8. AVIATION ACCIDENT INVESTIGATION COSTS

8.1 INTRODUCTION

All costs borne (or costs avoided) by all parties expected to result from proposed changes to FAA investments, regulations, and AIP grants should be considered in the conduct of benefit-cost analyses of these proposed activities. Avoided accidents are one of the principal safety benefits of FAA investment and regulatory programs. (It is assumed that these resources would be put to alternative uses if an accident could be avoided.) These are valued, in part, by using avoided injury and property damage costs.[1] However, there are other costs to society imposed by aviation accidents. One such cost is the expense of investigating aviation accidents. Investigations involve the expenditure of resources by several entities, including the National Transportation Safety Board (NTSB), the FAA and the private sector. FAA has increasingly focused its resources on accident prevention and increasing aircraft reliability which has consistently increased over time.

This analysis estimates costs incurred by governmental entities for accident investigation and provides approximations for costs incurred by the private sector. It should be noted that no U.S. passenger airline accidents that resulted in multiple fatalities occurred during the time period examined in the research for this update. Since these types of accidents typically result in the highest accident investigation costs (based on past publications of Economic Values), the accident investigation cost estimates presented in this publication may be understated for the types of accidents that did not occur during the analysis period. The most recent U.S. passenger air carrier accident that resulted in multiple fatalities in the U.S. was the Colgan Air accident in February 2009 that had 50 fatalities.[2] The Boeing 737 MAX had two catastrophic accidents in foreign countries that are not in the data because they occurred in FY 2019.[3] FAA's estimated expenditures were over $2.5 million (as of mid-2019) for 737 MAX related work because of these accidents.[4]

While the following data represents the most comprehensive estimates associated with the costs of a federal accident investigation, depending on the scope of a particular analysis, alternative estimates may be applicable.

8.2 DEVELOPMENT OF FEDERAL ACCIDENT INVESTIGATION COST ESTIMATES

The National Transportation Safety Board (NTSB) is responsible for the investigation of all civil aircraft (and certain public aircraft) accidents in the U.S. Aircraft accidents are defined as an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked,

[1] These are covered in Sections 1 to 5 of *Economic Values for FAA Investment and Regulatory Decisions, A Guide* https://www.faa.gov/regulations_policies/policy_guidance/benefit_cost/media/econ-value-toc.pdf
[2] NTSB Accident Report
[3] Lion Air accident was on October 29, 2018 and Ethiopian Airlines was on March 10, 2019.
[4] Source: Interview with FAA Cost Accounting Team August 2020

and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage.

The NTSB is normally a party to investigations involving U.S.-manufactured aircraft conducted by aviation authorities in foreign countries. U.S. private entities can ask to be a party to a U.S. or foreign accident if they have an interest (e.g., aircraft, engine, and parts companies) in the investigation. In addition, if there is not a qualified aviation authority in the country in which the accident occurred, a civil aviation authority from another country can be assigned to lead the investigation.

In the current work, GRA tabulated costs for FAA and NTSB separately. Although NTSB has legal responsibility for investigating all civil aircraft accidents in the U.S., in practice NTSB investigates air carrier and some general aviation (GA) accidents. FAA investigates most GA accidents. The investigations are conducted by the FAA Office of Accident Investigation (AVP) or by a Flight Standards District Office (FSDO). FAA-AVP also assigns one of its investigators to accident investigations led by the NTSB.

8.2.1 NTSB Accident Investigation Cost Estimates

NTSB cost estimates were derived from its cost accounting system by NTSB staff. Based on NTSB staff discussions and coordination with NTSB's chief financial officer, the following methodology was used to calculate NTSB investigation costs:

1. NTSB used completed investigations for 2013-2018 as the baseline for estimates. The time period was selected to have the most uniform direct cost calculations because it includes completed investigations and includes complete cost accounting data.
2. The resulting list of investigations was divided into categories:
    a. **Major** – includes a full investigative team, typically includes multiple specialist groups led by a chairman, and typically includes a Board Member on-scene, and where a full Board adopted report is produced. (cases identifiable by "MA" in the NTSB ID)
    b. **Foreign** – a foreign case for which NTSB assigned an Accredited Representative and NTSB staff traveled in support of the investigation. These are typically equivalent to major accident investigations, led by a foreign authority. (cases identifiable by "RA" in the NTSB ID)
    c. **Part 135** – All NTSB investigations of accidents involving Part 135 operations.
    d. **General Aviation, Field** – Accidents, typically fatal, involving operations other than Part 121, 129, or 135 air carrier operations and for which the NTSB investigator(s) responded to the scene. (cases identifiable by "FA" in the NTSB ID)
    e. **General Aviation, Limited** – Accidents involving operations other than Part 121, 129, or 135 air carrier operations and for which the NTSB investigator(s) did not travel to the scene but may have done subsequent investigation for wreckage or equipment exams. (cases identifiable by "LA" in the NTSB ID)
    f. **General Aviation, Data Collection** – Non-fatal accidents involving operations other than Part 121, 129, or 135 air carrier operations and for

which the NTSB investigator(s) did not travel to the scene and data were primarily collected from the accident pilot. (cases identifiable by "CA" in the NTSB ID)

3. For Major, Foreign, and Part 135 accidents, the costs were averaged across all investigations.
4. Due to the large number of general aviation investigations, the average costs were calculated from a random sample from each group. Sample sizes were selected to achieve at least a 95% confidence level.

Table 8-1 summarizes the NTSB investigation cost estimates. NTSB only provided direct costs and did not provide an indirect cost factor. However, 75.3% would be a reasonable estimate for indirect costs based on FAA overhead costs and this was used to develop final cost estimates for NTSB. NTSB provided nominal costs, which were adjusted for inflation by assuming that 2016 was the average nominal value and using BLS wage data[5] to adjust the average direct cost including estimated overhead to 2018 dollars.

Table 8-1: NTSB Accident Investigation Costs by Investigation Category

Category	Population Count	Sample Size*	Sample %	Average Direct Cost for Sample (nominal)	Average Direct Cost Including Estimated Overhead (nominal)**	Average Direct Cost Including Estimated Overhead** ($2018)
Major	18	18	100%	$574,588	$1,007,253	$1,037,282
Foreign	60	60	100%	$57,411	$100,641	$103,641
Part 135	161	161	100%	$23,908	$41,911	$43,160
GA field	659	303	46%	$21,526	$37,735	$38,860
GA limited	1,436	303	21%	$3,295	$5,776	$5,948
GA data collection	2,146	236	11%	$546	$957	$986

* Due to the large number of general aviation investigations, the average costs were calculated from a random sample of each group. Sample sizes were selected to achieve at least a 95% confidence interval.
** NTSB overhead rates are not available, so for comparison purposes with FAA costs GRA adjusted NTSB direct costs using the same 75.3% overhead rate as for FSDO labor.
Source: Memorandum regarding accident investigations from NTSB, September 19, 2019

8.3 FAA ACCIDENT AND INCIDENT INVESTIGATION COSTS[6]

In addition to participating in NTSB investigation of aircraft accidents, as described in Section 8.2, FAA also investigates aircraft incidents. Incidents are defined as an occurrence,

[5] BLS, National Industry-Specific Occupational Employment and Wage Estimates for NAICS 999100 - Federal Executive Branch (Occupation Code 00-0000)

[6] This report does not address costs for UAS accident investigation. These costs are expected to be scalable to the level of injury and/or destruction of property resulting from a UAS accident. While UAS differ in many respects from manned aircraft, the basic investigative process remains generally the same as for manned civil aircraft. However, for UAS investigations, issues involving command and control links, control station operation and the unique human factors aspects of remote pilot operation must be taken into consideration.

other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operations. This section describes FAA's cost of investigating both accidents and incidents.

FAA's financial systems could not provide a direct estimate of accident and incident investigation costs because some cost categories could not be reliably isolated in FAA's Cost Accounting System (CAS). Accident investigations are lumped into a general category of investigations which includes not only accidents but also includes other investigations, including but not limited to: accidents, incidents, violations, occurrences, and flight assists. As such, GRA worked with FAA to prepare an updated estimate based on several data sources. The key sources of data that were used included the following:

1. CAS for non-labor costs for FY 2016 – FY 2018
    a. FY2016 and FY2017 costs adjusted to 2018 dollars using BLS wage data[7]
2. FAA Aviation Safety Organization's (AVS) Zero Based Budget for FY 2018
3. Accident and incident investigation hours recorded on FAA Form 8020-23 for FY 2016 to FY 2018 (these were tabulated by Flight Standards Office of Foundational Business). These hours were converted to costs (in 2018 dollars) based on assumptions about the pay levels of FAA Safety Inspectors and adjusted for estimated time off and locality pay.

GRA also reviewed Program Tracking and Reporting Subsystem (PTRS) data, but an FAA expert for PTRS reported that this system records the number of activities but not the hours involved. GRA interviewed four FSDOs of different sizes (Anchorage, Spokane, Orlando, and South Florida) to assess how well the Form 8020-23 hours reflected the accident investigation level of effort. The FSDO's interviews reported the following:

1. Form 8020-23 provides primary data on the level of effort involved in GA accident and incident investigations.
2. Aviation safety inspectors generally spend from 1% to 5% of their work time on accident investigation.
3. Form 8020-23 data include the Federal Aviation Regulation (FAR) Part the aviation activity was conducted under, which allows distribution of investigation hours to FAR parts. Investigation costs are not reported by FAR Part because of small sample sizes.
4. The amount of time recorded on Form 8020-23 reflects the time spent on the investigation itself. Inspectors may spend some time after the investigation to complete information on activities related to the accident, but this is not believed to be a significant amount of time.

The investigation labor hours data recorded on Form 8020-23 are primary data that provides the best basis for an estimate of accident investigation costs for investigations conducted by AVP and the FAA Office of General Aviation Safety Assurance. The analysis assumes that the time spent by AVP acting as the FAA party to inspections conducted by NTSB

[7] BLS, National Industry-Specific Occupational Employment and Wage Estimates for NAICS 999100 - Federal Executive Branch (Occupation Code 00-0000)

or others is reflected in the costs of operating AVP. Most Part 121 investigation costs come from the AVP budget and some costs in other organizations. While AVP also provides some support for FAA-led accident investigations, the majority of its staff time and cost are for supporting investigations where AVP provides a representative to the NTSB team leading the investigation.

Most FAA investigations of general aviation accidents are handled by aviation safety inspectors in FSDOs. For relatively simple accidents/incidents the FSDO may conduct a desk review. On-site investigations are conducted for more serious accidents or accidents that may lead to an agency action.

The numbers of accidents and incidents by aircraft damage category and highest injury category are shown in Table 8-2. Over the three-year period, there were 3,736 accidents classified by highest injury category and 3,821 accidents classified by aircraft damage level. There also were 3,520 incidents when classified by highest injury category and 3,477 incidents when classified by aircraft damage. The numbers are different when reporting highest injury category and by aircraft damage because of the way in which FAA collects and records accident data.

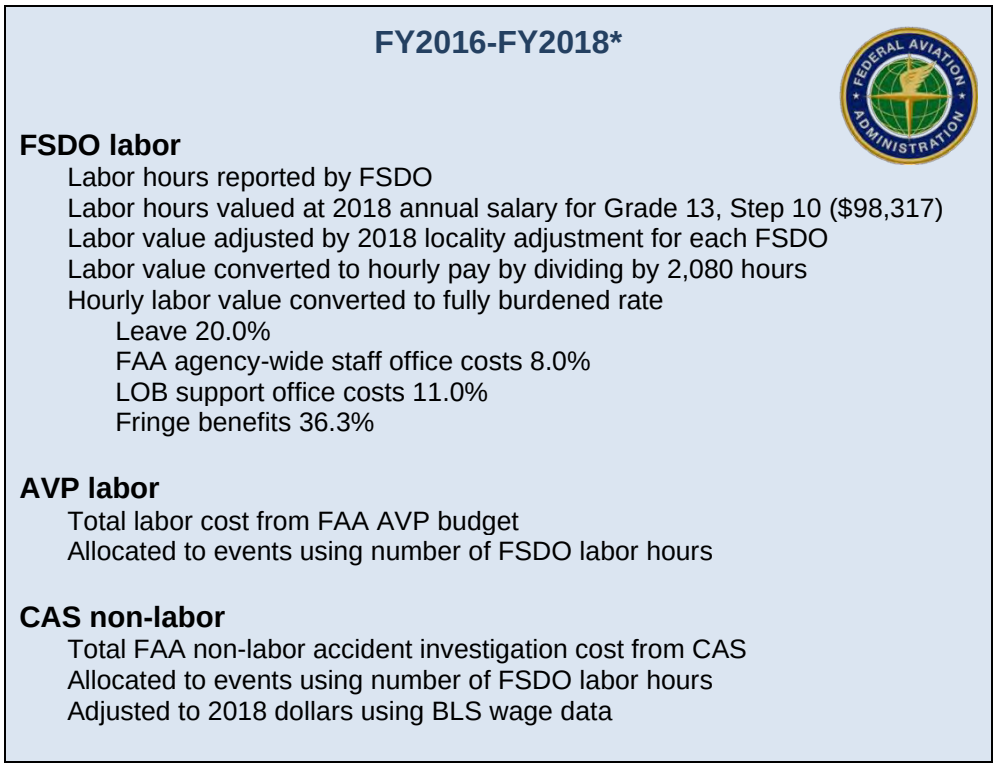
Table 8-2: Numbers of Accidents and Incidents and Investigator Hours (FY2016-FY2018)

Highest Injury Category	Count of Events		Investigator Hours		Average Investigator Hours per Event		Fully Loaded Investigator Cost per Event ($2018)	
	Accidents	Incidents	Accidents	Incidents	Accidents	Incidents	Accidents	Incidents
None or minor	2,782	3,520	50,957	44,164	18.3	12.5	$1,517	$1,039
Serious	323	N/A	7,734	N/A	23.9	N/A	$1,983	N/A
Fatal	631	N/A	26,662	N/A	42.3	N/A	$3,500	N/A
Total	3,736	3,520	85,353	44,164	22.8	12.5	$1,892	$1,039

Aircraft Damage	Count		Investigator Hours		Average Investigator Hours per Event		Fully Loaded Investigator Cost ($2018)	
	Accidents	Incidents	Accidents	Incidents	Accidents	Incidents	Accidents	Incidents
None	42	645	585	7,582	13.9	11.8	$1,154	$974
Minor	62	2,832	1,055	36,300	17.0	12.8	$1,410	$1,062
Substantial	2,802	N/A	54,384	N/A	19.4	N/A	$1,608	N/A
Destroyed	915	N/A	32,070	N/A	35.0	N/A	$2,903	N/A
Total	3,821	3,477	88,094	43,882	23.1	12.6	$1,910	$1,045

Figure 8-1 shows the approach used to expand investigator hours into the estimated total costs of FAA labor and non-labor expenditures for accident and incident investigations.

Figure 8-1: Converting Labor Hours to Full Costs of Accident and Incident Investigation



*AVP labor costs only available for FY2018

The factors from Figure 8-1 were used to convert the accident hours data to total FAA accident investigation cost estimates. As can be seen in Table 8-3, accidents with one or more fatalities had an average FAA investigation cost of $9,148 while accidents where the aircraft was destroyed had an average cost of $7,492. The average FAA investigation cost for incidents was approximately $2,700.

Table 8-3: Total FAA Investigation Costs for Accidents and Incidents by Highest Injury and Damage Categories

Highest Injury Category	Accidents ($2018)	Incidents ($2018)
None or minor	$3,966	$2,716
Serious	$5,184	N/A
Fatal	$9,148	N/A
Total	**$4,946**	**$2,716**

Aircraft Damage Category	Accidents ($2018)	Incidents ($2018)
None	$2,977	$2,513
Minor	$3,637	$2,740
Substantial	$4,149	N/A
Destroyed	$7,492	N/A
Total	**$4,928**	**$2,698**

8.4 APPROXIMATION OF PRIVATE SECTOR ACCIDENT INVESTIGATION COSTS

There are no direct estimates of private sector accident investigation costs. As such this analysis adopts the ratio of the number of private parties on an accident investigation sub team to the number of the NTSB sub teams used in the previous publication of *Economic Values for FAA Investment and Regulatory Decisions, A Guide*. These costs can vary greatly depending on the severity and location of the accident. The NTSB go team conducts an investigation by forming as many as twelve investigative sub-teams. Each sub-team, led by an NTSB investigator, is responsible for a particular subject matter area such as powerplants, airframes, avionics, control systems, operations, human factors, weather, survivability, and air traffic control. Most sub-team members, known as "parties," are from private industry and are invited to participate in the investigation by the NTSB. The party system allows the NTSB to leverage its resources and personnel by bringing to the investigation the technical expertise of the companies and entities (labor representatives, airlines, manufacturers, suppliers of components and sub-components, etc.,) that were involved in the accident or that might have specialized knowledge to assist the investigation.

This procedure results in significant investigation costs being incurred by the private sector. No systematic measures are available for this cost. However, an approximation may be made based on NTSB's costs. Discussions with NTSB and examination of NTSB accident reports suggested that about six private sector parties participate in major accident investigations and three private sector parties in regular field investigations.[8] Assuming that each of the private sector parties supports half of the investigative sub-teams at the same level of cost as incurred by NTSB for each sub-team, private costs may be approximated as three times NTSB costs for major investigations and 1.5 times NTSB costs for regular field investigations. In addition, the

[8] See: ECONOMIC VALUES FOR FAA INVESTMENT AND REGULATORY DECISIONS, A GUIDE Prepared by GRA Incorporated Under Contract No. DTFA 01-02-C00200.

private sector typically pays to remove aircraft wreckage. Aviation insurance industry sources placed this cost at about $138,000 per major accident.[9]

Applying these assumptions and values yields the approximation of private sector cost and total costs presented in Table 8-4. They range from an average of $58,000 for a GA field investigation to $3.1 million for a major investigation.

Table 8-4: Private Sector Accident Investigation Costs

Category	NTSB Average Direct Cost Including Estimated Overhead** ($2018)	Private Sector Multiplier	Private Sector Accident Investigation Cost ($2018)	Private Sector Aircraft Wreckage Removal Cost ($2018)
Major	$1,037,282	3.0	$3,111,845	$138,000
Foreign	$103,641	3.0	$310,924	$138,000
Part 135	$43,160	1.5	$64,741	$138,000
GA field	$38,860	1.5	$58,290	$138,000
GA limited	$5,948	-	$0	-
GA data collection	$986	-	$0	-

8.5 TOTAL PUBLIC AND PRIVATE SECTOR ACCIDENT INVESTIGATION COSTS

Although FAA and NTSB categorizations of accident investigations differ, reasonable assumptions can be made to estimate total public and private sector accident investigation costs. The NTSB categories are used for the basic structure and the most similar FAA categories are matched to the NTSB categories. Table 8-5 shows total public and private sector accident investigation costs. The FAA costs of incident investigation are excluded from this table.

[9] Clearly, there are major exceptions to this cost. As an example the costs of recovering, moving and storing the pieces of the TWA 800 wreckage.

Table 8-5: Total Public and Private Sector Investigation Costs per Accident

Category	FAA Labor and Non-Labor Accident Investigation Cost ($2018)	NTSB Average Direct Cost Including Estimated Overhead ($2018)	Private Sector Accident Investigation Cost ($2018)	Private Sector Aircraft Wreckage Removal Cost ($2018)	Total Public and Private Sector Accident Investigation Cost ($2018)
Major	$9,148[1]	$1,037,282	$3,111,845	$138,000	$4,296,274
Foreign	$9,148[1]	$103,641	$310,924	$138,000	$561,713
Part 135	$9,148[1]	$43,160	$64,741	$138,000	$255,049
GA field	$9,148[1]	$38,860	$58,290	$138,000	$244,298
GA limited	$5,184[2]	$5,948	$0	$0	$11,132
GA data collection	$2,977[3]	$986	$0	$0	$3,963

[1] Average FAA investigation cost per fatal injury accident
[2] Average FAA investigation cost per serious injury accident
[3] Average FAA investigation cost per no aircraft damage accident