates uncertainty factors that serve to achieve this regulatory standard, in reality, we may never know whether a pesticide is safe under all circumstances, nor can we predict with certainty its performance in hypothetical

[46] http://www2.epa.gov/pesticide-registration/about-pesticide-registration#laws
[47] http://www.mdpi.com/1660-4601/8/5/1402/htm#b29-ijerph-08-01402

situations." Thus, registration is an important step in the management of pesticides. It enables authorities primarily to determine which pesticide products are permitted to be used and for what purposes, and also to exercise control over quality, usage rates, claims, labelling, packaging and advertising of pesticides, thus ensuring that the best interest of end-users as well as the environment are well protected.[48]

Like with pesticides, sUAS users may not understand the risks involved, nor can users or regulators predict their performance in every hypothetical situation.

Food Facility Registration

According to the Centers for Disease Control and Prevention, about 48 million people (one in six Americans) get sick, 128,000 are hospitalized, and 3,000 die each year from foodborne diseases.[49]

Since 2003, the Food and Drug Administration (FDA) has required all food facilities to register with the agency.[50] The act directing the FDA to require food facility registration is the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (the Bioterrorism Act), which aims to take steps to protect the public from a threatened or actual terrorist attack on the U.S. food supply and other food-related emergencies.

A subsequent act, The Food Safety Modernization Act (FSMA), requires food facilities submit to FDA inspections and renew their registration on an annual basis. If the FDA determines that food manufactured, processed, packed, received, or held by a registered food facility has a reasonable probability of causing serious adverse health consequences or death to humans or animals, FDA may by order suspend the registration of that facility.

In August of 2015, four years after the FMSA was signed into law, FDA finalized two rules on preventive controls in human and animal food.[51] These rules require registered food facilities to maintain a food safety plan, perform a hazard analysis, and institute preventive controls for dealing with those hazards.[52] The human food rule also clarifies the definition of "farm," which is central to whether an entity has to register as a food facility and, thus, become subject to the new requirements for hazard analysis and risk-based preventive controls.

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[48] http://www.mdpi.com/1660-4601/8/5/1402/htm#b29-ijerph-08-01402
[49] http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm314178.htm
[50] http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/FoodDefense/ucm331957.htm
[51] http://www.foodsafetynews.com/2015/09/fda-finalizes-fsma-preventive-controls-rules-for-human-and-animal-foods/
[52] http://www.foodsafetynews.com/2015/09/fda-finalizes-fsma-preventive-controls-rules-for-human-and-animal-foods/

Overall, the FMSA and these new rules intend to better protect public health by, among other things, adopting a modern, preventive, and risk-based approach to food safety regulation.[53] These new rules allow the FDA to take a more preventative rather than reactionary approach to food safety.

Surgical Joint Replacement

Improper use of medical devices during surgery can lead to complications, and increased health care costs due to surgical revision. In 2007 for example, 47 knee replacement surgeries were performed incorrectly, the knee replacement implants were inserted in a non-cemented fashion, although these specific implants had been designed for cemented use only. As a result, 34 of these patients underwent surgical revision. One of the contributing factors leading to wrong use of this implant in this case was related to a mistranslation of the packaging from English to German. One report concludes "The shocking fact that 47 consecutive patients suffered from the same basic error implies that not only human failure, but also system errors and lacking control mechanisms may have contributed to this series of adverse events."[54]

Many countries, such as Sweden, Norway, Finland and the Netherlands have established arthroplasty (joint-replacement) registries that have improved the quality of joint replacements. The main purpose of the register is to detect inferior results of implants as early as possible.[55] Recent data from the Finnish Arthroplasty Register indicate that the results of total hip replacements are improving in Finland.[56] A recent Swedish study found that, in practice, total hip replacement in Sweden has improved, as judged by information from this Register about individualized patient risks, implant safety, and the greater efficacy of surgical and cementing techniques.[57]

A 2007 study compared surgical revision rates between the U.S. and Sweden and found that since the introduction of the Swedish hip registry in 1979, revision rates for hip arthroplasty have been reduced approximately by half, to currently seven percent. In the U.S., the mean revision rate for total hip arthroplasty is 18 percent. The study also stated "It is conceivable that formal registries on joint arthroplasties may help identifying implantation-related errors at an early stage and thus prevent further patients from undergoing inadequate surgical procedures."[58]

Formal registries can greatly improve long-term patient safety by reducing complication and revision rates significantly. These registries should be developed in a way to allow for early

[53] https://s3.amazonaws.com/public-inspection.federalregister.gov/2015-21920.pdf
[54] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2241776/
[55] http://www.ncbi.nlm.nih.gov/pubmed/11028881
[56] http://www.ncbi.nlm.nih.gov/pubmed/11728068
[57] http://www.ncbi.nlm.nih.gov/pubmed/10852315/
[58] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2241776/

identification of errors and failures, in order to avoid repetitive errors which may consecutively affect a large patient population.[59]

Commercial and Recreational Fishing

Licensing is one of the many legal and regulatory measures available for controlling overfishing. Many countries including the U.S. have set up Ministries/Government Departments, controlling aspects of fisheries within certain economic zones. One of the important rationales for these laws and regulations is to address adverse incentives for fishermen as a group to over-fish and/or exhaust populations; no one operator or person has incentives to consider the implications of actions taken by the group which together may exhaust a natural resource.

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) is the primary law governing marine fisheries management in U.S. federal waters. The 1976 law extended U.S. jurisdiction to 200 nautical miles and established eight regional fishery management councils (Councils) with representation from the coastal states and fishery stakeholders. Nationwide, there are 46 fishery management and ecosystem plans that provide a framework for managing the harvest of 446 fish stocks and stock complexes.[60] For example, the National Oceanic and Atmospheric Administration (NOAA) has a Greater Atlantic Regional Fisheries Office[61] with several programs dedicated to preservation, restoration and sustainable fisheries.

Key objectives of the Magnuson-Stevens Act are to:

- Prevent overfishing
- Rebuild overfished stocks
- Increase long-term economic and social benefits
- Ensure a safe and sustainable supply of seafood

According to NOAA, as a result of the Magnuson-Stevens Act, the United States is "ending and preventing overfishing in federally-managed fisheries, actively rebuilding stocks, and providing fishing opportunities and economic benefits for both commercial and recreational fishermen as well as fishing communities and shore-side businesses that support fishing and use fish products."[62]

[59] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2241776/
[60] https://www.st.nmfs.noaa.gov/Assets/economics/documents/feus/2012/FEUS2012.pdf
[61] http://www.greateratlantic.fisheries.noaa.gov/index.html
[62] http://www.fisheries.noaa.gov/sfa/laws_policies/msa/index.html

The centerpiece of the Magnuson-Stevens Act is the establishment of Annual Catch Limits (ACLs). One of the methods used to achieve optimal annual catch goals is through vessel or operator permits. For example, all vessels that fish for or possess fish or shellfish from federal waters (EEZ) and that are regulated by the Greater Atlantic Region must have a fishing vessel permit from the Greater Atlantic Permit Office and must sell only to federally permitted dealers.[63] Additionally, operator cards are required for any operator of a charter/party boat or a commercial vessel (including carrier and processor vessels) issued a vessel permit from the Greater Atlantic Region. Other regulations for operators of NOAA Fisheries Greater Atlantic Region permitted vessels include submitting a vessel trip report (VTR) for every fishing trip regardless of where the fishing occurs or what species are targeted, with the exception of those vessels that possess only a lobster permit. Operators of all federally permitted vessels must complete a VTR prior to landing.[64]

Additionally, licenses are required for recreational fishing, and recreational fishers must follow both federal and state regulations. Fisheries offices promote sustainable recreational fisheries by monitoring catch and implementing regulations in federal waters. For example, federal regulations for Greater Atlantic Region state which species can be caught, open season, minimum possession size, possession limit and any closed areas.[65] Individual states also require fishing licenses to realize their objectives, including maintaining the long-term viability of fishing habitats by restricting use and issuing minimum size limits for specific species.

As with commercial fishing, the objective in regulating recreational fishing is to manage various species and ecosystems and prevent over fishing. NOAA Fisheries estimates that nationally over 70 million recreational fishing trips were taken by more than 11 million marine anglers in 2011.[66] Absent any recreational regulation, over fishing would pose a real threat to the nation's oceans and fresh water habitats.

[63] http://www.greateratlantic.fisheries.noaa.gov/aps/permits/fishing/index.html
[64] http://www.greateratlantic.fisheries.noaa.gov/aps/evtr/index.html
[65] http://www.greateratlantic.fisheries.noaa.gov/sustainable/recfishing/regs/index.html
[66] http://www.greateratlantic.fisheries.noaa.gov/Sustainable/recfishing/