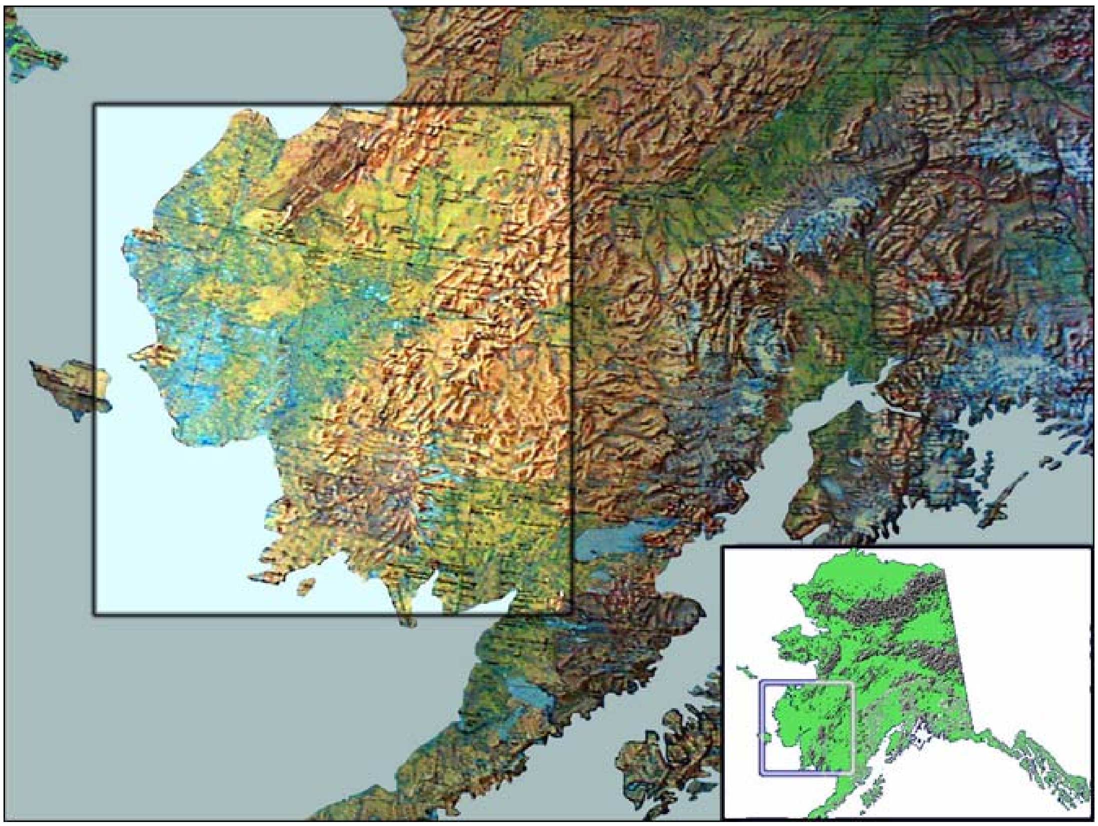
The Impact of Capstone Phase 1 Program
Final Report

September 2005



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1 Introduction[1]

1.1 Importance of Aviation in the Yukon-Kuskokwim Delta

Alaska relies on aviation more than any other state. Although Alaska covers 615,230[2] square miles, representing 16 percent of the total U.S. land area, it has only 13,628 miles of public roads.[3] Less than 10 percent of the state is accessible by road (the state capitol, Juneau, is accessible only by air or ferry), and river transport is possible only a few months of the year. As a result, aviation is the primary, and in most cases the only means of transport for Alaska's numerous remote villages. Unfortunately, most of these villages lack the aviation infrastructure found in the Lower 48. This, when added to the flying challenges posed by Alaska's mountainous terrain and fierce winter climate, has made safety the biggest concern for Alaska's aviation community.

The Y-K Delta area of Alaska is remote with only a few roads between villages and no road connections with any of Alaska's metropolitan centers. State of Alaska, in their YK Delta Transportation study, states that there are 54 villages in the YK Delta. Mekoryuk is not included in this Capstone Phase 1 Impact Study which considers only Bethel and the remaining 53 villages. As of 1999, there were 24,366 people living in the YK Delta: 22.5% of them live in Bethel and 39 of the villages (or 72%) have populations of less than 500 people. Transportation of goods and people takes place by water travel (where available) in the summer, snow travel in the winter and aviation travel year round. At some villages, there are many times during the year that aviation is the only means of transportation.

1.2 Traffic in the Y-K Delta

Of the 53 villages in the Y-K Delta, 33 are served by either air carriers operating from Anchorage, Fairbanks or Nome, or scheduled air taxis operating within the Y-K Delta. The scheduled air taxi routes are depicted in Figure 1.2-1 for airports with at least 52 scheduled flights per year. For the analyses in this report, any Y-K Delta accident or operation will have either its origin or destination at one of these 54 airports. The data supporting this figure can be found in Section 6.2, Appendix B.

Bethel, the largest community in the Y-K Delta, is the aviation center and also the economic, governmental, and cultural center of the region. Aniak, to the northeast, and St. Mary's, to the northwest, serve as economic and mail distribution hubs. The hubs receive daily scheduled service from passenger and cargo carriers. The mainline passenger and cargo flights to Bethel originate in Anchorage, the largest hub airport in Alaska. These flights use Boeing 737 and Beech 1900 passenger aircraft and DC-6, Boeing 727, and EMB 120 Brasilia cargo aircraft.

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[1] The contents of this material reflect the views of the authors. Neither the Federal Aviation Administration nor the Department of Transportation, makes any warranty or guarantee, or promise, expressed or implied, concerning the content or accuracy of the views expressed herein.

[2] Statistical Abstract of the United States, 2001, Table 343.

[3] Alaska DOT&PF, http://www.dot.state.ak.us/stwdplng/highwaydata/pub/cprm/2001cprm.pdf , Certified Public Road Mileage as of December 21, 2001. Excludes Marine Highway miles.

Since air is the only transportation mode that can operate in the region year-round, all passengers and 95 percent of all cargo arrive via scheduled air service. Bethel, Aniak, and, St. Marys are mail hubs for the smaller communities in the Y-K Delta. Single-engine and light twin-engine aircraft such as Cessna 207s, Cessna 208 Caravans, Cessna 172s, CASA 212s, and Twin Otters carry passengers and cargo to those smaller communities.

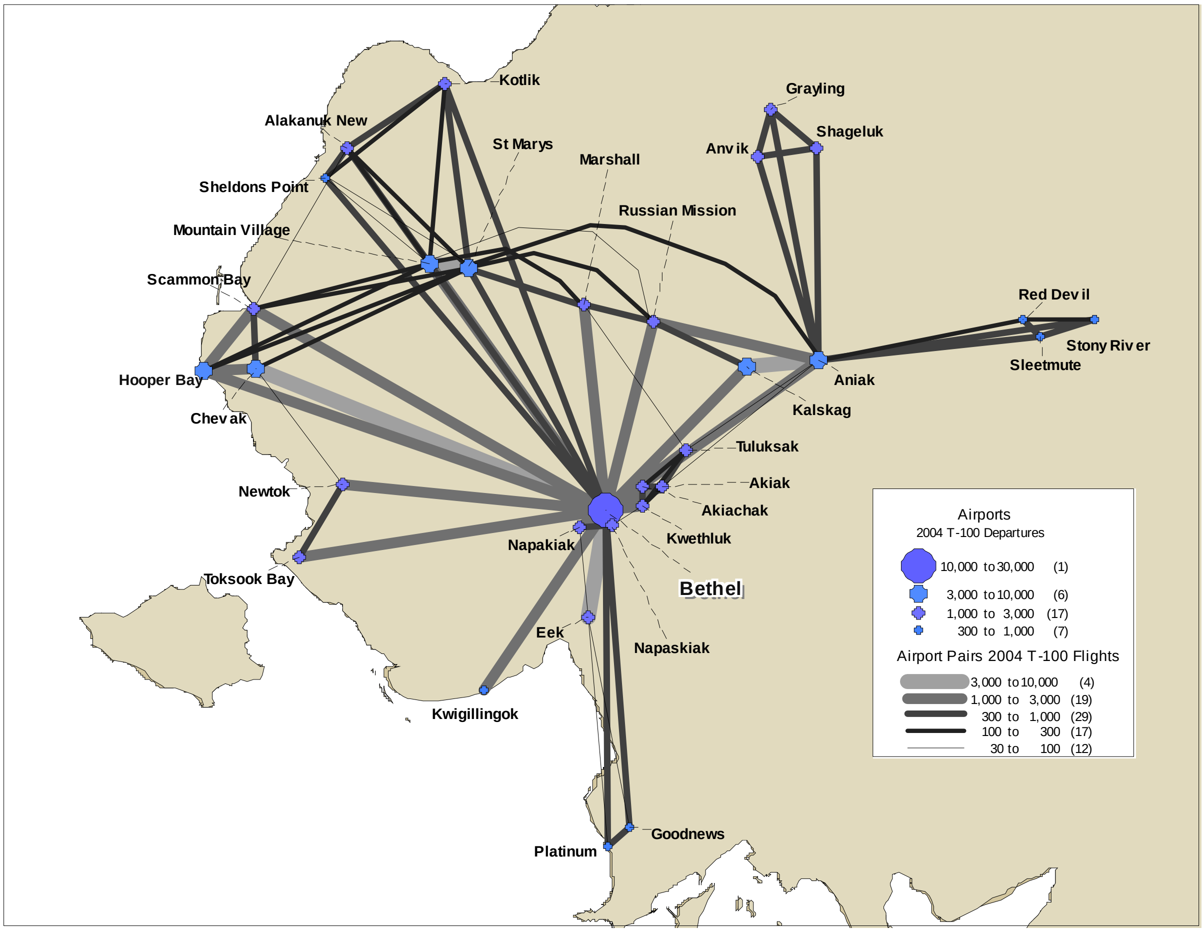

Figure 1.2-1 Airport Departures and Route Traffic in the Yukon-Kuskokwim Delta

In a typical scenario, an Alaska Airlines Boeing 737 flies from Anchorage to Bethel with 16,000 to 20,000 pounds of freight and mail and about 50 passengers. In Bethel, passengers, freight, and mail headed for other communities transfer to local carriers. For example, a Cessna 207 with 4 passengers and 300 pounds of mail might fly a circuit from Bethel to Hooper Bay, then Scammon Bay, and finally Chevak before returning to Bethel.

T-100 Segment Data maintained by the Department of Transportation's Bureau of Transportation Statistics is available for FAA operators certificated under FAR Part-135, Scheduled Operators. This information allows an in-depth analysis of Y-K Delta traffic distribution. Off Schedule routes are defined as flights conducted by a Scheduled Operator that were not scheduled. Non-scheduled operators are not required to file T-100 data and therefore are not included in the analysis below.

Figure 1.2-2 shows the distribution of flights within Alaska. Thirty-five percent of all Alaska operations from 2002 through 2004 are either Intra-Delta or fly between the Y-K Delta and other areas within Alaska. Intra-Delta flights account for 12 percent of all Alaska operations.

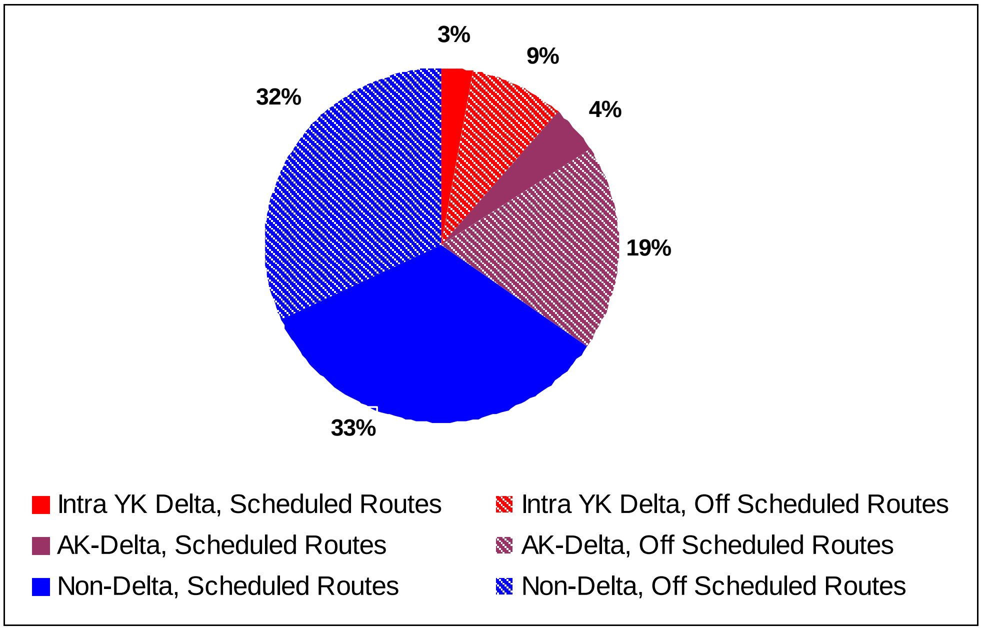

Figure 1.2-2 Intra Alaska Flights by Scheduled Operators, 2002-2004

Within the Y-K Delta the distribution of flights is primarily between hubs and villages, accounting for 71 percent of all operations. Traffic between villages account for 26 percent of all flights, and hub-to-hub operations make up only 3 percent. Figure 1.2-3 depicts this distribution.

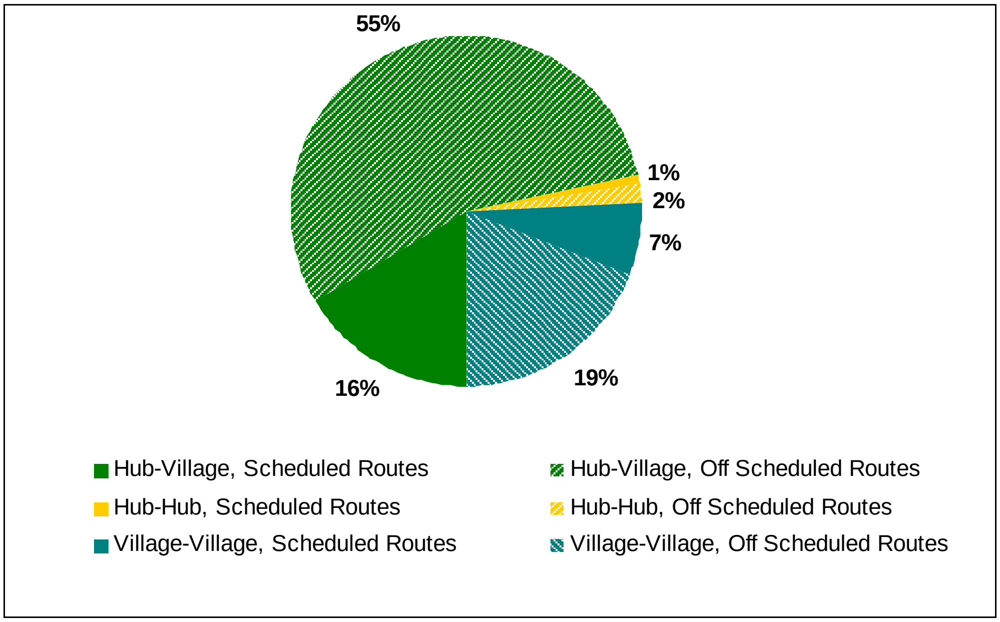

Figure 1.2-3 Distribution of Intra-Y-K Delta Flights by Scheduled Operators, 2002-2004

1.3 Historical Accidents in the Y-K Delta

Figure 1.3-1 depicts the types and causes of accidents prior to Capstone for commercial aircraft (operating under Federal Aviation Regulations Part-135) based in the Y-K Delta. These are the aircraft most directly affected by Capstone. Major categories (the inner pie slices) are explained below. Some accidents also fall within some special sub-category (outer pie segments) but many do not. The dark band and underlined categories and sub-categories identify causes of accidents that were targeted by Capstone prior to the start of the program. Since the program started, other areas have been impacted by Capstone, at least indirectly.

Fuel Mismanagement**:** Usually fuel exhaustion. Occasionally, failure to switch fuel tanks.

Mechanical Failure**:** Engine failure, inoperable control surfaces, failed landing gear, propeller or shaft failure. (There were no fatal accidents in this category by Y-K Delta based Part-135. In the Lower 48, 10% of mechanical accidents are fatal.)

Flight Information**:** Usually inadequate weather information, especially icing, but also visibility; rarely convective weather. (Surface winds contributing to take-off or landing accidents have been included under take-off or landing rather than here.) Occasionally, lack of information on changes in procedures or facility status.

Navigation: Usually Controlled Flight into Terrain (**CFIT**) while enroute, most often associated with reduced visibility. In the Y-K Delta, CFIT also occurs in nominal VFR conditions when "flat light" on snow-covered ground prevents recognition of terrain. Terrain Clearance Floor (**TCF**) warnings are a Terrain Awareness and Warning System (TAWS) function planned for Capstone Phase 2 that addresses the 20%-30% of CFIT accidents on approach or departure. These are not directly addressed by Capstone Phase 1 avionics. Rarely, accidents are due to mislocation, which can be addressed by a GPS- **map** display.

Traffic: Usually mid-air collisions between aircraft. Also includes accidents from last-moment avoidance of other aircraft.

Flight Preparation**:** Failure to ensure cargo is tied-down and within the aircraft's **weight and balance** limits. Failure to check fuel for the presence of water. Failure to remove ice or snow from the aircraft – often resulting in serious or fatal accidents (rare in the Lower 48 but more common in the Y-K Delta)

Take-off and **Landing:** Failure to maintain control (especially in wind), improper airspeed, or inadequate care near vehicles or obstacles. The Y-K Delta also includes unusually high numbers of accidents from poor runway **conditions**, from hazards at an off-runway **site** such as beaches and gravel bars, and from obstacles in water that are struck by float-planes.

Other: Taxi or airport vehicle accidents, low altitude maneuvering for game spotting or photography, spatial disorientation, improper carburetor heat, bird strikes.

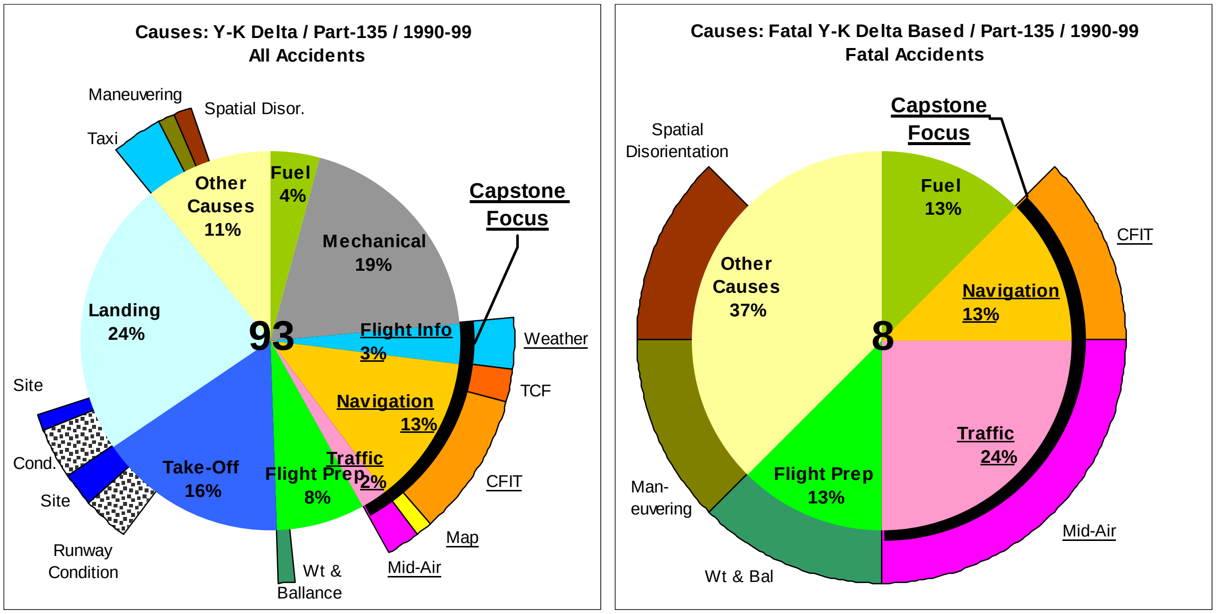

Figure 1.3-1 93 Accidents and 8 Fatal Accidents by Y-K Delta Part-135 Aircraft 1990-1999

Causes of overall accidents and causes of fatal accidents had very different percentages. Many accidents were associated with take-off, landing and mechanical problems, but relatively few of these caused injuries and none caused fatalities. By contrast, accidents from inadequate flight preparation, fuel mismanagement, lack of flight information, collisions with other aircraft, and difficulty navigating were much more likely to cause injuries and fatalities. Differences such as these are consistent with recent accident studies[4] for the US as a whole. The percentage of fatal accidents associated with traffic (collision or interaction with other aircraft) was higher than that in the Lower 48; the percentage associated with navigation was comparable. "Weather" accidents (which are split between several of the categories[5] used here) were often fatal in both the Lower 48 and Alaska. Capstone focuses on these more serious accident types.

[4] Annual *Nall Report*, AOPA Air Safety Foundation

[5] Weather contributes to accidents associated with navigation, flight preparation, and spatial disorientation, which have a high fraction of fatal accidents. It also contributes to take-off and landing accidents that cause few fatalities in the Y-K Delta – none from 1990 to 1999. (In the Lower 48 take-off accidents have significant fatalities.)

2 Capstone Program Background

2.1 Capstone Program Initiation

In early 1997, the Federal Aviation Administration began developing a proposal entitled "Flight 2000." Flight 2000 was the precursor to the Safe Flight 21 program. That initiative envisioned rapid deployment and field demonstration of advanced avionics capabilities leading toward implementation of Free Flight. The FAA analysis indicated that there would be a 38% reduction in commercial aircraft accidents if the Flight 2000-envisioned avionics were installed in Alaska.[6] Within the Alaskan Region, Flight 2000 served as the "capstone" for many additional initiatives, providing a common umbrella for planning, coordination, focus, and direction with regard to development of the future NAS.

The Capstone project was proposed as an operational demonstration program for Alaska, installing and demonstrating ADS-B technology in the Bethel and Y-K Delta area initially. This became know as the Capstone Phase 1 program. Coordination and regular meeting were held with the Alaska Aviation Industry Council to develop and tailor the program to suit all parties. Ten airports were to be the focus of the program. The Capstone proposal was funded with $11 million in Fiscal Year 1999.

In December 2000, an initial meeting with the Southeast Alaska Aviation Industry Council was held to discuss the potential for extending the Capstone program into Southeast Alaska (Phase II). Phase II officially began in March of 2003. The FAA is currently conducting research and developing a plan for Phase III which would include the entire State of Alaska.

2.2 Overview of the Technical Aspects of Phase 1

The capabilities of Capstone Phase 1 target four serious safety problems in Alaska:

- CFIT accidents (within the navigation category)
- Accidents associated with aircraft traffic – especially mid-air collisions
- Inadequate flight information – especially weather information
- Inadequate infrastructure to support IFR operations

Capstone's Phase 1 capabilities can also affect operations efficiency. While efficiency is not the subject of this paper, it is important to recognize that there are safety consequences to landing delays and to flights that are unable to reach their intended destinations. These inefficiencies typically occur in marginal visibility when the potential for icing is higher than otherwise and when it is more difficult to see-and-avoid aircraft circling to wait for Special VFR (SVFR)

[6] *Economic Justification for FAA's Flight 2000 Program,* September 23, 1997

clearance. Therefore, decreasing arrival delays or aborted flights (from radar-like services or increased IFR capability) seem likely to decrease accidents.

Capstone uses new technologies that have only recently become available or are being implemented for the first time. Figure 2.2-1 illustrates how Capstone works.

- Accidents associated with ***navigation*** are addressed by showing pilots their location on a ***moving map*** on a Multi-Function Display (MFD). The location of the aircraft is derived from GPS, and the map is stored as part of an onboard navigation database. ***En route CFIT*** is addressed using terrain elevations from the database. Nearby terrain is compared to the aircraft's altitude and GPS location and then color-coded on the MFD (yellow if close in altitude, red if immediately hazardous). The GPS unit also has programmable functions to aid en route flight planning and may reduce pilot navigation workload.
- Accidents associated with aircraft ***traffic*** are addressed by ATC radar-like services and by showing pilots the relative locations of other Capstone-equipped aircraft. This is derived from Automatic Dependent Surveillance Broadcast (ADS-B) messages transmitted via a Universal Access Transceiver (UAT) by other aircraft and received and processed to provide a Cockpit Display of Traffic Information (CDTI) – one of the functions of the MFD. CDTI also enhances pilot situational awareness and aids pilot-pilot coordination at non-towered airfields. In the future, locations of aircraft that are not Capstone equipped but are visible to ATC radar might be provided by Traffic Information Service Broadcast (TIS-B).
- ***Weather and flight information*** are provided by new Automated Weather Observing Systems (AWOS) at remote airports, and by Flight Information System Broadcast (FIS-B) of weather text and NEXRAD graphics. FIS-B is distributed by data network to Ground Based Transmitters (GBTs) that broadcast to equipped aircraft. Aircraft with Capstone avionics receive these broadcasts on a UAT and display them to pilots on the MFD.
- ***Increased IFR operation*** is supported at remote airfields by AWOS installations, which allow GPS instrument approaches to be approved for commercial operations. For qualified aircraft, this allows safe IFR operations in low visibility conditions that would be unsafe for VFR operations. IFR operations are improved and expanded by Air Traffic Control (ATC) use of ADS-B to support cost-effective ***radar-like services***. ADS-B takes an aircraft's location from GPS and transmits it once per second over the UAT. GBTs receive these messages from all nearby Capstone equipped aircraft, and forward them to ATC computers where they are processed and the aircraft locations displayed much like aircraft locations from radar. This allows controllers to provide flight following and surveillance-based separation services in airspace that is not visible to radar. (Note - ADS-B applications may use or require other on-board navigation sources instead of or in addition to GPS. Capstone avionics in Phase 1 use GPS and barometric altimetry.)
- The *situational awareness* for **tower operations** at Bethel airport now includes information from a "BRITE" display of ADS-B targets. This helps them visually locate aircraft and better coordinate arrival sequencing.

- Managers in companies that operate Capstone equipped aircraft use ***flight monitoring*** that shows the location of their aircraft on personal computers (PCs) connected to the Internet. This has the potential to significantly improve awareness of risks and to facilitate further improvements in safety posture.

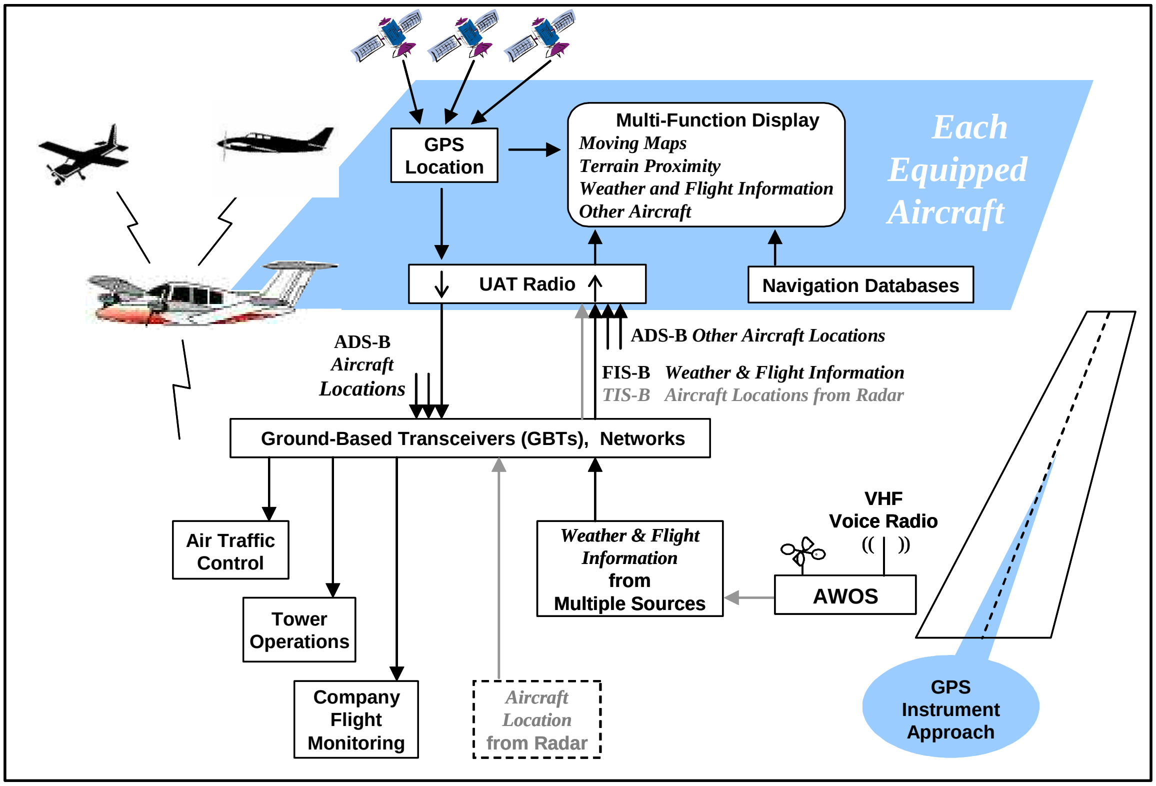

Figure 2.2-1 Capstone Avionics, Ground Systems, and Capabilities
Capabilities not operational in 2004 are gray

3 Capstone Implementation History

3.1 Overview

During 1999, the Capstone office was established and staffed, program planning was well underway, new routes and approaches were being developed and both flight and ground equipment specifications were being written. By late 1999, the Supplemental Type Certificate for installation of the flight avionics was approved and avionics were installed in the first two aircraft.

GBT and AWOS installations began in 2000. All GBT installations were completed by March 2002 and all AWOS installations were completed by September 2002. Software to process the ADS-B returns was installed in the Mirco-EARTS computer at the Anchorage Center in December 2000.

By the end of 2000, 78 aircraft had been modified with Capstone avionics; by 2001 140 were modified; and 208 had been modified by the end of the Phase 1 program in 2004. The following paragraphs provide an overview of the implementation of the individual program elements.

3.2 Approaches

One of the key elements of the Capstone Phase 1 program was to improve the approaches at a number of airports. During 1998 and early 1999, a list of ten airports that would receive new GPS non-precision instrument approaches was developed in collaboration with the Industry Council. Between December 1999 and December 2001, stand-alone GPS approaches were developed, approved and published at these ten airports. These airports were St. Michael, Mountain Village, Platinum, Holy Cross, Kalskag, Kipnuk, Koliganek, Russian Mission, Scammon Bay and Egegik. Pilot Point received a GPS approach in February, 2004.

3.3 AWOS

Ten airports have received AWOS stations associated with the GPS approaches under the Capstone Phase 1 Program. These airports; St. Michael, Mountain Village, Platinum, Holy Cross, Kalskag, Kipnuk, Koliganek, Russian Mission, Scammon Bay and Pilot Point; shown in Figure 3.3-1, had AWOS stations installed between June of 2000 and September of 2002. Egegik had a previously-installed AWOS that was included in the program. The new stations have more than doubled the number of full-time weather reporting sites in the Y-K Delta, reducing the distance between weather observations to less than 50 miles on most flight routes. Pilots can listen to vocalized current weather observations by phone prior to departure or by radio when flying near these sites. Since these stations are not connected to networks for national weather-data distribution, observations are not yet available on the MFD via FIS-B.

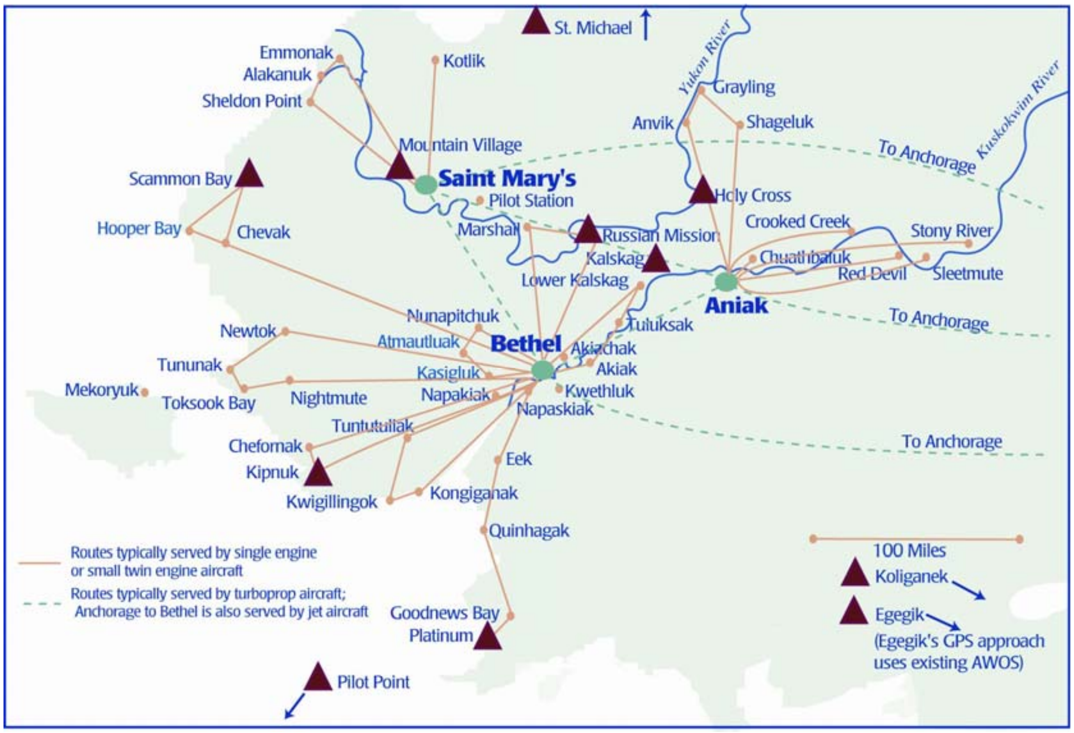

Figure 3.3-1 Locations of AWOS and Non-Precision GPS Instrument Approaches

The AWOS stations have proven to be very reliable. Full outages occurred less than one percent of the time during the year. Service from an AWOS is considered reduced if there is an outage of a single parameter, such as wind, ceiling, visibility, etc. Figure 3.3-2 shows that AWOSs were Fully Serviceable 90% of the time during the year and at Reduced Service only 9% of the time.

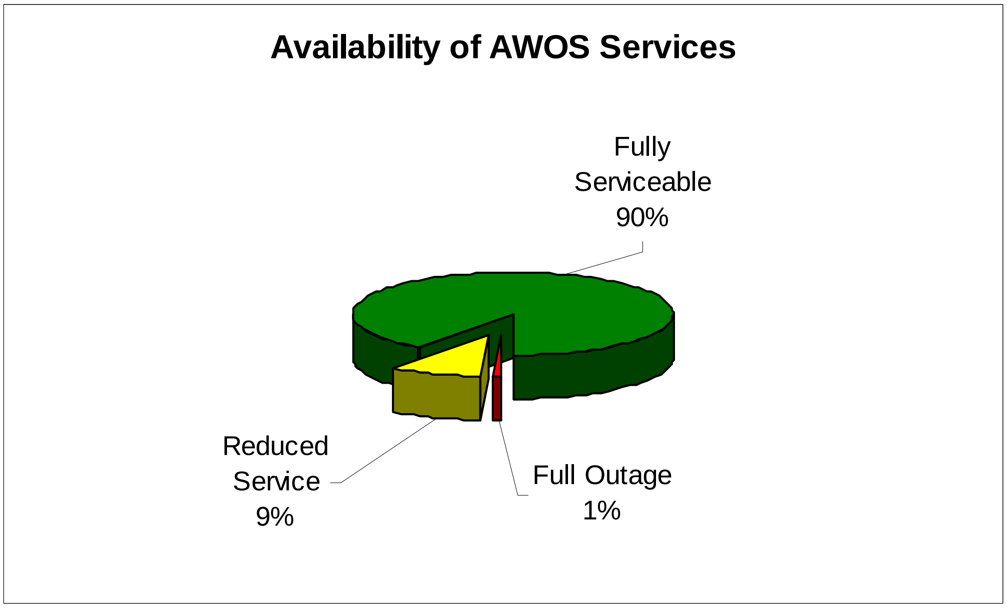

Figure 3.3-2 AWOS - Percent of Time Available

3.4 GBTs

A total of 11 Ground Based Transmitters were installed in the Y-K-Delta. Capstone GBTs used the frequency of 966 MHz for the initial demonstration phase. This frequency belonged to the Department of Defense and was temporarily approved for use in Alaska and the Ohio Valley during ADS-B development. Capstone received approval for use of 981 MHz on a year to year basis in October of 2000 as an interim while a permanent frequency assignment was approved. The GBTs and UATs in the Capstone Phase 1 program all used this interim frequency. This allowed Capstone to start operations using this developmental network but did not allow for self equipage. A permanent frequency assignment of 978 MHz was assigned and transition to the new frequency is to take place in early 2005 following GBT certification of Minimum Operational Performance Specification (MOPS) compliance.

The initial GBTs that were installed in the YK Delta were designated as developmental because of their lack of technological maturity. The second generation of GBTs were designed to be more robust and they were designated as the operational GBTs. There is a difference in the reliability of the developmental GBTs and those that are on the operational system. The GBTs at most sites have redundant GBT pairs to minimize non-availability of surveillance. Figure 3.4-1 shows the percentage of time that the GBTs had full capabilities with redundancy and availability of a single channel. In both 2003 and 2004, the operational GBTs had nearly 100% availability while the developmental GBTs were available just over 90% of the time.

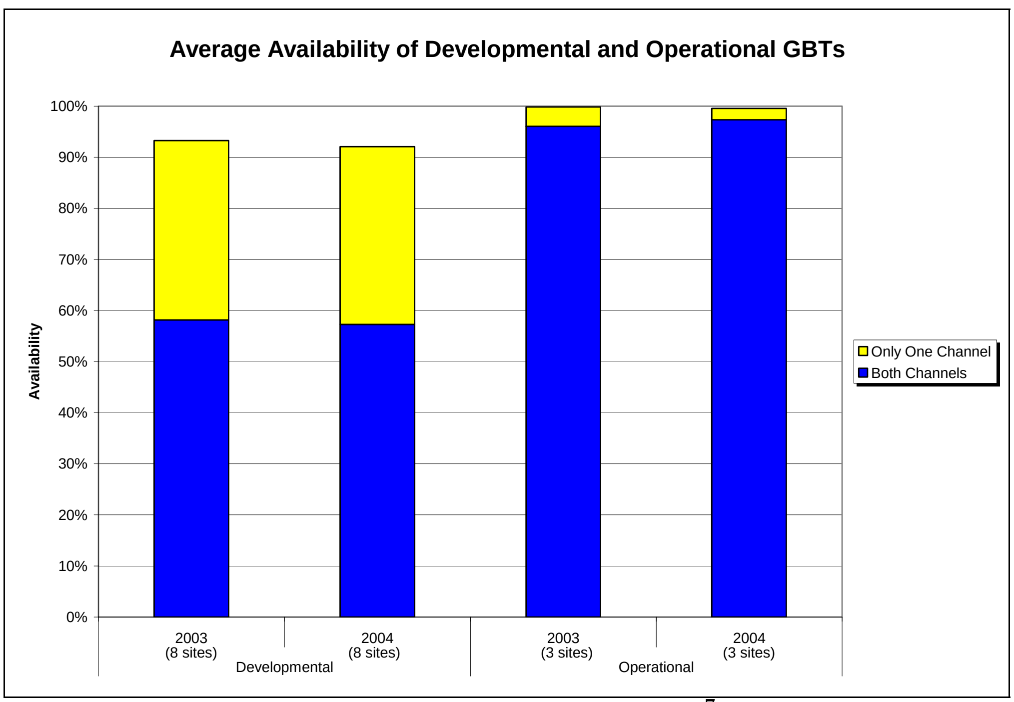

Figure 3.4-1 GBT Reliability[7]

[7] The data available for the developmental GBTs was the percentage of time during each month when the particular GBT at a site was on the air. Of the eight sites that had two GBTs it was assumed that the times that the GBTs were off the air were

3.5 Aircraft and Avionics

3.5.1 Aircraft Equipage

In 2000-2001, Capstone equipped almost six aircraft per month, reaching 140 of the 165 active Y-K Delta Part-135 aircraft by December 2001. By early 2003, a total of 200 aircraft were equipped – several of which operate as government or "public use" aircraft. At the end of Phase 1 in 2004, Capstone had equipped a total of 208 aircraft. Of these, 189 were operating commercially under FAA Part-135 or Part-121. The number of Class 4 (turbine) aircraft has increased 180% from 15 in 2000 to 42 in 2004. The number of IFR aircraft has increased 179% from 19 in 2000 to 53 in 2004. Figure 3.5-1 shows the equipage by year, class, and whether aircraft were Part-91 or Part-135. It also shows the number of IFR aircraft that were Capstone-equipped. Note: As will be discussed later in this report, economic decisions by the operators have changed the number of commercial aircraft actually operating in the Y-K Delta and the fleet mix of those aircraft.

At the end of 2004, Capstone-equipped aircraft accounted for nearly 100% of operations by Part-135 aircraft based in the Y-K Delta. Non-equipped, non-jet aircraft accounted for only 0.9%. One aircraft was also purchased near the end of 2004 and was operating in the Y-K Delta while waiting to be outfitted with commercially-available Capstone equipment.

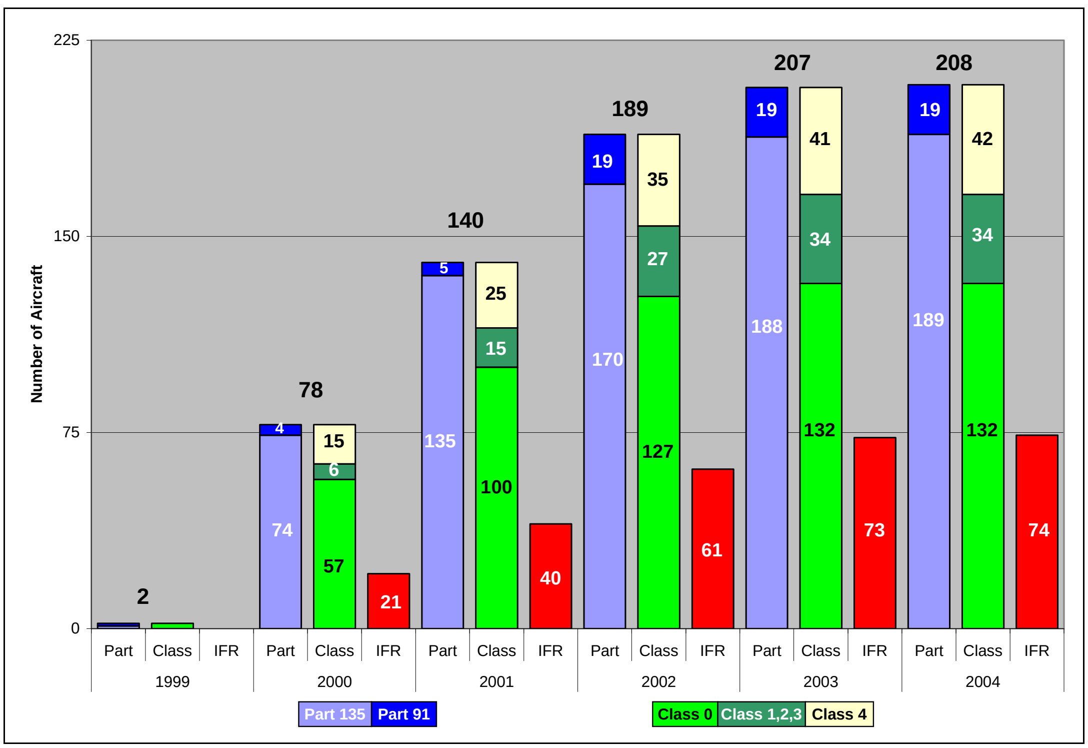

Figure 3.5-1 Equipage and Commercial Operations with Capstone Avionics by Part-135 Aircraft based in the Y-K Delta

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independent of each other. In other words it was assumed that there was no correlation between the down times for these paired units. This assumption will tend to overestimate the availability of the developmental GBTs.

3.5.2 Avionics Component Reliability

An effective aircraft and component reliability program requires an operator to have a number of aircraft of the same type (generally 6-8 aircraft minimum) and a capable, full-time records or engineering department. The diverse fleet mix and number of small operators in the Y-K Delta makes this impractical and reliability programs are not required by the FAA for small Part 135 operators. The only quantitative data available on the reliability of Capstone avionics is from the manufacturer concerning components that have been returned for repair.

The Capstone Phase 1 avionics components have shown good reliability considering that the systems are new and would be expected to have some transient difficulties in their introduction into Southwest Alaska. The charts in Figure 3.5.2-1 show both the number of units returned over the life of the program and the percentage of the total returns in several categories. There were a large percentage of the units, especially the UATs, which were returned for *Upgrades*. These upgrades are primarily driven by field experience and analysis of failed units and should reduce failure rates in the future. *Failure* means there was an actual failure of the unit which could include software, solder failures, loose parts, etc. *No Problem Found* and *Customer Caused* are indications that the systems were new and that maintenance staff were still learning how to effectively troubleshoot problems. The number of returns decreased as troubleshooting experience built and knowledge of the system improved.

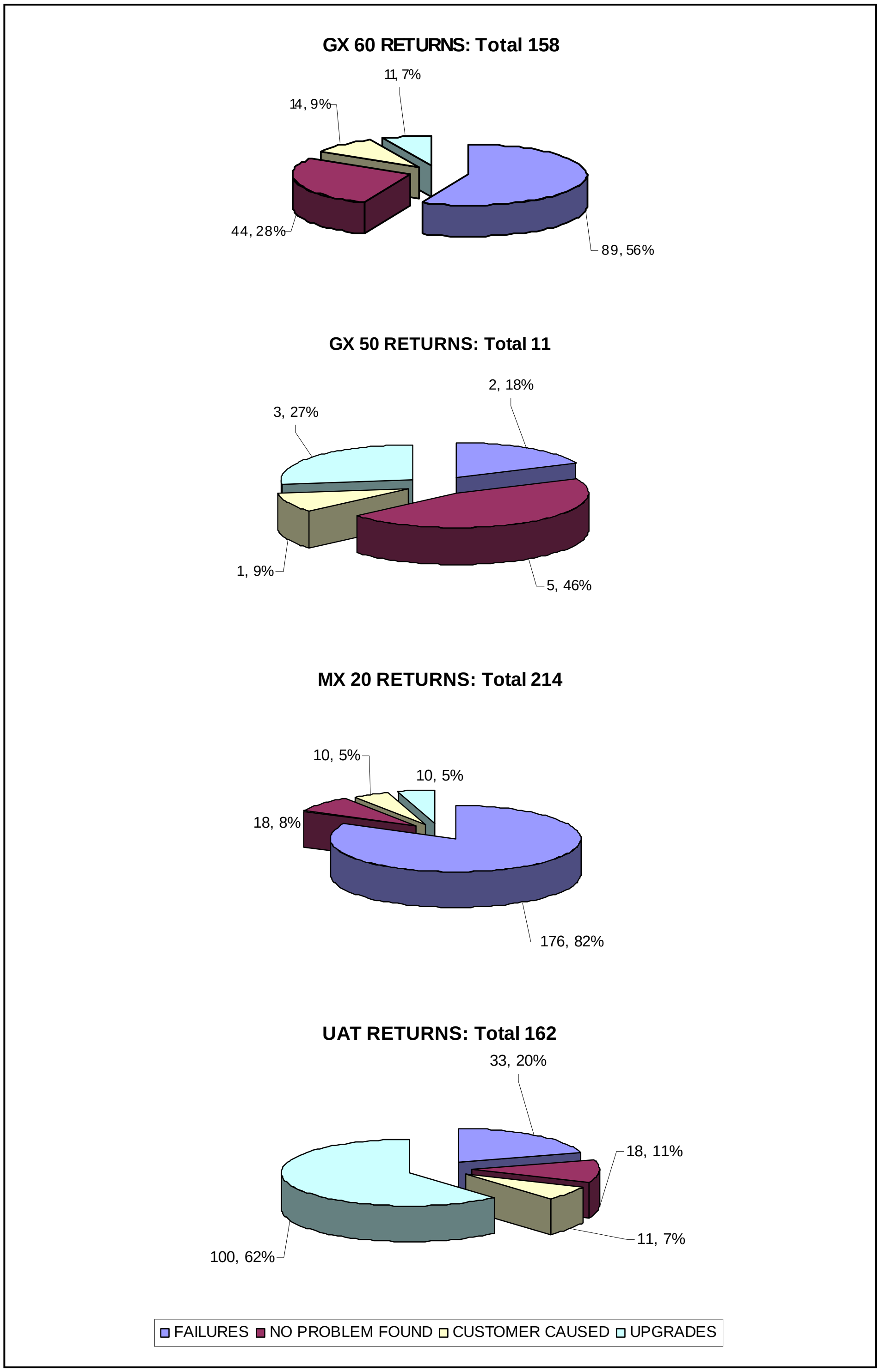


Figure 3.5-2 Avionics Returns Since 2000

3.6 Air Traffic Control

3.6.1 Radar-like Services

Flights below 6,000 feet in the Y-K Delta occur in a non-radar environment. The only radar coverage in the area is high-altitude coverage for long-range jets, controlled from Anchorage Center. Capstone's traffic awareness function, which lets anyone with an ADS-B receiver see the locations and altitudes of Capstone-equipped aircraft, brings the potential of "radar-like" services to the Y-K Delta. Controllers in Anchorage use Capstone's ADS-B feature to guide Capstone-equipped aircraft just as they now use radar to guide aircraft over 6,000 feet.

The Bethel Ground-Based Transceiver (GBT), commissioned in December of 2000, allowed radar-like services for the first time in the Y-K Delta. Capstone added GBTs at Aniak and St. Mary's GBTs in August of 2002, expanding the availability of radar-like services to 44% of all arrivals and departures. The following chart depicts the coverage based on the average monthly distribution of flights in the Y-K Delta.

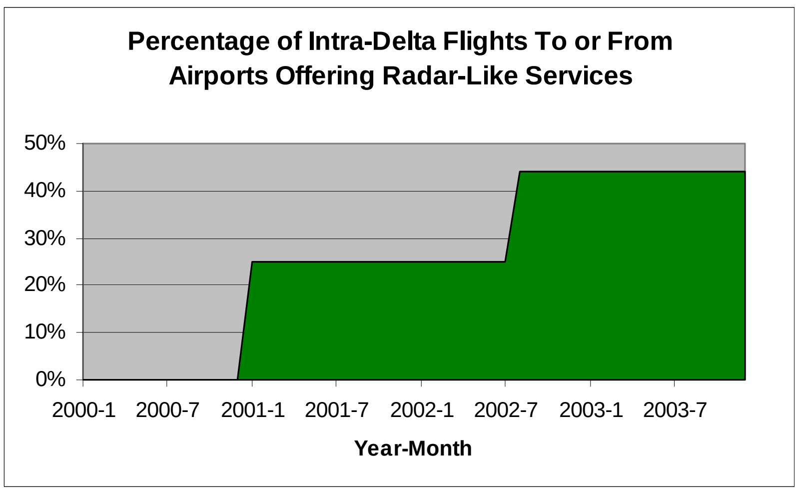


Figure 3.6-1 Radar-Like Services Availability

Although radar-like service is available for these flights, there is no data to confirm the actual number of radar-like services used. Until this data becomes available, it's impossible to determine the overall benefits or even estimate the potential safety benefit. There is, however, an estimate of the communications benefit from radar-like services discussed in Section 4.2.2.2.

3.6.2 Tower Services and Approach Control

The Bethel tower currently provides services for VFR and Special VFR (SVFR) traffic and coordinates with Anchorage Center on IFR traffic to and from the Bethel airport. Intermittently during 2002, Bethel controllers were able to use a "BRITE" display to more easily acquire and track ADS-B equipped aircraft. The FAA continued to work on implementing ADS-B capability as part of an approach control system for Bethel through 2003. Approach control, which is planned, could potentially allow air traffic controllers located in Fairbanks to use Capstone technology to space and sequence IFR or SVFR aircraft landing at Bethel. The use of ADS-B as part of an approach control system may improve traffic flow in IFR and Marginal VFR (MVFR) conditions. Operators are eager to see this capability in place, and the FAA is working through the complex regulatory and contractual issues.

3.6.3 Flight Monitoring

In 2002, the Applied Physics Laboratory at Johns Hopkins University developed software that runs a CRABS (Comprehensive Real-Time Assessment Broadcast System) display, allowing operators who sign up for the service to monitor the locations of their Capstone-equipped aircraft over the Internet. Capstone provided this service, at no cost, to all of the operators with equipped aircraft.

3.7 Training

The University of Alaska Anchorage, through an agreement with the FAA Capstone office, provided initial training to the air carriers' trainers on the operation and use of the Capstone system via a "train the trainer" program. The UAA training program consisted of 16 hours of structured training using both classroom instruction and desktop avionics simulator training devices. The University also provided each operator with an FAA compliant training program master syllabus outlining ground training, flight training, checking and recordkeeping that could easily be used by the company for their FAA-approved training programs.

This "trainer-the-trainer" program began in spring of 2000 and continued through 2003. The University provided initial training for 35 operators with a total of 68 company trainers completing the course. The training was delivered to each operator as close as practical to the delivery of their first Capstone equipped aircraft. The typical operator had two people receiving 16 hours of classroom instruction including the use of the avionics training device. This initial training evaluated each participant and his/her ability to properly use the GX60 GPS and the MX20 MFD provided by Capstone. In addition to the 35 commercial operators, there were 11 Part 91 operators trained by the UAA, including the Civil Air Patrol, forestry personnel, and trainers from M.A.R.C. The UAA also provided training to personnel from Transport Canada, the NTSB, and FAA air traffic personnel. Because the UAA had trained trainers for all companies in prior years, they conducted no training directly for the Capstone program in 2004.

Once each operator had a trained trainer and an FAA-approved training program, most operators began conducting their own training. Ten operators use the UAA avionics training devices in their current training programs. The UAA offers the use of the avionics training devices to companies who request it. The University was also contracted by two operators to provide 100% of their initial training to all of their pilots during the 2000-2001 timeframe. These two companies continue to have all of their initial training conducted by the UAA and one of these two continues to use the UAA to provide their recurrent training as well.

The operations data for 2004 listed 18 commercial air carriers operating out of Bethel in scheduled service. Of those 18, 12 had trainers trained by the UAA Capstone "train-the-trainer" program. These 12 companies comprise 93.25 % of the total Y-K Delta commercial operations for 2004 as shown in Figure 3.7.1-1. Figure 3.7.1-2 shows the percentage of Y-K Delta operations conducted by each operator with a UAA trained trainer. These data do not include the FAR 135 "On-Demand" operations.

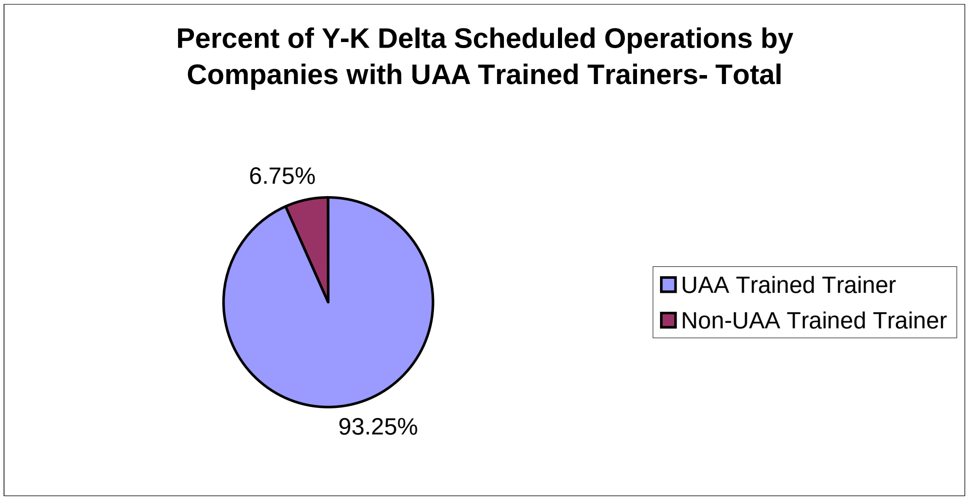


Figure 3.7.1-1 Percent of Operations with UAA Trained Trainers

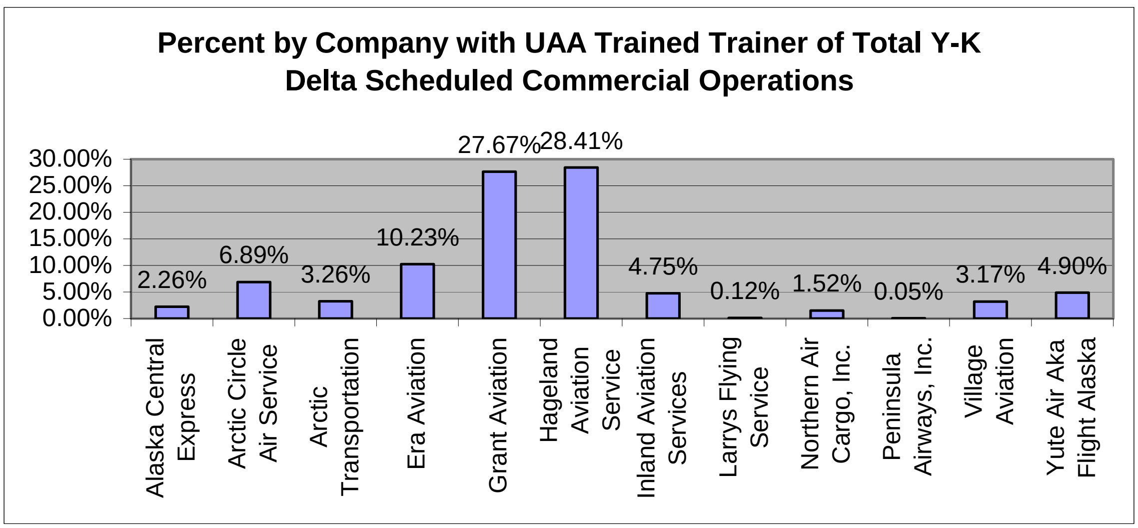


Figure 3.7.1-2 Percent of Operations by Company with UAA Trained Trainer

Operators and pilots surveyed generally agreed that Capstone training should include both initial and recurrent training, classroom, desktop simulator, and flight training, and flight checking. The Capstone pilots surveyed reported how many hours of classroom training, classroom with desktop-simulator training, and flight training they had received. The majority of these pilots reported getting initial and recurrent training from their company. Figure 3.7.1-3 shows the reported number of training hours received by pilots for 2003 and 2004.

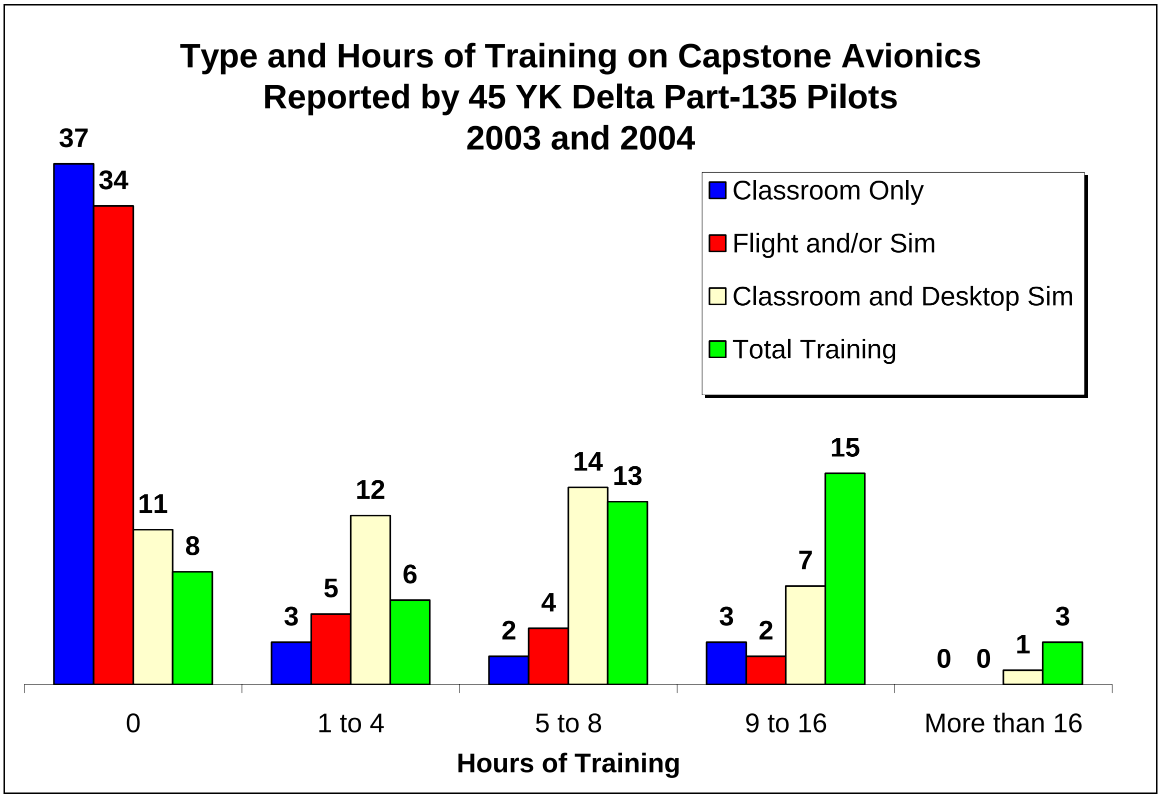


Figure 3.7.1-3 Pilot reported training hours.

Training levels ranged from none up to several days of classroom/simulator training supplemented by substantial flight training. In 2003, the training levels for Capstone pilots employed by Y-K Delta Part-135 operators were summarized and sorted into five groups, estimating an effectiveness rating for each. A 100 percent effectiveness rating would mean that a pilot would always use the equipment perfectly in every instance where it could be useful. Fifty percent effectiveness would mean that over time, we expect a pilot would avoid 50 percent of the accidents and incidents where Capstone avionics could theoretically be useful. Zero percent effectiveness would be that expected with the avionics turned off. This data was combined with classroom observations, pilot self-reports, field interviews, and in-flight observations in live operations by researchers from CAMI, VOLPE, triOS, and UAA over an eleven-day period, to add an additional measure for the pilot's operating experience to yield the following measures of training effectiveness.

The training effectiveness for pilots, based on survey results and initial training, was 53 percent. When pilots with more than 1 year of operating experience were given additional effectiveness credit, the overall effectiveness level reaches 87 percent. Combining results from newly trained pilots and experienced pilots in the Capstone operating area yielded an effectiveness level of 75 percent at the end of 2003. Figure 3.7.1-4 shows the trend in pilot effectiveness from 2000 through the end of 2003. Because of the complexity of updating this data through field interviews combined with classroom observations, and in-flight observations of actual revenue flights throughout the region by researchers, this was not done during 2004. However, because of the stability in operators, the fact that some have up to four years experience with the

Capstone equipment and training their pilots to use the equipment, and based on comments from those involved in the training, these figures should prove to be fairly stable if not somewhat improved.

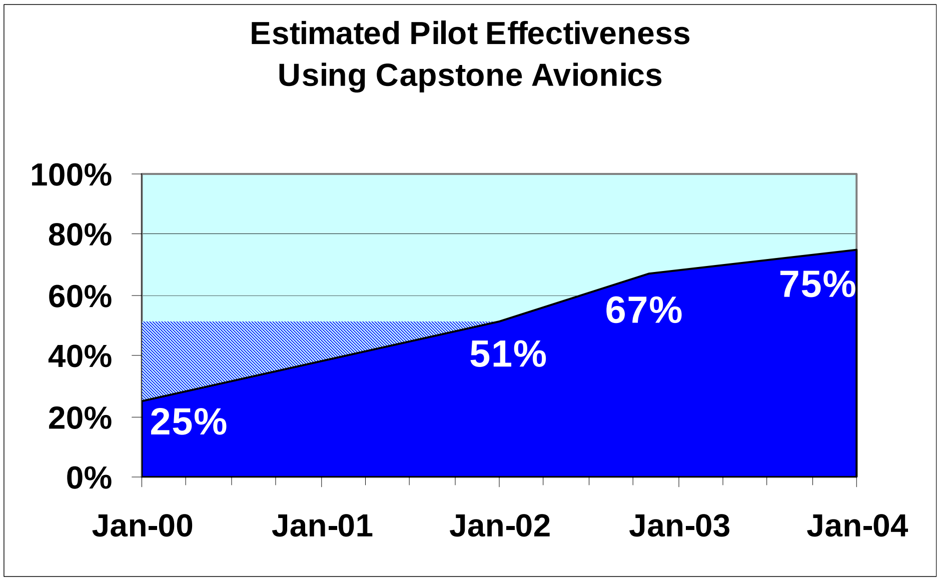


Figure 3.7.1-4 Pilot Effectiveness with Capstone assessed from Training and Experience Levels

4 Capstone Achievements

4.1 Aviation Operations

4.1.1 Airline Management's Viewpoint

Interviews with airline managers in Bethel indicate that Capstone has definitely improved the safety of flying in the Y-K Delta. Fifty percent of the managers' interviews stated that they had made changes to the company's safety programs.

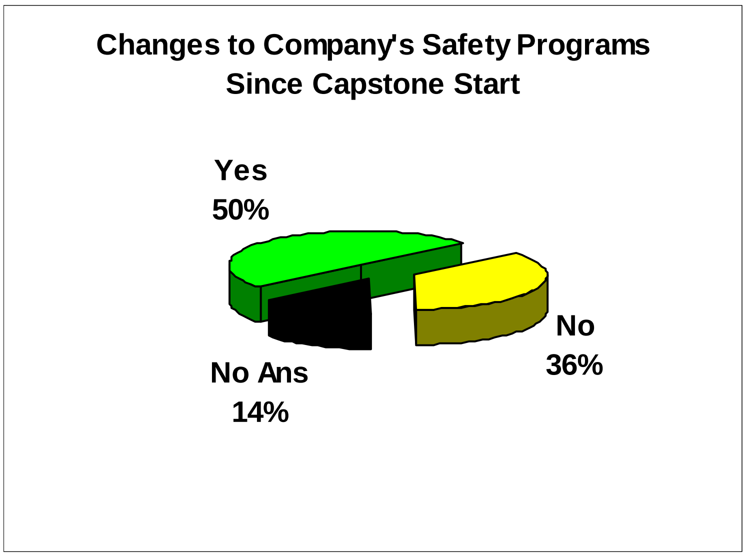


Figure 4.1.1-1 Airline Management's Opinion on Safety

Thirty-six percent of the operators indicated improved economics since Capstone was implemented. No operator indicated that the company economics had deteriorated because of Capstone. Most considered the improvements were due to better flight monitoring, improved weather information and the ability to fly more direct routes. One owner commented that costs had gone up due to additional holding time for SVFR aircraft in Bethel and that the "promised" Approach Control had not materialized, but the owner also stated that company economics had improved since the program's start. Some concerns were expressed for the upcoming transition at the end of the program and the costs related to purchasing new and maintaining the existing equipment (mostly expressed as concern that "the other operators" would not do what was needed to maintain the system).

Full details of the interviews can be found in Section 6.5, Appendix E.2. The following are some specific comments from interviewees:

> "Increased awareness of terrain hazards, collision hazards and knowledge that flight was being monitored, (have made operations) more professional."
>
> "High density traffic in the Bethel area is immeasurably safer because of traffic awareness, better situational awareness, and better flight following ability."

"There have been changes to our program and culture, but we cannot quantify which change, if any, has resulted directly from the Phase I program."

"The unit is a very good CFIT tool. It has served to locate more quickly airplane(s) that made unscheduled landings off-airport. Since all crews use the unit's communication regarding position, reporting is more accurate in reference to known traffic which is also more reliably located."

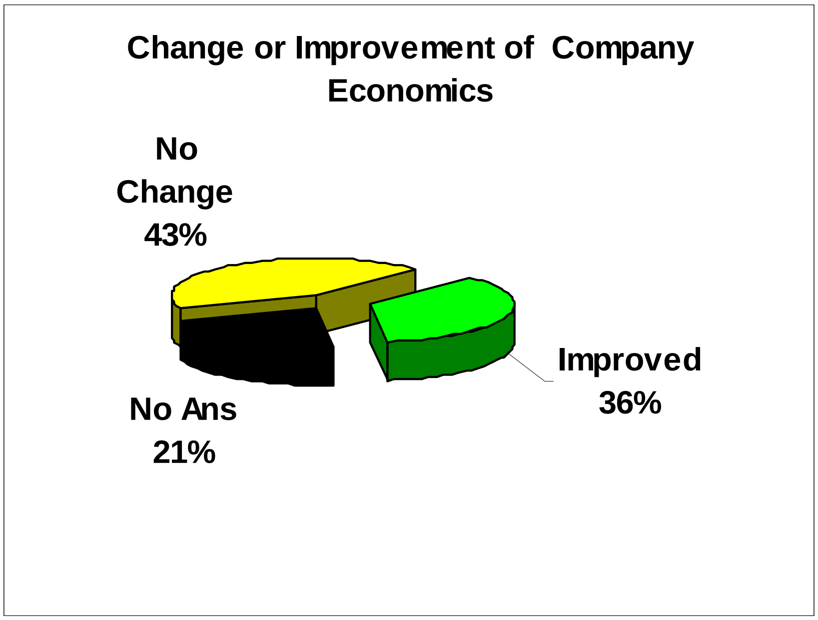


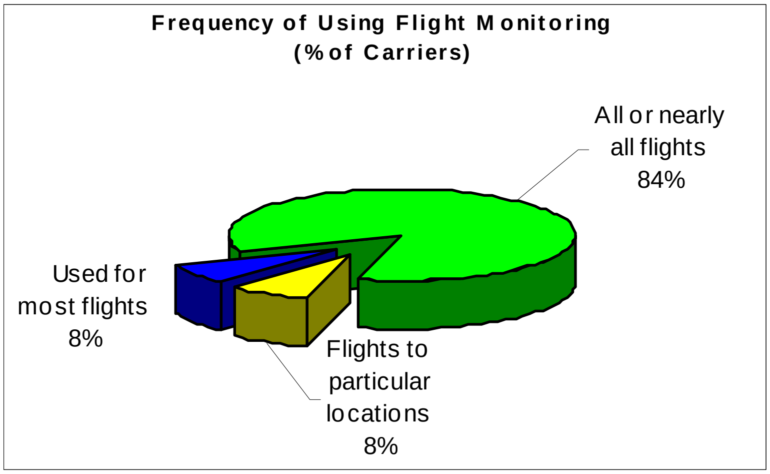
Figure 4.1.1-2 Airline Management's Opinion Economic Changes

4.1.1.1 Scheduling and Dispatch

Under FAA Part 135 the dispatch function does not require an FAA licensee and most of the operators in the Y-K Delta do not employ professional dispatchers. Sixty-six percent of the dispatchers and personnel assigned to dispatch interviewed indicated that the dispatch operation had improved during the Capstone program. Ninety-one percent felt that flight monitoring was the most significant change in their operation and that function was considered the most important for dispatch by 66%, followed by weather data and then, weather cameras. Seventy-five percent indicated that Capstone had improved their ability to communicate with other aircraft that were in the area where they would be dispatching an aircraft. Details of the interviews can be found in Section 6.5, Appendix E.2.

4.1.1.2 Flight Monitoring

Since 2002, the Capstone program has provided internet/PC software for flight monitoring and aircraft location data from the GBT network to air-transport companies operating in the Y-K Delta. Nearly all Y-K Delta operators signed up for flight monitoring, and these companies use it extensively for oversight, management, planning, and monitoring the safe operation of their aircraft. Figure 4.1.1-3 shows the results of interviews conducted with company officials on their use of flight monitoring and their assessment of the impact of flight monitoring on their company's safety and decision-making. There has been a steady increase in the frequency of use since 2002, and virtually all operators are now using flight monitoring on a regular basis. Sixty-nine percent of those operators interviewed feel that flight monitoring has improved safety awareness and decision making. This is up 4% over the past year.



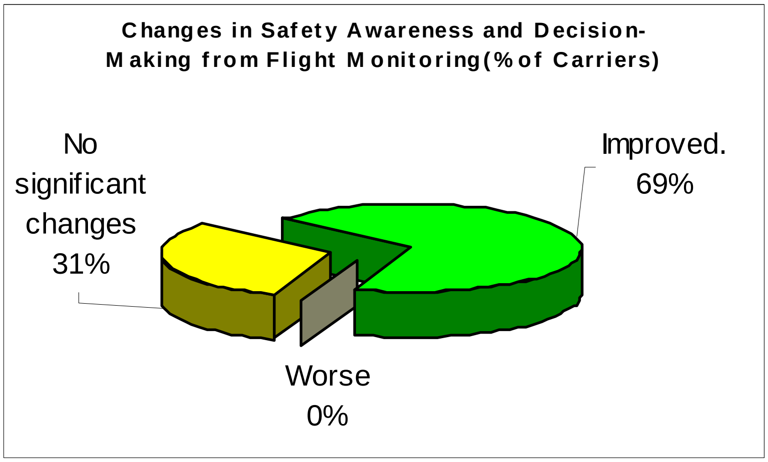


Figure 4.1.1-3. Flight Monitoring Use and Impact on Safety Awareness and Decision-Making

4.1.1.3 Pilot Surveys

4.1.1.3.1 Overview

Since 2000, Capstone researchers have interviewed pilots to determine pilot perceptions of Capstone technology. In 2000, 2001, and 2002, pilots answered a series of questions related to potential Capstone benefits. In 2003 and 2004, pilots answered questions concerning the usefulness, ease of use, and frequency of use of Capstone capabilities. The following paragraphs discuss survey results for each Capstone function.

Surveys in 2004 and early in 2005 asked pilots how often they used the capabilities of Capstone Phase 1 avionics and ground systems, its ease of use (relative to other avionics they are familiar with), and its usefulness. The array of pie charts in Figure 4.1.1-4 summarizes combined pilot responses for the two final years of the program. We compared the reported use, ease-of-use, and usefulness of the capabilities to the reported training levels and Capstone flight-time of each pilot and detected no significant correlation between assessments and training or experience factors. The remaining figures in Section 4.1.1.3 provide further details of the surveyed pilots' expectations before and early in the program and specific use, usefulness and usability opinions during the last two years of the program.

The vast majority of the pilots are in agreement that Capstone has significantly increased the safety of flying in the Y-K Delta. During the interviews, a number of pilots indicated they would never like to go back to flying without Capstone. Some examples of the comments:

> "Incredible service to have for all phases of flying and safety. You know where, when, and how planes are flying; terrain avoidance also VFR holding at Bethel; you know where a pilot is and where he/she is in the hold."
>
> "Program is biggest boon for safety in region that I have seen."
>
> "Definite increased safety level & situational awareness; also great sense of search/rescue capabilities."

A number of pilots continue to express concern over the idea that the FAA will be monitoring their flights with the potential for violation. These comments tended to come from the older pilots and even the younger pilots express that it was mostly a concern of the older pilots.

> "Some more 'experienced' crew believes the ADS-B service may be used to 'trap' them with some sort of violation."
>
> "We all know that bush flying can be incriminating if you are constantly monitored."
>
> "I have heard people (mostly older pilots) worry about being watched. But most feel the benefit outweighs the problem."

Many pilots also said their safety would be enhanced if all Part-91 aircraft were equipped.

> "Don't change a thing, the only thing I wish is private planes had Capstone in the Y-K Delta."
>
> "Works great for separation as long as everyone has a Capstone…outfit Part-91 operations."

There were a number of comments concerning SVFR operations at Bethel, both pro and con:

> "It would be nice if the tower here and approach in Anchorage would work together to speed up special VFR, especially with Capstone-equipped aircraft."
>
> "All too often VFR pilots left circling in minimum weather conditions."
>
> "A drastic improvement in special VFR efficiency in Bethel area. Having returned to Bethel recently after 6-yr absence, difference is amazing; makes whole new ballgame."

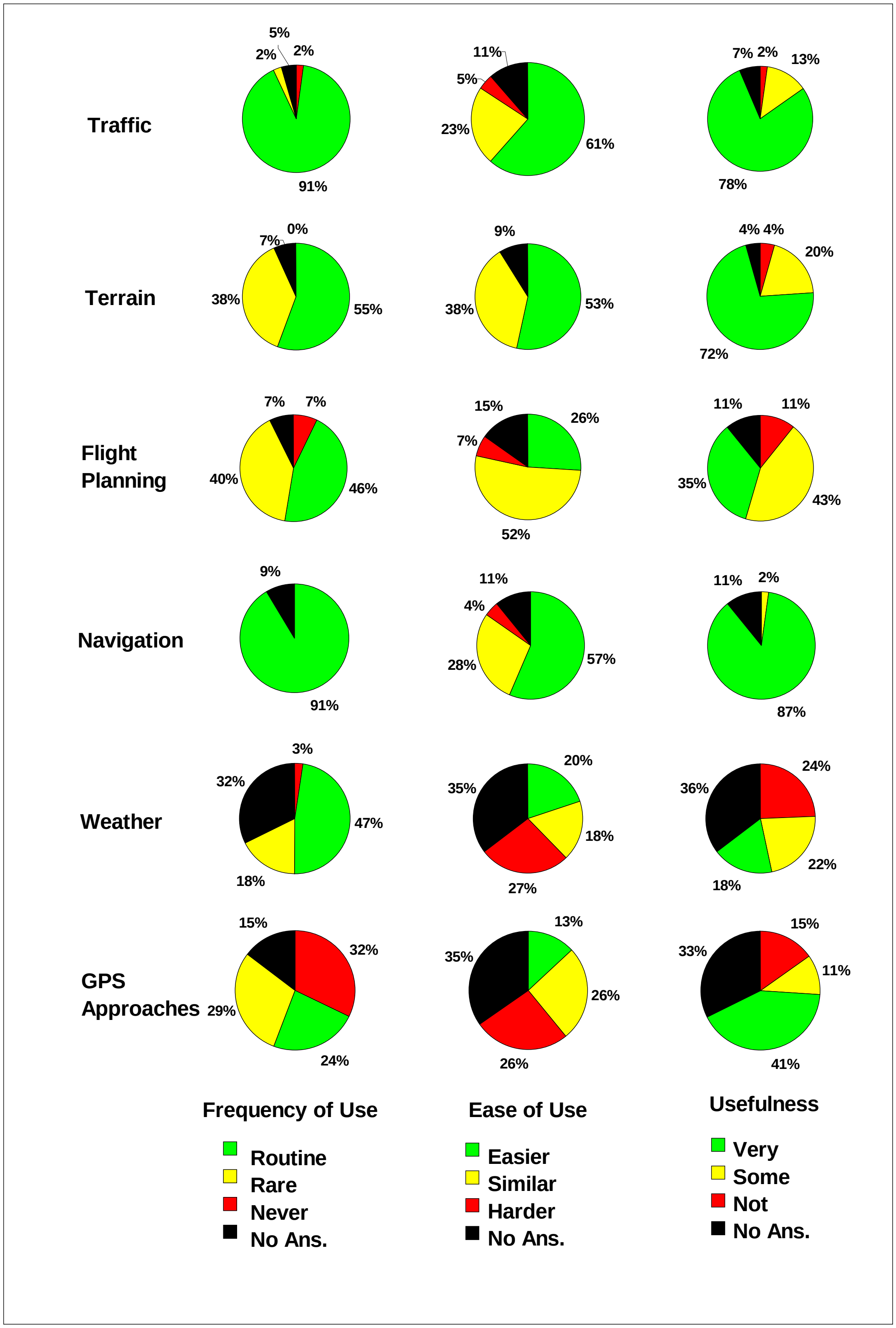
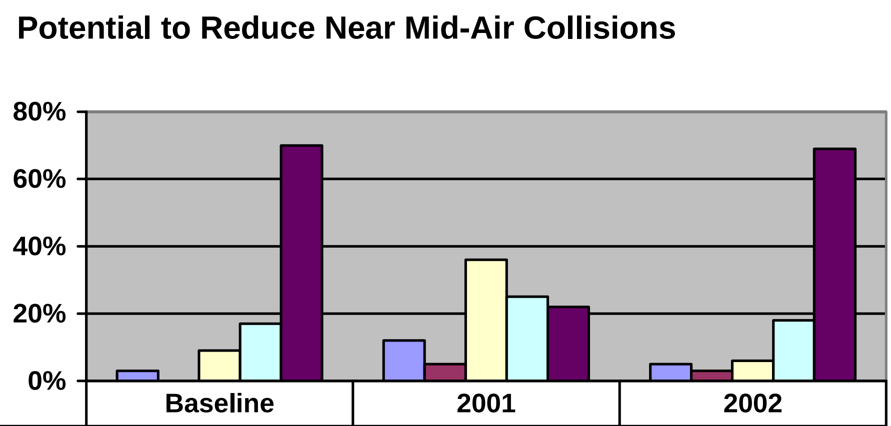


Figure 4.1.1-4 Pilot Reported *Use*, *Ease of Use*, and *Usefulness* of Capstone Services and Capabilities

4.1.1.3.2 Traffic

In the 2000 – 2002 question set, pilots were asked to assess Capstone's potential benefit to reduce near-mid-air collisions. Figure 4.1.1-5 shows the pilot reported expectations.

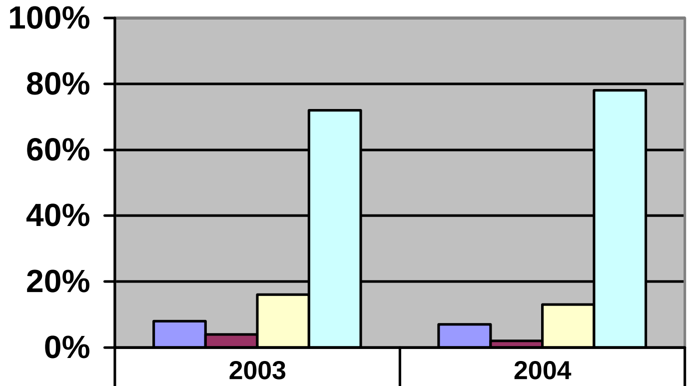


	Baseline	2001	2002
No Benefit	3%	12%	5%
Very Small Benefit	0%	5%	3%
Some Benefit	9%	36%	6%
Significant Benefit	17%	25%	18%
Major Benefit	70%	22%	69%

Figure 4.1.1-5 Traffic Function Expectations

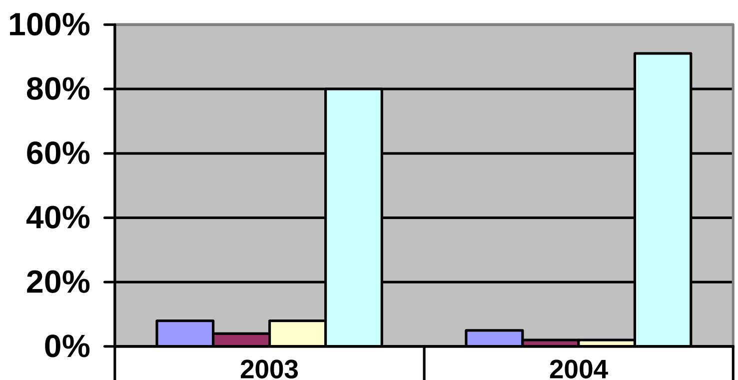
In 2001, optimism dropped sharply as pilots began training to use the system but quickly rebounded during 2002 with 87% of pilots surveyed responding that Capstone's ability to reduce near mid-air collisions was at least a significant benefit. Similarly, surveys in 2003 and 2004, showed that pilots considered traffic avoidance to be one of the more useful and most frequently used Capstone capabilities. Additionally, pilot ratings of the usefulness, frequency of use, and ease of use of Capstone's traffic avoidance capability improved from 2003 to 2004. Figure 4.1.1-6 depicts pilot responses to the 2003 and 2004 surveys.

Usefulness of Traffic Capability



	2003	2004
No Answer	8%	7%
Not Very Useful	4%	2%
Somewhat Useful	16%	13%
Very Useful	72%	78%

Frequency of Use of Traffic Capability



	2003	2004
No Answer	8%	5%
Never Use	4%	2%
Rarely Use	8%	2%
Routinely Use	80%	91%

Figure 4.1.1-6 Traffic Use, Usefulness, Usability

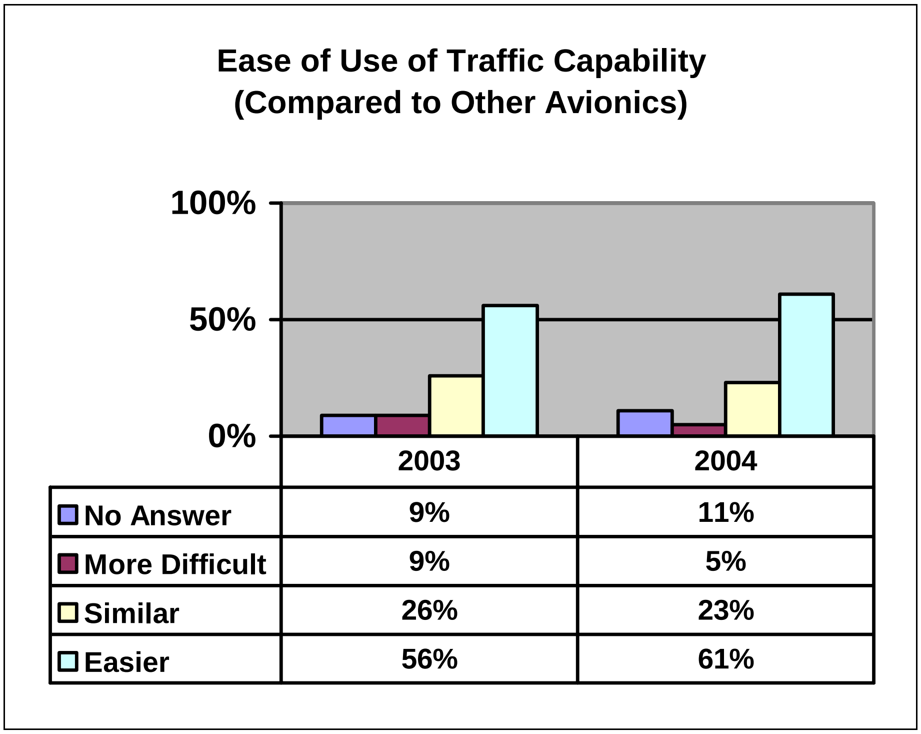
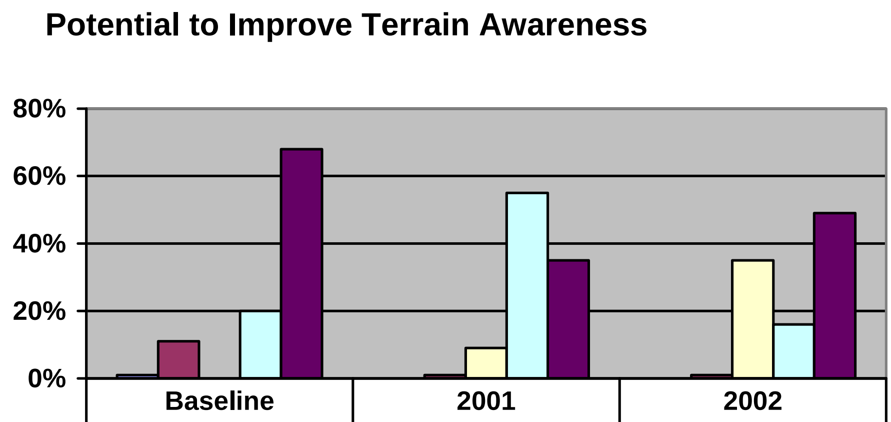


Figure 4.1.1-6 Traffic Use, Usefulness, Usability (concluded)

4.1.1.3.3 Terrain

The 2000 – 2002 surveys asked pilots to assess Capstone's potential to improve terrain awareness. As the Figure 4.1.1-7 below shows, 88% of pilots surveyed in 2000 thought Capstone would at least significantly improve terrain awareness. In fact, pilots were more optimistic about Capstone's terrain awareness capability than any other capability. As with all areas assessed in the 2000 – 2002 surveys, there was a significant drop in pilot use, usefulness and usability in 2001, most likely due to an expected drop in pilot confidence as a new learning curve is traversed. Percentages then rebounded in 2002 as pilots became more familiar with the equipment.

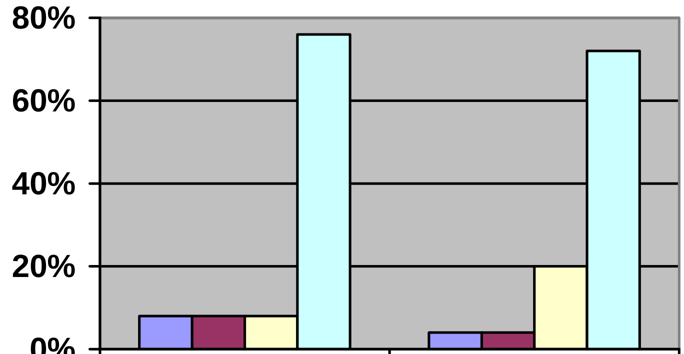


	Baseline	2001	2002
No Benefit	1%	0%	0%
Very Small Benefit	11%	1%	1%
Some Benefit	0%	9%	35%
Significant Benefit	20%	55%	16%
Major Benefit	68%	35%	49%

Figure 4.1.1-7 Terrain Function Expectations

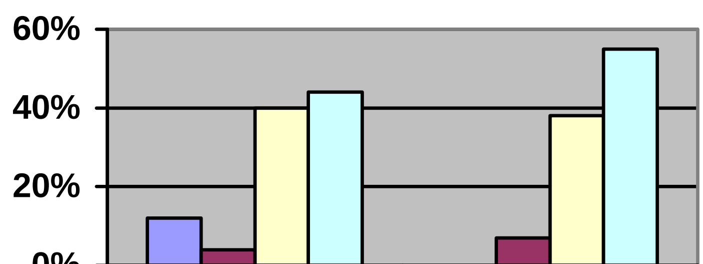
In the 2003 and 2004 surveys, Capstone's terrain avoidance capability has been rated one of the most useful capabilities. From 2003 to 2004, the percentage of pilots reporting the capability as not useful declined from 8% to a mere 4%. Interestingly, the frequency of use is less than what would be expected for a capability with such a high usefulness rating. However, many pilots have reported that better than normal weather the past two years has reduced the need for the terrain avoidance capability. Figure 4.1.1-8 below also shows that this capability is the easiest of Capstone's features to use.

Usefulness of Terrain Capability



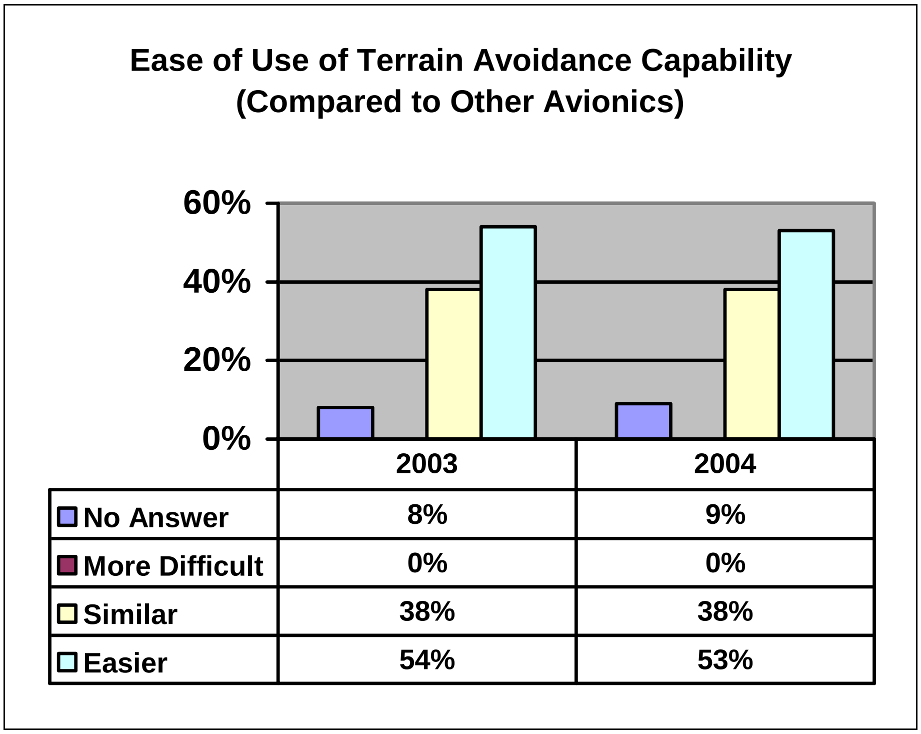
	2003	2004
No Answer	8%	4%
Not Very Useful	8%	4%
Somewhat Useful	8%	20%
Very Useful	76%	72%

Frequency of Use of Terrain Avoidance Capability



	2003	2004
No Answer	12%	0%
Never Use	4%	7%
Rarely Use	40%	38%
Routinely Use	44%	55%

Figure 4.1.1-8 Terrain Use, Usefulness, Usability



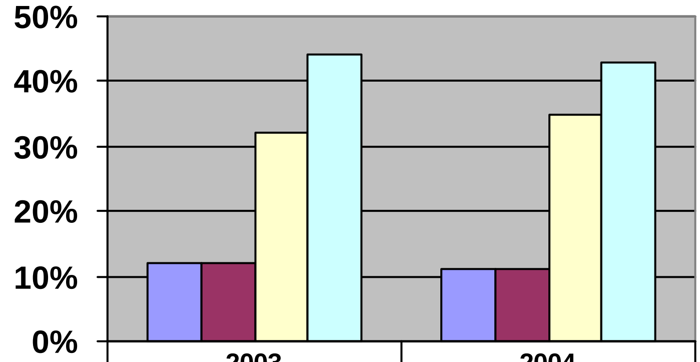
	2003	2004
No Answer	8%	9%
More Difficult	0%	0%
Similar	38%	38%
Easier	54%	53%

Figure 4.1.1-8 Terrain Use, Usefulness, Usability (concluded)

4.1.1.3.4 Flight Planning

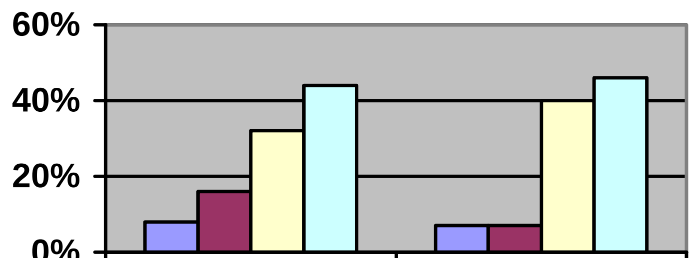
The 2000 – 2002 surveys did not directly address Capstone's flight planning capability. Results from the 2003 and 2004 surveys show that the capability is generally useful and easier or just as easy to use as other avionics. Less than half the pilots routinely used the capability in 2003 and 2004, which could have been due to unusually good weather, especially during 2004. As Figure 4.1.1-9 below shows, results for both surveys have been relatively unchanged.

Usefulness of Flight Planning Capability



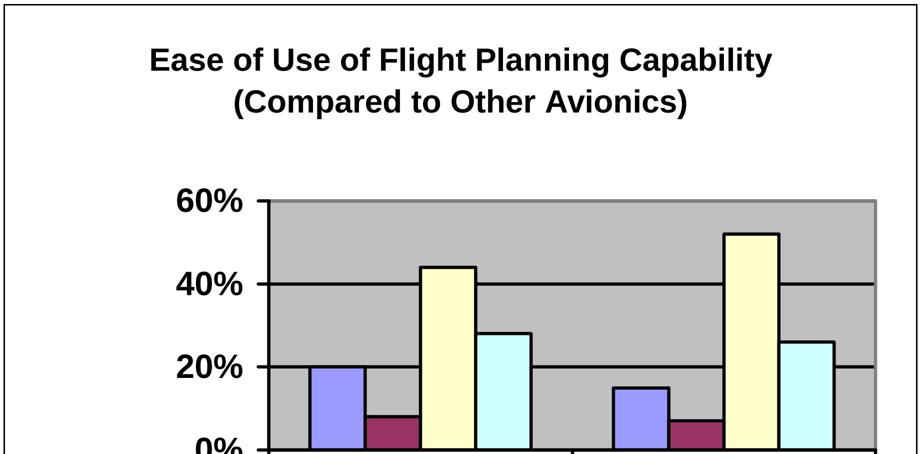
	2003	2004
No Answer	12%	11%
Not Very Useful	12%	11%
Somewhat Useful	32%	35%
Very Useful	44%	43%

Frequency of Use of Flight Planning Capability



	2003	2004
No Answer	8%	7%
Never Use	16%	7%
Rarely Use	32%	40%
Routinely Use	44%	46%

Figure 4.1.1-9 Flight Planning Use, Usefulness, Usability

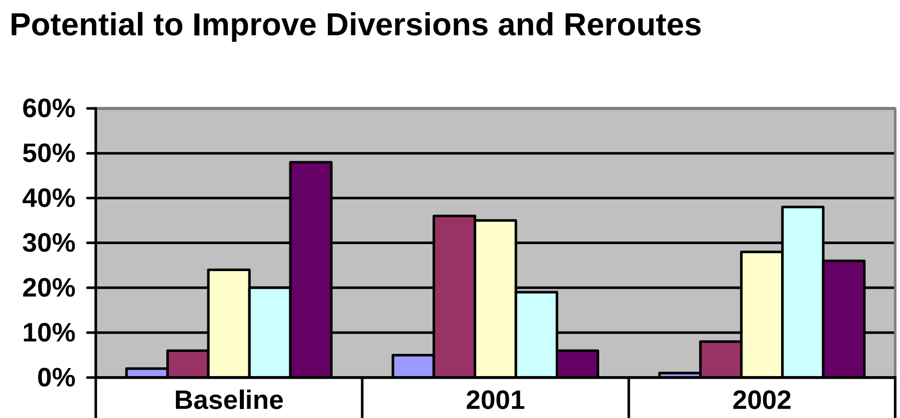


	2003	2004
No Answer	20%	15%
More Difficult	8%	7%
Similar	44%	52%
Easier	28%	26%

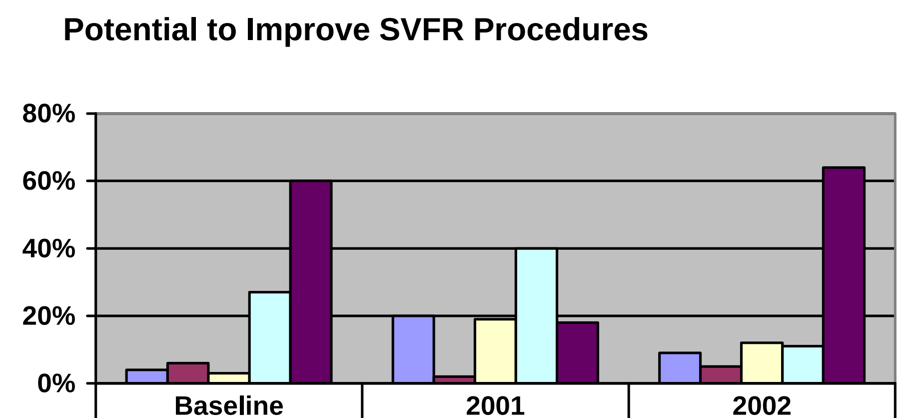
Figure 4.1.1-9 Flight Planning Use, Usefulness, Usability (concluded)

4.1.1.3.5 Navigation

The 2000 – 2002 surveys only indirectly surveyed pilots on Capstone's navigation capability, asking pilots to assess Capstone's benefits for in-flight diversions and rerouting. The survey also asked pilots to assess Capstone's ability to improve SVFR procedures. Initially, 68% of pilots surveyed expected to see at least a significant benefit for rerouting. By 2002, that number had declined to 54%. Pilots overwhelmingly expected to benefit from improved SVFR in 2000 and 2002.



	Baseline	2001	2002
No Benefit	2%	5%	1%
Very Small Benefit	6%	36%	8%
Some Benefit	24%	35%	28%
Significant Benefit	20%	19%	38%
Major Benefit	48%	6%	26%

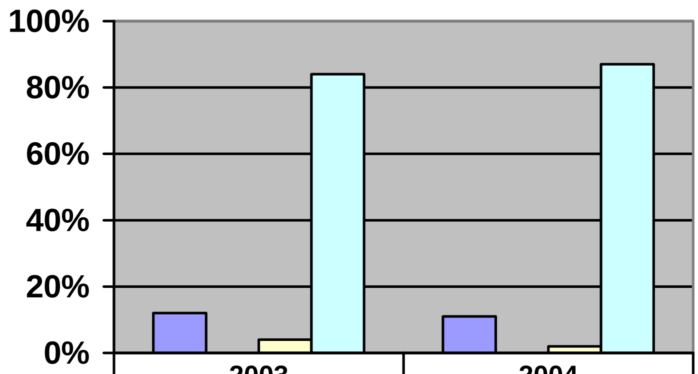


	Baseline	2001	2002
No Benefit	4%	20%	9%
Very Small Benefit	6%	2%	5%
Some Benefit	3%	19%	12%
Significant Benefit	27%	40%	11%
Major Benefit	60%	18%	64%

Figure 4.1.1-10 Navigation Function Expectations

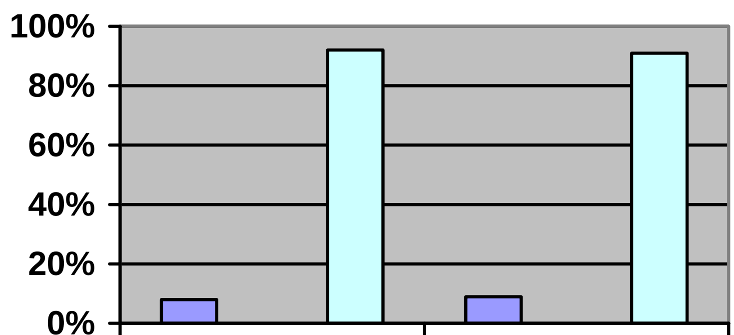
The 2003 and 2004 surveys show that pilots consistently view Capstone's navigation capability as the most useful, most frequently used, and easiest to use capability. It is the only capability that is routinely used by all pilots that answered the specific survey question, and it is the only capability that is rated at least somewhat useful by all respondents.

Usefulness of Navigation Capability



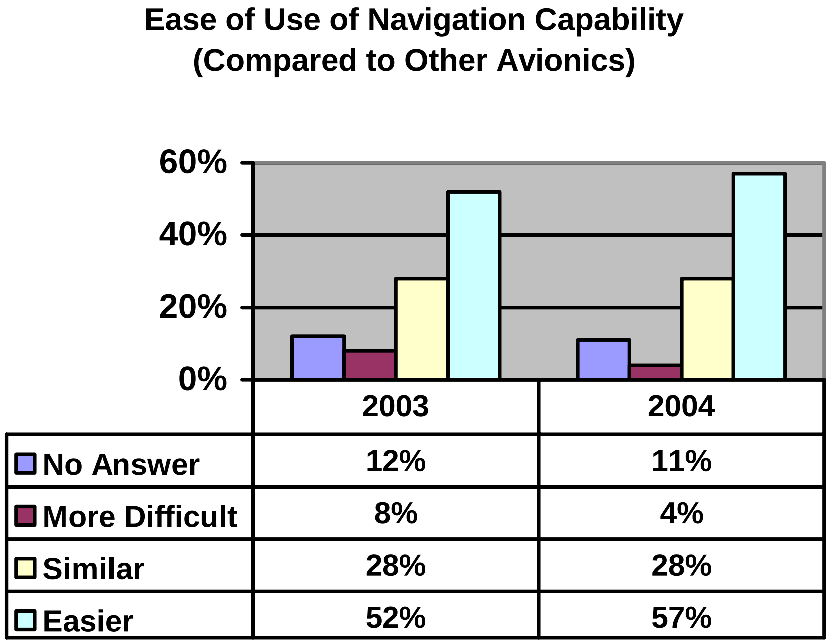
	2003	2004
No Answer	12%	11%
Not Very Useful	0%	0%
Somewhat Useful	4%	2%
Very Useful	84%	87%

Frequency of Use of Navigation Capability



	2003	2004
No Answer	8%	9%
Never Use	0%	0%
Rarely Use	0%	0%
Routinely Use	92%	91%

Figure 4.1.1-11 Navigation Use, Usefulness, Usability



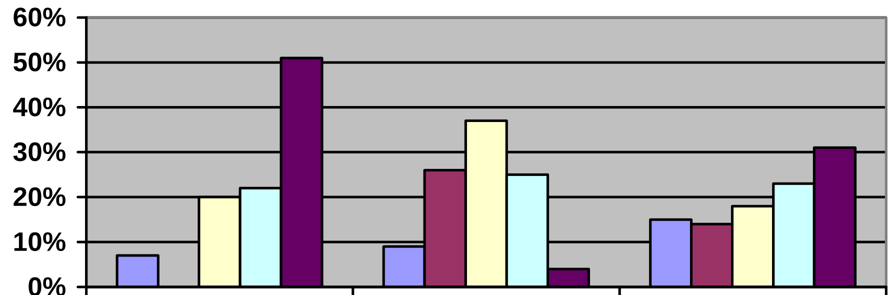
	2003	2004
No Answer	12%	11%
More Difficult	8%	4%
Similar	28%	28%
Easier	52%	57%

Figure 4.1.1-11 Navigation Use, Usefulness, Usability (concluded)

4.1.1.3.6 Weather

The 2000 – 2002 surveys asked pilots to assess Capstone's ability to provide useful weather information. In 2000, 73% of pilots expected to see at least a significant benefit. The number dropped significantly in 2001 but rebounded to 54% by 2002. Again, pilots' learning curves affected the 2001 results as did a lower than expected FIS-B and NEXRAD availability.

Potential to Provide More Useful Weather Info

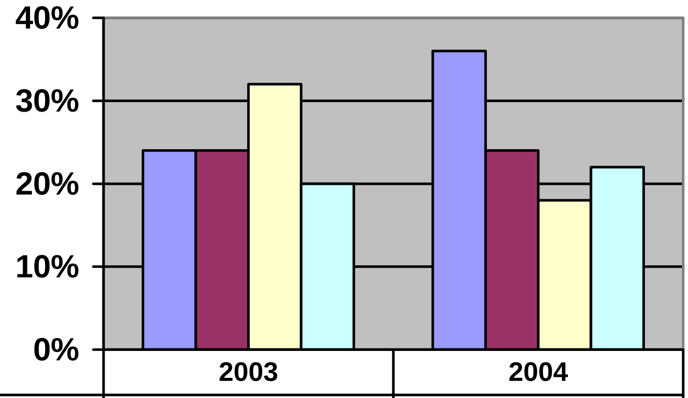


	Baseline	2001	2002
No Benefit	7%	9%	15%
Very Small Benefit	0%	26%	14%
Some Benefit	20%	37%	18%
Significant Benefit	22%	25%	23%
Major Benefit	51%	4%	31%

Figure 4.1.1-12 Weather Function Expectations

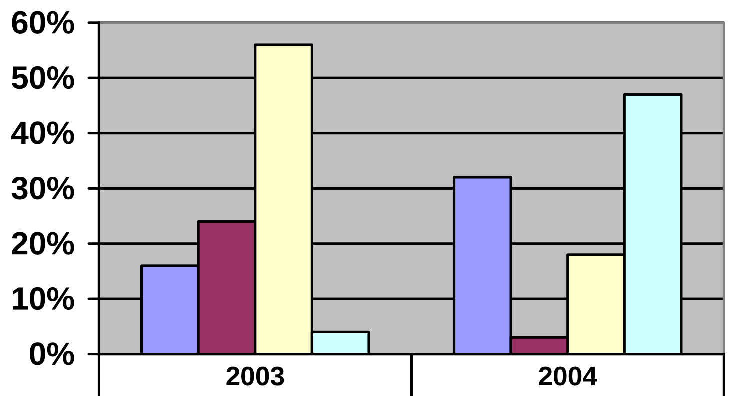
In the 2003 and 2004 surveys, Capstone's weather information capability has been rated least useful of all Capstone capabilities. Previous interim reports have noted that weather information is often not available outside the Bethel area and NEXRAD coverage is problematic. Routine use of the weather capability increased from 4% in 2003 to 47% in 2004 indicating that weather information is now more readily available and is being routinely used by the pilots. Usefulness of the weather data will be better determined in the future now that it is being more widely used. Ease of use ratings also declined to the point that the weather capability is rated by only 38% of pilots to be at least as easy to use as other avionics.

Usefulness of Weather Capability



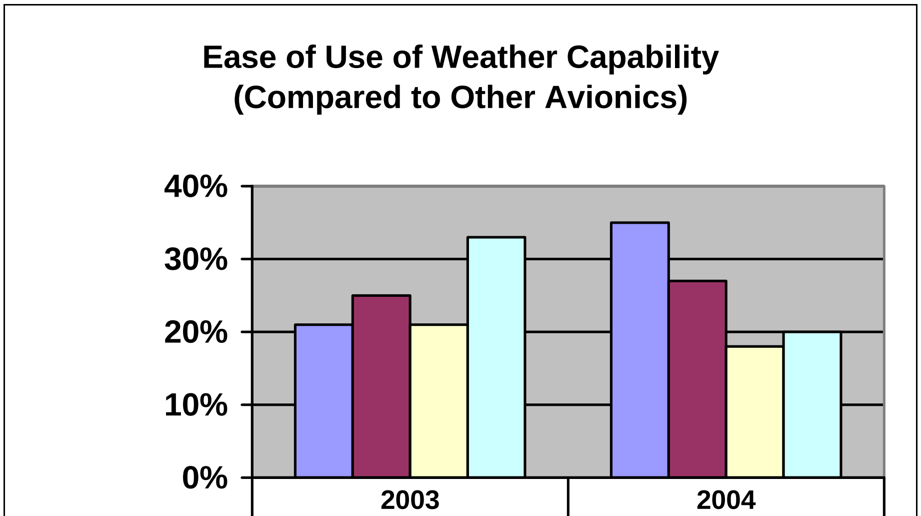
	2003	2004
No Answer	24%	36%
Not Very Useful	24%	24%
Somewhat Useful	32%	18%
Very Useful	20%	22%

Frequency of Use of Weather Capability



	2003	2004
No Answer	16%	32%
Never Use	24%	3%
Rarely Use	56%	18%
Routinely Use	4%	47%

Figure 4.1.1-13 Weather Use, Usefulness, Usability



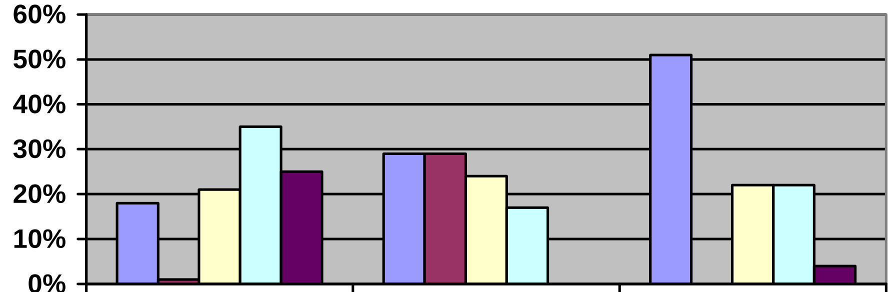
	2003	2004
No Answer	21%	35%
More Difficult	25%	27%
Similar	21%	18%
Easier	33%	20%

Figure 4.1.1-13 Weather Use, Usefulness, Usability (concluded)

4.1.1.3.7 GPS Approaches

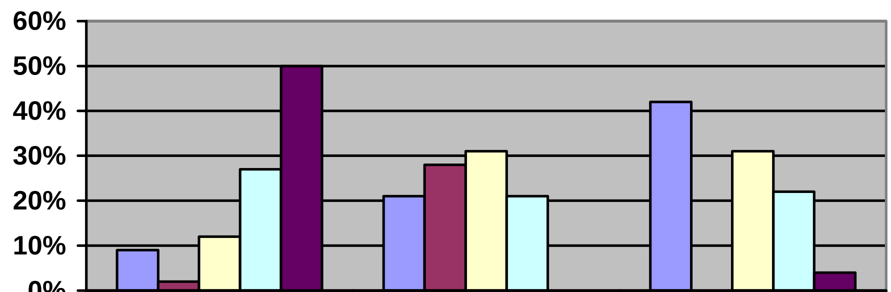
The 2000 – 2002 surveys asked pilots to assess Capstone's potential capability to reduce cancelled flights due to new GPS instrument approaches. In 2000, 60% of pilots surveyed rated Capstone's potential benefit as significant or major, the lowest of any benefit discussed in this report. In 2001, the expectation decreased significantly with very little rebound in 2002. Pilots were also asked to assess Capstone's potential to improve safety at remote airports through use of instrument approaches. Initially, 77% of pilots expected at least a significant benefit. By 2002, only 26% expected a significant benefit. In both cases the decline was most likely due to pilots' unfamiliarity with the capability and the approaches.

Potential for Fewer Cancelled Flights due to Approaches



	Baseline	2001	2002
No Benefit	18%	29%	51%
Very Small Benefit	1%	29%	0%
Some Benefit	21%	24%	22%
Significant Benefit	35%	17%	22%
Major Benefit	25%	0%	4%

Potential to Safety Improvements due to Approaches

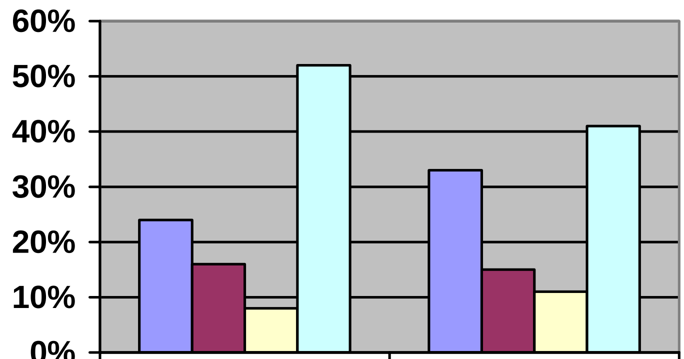


	Baseline	2001	2002
No Benefit	9%	21%	42%
Very Small Benefit	2%	28%	0%
Some Benefit	12%	31%	31%
Significant Benefit	27%	21%	22%
Major Benefit	50%	0%	4%

Figure 4.1.1-14 GPS Approach Expectations

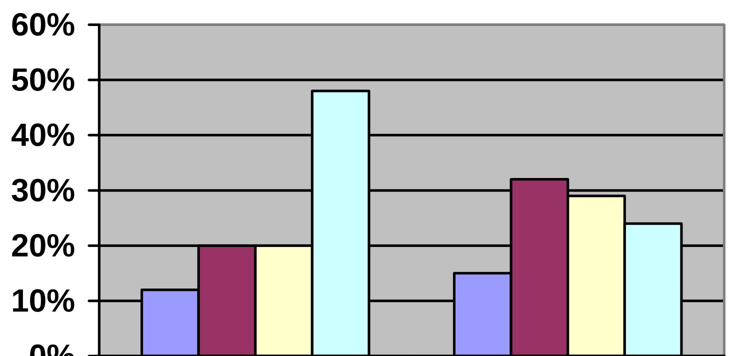
The 2003 survey showed a much improved usefulness rating for the approaches with 52% indicating the approaches were very useful and another 8% citing some usefulness. Usefulness ratings declined slightly in 2004. This correlates with a reduced frequency of use, due most likely to good weather, and reduced ease of use ratings, which might indicate an increase in the number of pilots unfamiliar with the capability and the approaches.

Usefulness of GPS Approaches



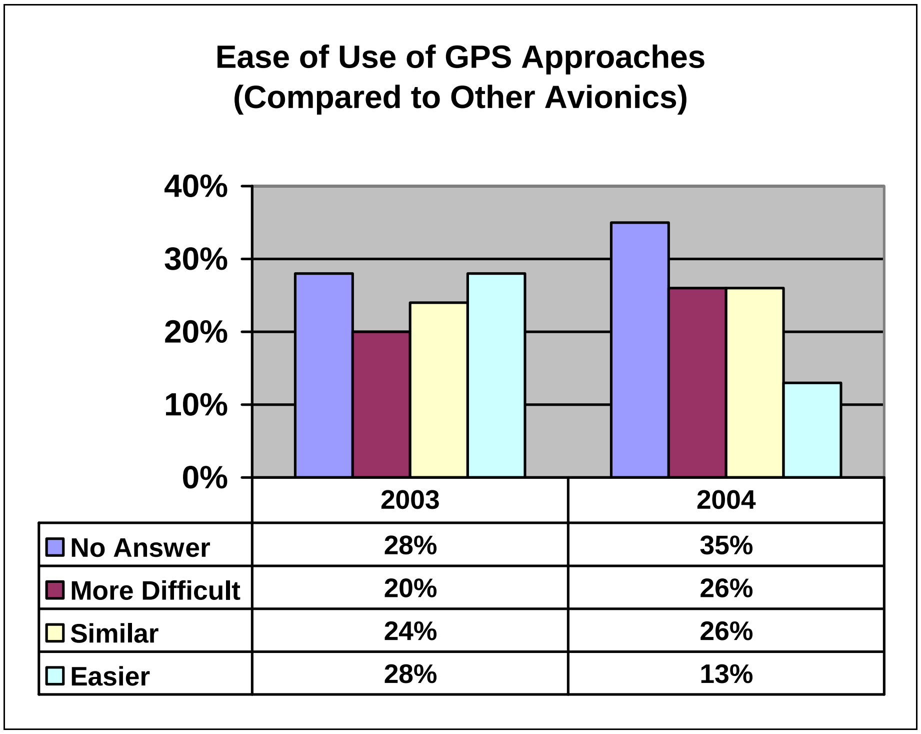
	2003	2004
No Answer	24%	33%
Not Very Useful	16%	15%
Somewhat Useful	8%	11%
Very Useful	52%	41%

Frequency of Use of GPS Approaches



	2003	2004
No Answer	12%	15%
Never Use	20%	32%
Rarely Use	20%	29%
Routinely Use	48%	24%

Figure 4.1.1-15 GPS Approach Use, Usefulness, Usability



	2003	2004
No Answer	28%	35%
More Difficult	20%	26%
Similar	24%	26%
Easier	28%	13%

Figure 4.1.1-15 GPS Approach Use, Usefulness, Usability (concluded)

4.2 Aviation Services

4.2.1 Fleet Changes

The Y-K Delta fleet has changed significantly during the implementation period of Capstone. Aviation markets are dynamic with operators moving into and out of markets based on the traffic and operating economics, bankruptcies, competitive pressures and other factors. A November 2003 change in the US Postal Service contract had a major impact as several operators were not awarded postal service flights and ceased operations in the Y-K Delta. Section 4.6.1 provides further details on the mail rule change. The number of Capstone-equipped aircraft in the commercial operating fleet declined to 116. As shown in Figure 4.2.1-1, a significant number of Capstone-equipped commercial aircraft left the Y-K Delta due to the mail rule change and other factors.

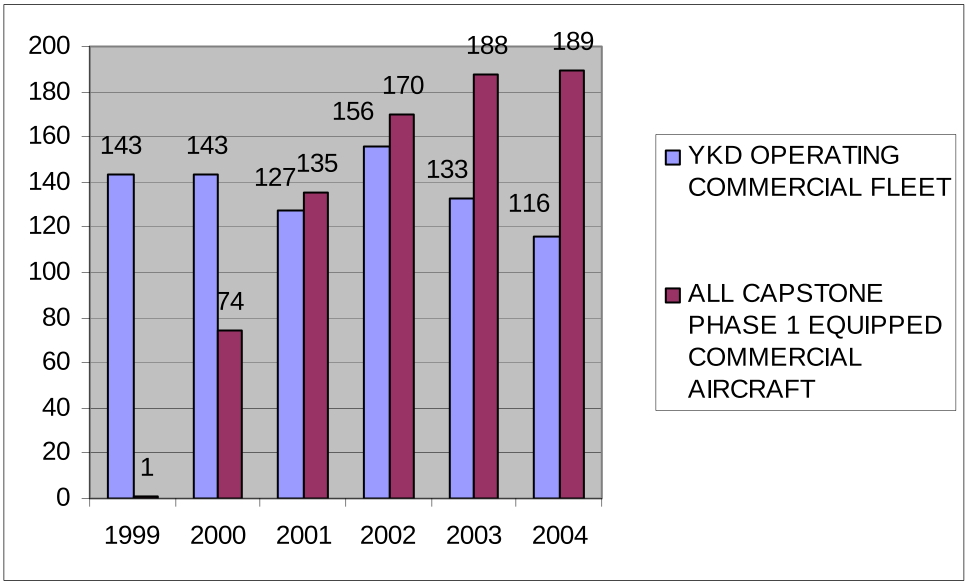


Figure 4.2.1-1 Y-K Delta and Capstone-Equipped Commercial Fleet Size over Time

Figure 4.2.1-2 shows the percentage breakdown by class of the commercial operating fleet at the beginning of 2003 and 2005. Figure 4.2.1-2 shows that of the 116 Capstone-equipped aircraft remaining in the Y-K Delta commercial fleet at the end of 2004, half are single engine piston aircraft (Class 0), about ¼ of the aircraft are turbine powered (Class 4) and the rest are light twins (Classes 1, 2 and 3).

Class 0	Single Engine Piston
Class 1	2 Engine Piston
Class 2	3 or 4 Engine Piston
Class 3	Helicopter
Class 4	1 or 2 Engine Turbine

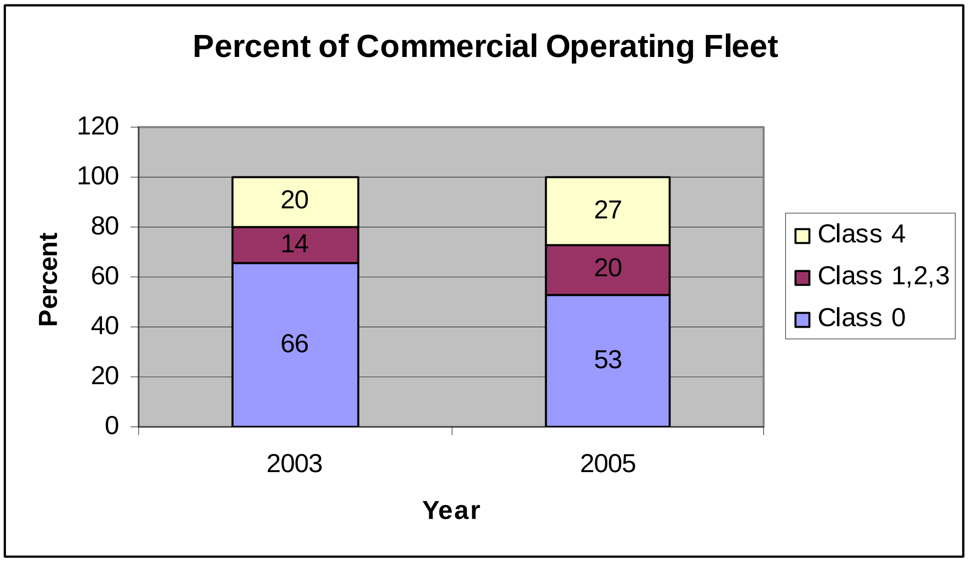


Figure 4.2.1-2 Percentage Y-K Delta Commercial Fleet by Class of Aircraft

The aforementioned new GPS approaches double the percentage of Y-K Delta flight segments flown with IFR infrastructure available at both ends. We believe this change (as well as radar-like services) has had a significant impact on the air transportation market in the Y-K Delta, making IFR-capable flights more preferable (due to increased operating reliability) than VFR and providing a larger competitive advantage to operators who increase the capability of their aircraft. Commercial operators have upgraded to more capable aircraft classes suited to IFR as seen above and have increased the number of IFR-qualified aircraft. Figure 4.2.1-3 shows that IFR qualified aircraft now account for 46% of the current operating fleet compared to 34% in 2003. IFR commercial operations have historically had a much lower accident rate. These changes are almost certain to improve safety in the long term.

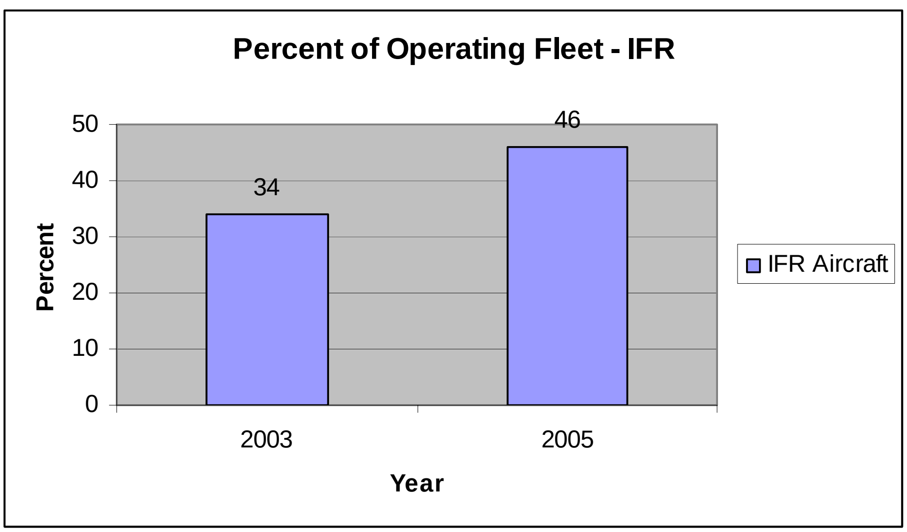


Figure 4.2.1-3 Comparison of the Percentage of Commercial Operating Fleet that is IFR Capable

4.2.2 Improved Access

As more ATC services are offered to those flying under an IFR flight plan in the Y-K Delta we would expect more operators to equip their aircraft to fly IFR. Flying IFR implies that the pilots have more training and higher skills than those flying VFR. This should increase the safety of operations. As seen above, the percentage of IFR aircraft initially outfitted has increased but we do not have direct evidence that any equipment on the Part-135 fleet has been upgraded to IFR after the aircraft were modified with Capstone. Furthermore, it does appear from the traffic counts at the Bethel tower that a greater percentage of the operations were conducted under IFR after Anchorage Center controllers started using ADS-B surveillance data in January 2001. This is shown in Figure 4.2.2-1. It should be noted that it was indicated during pilot interviews that the pilots perceived the weather during 2003 and 2004 as better than in previous years and they would be less likely to file IFR with good weather. Therefore, it is possible that the average shown below for after 1/1/01 would be higher than shown.

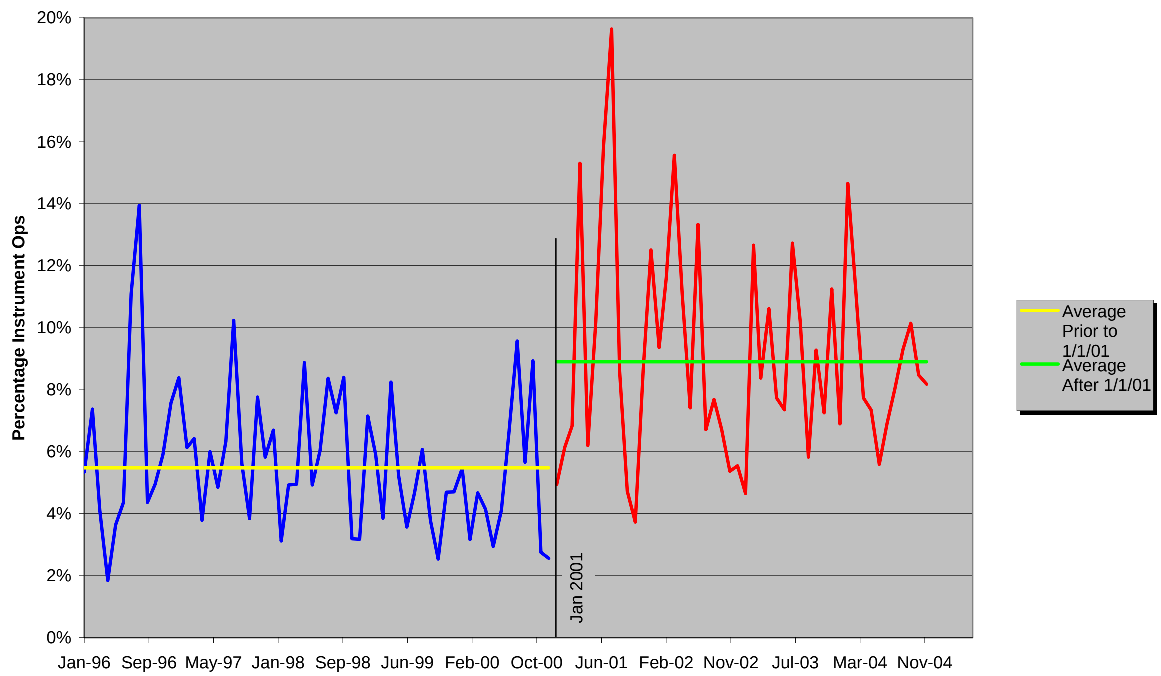


Figure 4.2.2-1 Percentage Instrument Ops by Air Taxis at Bethel

Also of great significance is the improvement in village access offered by the new instrument approaches. A comparison of nearby weather patterns to the minimum ceiling and visibility for approach under Visual Flight Rules finds airports such as Kipnuk and Scammon Bay were inaccessible nearly 30% of the time. IFR operations enabled by the instrument approaches are reducing the time that the villages are inaccessible by an average of 50% as shown in Figure 4.2.2-2.

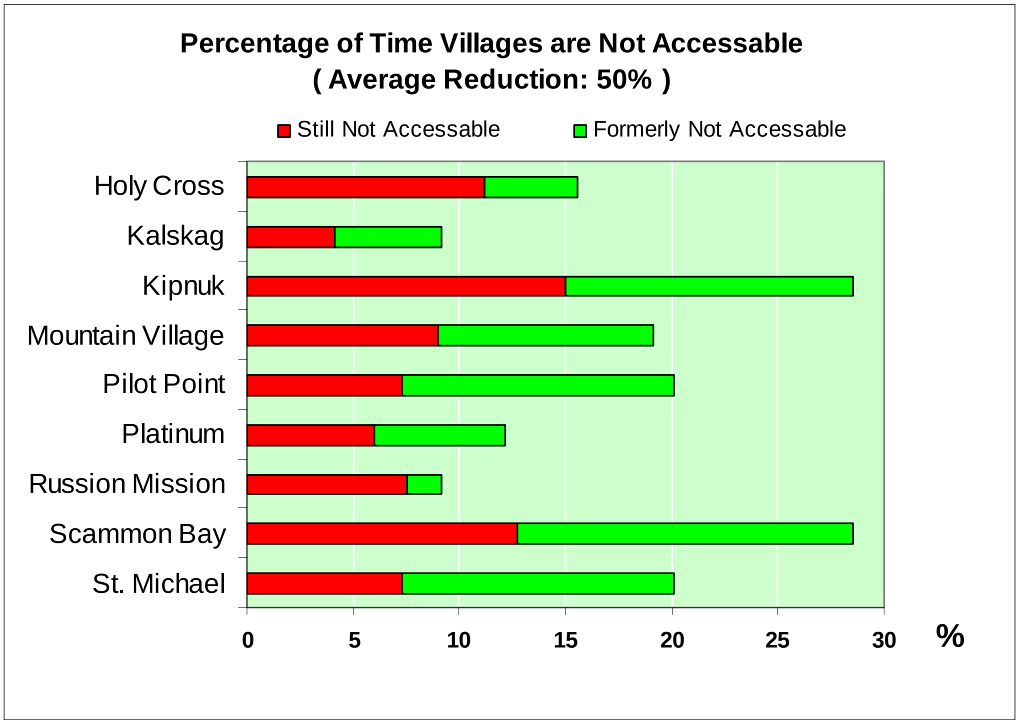


Figure 4.2.2-2 Reductions in the Percentage of Time Villages are Without Air Transportation

4.2.2.1 Business Leader's and Public Servant's Viewpoint

Users of aviation services in the Y-K Delta were also interviewed to determine their opinion of changes in quality aviation services and safety or the economic impact of the Capstone program on the area. Virtually all were familiar with the Capstone Program and were of the opinion that aviation services and safety have significantly improved due to Capstone. Several also cited Capstone for improving service to and from Bethel, and a majority stated that they wanted the Capstone program to continue. Only two interviewees (at the same organization) responded negatively to Capstone service and safety improvements, stating that improved awareness of weather conditions had made pilots less likely to take risks (which could be viewed as a safety improvement).

Most responses, however, were similar to the following examples:

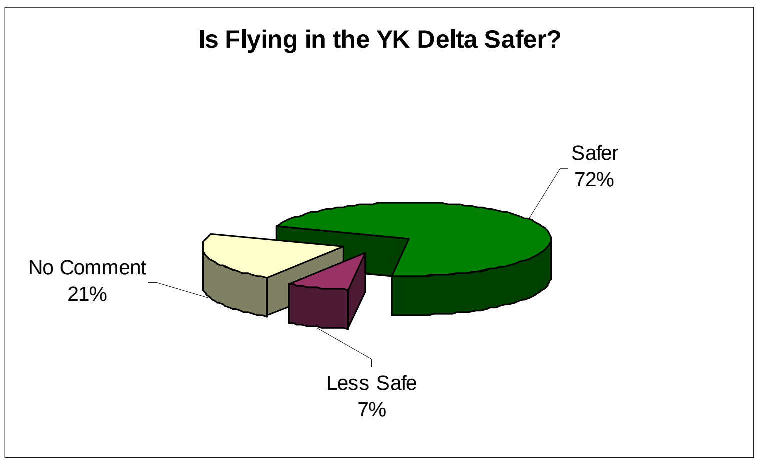
> "Better attitude towards safety (increased awareness). We are a field office for 37 villages and we fly commercial aircraft almost daily. Capstone is a safety measure in the commercial aircraft that we have become accustomed to having."
>
> "Positive changes, travelers are most confident in the air taxi operations, the pilot and the aircraft. A very definite improvement. Travel between the villages and Bethel is clearly safe for the purpose of goods sold here, visits to hospital are more consistent and travel to the hub for jet service is dependable."

> "The Capstone aircraft have helped. We can get to more airports on time than before Capstone. We spend more time at the jobs and not as much sitting in the airports. Capstone has saved use of lots of time and money. Please keep it up. We feel much safer in our travels. Thank you."

None of the business leaders interviewed had an opinion on specific economic impacts. Most felt that it was too soon to make that determination. Only one specific comment was made:

> "Accidents are down. People feel safer flying which means more people in town to shop at my store."

Figure 4.2.2-3 summarizes the responses and full responses can be found in Section 6.6, F.1.



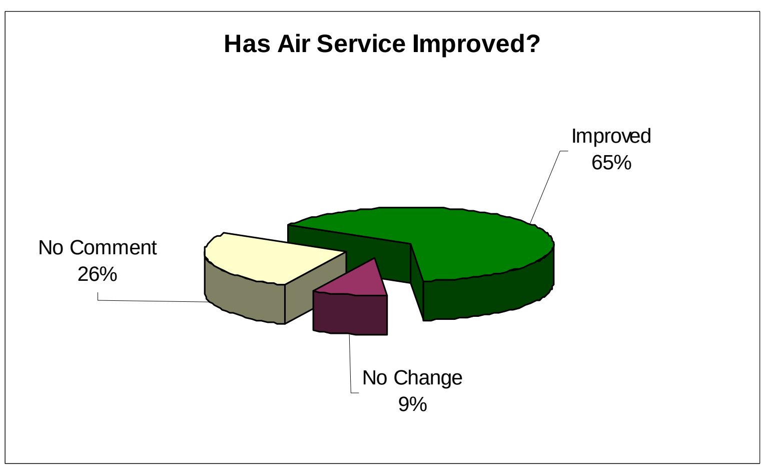


Figure 4.2.2-3 Community Responses to the Capstone Program

4.2.2.2 Village Leadership's Viewpoint

Bethel is the headquarters of the Association of Village Council Presidents (AVCP) which represents 56 tribes in the Y-K Delta region. UAA-conducted interviews with 13 members of the AVCP indicate that Capstone is well-known and well-received among village leaders with the majority believing that Capstone has improved flight safety and access to villages.

Of the 13 leaders interviewed, ten stated that they believed Capstone had made travel to remote villages safer and seven stated that access to villages had been improved or that there were fewer flight delays or cancellations since Capstone's implementation. The comments also showed that the village leaders were very aware of the capabilities of Capstone avionics, especially terrain and aircraft avoidance features.

The following comments were typical and full responses can be found in Section 6.6, F.2:

> "I travel quite frequently in the Y-K Delta and other remote locations in Alaska. My personal opinion is that the Capstone Project has made a significant positive impact on travel in the remote locations in Alaska and has contributed immensely to passenger safety."
>
> "In the past, village stores would run short of supplies for a week or so due to weather."
>
> "I have heard that people feel more comfortable flying since Capstone has been used. The passengers feel a little safer than when it wasn't being used."
>
> "Scheduled flights are not disturbed as often as they used to be."
>
> "I feel safer now, as pilots are more aware of other planes and get directions that would not be possible with other visual instruments."
>
> "Air travel seems safer, and people are more willing to travel to other towns to shop and visit."

4.3 Search and Rescue

The search and rescue (SAR) system relating to missing and downed aircraft in Alaska involves both federal and state agencies, including the Alaska Air National Guard (ANG), the US Coast Guard (CG), the FAA, the National Oceanic and Atmospheric Administration (NOAA), the Alaska State Troopers (AST), and the Alaska Civil Air Patrol (CAP). In the area of northern Alaska, which includes the Y-K Delta, the coordination of SAR missions is the responsibility of the Alaska Rescue Coordination Center (RCC), manned continuously by ANG personnel.

Historically, large and lengthy searches for missing aircraft have been frequent in Alaska. Lacking modern navigation and communication equipment, flying visually in unpredictable weather, and leaving little information upon which to base the search, many aircraft vanished. Even with information concerning the pilot's intended route of flight, searches were often unsuccessful. Reducing this uncertainty, shortening the search phase required locating downed aircraft, and increasing the chance of the successful rescue of survivors have been continuing SAR objectives.

.

The component of the Capstone airborne system that is most relevant to SAR is the Automatic Dependent Surveillance-Broadcast (ADS-B) function. An onboard Universal Access Transceiver continuously broadcasts the GPS-based position of the aircraft and other information through ground stations to the Anchorage Center and other aircraft, and is available to operators for flight following. The potential for monitoring the location of Capstone-equipped aircraft, and noting the loss of ADS-B data, could initiate the SAR process, whether or not the onboard ELT functions and track data can also be retrieved by the Anchorage Center if the aircraft is reported missing or overdue, to determine the last known position (LKN).

The Capstone Phase 1 program has provided an improved SAR capability to locate aircraft equipped with ADS-B that may be in distress, overdue or down, and to quickly reach a crash site and affect a rescue of survivors. This improved capability affects both the cost and effectiveness of SAR by reducing the time for notification of missing or overdue Capstone aircraft, and by providing reliable track data to the point of last transmission, thereby permitting the launch of appropriate SAR assets to that location, without the costly and time-consuming step of initiating a search mission to locate the crash site.

The Capstone Program provides an overall emphasis on improved air safety, which has translated into fewer needs for SAR in the Y-K delta. Together with putting into the hands of pilots the avionics to navigate precisely and avoid accidents, the ADS-B has placed into the hands of operators the ability to follow their aircraft, and immediately detect when a Capstone aircraft is in distress or down. This translates into a level of confidence in pilots that SAR help will be dispatched in the event of a mishap, not dependent upon an ELT beacon that may not operate, or upon ability to communicate. A Civil Air Patrol (CAP) squadron is located in Bethel, Alaska, where at least one Capstone equipped Cessna 180 is always available for search missions tasked by the RCC. The precise navigational capability and search pattern feature of the Capstone avionics have supported more efficient performance of search missions. The CAP reports that the ability to monitor Capstone-equipped search aircraft permits their redeployment and enhances the safety of SAR searches.

This improved capability was clearly demonstrated on the night of October 28, 2002, in an instance where a Capstone equipped aircraft crash did not result in the activation of the aircraft ELT beacon, and the pilot was injured and unable to communicate. Based on ADS-B data, the SAR Rescue Coordination Center (RCC) directed a military helicopter, with rescue personnel, to the point of last transmission. The crash site was identified and the rescue was accomplished, with the aid of night-vision equipment, resulting in the saving of the pilot’s life. The elapsed time from the notification to the RCC of this accident until the pilot was receiving medical treatment was 2 hours and 30 minutes, a remarkable SAR mission.

Insufficient data on the cost and time factors relating to SAR was available to perform a definitive cost/benefit analysis of Capstone, but there is agreement by SAR persons at the RCC that any data that assists in reducing the time to initiate SAR actions, or accelerates the process of locating and reaching survivors, has the potential benefit in saving lives.

Section 6.7, Appendix G provides further details on SAR and the impact of the Capstone Phase 1 program.

4.4 Air Traffic Control

4.4.1 Air Traffic Control Changes

To assess the impact of the Phase 1 Capstone program on air traffic control, the controllers at the Anchorage Center and at the Bethel Tower were interviewed. The controllers at the tower were interviewed on 6 December 2004. The controllers at the Anchorage Center were interviewed during the week of 28 February 2005. Subsequent to the center interviews, another data collection effort was made at the center during the week of 20 June 2005.

4.4.1.1 Bethel Tower

The Bethel Tower is a contract tower handling about 100,000 operations annually. Of these operations, 4% are air carrier, 7% are general aviation, and the remaining 89% are air taxis.

Six controllers were interviewed for their opinions of Capstone. The interviews were informal and the controllers were asked what was positive and what was negative about the Capstone equipment. Other demographic information was also obtained. In general, the tower controllers thought that the Capstone equipment was reliable and that it provided improved situational awareness for both the pilot and the controller. However, the display that the towers look at is not certified so that not all of the information can be used in giving traffic calls. The detailed responses can be found in Section 6.4, Appendix D.

4.4.1.2 Anchorage Center

At the Anchorage Center there have been approximately 50 controllers who have been exposed to ADS-B operations in the Bethel area. Of those, 30 controllers currently work in that sector. Of the 30, five controllers were on leave the week the questionnaire was administered. Of the remaining 25, 14 filled out the questionnaire. There were also 3 controllers that filled out the questionnaire who do not currently work the sector. We heard from a few others that, even though they did not fill out a questionnaire, had opinions about Capstone. The questionnaire and a tabulation of responses can be found in Section 6.4, Appendix D.

There was a consensus that the ADS-B technology was good. The ADS-B returns were accurate, the acquisition of the track was quick, and the technology provided target information where none was previously available with radar. However, some controllers, in discussions after the questionnaire was filled out, expressed the feeling that providing ADS-B to the controllers was an afterthought. As examples of this they referred to certain interactions between the ADS-B messages and the Micro-EARTS radar processing system that caused them problems. In general, several controllers characterized the introduction of this technology as being less smooth than the introduction of other technologies at this center.

From the responses to the questionnaire it was noted that the controllers felt that the overall efficiency of the operations was improved by Capstone. Furthermore, the controllers thought that Capstone decreased the amount of time that the controller spends on separation services when the weather is poor. Figure 4.4.1.-1 summarizes these results.

Upon further questioning of the controllers it was learned that without surveillance, arriving aircraft need to be stepped down in altitude. If there is surveillance, that is not necessary. Every time that a step down is required the controller has to communicate with the pilot. Reducing the communications workload is one of the primary factors in improving the efficiency of the operations according to the controllers.

To assess how large an impact this might be, an analysis of flight progress strips was conducted during the week of 20 June 2005 at the Anchorage Center. Flight progress strips covering the period from 10 May 2005 through 6 June 2005 were available for analysis. One day (16 May 2005) and one sector (Sector 13) were chosen because Bethel experienced IFR conditions for a significant portion of that day.

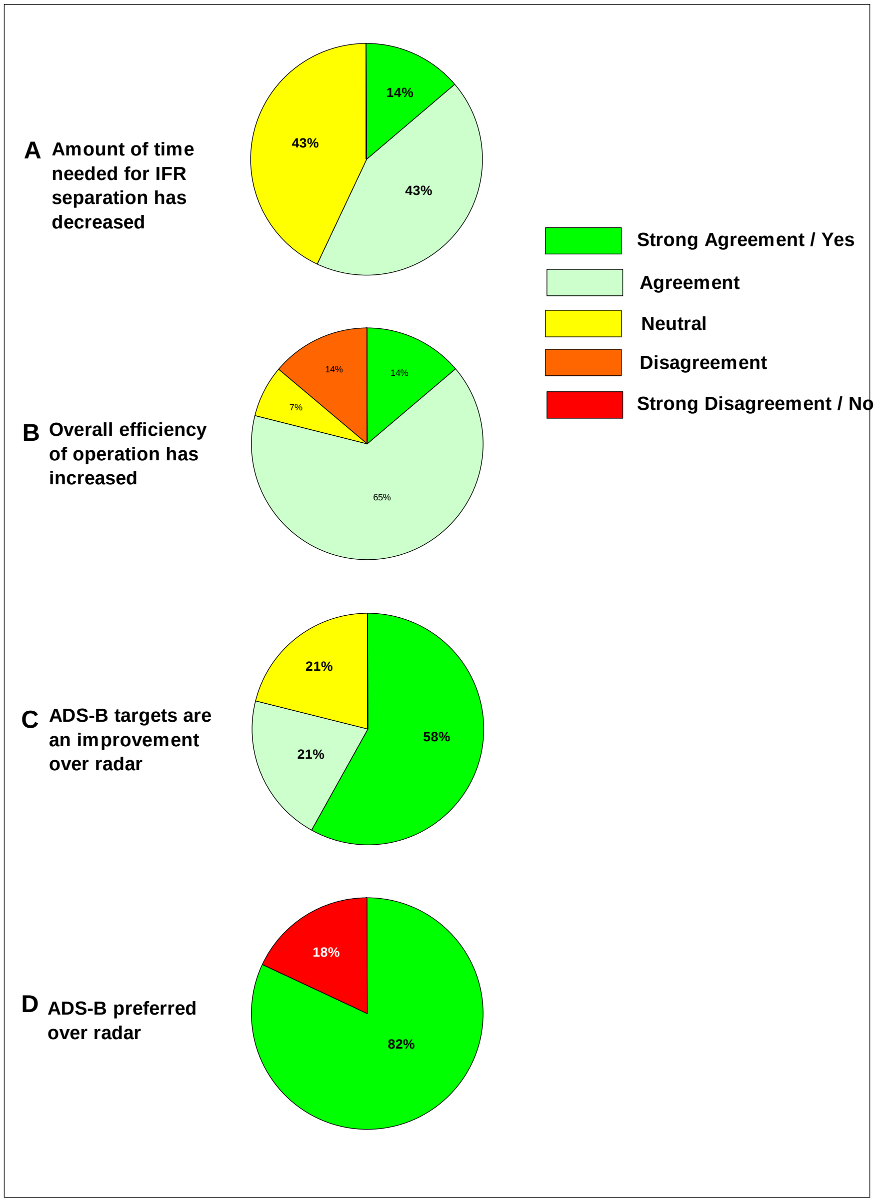


Figure 4.4.1-1 Summary of Anchorage Center Interviews

With the help of three controllers, flight progress strips from one hour from this day were chosen for analysis. It was assumed that none of these aircraft were using ADS-B because of the types of markings on the flight strips. Next, the controllers were asked to estimate the number of transmissions the controller would have made to the aircraft as shown by the markings on the strips. Then, the controllers were asked to estimate the number of transmissions that would have been made if all the aircraft were ADS-B equipped. These estimates took into account a number of factors, including how many aircraft were vying for services at the same time. The result was that if all the aircraft in this sample were equipped with the Capstone equipment there would have been a 26% decrease in the number of communications to those aircraft. This represents a significant reduction in communications workload in those areas not within radar coverage.

4.5 Aviation Safety

This section characterizes numbers and rates of accidents in the Y-K Delta. First, it classifies accidents in 2004 and in the 2000-2004 Capstone period and compares types of accidents between Capstone-equipped and non-equipped aircraft. Second, it compares rate changes of specific types of accidents targeted by Capstone to what we should expect if the capabilities work as hoped and progress on implementation is as we have described. The third analysis compares overall accident rates between commercial aircraft in the Y-K Delta and other parts of Alaska. It also compares overall accident rates between aircraft prior to equipage and after equipage. The final analysis compares accident counts between operator and operation types before and during the Capstone period.

4.5.1 Accidents in 2004

The left side of Figure 4.5.1- shows the accident categories of Y-K Delta Part-135 aircraft involved in accidents in 2004. All Part-135 aircraft based in the Y-K Delta were Capstone equipped. The right side of the figure shows all Part-135 accidents in the Y-K Delta since Capstone implementation began.

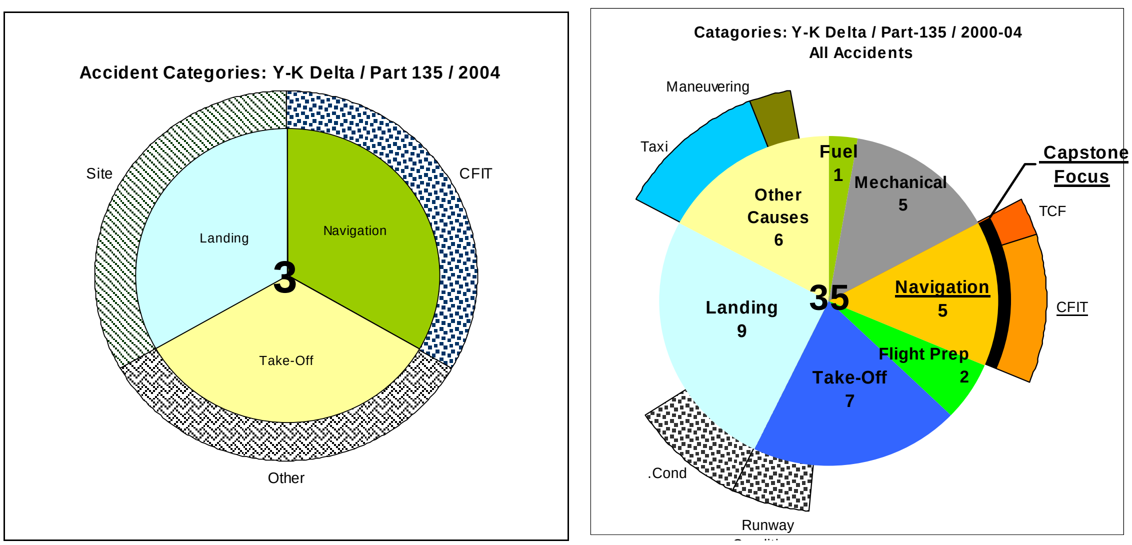


Figure 4.5.1-1 Categories of Accidents in 2004 and Since Capstone Implementation

Figure 4.5.1-2 shows accident categories for Capstone non-equipped and equipped aircraft since 2000. The breakdowns of accidents by major category are essentially similar and within the levels of variation one should expect for this number of occurrences. Details of the Capstone equipped accidents can be found in Section 6.1, Appendix A.

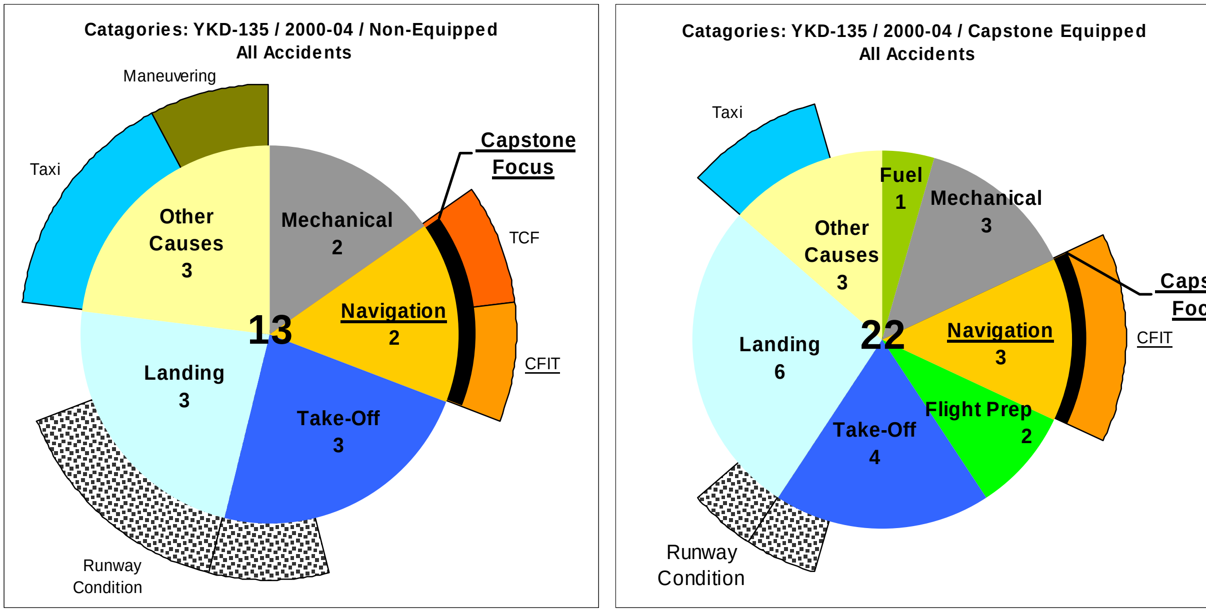


Figure 4.5.1-2 Categories of Accidents by Non-Equipped and Capstone-Equipped Aircraft 2000—2004

4.5.2 Comparison of Accident Types to Projected Capstone Benefits

The safety benefit expected from Capstone depends on the types (and rates of occurrence) of accidents before Capstone, the projected effectiveness of a complete implementation, and the progress on implementation that Capstone has actually made. Since the safety impact of Capstone is best quantified over time, we expect to see changes from increased IFR capability, changes in safety posture from Capstone and other causes, and changes in operations from using Capstone capabilities in ways not predicted. As of this report, we can quantify expectations for only two of the accident types that are the direct focus of Capstone: accidents associated with navigation/CFIT and those associated with traffic.

The level of Capstone equipage and the effectiveness of Capstone training have had a positive impact on the prevention of navigation/CFIT accidents. From 2000 through 2004 an average of 78% of Y-K Delta-based Part-135 flight operations were equipped, and the average effectiveness of pilots using Capstone avionics was assessed to be 49%. In 2000-2004 we estimate 44% of preventable navigation and CFIT accidents were avoided as a result of Capstone. Since warnings on Terrain Clearance Floor violations are not included in Phase 1 avionics (they are planned for Phase 2), collisions with terrain during approach are not directly affected. For en route CFIT the full-implementation effectiveness was assumed to be 90%.

Progress on implementation affects traffic/mid-air accidents differently. While an average of 78% of Part-135 flight operations from 2000 through 2004 were equipped, only about 2/3 of all flights are Part-135 (the remainder are mostly Part-91 and public use). On average, if a Part-135 aircraft was at risk of a mid-air collision with a second aircraft, the chance they were both Capstone-equipped was only 52%. Even limited training levels can reduce this further. In 2000-

2004 we estimate that 30% of mid-air accidents would be avoided as a result of Capstone (assuming a full-implementation effectiveness of 100%).

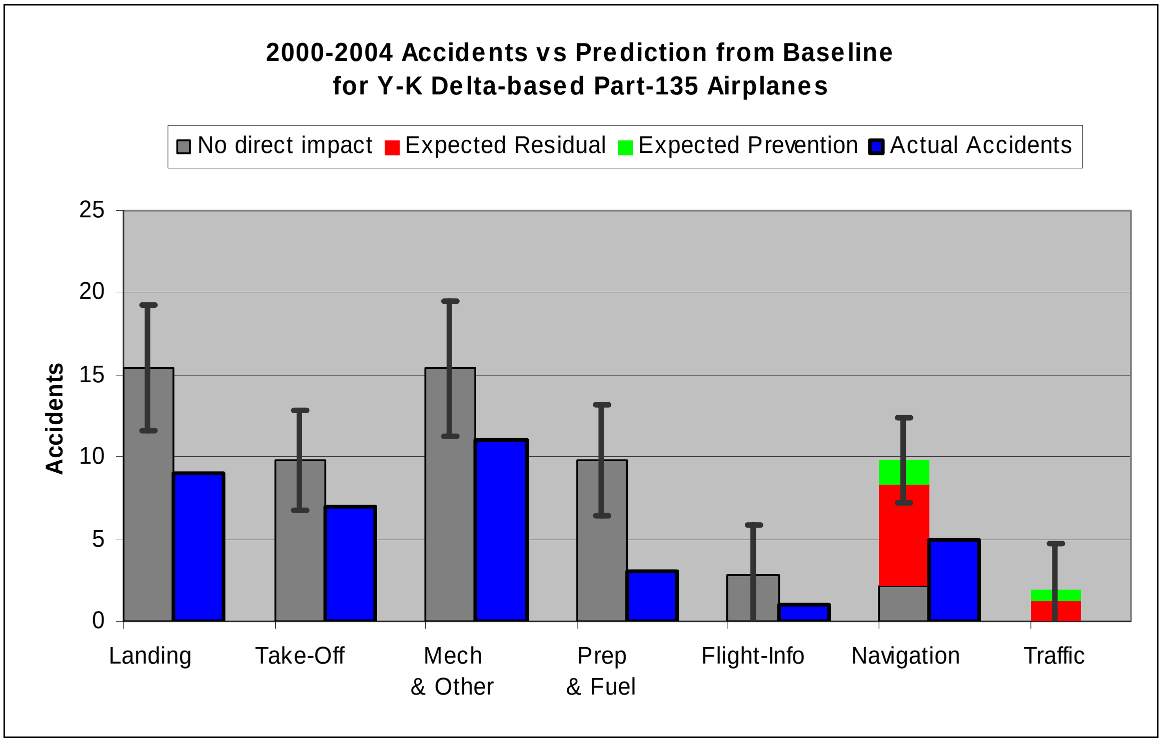


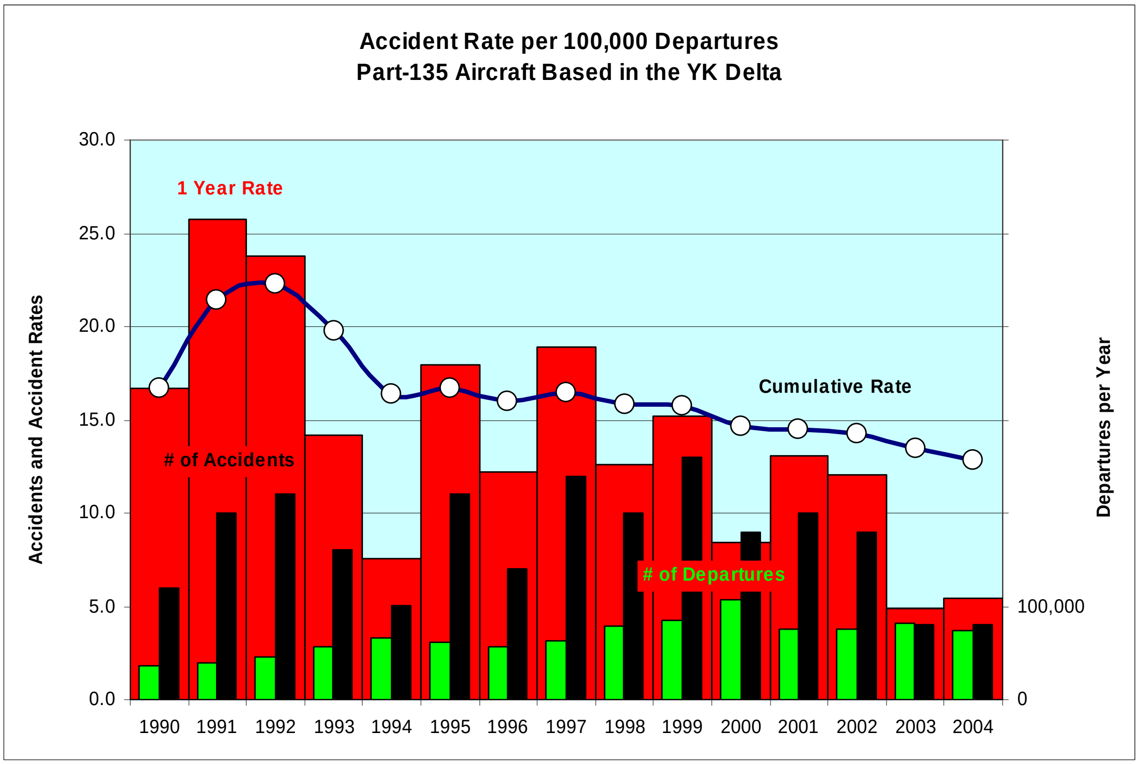
Figure 4.5.2-1 2000-2004 Accidents vs Prediction from Baselinefor Y-K Delta based Part-135 Aircraft

Figure 4.5.2-1 uses these estimated safety benefits for Navigation and Traffic accidents to project the number of accidents we should expect in 2000-2004 for Part-135 aircraft based in the Y-K Delta and compares this to the number that actually occurred. The projection uses the types and rates of accidents from 1990-99 scaled-up for observed growth in operations. The figure also shows error bars for the numbers of accidents that should be expected from history. This is the standard deviation for four-year periods scaled for growth. If there were no underlying changes in accident rates, the chance of observing a number in this range would be about 67%. For small numbers such as these, this variability is large compared to the average value (this is particularly true for fatal accidents, which are only about one tenth as numerous). In many cases, observing zero accidents is well within typical variations, and a gap in accidents will need to persist for several years before we can be certain it is significant. The estimated navigation and traffic accidents prevented by Capstone in 2000-2004 are comparable to these expected random variations. This means that further time will be needed at high levels of equipage and training before reductions of specific types of accidents can become statistically significant.

4.5.3 Comparison of Y-K Delta Accident Rates to Other Parts of Alaska

Until recently, lack of data on aircraft flight hours and operations counts has constrained evaluation of accident rates in rural Alaska. Beginning in 2002, the Bureau of Transportation Statistics began archiving additional data on *scheduled* small carriers. In the Y-K Delta, some further information on hours flown by *unscheduled charter* operators (as a percentage relative to flight hours by scheduled operators) is also derivable from the flight-monitoring data archived by CRABS. Current and historical operations data and the methods by which we estimate historical operations counts are described in the appendices.

Figure 4.5.3-1 shows departure count, accident count, and accidents per 100,000 departures for Part-135 and Part-121 aircraft within the Y-K Delta and for all other flights in Alaska. The scale for accident rates (the wide red bars) is the same in both the upper and lower sections of the figure, indicating that over time the accident rate within the Y-K Delta has been two to four times the rate for other parts of Alaska. From year to year, the accident rate in the Delta is also much more variable than in the remainder of Alaska.



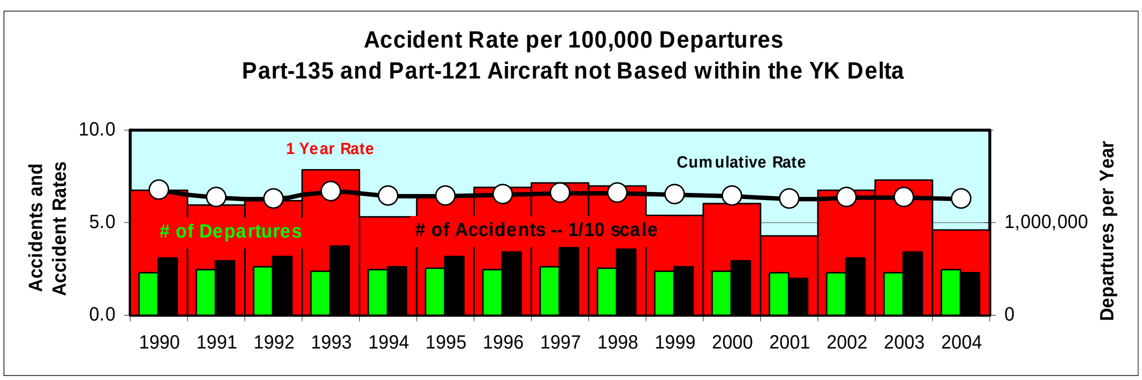


Figure 4.5.3-1 Accident Rates for Y-K Delta Part-135 Aircraft and Those Based Elsewhere in Alaska

The continuous curve (black line with white dots) on each chart represents the cumulative total rate of accidents per departure from 1990 to the year shown. For other parts of Alaska, this cumulative rate has been quite stable. For operations in the Y-K-Delta, there was a substantially higher rate of accidents in the early '90s from which the cumulative average has been slowly falling.

The figure also shows that the accident rate for the last two years for commercial flights in the Y-K Delta, all of which are Capstone-equipped, is the lowest it has been since the beginning of our accident baseline in 1990, and the accident rate in the Delta fell below the rate for the rest of the state for the first time in 2003 and has remained below the rate for the rest of the state in 2004.

4.5.4 Comparison of Accident Rates Before, During, and After Equipage/Start of Services

The relative stability of Part-135 accident rates in the Y-K Delta since 1993 extends through the end of 2004 for aircraft not equipped with Capstone at which time all the Part-135 aircraft based in the Y-K Delta were Capstone-equipped. A time-magnified view from 1999 through 2004 (using daily data), is shown in red on Figure 4.5.4-1.

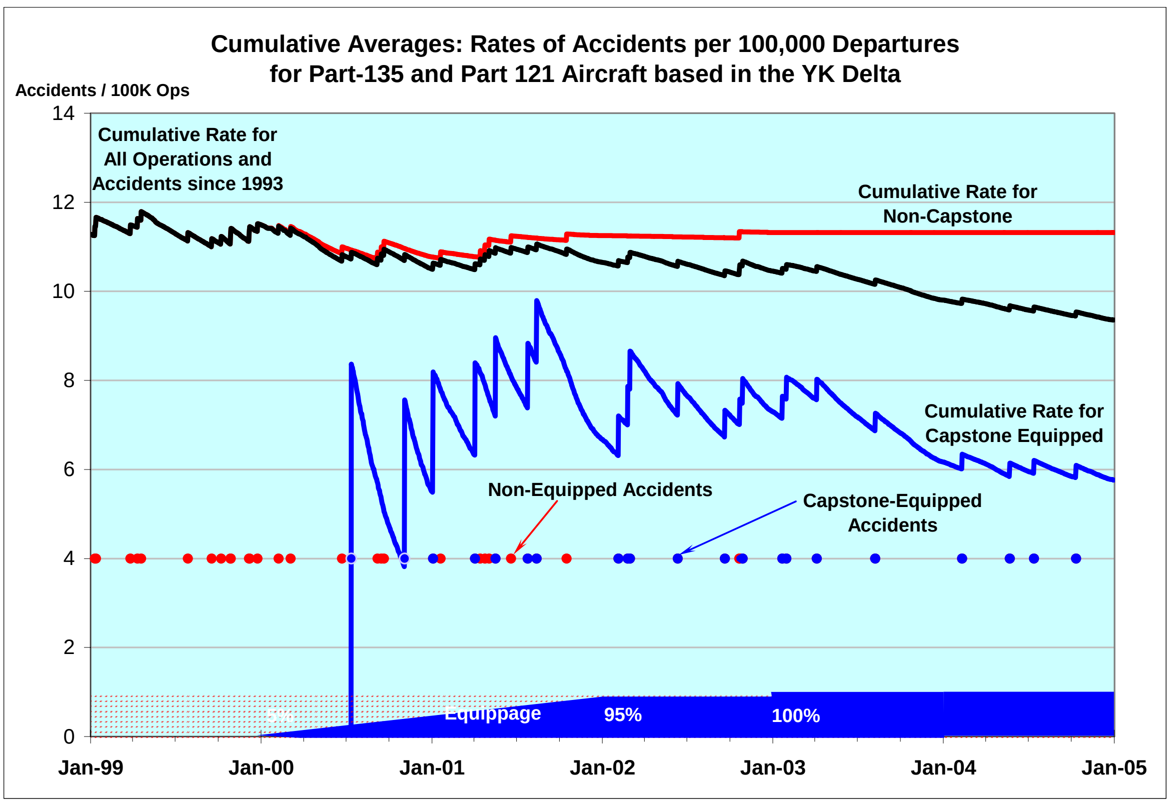


Figure 4.5.4-1 Relative Accident Rates for Y-K Delta Commercial Aircraft <u>Without</u> and <u>With</u> Capstone Avionics

The blue line is the equivalent curve for Capstone-equipped aircraft. There were no accidents and few operations before July '00 for Capstone-equipped aircraft, so this curve is less stable. Nevertheless, the Capstone-equipped accident rate appears to have trended strongly towards stability at a rate significantly below that for non-equipped aircraft. The rate of accidents by

Capstone-equipped aircraft is lower than that for non-equipped aircraft. The rate for equipped aircraft still varies due to the smaller volume of data. The rate of non-equipped aircraft does not vary after January 2003 because there are no operations by non-equipped Part-135 aircraft based in the Y-K Delta. The percentage improvement in the accident rate from 2000 through 2004 is 47%, though this has varied and will continue to vary significantly because of random fluctuations. These results do not determine whether the improvement is due to safety benefits of the specific Capstone capabilities or to a heightened attention to safety on the part of pilots and companies flying Capstone-equipped aircraft.

4.5.5 Comparison of Accident Rates Between Operator and Operations Types

Public aviation transport in the Y-K Delta relies on three major carrier types: Part-121 Air Transport operations, which fly larger, more capable aircraft with multiple crew members and have comparatively few accidents in the Delta (or any where else in the US); Part-135 Commuter operators whose operations include at least some scheduled service; and, Part-135 Charters who are not scheduled. Reporting requirements (and hence, available operations data) are very different between the two Part-135 types. Fortunately, CRABS' flight monitoring ability has provided data with which we could determine that charter flight time has averaged approximately 10% of carrier operations.

Accident rates for scheduled commuters and unscheduled charters are comparable. Figure 4.5.5-1 shows the variation of the percentage of accidents by charters over time. The orange area indicates that the charter accident rate has in fact been somewhat higher than that for commuters, but if accidents are omitted from one frequent-accident charter operator, the remaining rate is clearly at or less than charters' 10% share of flight time.

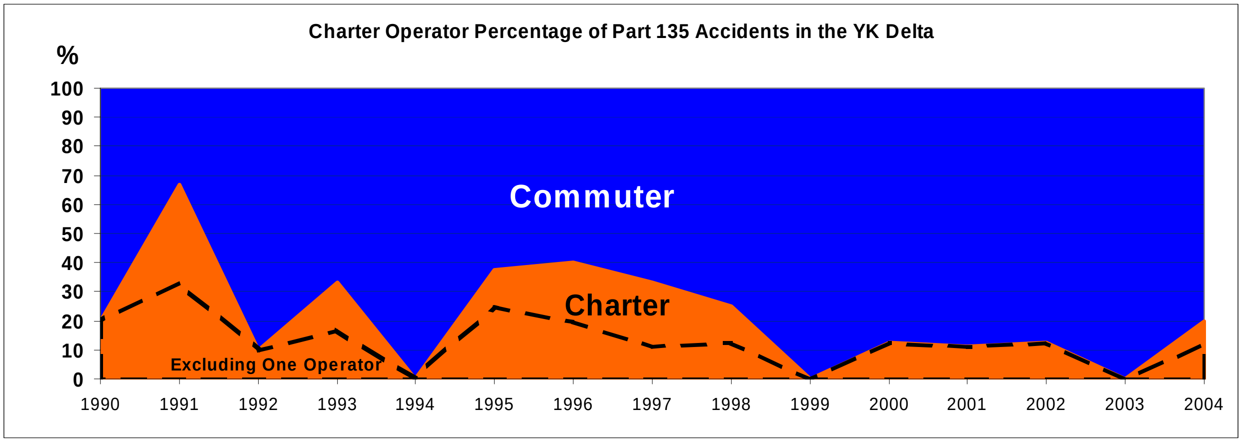


Figure 4.5.5-1 Relative Accident Rates for Scheduled/Unscheduled Operators in the Y-K Delta

Both types of Part-135 operators use non-revenue flights to ferry or position aircraft and for testing or training. In addition, commuter operators often fly unscheduled as well as scheduled flights. Figures 4.5.5-2 and 4.5.5-3 show the breakdown of historical and Capstone-era accidents for these operations types.

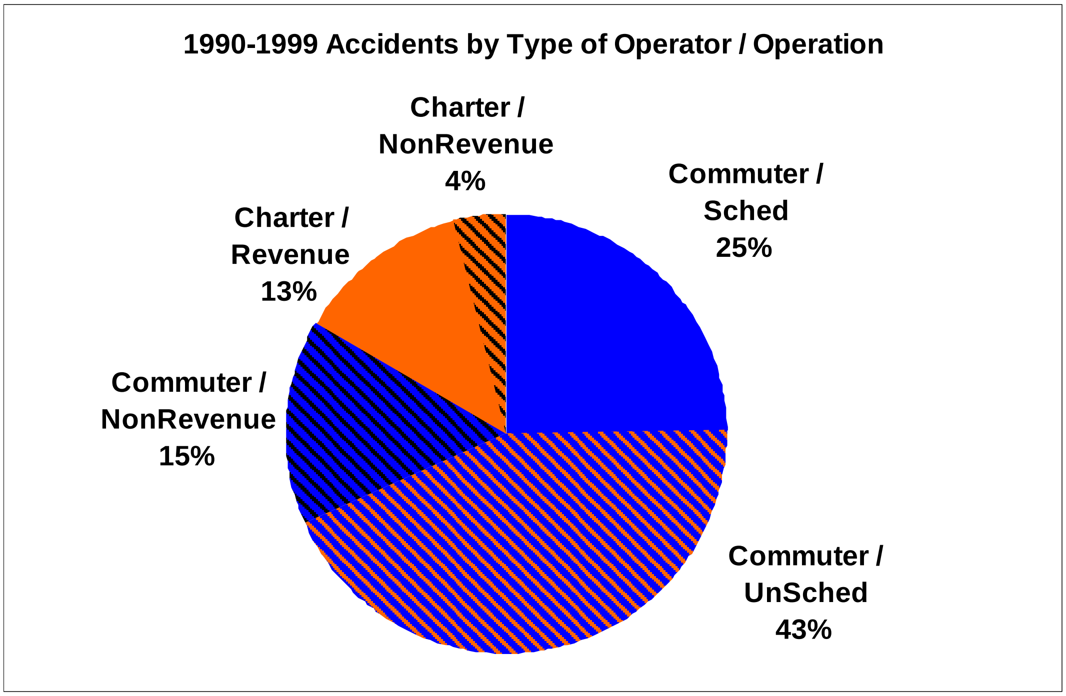


Figure 4.5.5-2 Historical Proportions of Accidents by Operator/Operations Types in the Y-K Delta

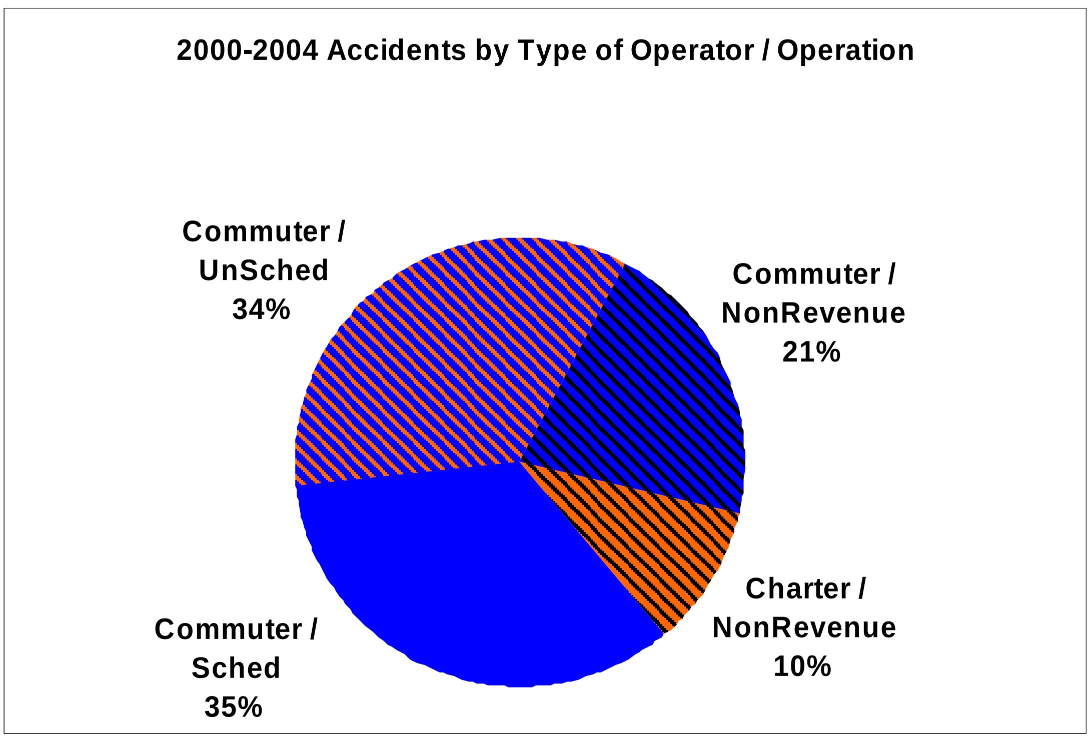


Figure 4.5.5-3. Proportions of Accidents by Operator/Operations Type Since Capstone

4.6 Other Y-K Delta Programs/Impacts

There is no quantifiable data available to verify that Y-K Delta operators have changed their safety posture. Since operators are small companies and certified under Part-135, their quality assurance programs and records keeping requirements are limited. Using surveys to determine if the safety posture had changed did not provide any sufficient quantitative data. Fifty percent of the respondents indicated they have changed their safety program, but when asked if they had physically generated safety letters to the pilots or made changes to their flight operations manuals for safety issues, all replied that they had not but had “spoken” with the flight crews about these issues.

During discussions with the inspectors from the Flight District Standards Office responsible for the Y-K Delta, they expressed the opinion that safety and safety awareness in the Y-K Delta has improved over the past five years. They felt Capstone has been part of this improvement and also cited other impacts such as more experienced pilots, more IFR flying, higher insurance requirements, the mail contract change, and the fact that some of the weaker operators had left the market. All inspectors expressed concern over what will happen after the Capstone program ends, leaving operators with the responsibility for the continuation of the program. Concern was expressed regarding the outfitting of additional aircraft, maintenance of the equipment/software, and continued training of pilots.

4.6.1 Mail Rule Change

The United States Post Service mail rule change has impacted the number of operators in the marketplace of the Y-K Delta. There were 6 operators representing 36 Capstone equipped aircraft that have left the Bethel hub and the Capstone area as a base of operations. The operators that have left the market were primarily mail only carriers that did not control a large enough share of the market to remain in the mail tender after the new rules became effective on November 6, 2003. The details of the new mail rule can be found at HR 4775 Enrolled Bill July 24, 2003 SEC. 3002. RURAL SERVICE IMPROVEMENT, (cited as the “Rural Service Improvement Act of 2002”).

The primary change to safety is the aircraft that have left the market were primarily single engine piston aircraft and the mail lift has gone to turbine powered aircraft with greater capacity. The intent of the regulation dealing with mail distribution was to move passengers to a more reliable transportation system.

4.6.2 Medallion Program

The Medallion Foundation, created in 2001, is one of the more important flight safety programs in Alaska. Although program membership is voluntary, the prestige that comes with earning a Medallion Shield has proven to be a powerful incentive for Y-K Delta carriers to join. To earn the shield, air carriers must complete five program goals (Stars) designed to increase safety awareness and improve safety practices. At the end of 2004, 13 of 35 Capstone-equipped commercial carriers in the Y-K Delta, representing 64% of the Capstone-equipped fleet, have joined the Medallion program. As shown in Figure 4.6.2-1, five carriers have earned Medallion Stars for meeting some of the program goals. Two of those carriers have earned the Medallion

Shield, meaning that the carriers met all Medallion Program goals. Two carriers have achieved 2 Stars, and one has received a single Star. Seven of the operators have yet to earn Stars.

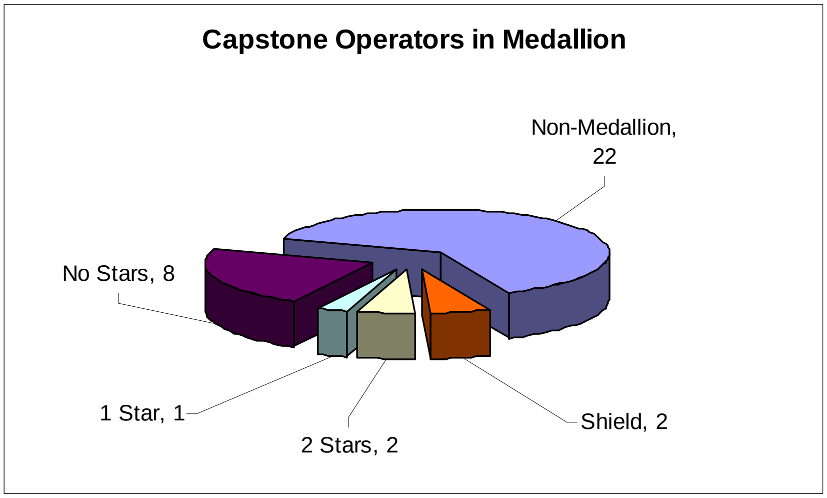


Figure 4.6.2-1 Stars Earned by Y-K Delta Operators

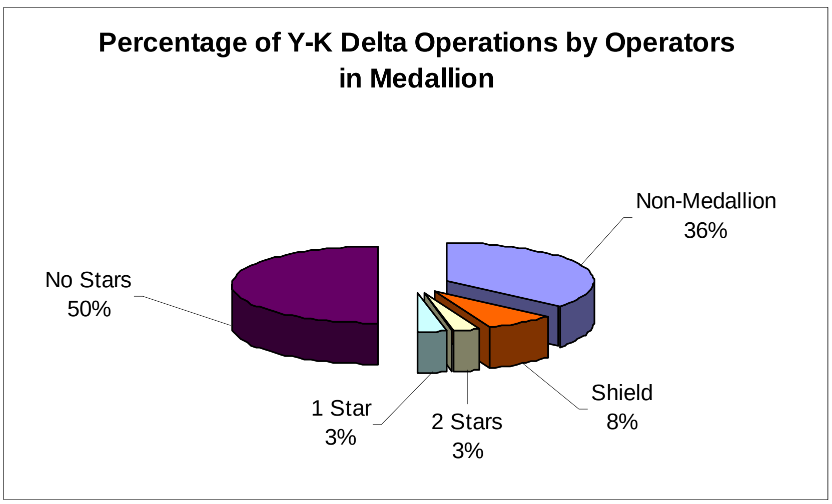


Figure 4.6.2-2 Impact of Medallion Program on Operations in the Y-K Delta

Although the Medallion Program has enrolled a majority of the Y-K Delta operators and fleet, its impact at this point cannot be considered significant. Only 14% of the operators have achieved one or more of the five Stars necessary to obtain a Shield. Figure 4.6.2-2 shows that operators with at least one Star were responsible for only 14% of Part-135 operations. Finally, non-Medallion members and those members who have yet to earn a single Star conducted 86% of the operations in the Y-K Delta.

5 Conclusions

5.1 Summary Conclusions

The Capstone Phase 1 program provided the Y-K Delta a significant technological improvement that in turn produced safer operations in the area. The accident rate reduction alone indicates the success of the program. Improved access due to new approaches, additional weather reporting sites, better flight monitoring and additional Search Air Rescue capabilities also are benefits that Capstones has brought to the area.

5.2 Lessons Learned – Safety and Impact Reporting

As with any program that extends over a period of time, there are internal and external dynamics that affect monitoring of the program and its impacts. In conducting an annual safety assessment and a final report, the team has learned a number of important lessons that should be taken into consideration as the Capstone program expands to other areas or other similar programs are implemented. The following are key elements noted by the team.

5.2.1 Operations Data

Operations data provisions should be included in the contract requirements for all participants.

Collecting the necessary operations data for meaningful analysis has proven to be a challenge with the small operators that were involved in the Capstone program. The data necessary for accident analysis includes aircraft fleet operating time and the locations flown to by the operators. Reporting this data was not a regulatory requirement prior to 2002 and that data is still not required to be reported for operators who do not fly any scheduled operations such as charter only operators. It is recommended that in future programs this data reporting be a requirement that includes a one year history prior to program start, then quarterly reporting for the duration of the program. Reporting should include aircraft that have been modified and are operating out of the specified operating area.

In order to analyze changes in operations and access changes, data is needed on the number and locations of IFR operations and data on the number of IFR-qualified pilots. Weather data for the specific airports should be gathered and archived for inclusion in the analysis. This data should be included in the agreement with future participants.

Most of the small operators do not have an equipment reliability program due to fleet size. In order to effectively analyze the reliability of the installed components, tracking of the installed and removed time is necessary to calculate Mean Time Between Repair. This was not available during Phase 1 and components could only be tracked based on removal and repair data. A tracking program and reporting system should be a participant requirement.

5.2.2 Population Definition

Defining the scope of the report and the population to be analyzed must be specifically designed at the start of the program, but must also be flexible enough to allow amendments as further knowledge is obtained.

The baseline analysis and report should very specifically define the physical areas of operation, the fleet to be included such as Part 91, Part 135 and Part 121 and specified airports. The baseline should also define the specifics for accident analysis such as inclusion or exclusion of aircraft such as helicopters, how Part 135 aircraft operating as Part 91 should be handled, etc.

5.2.3 Survey Data Gathering

Survey requirements and data provisions should be included in the contract requirements for all participants.

Surveying the pilots during this program has proven to be a difficult task. Early in the program written surveys were provided to the pilots to be sent back. This did not work, as the pilots failed to return the surveys and the only way that data was gathered was physically catching the pilots and interviewing them. This reduced the number of surveys and increased the time and cost. In the future, the participating agreement should specify that each pilot at each operator will provide responses to surveys on an annual basis.

5.2.4 Predicting Program Impacts

The safety impacts of the program are broad and the mechanisms of these impacts are difficult to measure. External impacts add to the difficulty of understanding the broader impacts.

The program will have both internal and external forces that will change the initial predicted program impacts. It has been found during these studies that it is difficult to predict and understand all of the impacts that a program will have on the operations and the area they serve. During the program life, other changes, such as the mail rule change, can significantly affect the impact of the program. The impacts were found to be broader than expected and difficult to define. This has been especially difficult for impacts such as economic affect on the villages, communications improvements, changes in operator safety posture, etc. The study group should be prepared to monitor the program for unanticipated impacts and adjust the reporting to reflect those changes.

5.3 Future

The Capstone Phase 1 program has had a positive impact on the Y-K Delta, including reduced accident rates and improved accessibility during less-than-VFR weather conditions. The Capstone program provided the initial equipment, training and infrastructure necessary for these improvements to take place. The FAA provisioning of equipment spares and training for the Capstone Phase 1 program ended in 2004. The responsibility for continuing these functions has been transitioned to the operators. Maintaining these improvements and continuing in a positive direction is dependent on both the government and private sector. Bethel TRACON has been planned and approved and should be in operation within two years. This will have new operating and safety impacts that should be measured and assessed.

Concern was expressed in interviews with pilots, FAA Inspectors and airline management about the future after the Capstone program ends. All agreed that the program had been beneficial and many felt that it would "breakdown" after the program ended. None believed that it would be themselves that would be the cause of the breakdown; it would be the other participants. In order to better understand how effective this transition is and the longer term safety impacts on the operators, Y-K Delta aviation should be monitored during this changeover.

The FAA has agreed to continue to study the impact of the transition of the Phase 1 program in the Y-K Delta from government equipage and support to industry responsibility. For the next three years, an annual report will be provided assessing the transition.

The Capstone Phase 2 program in Southeast Alaska has started and Capstone Phase 3, which will encompass the entire state of Alaska, is currently in the planning and budgeting stage. These programs should take into consideration the lessons learned during the Phase 1 program.

6 Appendices

6.1 Appendix A: Capstone Equipped Aircraft Accidents

The tables below summarize the accidents involving aircraft in the Y-K Delta from 1990 through 2004. The tables are separated into Capstone equipped aircraft, accidents since the start of the Capstone program to non-equipped aircraft and pre-Capstone program aircraft accidents.

The Table A-1 summarizes the accidents involving Capstone equipped aircraft from 2000 through 2004. The NTSB accident narratives for these accidents follow the tables. The accident numbers are linked to the narratives if viewing this report electronically.

Table A-2 summarizes the accidents from 2000 through 2004 in the YK Delta that were not equipped with the Capstone equipment. The list contains the NTSB accident identification number.

Table A-3 summarizes the accidents from 1990 through 1999 in the YK Delta. The list contains the NTSB accident identification number.

Cause category explanations are listed below, with the abbreviations used in the table in parentheses.

Mechanical Engine failure, inoperable control surfaces, failed landing gear, propeller or shaft failure.

Navigation Usually Controlled Flight into Terrain (CFIT) while en route, most often associated with reduced visibility. In the Y-K Delta, CFIT also occurs in nominal VFR conditions when "flat light" on snow-covered ground prevents recognition of terrain. Terrain Clearance Floor (TCF) warnings are a Terrain Awareness and Warning System (TAWS) function planned for Capstone Phase 2 that addresses the 20%-30% of CFIT accidents on approach or departure. These are not directly addressed by Capstone Phase 1 avionics. Rarely, accidents are due to disorientation, which can be addressed by a GPS-map display.

Traffic Usually mid-air collisions or near mid-air collisions (NMACs) between aircraft. Also includes accidents from last-moment avoidance of other aircraft and from jet blast on airport surface.

Flight Information (Weather, Ice, IMC)
Usually inadequate weather information, especially icing, but also visibility; rarely convective weather. (Surface winds contributing to take-off or landing accidents have been included under take-off or landing rather than here.) Occasionally, lack of information on changes in procedures or facility status.

Fuel Usually fuel exhaustion. Occasionally, failure to switch fuel tanks.

Flight Preparation

Failure to ensure cargo is tied-down and within the aircraft's weight and balance limits. Failure to check fuel for the presence of water. Rare in the lower 48 but significant in the Y-K Delta is failure to remove ice or snow from the aircraft – often resulting in serious or fatal accidents.

Take-off and **Landing**

Failure to maintain control (especially in wind), improper airspeed, or inadequate care near vehicles or obstacles. The Y-K Delta also includes unusually high numbers of accidents due to poor **runway conditions**, hazards at off-runway sites such as beaches and gravel bars, and submerged obstacles struck by float-planes.

Other Includes unusual causes such as bird strikes or collisions with ground vehicles.

Table A-1. YK Delta Accidents Involving Capstone Equipped Aircraft Flying Under Part-135 or Part-121 from January 2000 through December 2004

NTSB Report Number	Date	Injury Level	Cause
ANC00LA086	12-Jul-2000	NONE	Landing
ANC01LA017	03-Nov-2000	NONE	Takeoff
ANC01LA028	03-Jan-2001	NONE	Landing
ANC01LA046	03-Apr-2001	SERIOUS	CFIT
ANC01LA117	25-Jul-2001	NONE	Takeoff
ANC01LA108	13-Aug-2001	NONE	Takeoff
DCA02MA003	10-Oct-2001	FATAL	Pre-Flight
ANC02FA014	04-Feb-2002	FATAL	CFIT
ANC02LA016	24-Feb-2002	NONE	Taxi-RwyCond
ANC02LA019	01-Mar-2002	NONE	Landing
ANC02LA047	11-Jun-2002	NONE	Landing
ANC02LA066	30-Jun-2002	NONE	Landing
ANC02LA123	20-Sep-2002	NONE	Pre-Flight
ANC03LA005B	22-Oct-2002	NONE	Taxi
ANC03LA007	28-Oct-2002	SERIOUS	CFIT
ANC03LA024	21-Jan-2003	NONE	Landing-RwyCond
ANC03LA030	30-Jan-2003	NONE	Pre-Flight
ANC03LA091	08-Aug-2003	NONE	Mechanical
ANC04LA032	10-Feb-2004	NONE	Takeoff-RwyCond
ANC04LA059	22-May-2004	NONE	Takeoff-RwyCond
ANC04LA078	13-Jul-2004	NONE	Mechanical
ANC05LA005	11-Oct-2004	NONE	Other

Table A-2. YK Delta Accidents Involving Non-Capstone Equipped Aircraft Flying Under Part-135 or Part 121 from January 2000 through December 2004

NTSB Report Number	Date	Injury Level	Cause
ANC00LA025	2/7/2000	NONE	Takeoff-RwyCond
ANC00LA033	3/4/2000	NONE	Mechanical
ANC00FA076	6/22/2000	FATL	Takeoff
ANC00FA081	6/30/2000	FATL	Pre-Flight
ANC00LA115	9/6/2000	NONE	Landing-RwyCond
ANC00LA133	9/14/2000	NONE	Landing-RwyCond
ANC00FA128	9/20/2000	FATL	CFIT
ANC01LA031	1/19/2001	NONE	Takeoff
ANC01LA056	4/14/2001	NONE	Mnvr
ANC01LA059	4/24/2001	NONE	Taxi
ANC01LA053	5/3/2001	NONE	Landing
ANC01LA083	6/19/2001	NONE	Mechanical
ANC02LA066	6/30/2002	NONE	Landing
ANC03LA005A	10/22/2002	NONE	Taxi

Table A-3. YK Delta Accidents Involving Aircraft Flying Under Part-135 or Part 121 from January 1990 through December 1999

NTSB Report Number	Date	Injury Level	Cause
ANC90FA039	3/16/1990	FATL	Spatial Disorient
ANC90FA047	3/29/1990	NONE	Landing
ANC90FA086	6/9/1990	FATL	Fuel
ANC90LA096	6/23/1990	NONE	Landing
ANC90LA124	7/27/1990	NONE	Mechanical
ANC91LA015	12/11/1990	NONE	Approach
ANC91LA033	3/8/1991	NONE	Mechanical
ANC91LA038	3/27/1991	MINR	CFIT
ANC91LA040	3/28/1991	NONE	Landing
ANC91IA052	4/8/1991	NONE	Mechanical
ANC91LA055	5/3/1991	NONE	Landing
ANC91LA066	6/5/1991	NONE	Mechanical
ANC91LA118	8/8/1991	NONE	Takeoff
ANC92FA002	10/3/1991	NONE	Mechanical
ANC92LA007	10/18/1991	MINR	Landing
ANC92LA010	10/26/1991	NONE	Takeoff
ANC92LA025	1/6/1992	NONE	Landing-RwyCond
ANC92LA031	2/4/1992	NONE	Landing
ANC92LA045	2/28/1992	NONE	Mechanical
ANC92LA052	3/24/1992	MINR	Takeoff
ANC92LA095	6/18/1992	NONE	Mechanical
ANC92FA106	7/13/1992	FATL	Wt&Bal
ANC92LA118	8/3/1992	NONE	Mechanical
ANC92LA122	8/8/1992	MINR	CFIT
ANC92IA147	8/29/1992	NONE	Mechanical
ANC93LA005	10/6/1992	NONE	Landing
ANC93LA019	12/4/1992	NONE	CFIT
ANC93LA024	1/5/1993	MINR	TCF
ANC93LA052	4/12/1993	NONE	Takeoff-RwyCond
ANC93LA059	5/1/1993	NONE	Takeoff-RwyCond
ANC93FA060	5/6/1993	NONE	CFIT
ANC93LA098	6/19/1993	NONE	Mechanical
ANC94LA016	11/8/1993	NONE	Approach
ANC94LA021	12/3/1993	NONE	Landing
ANC94LA022	12/3/1993	NONE	Takeoff
ANC94LA031	2/8/1994	NONE	MAP
ANC94LA102	8/9/1994	MINR	Landing
ANC95LA010	11/12/1994	NONE	Landing
ANC95LA013	11/18/1994	NONE	Landing
ANC95LA020	12/13/1994	NONE	CFIT
ANC95LA025	1/4/1995	NONE	Landing-RwyCond
ANC95LA029	1/20/1995	NONE	Mechanical
ANC95LA036	3/20/1995	NONE	CFIT

NTSB Report Number	Date	Injury Level	Cause
ANC95LA040	3/29/1995	NONE	Landing
ANC95LA043	4/14/1995	NONE	Surface
ANC95LA058	5/25/1995	NONE	Landing
ANC95LA161	9/8/1995	NONE	Takeoff
ANC95LA172	9/20/1995	NONE	#N/A
ANC96LA012	11/3/1995	NONE	Pre-Flight
ANC96LA017	11/18/1995	NONE	Mechanical
ANC96LA019	12/16/1995	NONE	Takeoff
ANC96LA082	6/4/1996	MINR	Takeoff
ANC96LA117	8/3/1996	SERS	Taxi
ANC96LA164	9/24/1996	NONE	Pre-Flight
ANC97FA008	11/26/1996	FATL	Unknown
ANC97FA009	11/30/1996	FATL	MNVR
ANC97LA010	12/4/1996	NONE	Takeoff
ANC97LA012	12/5/1996	NONE	Fuel
ANC97LA022	1/17/1997	SERS	CFIT
ANC97LA027	2/22/1997	NONE	TCF
ANC97FA037A	3/25/1997	FATL	Air-to-Air
ANC97FA037B	3/25/1997	FATL	Air-to-Air
ANC97LA042	3/27/1997	MINR	Mechanical
ANC97LA055	4/12/1997	NONE	Mechanical
ANC97TA098	7/7/1997	MINR	Landing
ANC97LA129	8/24/1997	SERS	Fuel
ANC97LA134	9/6/1997	NONE	Landing
ANC98IA004	10/20/1997	NONE	Pre-Flight
ANC98LA012	12/15/1997	NONE	Fuel
ANC98LA013	12/16/1997	NONE	Landing
ANC98LA025	2/24/1998	NONE	Landing
ANC98LA040	4/22/1998	MINR	CFIT
ANC98LA056	5/21/1998	NONE	Takeoff-RwyCond
ANC98LA059	5/29/1998	NONE	Mechanical
ANC98LA104	6/17/1998	NONE	Other
ANC98LA078	6/19/1998	NONE	Mechanical
ANC98LA149	9/13/1998	NONE	Takeoff
ANC98LA161	9/26/1998	MINR	Takeoff
ANC99LA002	10/8/1998	MINR	Pre-Flight
ANC99LA009	10/26/1998	MINR	Mechanical
ANC99FA021	1/10/1999	MINR	Mechanical
ANC99LA023	1/12/1999	NONE	Weather
ANC99LA039	3/27/1999	NONE	Landing
ANC99LA045	4/11/1999	NONE	Landing
ANC99LA051	4/19/1999	NONE	Landing-RwyCond
ANC99LA098	7/28/1999	NONE	Takeoff
ANC99LA153	9/17/1999	NONE	Taxi
ANC00LA005	10/7/1999	NONE	Other
ANC00LA008	10/27/1999	NONE	Weather

NTSB Report Number	Date	Injury Level	Cause
ANC00LA009	10/28/1999	NONE	Weather
ANC00LA017	12/6/1999	NONE	Pre-Flight
ANC00FA018	12/7/1999	FATL	CFIT
ANC00LA021	12/24/1999	MINR	Pre-Flight

ANC00LA086

On July 12, 2000, about 1300 Alaska daylight time, a wheel equipped Cessna 207 airplane, N1549U, sustained substantial damage during a hard landing at the New Kotlik Airport, Kotlik, Alaska. The flight was being conducted under Title 14, CFR Part 135 as an on-demand cargo flight, when the accident occurred. The airplane was operated by Larry's Flying Service, Inc., Fairbanks, Alaska. The solo commercial pilot was not injured. Visual meteorological conditions prevailed, and a company flight plan was in effect. The flight originated at the Emmonak Airport, Emmonak, Alaska, about 1230.

During a telephone conversation with the National Transportation Safety Board investigator-in-charge on July 13, and in her NTSB Pilot/Operator report, the pilot reported she misjudged the landing, and landed hard in a nose low attitude. She said the nose wheel hit first, then the airplane rocked back and the main wheels and tail cone contacted the runway surface. The tail cone and empennage sustained substantial damage. The pilot estimated there was 1,000 pounds of cargo, and the fuel tanks were about 1/2 full. She indicated there were no preaccident mechanical anomalies with the airplane.

ANC01LA017

On November 3, 2000, about 1345 Alaska standard time, a wheel equipped Cessna 207A airplane, N7336U, sustained substantial damage during an aborted takeoff from the Bethel Airport, Bethel, Alaska. The airplane was being operated as a visual flight rules (VFR) on-demand cargo flight transporting mail under Title 14, CFR Part 135, when the accident occurred. The airplane was owned by Flight Alaska, Inc., doing business as Yute Air Alaska. The solo commercial pilot was not injured. Visual meteorological conditions prevailed, and company visual flight rules (VFR) flight following procedures were in effect for the flight to Kongiganak, Alaska.

During a telephone conversation with the National Transportation Safety Board investigator-in-charge on November 3, the pilot reported that while taxiing from the parking apron, en route to the departure runway, the Bethel Air Traffic Control Tower (ATCT) advised him that an immediate departure would be possible if he was able to accept another runway, runway 29. The pilot said that after accepting the alternate runway, he taxied onto runway 29 at intersection Echo. He said runway 29 was a gravel runway that had a light accumulation of heavy, wet snow/slush, and estimated that he would have about 1,500 feet of runway remaining from intersection Echo. The pilot said while departing runway 29, the airplane veered to the left, and he applied full right rudder to correct the veer. He said that he was unable to correct the veer, so he closed the throttle, aborted the takeoff, and applied maximum braking. The airplane ran off the end of the runway, down an embankment, and struck a chain link fence. The airplane sustained substantial damage to both wings.

Bethel tower personnel reported that when departing runway 29 from intersection Echo, the published usable remaining runway is 1,350 feet. In addition, published usable full-length of runway 29, is 1,850 feet.

The closest weather observation station is Bethel. On November 3, at 1353, an Aviation Routine Weather Report (METAR) was reporting in part: Sky conditions and ceiling, 4,000 feet broken, 10,000 feet broken, 14,000 feet overcast; visibility, 10 statute miles; wind, 093 degrees (magnetic) at 9 knots; temperature, 37 degrees F; dew point, 33 degrees F; altimeter, 29.84.

The pilot submitted a written report to the NTSB dated November 4. In his written report, the pilot wrote, in part: "After a few hundred feet I could feel the right main gear grabbing. I let off of the right rudder and it still continued. I began to drift from centerline, and found myself using more left rudder than right. Realizing that the right main gear was stuck or frozen, I thrusted my right foot on the right break in hopes of breaking it free. This maneuver failed so I immediately applied breaks and pulled the throttle to idle."

On November 15, the operator reported that there were no postaccident mechanical anomalies noted with the accident airplane's engine, flight controls, or brakes.

ANC01LA028

On January 3, 2001, about 1740 Alaska standard time, a wheel-equipped Cessna 172 airplane, N19771, sustained substantial damage during landing at the Atmautluak Airport, Atmautluak, Alaska. The airplane was being operated as a visual flight rules (VFR) on-demand passenger flight under Title 14, CFR Part 135, when the accident occurred. The airplane was registered to, and operated by, Village Aviation, Inc., Bethel, Alaska. The certificated commercial pilot, and the two passengers aboard, were not injured. Visual meteorological conditions prevailed, and VFR company flight following procedures were in effect. The flight originated at the Bethel Airport, Bethel, about 1730.

During a telephone conversation with the National Transportation Safety Board investigator-in-charge on January 4, the pilot stated that while on final approach to runway 33, he inadvertently allowed the airplane to descend below his intended glide path. He said that in an attempt to arrest the descent he applied full engine power, but the airplane continued to descend. The airplane inadvertently touched down on the snow-covered approach end of the runway, about 15 yards short of the runway surface. He said that as he attempted to abort the landing, the airplane become airborne, drifted to the left of the runway, and settled into an area of soft snow. During the second touchdown, the nose wheel collapsed at the firewall bulkhead. The airplane sustained substantial damage to the engine firewall. The pilot reported that wind conditions at the time of the accident were from the northeast at 5 knots.

The pilot indicated that there were no preaccident mechanical anomalies with the airplane.

ANC01LA046

On April 3, 2001, about 1745 Alaska daylight time, a wheel-equipped Cessna 207 airplane, N1581U, sustained substantial damage after colliding with terrain, about eight miles north of Nightmute, Alaska. The airplane was being operated as a visual flight rules (VFR) scheduled domestic passenger flight under Title 14, CFR Part 135, when the accident occurred. The airplane was operated as Flight 262 by Grant Aviation Inc., Anchorage, Alaska. The commercial certificated pilot and one passenger received serious injuries, two passengers received minor injuries, and three passengers were not injured. Visual meteorological conditions prevailed in the area of the accident, and VFR company flight following procedures were in effect. The accident flight originated at the Nightmute Airport, about 1730. The intended routing of Flight 262 was from Bethel, Alaska, to Toksook Bay, Alaska, to Nightmute, to Newtok, Alaska, and then a return to Bethel.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on April 3rd, the director of operations for the operator reported that the flight had crashed, and search and rescue operations were underway. On April 6, 2001, the NTSB IIC interviewed the pilot who stated that while he was en route to Toksook Bay, he contacted the village agent via radio. The weather conditions were reported by the agent as 800 feet overcast, visibility 5 miles, with a light wind from the southeast. Before departing Nightmute, the pilot said he set the airplane's altimeter to the field elevation (15 feet msl). After departure, he proceeded toward Newtok, but skirted an area of low hills by flying toward the east before turning toward Newtok. He said he was flying about 450 feet above the ground. About 10 minutes after departure, the pilot said the horizon began to become obscured and the area ahead of the airplane turned white. He said there was no precipitation, rather the ground and sky became indistinguishable. He began a right turn toward the east, but about 2 seconds after beginning the turn, the airplane suddenly collided with snow-covered terrain.

In the Pilot/Operator report (NTSB Form 6120.1/2), the director of operations reported the weather conditions at the accident site as an estimated indefinite ceiling of 500 to 600 feet agl, and the visibility was estimated as two miles in haze/whiteout with no precipitation.

On September 13, 2001, in a telephone conversation with the NTSB IIC, the right front seat passenger reported that as the flight progressed toward Newtok, the visibility was about one mile under gray sky conditions. Just prior the accident, the visibility began to decrease, and the airplane then collided with the snow. The passenger did not report any precipitation.

The airplane came to rest on its right side. The engine and propeller were torn off the airframe. The pilot provided emergency care for the passengers, and contacted an over-flying jet airplane on a hand-held radio. Emergency personnel arrived by helicopter about 2 hours later.

The airplane was equipped with an avionics package provided by the Federal Aviation Administration's Capstone Program. The Capstone Program is a joint industry/FAA demonstration program that features, among others, global positioning system (GPS) avionics, weather and traffic information provided through automatic dependent surveillance-broadcast

(ADS-B), traffic information service-broadcast (TIS-B) equipment, and terrain information depicted on a multifunction display (MFD) installed in the cockpit. The Capstone program provides radar-like services to participating air carrier aircraft operating in a non-radar environment of Western Alaska. At the time of the accident, position information from Capstone equipped airplanes, to the Anchorage Air Route Traffic Control Center (ARTCC), Anchorage, Alaska, is provided by the ADS-B equipment in the airplane, and requires ground based radio repeater sites to facilitate the transmittal of position data. The area of the accident was not within radio coverage of a currently established repeater site.

Terrain depiction information, based on GPS data, is one of several visual display options available to the pilot. Other options include custom maps, VFR sectional charts with topographical features, IFR charts, flight plan and traffic information, and weather data. The airplane's position can be displayed in relation to its location over the terrain, and may include bearing and distance information to selected points. Selection of the terrain mode for display, provides the pilot with color shading, depicting areas of terrain that are black (2,000 feet below the aircraft), green (between 2,000 and 700 feet below the aircraft), yellow (between 700 and 300 feet below the aircraft), and red (at or within 300 feet of the aircraft). Accurate depiction of terrain (in the terrain mode) requires the pilot to manually set a barometric pressure setting in the multifunction display menu. The Capstone avionics equipment does not automatically receive barometric pressure data from the aircraft's altimeter. Selection of the map mode does not provide any terrain warning/awareness information.

During the interview with the NTSB IIC, the pilot said that he received training in the use of the Capstone equipment from the University of Alaska, Anchorage, and from his company. He also said that during the accident flight, he selected the moving map display with a five mile scale. He did not observe any warning flags illuminated on the multifunction display. He did not manually enter any barometric pressure data into the Capstone equipment. The pilot said that he routinely utilized his own personal GPS receiver that has a color moving map display. He said he is more familiar with his own GPS, and had it installed on the top of the instrument panel glare shield. He said that since the terrain in Western Alaska is usually quite flat, he routinely utilized the Capstone map mode with the GPS "go to" function for each leg/destination of a route, not the terrain mode.

The closest official weather observation station to the accident site is Hooper Bay, Alaska, which is located 71 nautical miles northwest of the accident site. On April 3, at 1835, an Aviation Routine Weather Report (METAR) was reporting in part: Wind, 140 degrees (true) at 9 knots; visibility, 9 statute miles; clouds and sky condition, 800 feet broken, 1,200 feet broken, 3,100 feet overcast; temperature, 32 degrees F; dew point, 28 degrees F; altimeter, 28.92 inHg.

On April 3, at 1753, a METAR from Bethel, located 81 nautical miles east of the accident site, was reporting in part: Wind, 160 degrees (true) at 18 knots, gust to 24 knots; visibility, 10 statute miles; clouds and sky condition, 1,900 feet broken, 2,600 feet overcast; temperature, 35 degrees F; dew point, 32 degrees F; altimeter, 28.94 inHg.

ANC01LA117

On July 25, 2001, about 1310 Alaska daylight time, a Cessna 207 airplane, N9973M, operated by Grant Aviation as a scheduled commuter flight under 14 CFR Part 135, received substantial damage when it collided with a tree shortly after takeoff from the Kalskag Airport, Kalskag, Alaska. The solo commercial pilot was not injured. The flight was en route to Emmonak, Alaska, and operated in visual meteorological conditions. A company flight plan was in effect.

According to a letter dated July 27, 2001, from the director of operations for Grant Aviation and addressed to an Anchorage, Alaska, Flight Standards District Office air safety inspector, the accident airplane's left wingtip collided with a tree while in a low altitude turn shortly after takeoff. The pilot reportedly thought it was bird strike, and he elected to continue to his destination of Emmonak.

Postaccident inspection of the airplane disclosed a damaged wingtip, a crushed outboard nose rib, and a damaged leading edge. Repairs made to the airplane included a replacement nose rib, a new wingtip, and a new segment of leading edge skin, which required riveting to the semi-monocoque wing structure.

ANC01LA108

On August 13, 2001, about 1154 Alaska daylight time, a wheel-equipped Cessna 207 airplane, N562CT, operated by Grant Aviation, Bethel, Alaska, as scheduled commuter Flight 2202, under 14 CFR Part 135, sustained substantial damage during an attempted takeoff from the Akiachak Airport, Akiachak, Alaska. The commercial pilot and the six passengers reported no injuries. The flight operated in visual meteorological conditions, and a company flight plan was in effect. The flight departed Bethel about 1110, and Akiachak was an intermediate stop prior to returning to Bethel.

According to witnesses and passengers, the pilot began the takeoff on runway 29, after a back-taxi to use the full length of the 1,625 feet long gravel runway. During the takeoff roll, the airplane lifted off the runway two times, and each time settled onto the runway. At the end of the runway, the airplane lifted off again, bounced hard on the tundra, and continued to fly a short distance before coming to rest, about 1,300 feet from the departure end of runway 29. The witnesses and passengers all noted that the engine appeared to be operating normally at a high power setting. Four ground witnesses said the airplane took off downwind, and estimated the wind to be about 10 miles per hour.

An Alaska State Trooper/pilot flew his airplane to Akiachak to ascertain if there had been injury or loss of life. He stated to the NTSB investigator-in-charge on August 14, that he landed on runway 11 about 20 minutes after the accident. He said he estimated the wind to be approximately from 135 degrees magnetic, at 10 to 12 knots. He said he interviewed another air taxi pilot who landed immediately after the accident. According to the trooper, the air taxi pilot saw the accident airplane taxi to the end of runway 29, and then start a takeoff roll downwind. The trooper stated he talked with the accident pilot, and asked the pilot how he determined the wind direction. The pilot reportedly said he looked at the wind sock from the ramp area prior to departure. At the time of the interview with the pilot, the trooper and the pilot were at the ramp area. The trooper said the wind sock is not visible from the ramp due to high willows and brush. The trooper also said he interviewed four other witnesses, and they all indicated the engine sounded like it was operating at a high power setting, and that the airplane's takeoff run was downwind. According to the trooper, he looked at the airplane's logbooks and associated paperwork. He said he could find no current weight and balance calculations by the pilot for the accident flight, although there were weight and balance calculations for flights conducted days earlier. The trooper also related that the cargo in the back of the airplane had not been secured, although a tie-down cargo net was available.

Akiachak is approximately 17 miles northwest of Bethel. At 1153, the Bethel METAR weather report indicated the surface wind was 153 degrees magnetic at 13 knots.

DCA02MA003

HISTORY OF FLIGHT

On October 10, 2001, about 0926 Alaska daylight time (all times in this brief are Alaska daylight time based on a 24-hour clock), Peninsula Airways, Inc. (PenAir) flight 350, a Cessna CE-208 Caravan, N9530F, crashed shortly after takeoff from the Dillingham Airport (DLG), Dillingham, Alaska. The pilot and nine passengers were killed, and the airplane was destroyed. (One passenger was evacuated to Anchorage, Alaska, but died the next day.) There was no fire. The impact site was located about 0.7 nautical miles (nm) northeast of the departure end of runway 01 at DLG. The accident occurred during daylight hours, and visual meteorological conditions prevailed at the time of the accident. The flight was operated by PenAir as a visual flight rules flight in accordance with Title 14 Code of Federal Regulations (CFR) Part 135 of the Federal Aviation Regulations (FAR). Flight 350 was bound from DLG to King Salmon, Alaska.

The pilot of the accident airplane arrived for duty at DLG about 0800 the morning of the accident. The flight coordinator informed the pilot that he would fly N9530F to King Salmon, Alaska, with nine passengers.

The airplane had been parked outside on the ramp overnight, and flight 350 was to be its first flight of the day. DLG had experienced light rain and mist for most of the day before the accident. This precipitation turned to light snow and mist about 2016 and continued until about midnight as the first major winter weather of the season passed through the Dillingham area. Temperatures dropped steadily to about -4 degrees C (24 degrees F).

Several pilots whose airplanes were also parked outside overnight were interviewed about the snow accumulation on their airplanes the morning of the accident. A PenAir check airman who was scheduled to fly a Cherokee to King Salmon, Alaska, with the overflow passengers from PenAir flight 350 described the contamination on his airplane as "like epoxy" and said that he observed that the snow/ice on his airplane and on the accident airplane were the same. Another PenAir pilot reported that his airplane had 1/8-inch-thick icy patches covered by about 1/4 inch of snow. Another pilot on the field stated that his airplane was covered with 1/4 to 1/2 inch of clear ice with snow/frost on top.

Between about 0830 and 0840, a pilot from another operator on the field observed the accident pilot conducting a preflight check of the accident airplane. The accident airplane had not yet been deiced.

The PenAir ramp supervisor reported that, sometime before 0900, the accident pilot asked him to fuel the accident airplane with 60 gallons of Jet A fuel (30 gallons in each wing tank). The ramp supervisor told the pilot that his airplane would need deicing. The pilot did not acknowledge this comment. While returning to the flight office, the pilot met the PenAir check airman and asked what the deicing procedures were in Dillingham. The check airman told Safety Board investigators that he did not think the pilot's question was unusual because the pilot had not deiced at Dillingham previously. He told the pilot that the deicing procedures were the same as for a Cherokee and that the pilot should make sure that his airplane was thoroughly deiced that morning.

The PenAir ramp employee who fueled the accident airplane said that he had trouble removing the accident airplane's left fuel cap due to what he described as "1/4 inch of frost with maybe ice underneath." He reported that he had to use a tool to remove the fuel cap.

After the fueling was complete, the ramp supervisor sprayed deicing fluid on the accident airplane. The PenAir ramp employee who had fueled the airplane drove the forklift with the deicing equipment attached. The supervisor described the accident airplane as having 1/8 inch of frost that covered the entire airplane. He said that he did not physically touch the surfaces of the wing after the deicing process because he believed that the upper surface of the wing was clear of ice. The ramp employee driving the forklift said that he could not see the accident airplane's wing after deicing but that "a lot of glycol" had been applied. The pilot was not present during the deicing.

About 0850, the PenAir check airman flying the Cherokee to King Salmon was on the ramp and watched as the accident airplane was deiced. He stated that he saw the accident airplane deiced one time and that the process was completed in about 20 minutes. The same crew and equipment that deiced the accident airplane deiced his airplane.

No witnesses were found who could verify whether, after the fueling and deicing of the accident airplane was complete, the accident captain climbed a ladder or used any other means to check that the fuel caps were replaced properly or that the upper wing surfaces were clear of ice, snow, or frost. A PenAir customer service manager did state that he saw glycol on the accident pilot's coat prior to the accident airplane's departure. In addition, the PenAir check airman reported that, when he looked at the accident airplane from the ground and again from the wing of his own airplane, the accident airplane appeared to be free of snow.

About 0920, as he taxied the Cherokee out to the runway, the check airman observed the accident airplane's takeoff roll. He said that the accident airplane used the normal amount of runway. After aligning the Cherokee with the centerline of runway 01, the check airman looked up and saw the accident airplane make the standard 45-degree right turn to depart the local airport traffic pattern. The check airman reported that everything appeared normal about the accident airplane at that time. A pilot doing a preflight check on his airplane on the north end of the field said that he glanced up and saw the accident airplane during takeoff, about 50 feet above the Bravo intersection.

A private pilot who was talking on the telephone in his office less than 1 mile from the accident site watched as the accident airplane took off. This witness said that the airplane was traveling from left to right and was moving slightly away from him. The airplane appeared to be straight and level and at an altitude of less than 1000 feet above ground level. The sound of the engine was normal and gradually dissipated as the airplane traveled across his field of view. This witness stated further that the flight appeared to be normal until the airplane abruptly pitched up, rolled more than 90 degrees to the left, and yawed to the left, "back towards the airport," when he was able to see the entire top of the airplane. The witness reported that the nose of the airplane then dropped until the nose pointed directly down as the airplane rolled to the right. The airplane did not spin. The airplane finally disappeared behind a small hill in a nose-down attitude. The witness immediately hung up the telephone, dialed 911, and left for the accident site. When he arrived, fire and rescue personnel were already on scene.

PILOT INFORMATION

The pilot, age 41, held a commercial pilot certificate with an airplane single-engine and multi-engine land, and instrument rating; he also held an airframe and powerplant mechanic certificate. His most recent second-class medical certificate was issued on February 9, 2001, with the limitation, "The holder shall wear corrective lenses."

PenAir hired the accident pilot on October 16, 2000, and he had accrued 869 hours of total flight experience since that time. PenAir records also indicate that, at the time of the accident, the pilot's total flight experience consisted of about 3,100 hours. In the 90 days, 30 days, and 24 hours prior to the accident, PenAir records show that the pilot had accrued a total of 271, 86, and 4.4 hours, respectively.

PenAir records show further that the pilot had accrued a total of about 74 hours in the Cessna CE-208 Caravan, the same airplane make and model as the accident airplane. Records also show that the pilot's initial flight training in the CE-208 occurred on June 4, 2001, that his last CE?208 FAR 135.293 competency check and FAR 135.299 line check prior to the accident also occurred on June 4, 2001, and that his initial operating experience in the CE-208 occurred on August 11, 2001. PenAir's records indicate that the accident pilot was also qualified in the Piper PA-32.

AIRPLANE INFORMATION

The accident airplane, a Cessna Caravan CE-208, N9530F, S/N 20800088, was manufactured in 1986. The airplane had accumulated 10,080 hours since it was manufactured. The most recent inspection was accomplished on October 5, 2001, 12.4 hours before the accident.

The airplane was equipped with a Pratt & Whitney Canada (PW&C) PT6A-114 turbopropeller engine and a three-bladed Hartzell Propeller, model number HC-B3MN-3, with M10083K composite blades. The engine had accumulated 10,984 hours.

The airplane's weight and balance were within the normal operating range. A review of the airplane and engine logbooks revealed no discrepancies and no deferred items for the accident flight.

METEOROLOGICAL INFORMATION

At 0851, the on-field Federal Aviation Administration (FAA) flight service station reported the DLG weather as follows: wind, from 260 degrees at 5 knots; visibility, 10 statute miles with a few clouds at 2,000 feet; temperature, -4 degrees C (24.8 degrees F); dew point temperature, -10 degrees C; and altimeter, 29.40 inches of Hg.

AIRPORT INFORMATION

Dillingham airport is an uncontrolled airport with a part-time FAA Flight Service Station located on the field. The airport has one grooved asphalt runway, 01/19, which is 6,404 feet long. No radar services are available locally.

WRECKAGE AND IMPACT INFORMATION

The airplane came to rest in a level attitude approximately 0.7 nm northeast of the departure end of runway 01 at approximately N59°03.15' latitude and W158°28.41' longitude. The entire debris field stretched along a magnetic heading of 059 degrees for approximately 163 feet and was approximately 118 feet wide. Based on tree strikes and initial impact marks in the soft tundra, the flight path angle was estimated to be equal to or greater than 40 degrees down.

The entire airplane structure was found within the impact area. There was no fire, but the crash site did have a strong smell of jet fuel. The fuselage came to rest approximately 121 feet from the initial impact crater with the nose of the airplane pointing almost perpendicular to the wreckage path. The fuselage exhibited significant vertical compression with little longitudinal compression. The empennage structure was separated from the fuselage but remained connected by pushrods and cables.

Both wings sustained significant leading edge impact damage near the wing root. The right wing had separated from the fuselage and was found upside down and slightly ahead of the fuselage. The left wing remained attached to the fuselage, but the front spare web was fractured outboard of the wing root.

All flight control surfaces (ailerons, spoilers, elevators, and trim tabs) were found attached to their respective hinge attach points except for the outboard half of the left elevator, which was found in the wreckage field. Control system continuity was verified in the rudder and elevator control systems. The elevator trim actuator was measured to be at 0-degree deflection. The rudder gust lock handle was found in the unlocked position. The left aileron control cables were continuous. The right aileron control cables were found separated at the wing root and exhibited a "broom straw" appearance.

The flap selector handle was found positioned against the 10-degree stop. The flap indicator was positioned at approximately 2 degrees but was free to move. The left flap surface was attached to the left wing in the retracted position. The right flap surface was attached to the right wing in an extended position. The flap jackscrew and transmission assembly (part of the flap gearbox) and the flap actuator tube assembly were attached to the right wing. The wing flap actuator jackscrew was intact and was attached to the fuselage mount, but the fuselage mount was ripped from the fuselage. Measurements indicated by the position of the gearbox were considered unreliable because the gearbox was separated from the transmission assembly and was free to rotate around the jackscrew. The entire flap mechanical control system linkage was inspected, and no preexisting failures were noted that would indicate an asymmetric flap existed at impact.

Examination of the cockpit area revealed that both the pilot's and copilot's control yokes were broken free of their respective attaching mounts and were fractured at nearly the same length, indicating approximately full airplane nose-up elevator. The pilot's seat was found locked and positioned in the sixth hole forward of the aft stop pin.

The left pitot/static tube was broken from its structural wing attach point but remained connected by electrical wires. No damage was observed to the stall detector, and the tab (vane) was unrestricted and free to move. The right pitot/static tube remained intact, and the tubing was free of any obstruction.

The left and right fuel tank selector knobs were found in the OFF position. The left fuel tank shutoff valve handles in the left wing tanks were both in the OPEN position against the mechanical stops. The right fuel tank aft shutoff valve handle was found in the OPEN position, and the right fuel tank forward shutoff valve handle was found between the OPEN and CLOSED positions. Examination of right and left wing integral fuel tanks revealed a significant amount of fuel.

Examination of the PT6A-114 turbopropeller engine revealed that the compressor section had ingested tundra and that all compressor and turbine blades exhibited blade tip rub of varying degrees. All three propeller blades were found at the wreckage site and were fractured in about the same lengthwise location, just outboard of the blade butt.

MEDICAL AND PATHALOGICAL INFORMATION

A postmortem examination of the pilot was conducted under the authority of the Alaska State Medical Examiner, Anchorage, Alaska, on October 12, 2001. The cause of death for the pilot was reported to be multiple blunt force injuries.

A toxicological test performed by the FAA's Civil Aeromedical Institute was negative for ethanol and drugs.

TESTS AND RESEARCH

The engine, engine controls, and propeller were sent to the PW&C facility in Montreal, Quebec, Canada, where they were disassembled and examined. No preexisting defects or anomalies were found that would have prevented normal engine or propeller operation. All internal damage was consistent with that of an engine that was operating at impact. Spinner damage showed that the propeller's blade angle was in the normal operating range at the time of the impact.

The accident airplane was equipped with a TrendCheck Engine Monitor, which was removed from the accident engine. Its data were downloaded at the manufacturer's facility in Norwood, Massachusetts. No anomalous events were recorded that would indicate engine stoppage prior to impact. Parameters recorded for the accident flight included an engine run duration of 509 seconds and a maximum pressure altitude of 1021 feet (651 feet mean sea level).

The Cessna CE-208 Caravan is equipped with a warning system that activates if one or both tank selector knobs are placed in the OFF position and/or if the fuel level in the reservoir tank or wing tanks becomes low. The system includes annunciator lights in the cockpit annunciator panel (CAP) and redundant warning horns. The CAP, various cockpit gauges, and stall heat and pitot/static heat switches were examined at the Safety Board's Materials Laboratory. None of the CAP bulb filaments showed any evidence of hot filament stretching, and none of the cockpit gauge faceplates displayed any needle contact marks. Internal examination of both heat switches confirmed that they were in the OFF position at impact.

An airplane performance study was conducted using data obtained during the investigation, including data from the engine monitor. However, because no radar data was available, the study was inconclusive. The report is contained in the Airplane Performance Study Report, which is included in the public docket.

Fuel samples from both wings and the fueling truck were sent to CT&E Environmental Services, Inc., Anchorage, Alaska, for testing. No anomalies were noted in any of the fuel samples. The deicing fluid was determined to be 70.8 percent water.

ADDITIONAL INFORMATION

PenAir Deicing/Anti-icing Equipment and Procedures

PenAir uses a portable 300-gallon deicing unit with an operator bucket attached. Electrical power is used to keep the deicing fluid heated to an operational temperature within the unit. Before each use, the outside air temperature, freeze point of the fluid, and fluid temperature are documented. When airplane deicing is required, one ground employee picks up the deicing unit with a forklift and positions it at the airplane for the deicing process. Another ground employee stands in the bucket atop the unit and sprays the airplane with deicing fluid.

According to the PenAir ramp supervisor, the company receives large plastic containers with 100 percent freeze point depressant fluid. (It was reported that the fluid was Union Carbide type 1 fluid and was 92 percent ethylene glycol, 7.5 percent water, and 0.5 percent processing additives.) He reported that they drain half the mixture into another plastic container and then fill both containers with water to create a 50 percent fluid mixture (50 percent glycol and 50 percent water). PenAir's FAA-approved deicing/anti-icing program requires the deicing mixture to be 50 percent glycol, which has a freeze point of about -28 degrees C.

The supervisor stated that the deice machine had been operationally ready since October 1, 2001, and contained 300 gallons of heated 50 percent water/glycol mixture. On the morning of the accident, the outside air temperature, freeze point of the fluid, and fluid temperature were recorded as 32 degrees F, 0 degrees F, and 140 degrees F, respectively. A sample of the deice fluid was also sent to CT&E Environmental Services, Inc., for testing. The deicing fluid was determined to be 70.8 percent water. According to FAA advisory material, the freeze point of a 70 percent glycol/water mixture is approximately 5 degrees F (accepted industry practice is for the freeze point of deice fluid to be at least 18 degrees F below the outside air temperature).

At the time of the accident, PenAir's deicing/anti-icing program stated the following in part:

A pretakeoff check is a check of the "representative aircraft" to make sure other critical surfaces are free of frost, ice and snow. This check must be conducted within five minutes prior to beginning the takeoff. It must be accomplished from outside the aircraft unless an alternate procedure is used.

PenAir's alternate procedure was defined as follows:

When deicing/anti-icing fluid has been applied, the flight crew will make a visual check of the inboard leading edge of both wings prior to taking the active runway for departure. The visual check will verify that contaminants have not built up on the aircraft during the holdover period.

PenAir's deicing/anti-icing program did not require pilots or ramp personnel to physically check their airplanes' critical surfaces after deicing. The pilot's preflight walk around in the PenAir C-208 Company Flight Manual states in part, "Warning: It is essential in cold weather to remove even small accumulations of frost, ice or snow from the wing and control surfaces." PenAir personnel stated that after deicing, operational procedures called for the pilot to visually check the airplane. PenAir did have ladders available at DLG so that pilots could check the upper surfaces of their airplanes if they thought such a check was necessary.

While on scene, Safety Board investigators inspected another PenAir CE-208B and found that, due to the airplane's high-wing configuration, a pilot would have to stand about 10 to 15 feet behind the airplane in order to see most of the upper surface of the wing.

Technical and Advisory Information

Safety Board staff questioned the FAA's Chief Scientific and Technical Advisor for Flight Environmental Icing about airplane deicing. He stated that the heat of the glycol/water fluid de-bonds the frozen contamination from the aircraft surface and the force of the fluid jet drives/flushes the de-bonded frozen contamination from the surface. The glycol in the fluid acts as a freeze point depressant and keeps the fluid mixture from refreezing.

The advisor also stated that clear ice, a form of glaze ice, is difficult to see and has a high adhesion strength. He also stated that the density of glaze ice inhibits penetration by deicing fluids, making it difficult to remove.

Icing Advisory Material

Title 14 CFR 135.227 prohibits airplanes from taking off when snow, ice, or frost is adhering to the airplanes' wings, propellers, or control surfaces. FAA Advisory Circular (AC) 20-117, Hazards Following Ground Deicing and Ground Operations in Conditions Conducive to Aircraft Icing (3/29/88), states that testing has shown that ice formations on various aircraft components can have significant and sometimes devastating effects on airplane flight characteristics. The AC further states that surface roughness on the afterbody of a wing can have an effect approximately equal to the effect of similar surface roughness on the leading edges of some airfoils. One of these effects can be to decrease the stall angle of attack, possibly before activation of stall warning devices.

The Society of Automotive Engineers report ARP4737, Rev. E, "Aircraft Deicing/Anti-icing Methods," addresses several precautions concerning clear ice, including the following:

- Clear ice can form on aircraft surfaces below a layer of snow or slush. It is, therefore, important that surfaces are closely examined following each deicing operation, in order to ensure that all deposits have been removed.
- Clear ice formation is extremely difficult to detect. Therefore, when [clear icing] conditions prevail, or when there is otherwise any doubt that clear ice may have formed, a close examination shall be made prior to departure, in order to ensure that all frozen deposits have been removed.

ANC02FA014

HISTORY OF FLIGHT

On February 4, 2002, about 1042 Alaska standard time, a wheel-equipped Cessna 206 airplane, N756HL, was destroyed when the airplane collided with remote, snow-covered terrain, during cruise flight, about 80 nautical miles northwest of Bethel, Alaska. The airplane was being operated as a visual flight rules (VFR) on-demand cargo/U.S. mail flight under Title 14, CFR Part 135, when the accident occurred. The airplane was registered to a private individual, and operated by Flight Alaska, Inc., dba: Yute Air Alaska. The solo certificated commerical pilot received fatal injuries. Visual meteorological conditions prevailed at the departure airport, and no flight plan was filed. The flight originated at the Bethel Airport, Bethel, at 1004, and was en route to Chevak, Alaska.

According to the company's director of operations, when the flight failed to return to Bethel by 1430, company personnel initiated a phone search, and discovered that the flight had never reached Chevak. The flight was officially reported overdue to the Federal Aviation Administration (FAA) about 1545.

About 1209, an emergency locator transmitter (ELT) signal was received by a search and rescue satellite. Personnel from the Bethel wing of the Civil Air Patrol were dispatched to conduct an aerial search, and determine the source of the ELT signal. The Civil Air Patrol personnel reported that they were unable to complete the mission due to low clouds, low visibility, and icing conditions. At 1605, an Alaska Army National Guard HH-60 helicopter was dispatched from Bethel to begin an aerial search. The helicopter crew located the wreckage about 1650, about 70 miles east of Chevak, along the accident airplane's anticipated route of flight.

CREW INFORMATION

The pilot held a commerical pilot certificate with airplane single-engine land, single engine sea, and instrument airplane ratings. The most recent second-class medical certificate was issued to the pilot on April 6, 2001, and contained no limitations. No personal flight records were located for the pilot. According to company records, the pilot's total aeronautical experience consisted of 7,800 hours, of which 200 hours were accrued in the accident airplane make and model. In the preceding 90 and 30 days prior to the accident, the company listed the pilot's flight time as 20 and 10 hours, respectively. The operator hired the pilot on May 7, 2001. According to the operator's director of operations, prior to joining the company, the accident pilot had accrued extensive 14 CFR Part 135 experience flying in Alaska,. The pilot completed an airman competency/proficiency check flight under Title 14 CFR Part 135.293 (Initial and Recurrent Testing), and 135.299 (Pilot-in-Command Line Check), with the chief pilot for the operator in a Cessna 207 airplane on April 25, 2001. In the remarks section of FAA form number 8410-3 (airman competency/proficiency check form), the chief pilot wrote: "Demonstrated instrument proficiency."

The accident flight was the pilot's first flight of the day.

AIRCRAFT INFORMATION

The airplane had accumulated a total time in service of 10,607.2 hours. The most recent 100 hour inspection was accomplished on November 29, 2001, 46.2 hours before the accident.

The engine had accrued a total time in service of 5,337.1 hours, and 844.5 hours since overhaul.

METEOROLOGICAL INFORMATION

According to the company's director of operations, the pilot obtained current weather information for Chevak from the flight-planning desk located at the operator's base of operation in Bethel. The director of operations reported that company operations personnel in Bethel collect this weather information by calling each village agent in the villages serviced by the operator.

In a written statement provided to the National Transportation Safety Board, the employee who prepared the weather information prior to the accident flight's departure, said that he called the village agent in Chevak about 0900, and requested the current weather conditions. He added that weather information and aircraft loading calculations were relayed to the accident pilot prior to his departure. According to company records provided by the operator, the 0900 weather for Chevak was reported as: Sky conditions and ceiling, 5,000 feet overcast; visibility, 20 statute miles; wind from the northeast at 10 knots.

The closest weather observation station to the accident site is Hooper Bay, Alaska, which is located about 60 nautical miles west of the accident site. On February 4, at 1035, an unaugmented AWOS was reporting, in part: Wind, 190 degrees (true) at 6 knots; visibility, missing; clouds, 100 feet overcast; temperature, 19 degrees F; dew point, 17 degrees F; altimeter, 28.93 inHg.

Bethel is located about 80 nautical miles southeast of the accident site. At 1053 an Aviation Routine Weather Report (METAR) was reporting, in part: Sky conditions and ceiling, 3,900 feet broken; visibility, 10 statute miles; wind, 050 degrees at 13 knots; temperature, 10 degrees F; dew point, minus 6 degrees F; altimeter, 28.90.

An area forecast for the Yukon-Kuskokwim Delta, issued on February 4, 2002, at 0545, and valid until 1800, was forecasting, in part: Clouds and weather, 2,000 feet scattered, 5,000 feet broken, tops at 8,000 feet, with layers above 26,000 feet.

An AIRMET valid until 0000, was forecasting mountain obscuration in clouds and precipitation along the pilot's planned route of flight, with occasional moderate rime icing conditions in the clouds from 1,200 feet to 10,000 feet.

A pilot who departed from Chevak about 1043 en route to Bethel, characterized the weather conditions between Bethel and the accident site as overcast with ceilings ranging between 1,000 and 1,300 feet. He said that as his flight progressed, and as he approached the site where the wreckage was eventually discovered, he encountered momentary visibility restrictions due to fog and light snow. He added that flat light conditions made it very difficult to discern any topographic features among the featureless, snow-covered terrain. The pilot stated that he changed his route in order to avoid worsening weather conditions.

A pilot who departed Bethel about 25 minutes before the accident airplane's departure, also en route to Chevak, characterized the weather conditions along the accident airplane's route as "low visibility with light snow squalls moving through the area." He added that flat light conditions made it very difficult to discern any topographic features. He said that with satisfactory weather conditions, and given the intended destination of the accident airplane, the standard route of flight would be directly over the flat, featureless area where the accident occurred.

COMMUNICATIONS

Review of the air-ground radio communications tapes maintained by the FAA at the Bethel Flight Service Station (FSS) facility, revealed that just before takeoff from Bethel, the pilot communicated with the local ground and tower control positions. After departure, no further communications were received from the accident airplane.

A transcript of the air to ground communications between the airplane and Bethel local control is included in the public docket for this accident.

WRECKAGE AND IMPACT INFORMATION

The National Transportation Safety Board (NTSB) investigator-in-charge, along with an additional NTSB investigator, and the operator's chief pilot, examined the wreckage at the accident site on February 6, 2002. About 2 inches of snow had fallen at the wreckage site since the accident. A depression in the snow, followed by a path of wreckage debris to the main wreckage point of rest, was observed on a magnetic heading of approximately 095 degrees, consistent with the airplane impacting the ground on a southeasterly heading (opposite of the on-course heading for the intended flight).

The first observed point of impact was the semi-circular depression noted above. It was about four feet wide and eight feet long. Two smaller impressions were observed on either side of the main depression. The first portion of the airplane located along the wreckage path was the right-side fuselage step. The step was located within the initial impact depression. About 20 feet beyond the depression was the aft section of the airplane's right-side cargo door. Additional portions of the airplane were found along the wreckage path, and included, in the order observed: right elevator, portions of the upper engine cowling, the right wingtip fairing, the nose wheel strut, the right main landing gear leg, the forward section of the right-side cargo door, fragments of the engine mount, nose cargo door and nose wheel, portions of the nose/engine keel structure, and propeller.

The main wreckage came to rest about 250 feet from the initial impact depression. The airplane was lying inverted. Both wings remained attached to the fuselage.

Both wing lift struts were attached to the wing, but separated from the fuselage. Both wings displayed extensive aft crushing of the leading edges.

The empennage, just forward of the vertical stabilizer attach point, was twisted and buckled to the left. The empennage came to rest in an upright position. Both horizontal stabilizers sustained extensive aft crushing of the leading edges. The vertical stabilizer and rudder were free of any major damage.

The flap jackscrew actuator was in the retracted position. According to the airplane manufacturer, the flap jackscrew extension corresponded to a zero flap condition.

The propeller hub assembly separated from the engine at the engine crankshaft propeller flange. The propeller was located about 204 feet from the initial observed point of impact. All six bolts attaching the propeller to the crankshaft flange were sheared. All three propeller blades were retained in the hub, but were loose and rotated within the hub. The first propeller blade had about 90 degree aft bending and aft curling at the tip. The leading edge had file marks, and a gouge about 10 inches inboard from the tip, but was generally free of damage. Minor paint removal was evident about 8 inches inboard from the tip, with minor scuffing along the upper surface of the blade. The second blade had an aft 90 degree bend, about 10 inches inboard from the tip. Spanwise scuffing and scratching were observed about two inches inboard from the tip. The third blade had an aft 90 degree bend, about 8 inches inboard from the tip. The blade had significant torsional twisting, and minor scuffing at the tip. The leading edge had file marks, but no chordwise scratching or gouging.

The engine separated from the fuselage, and was located about 5 feet from the fuselage, and about 245 feet from the initial observed point of impact. It sustained impact damage to the underside, and front portion of the engine oil sump. The exhaust tubes had minor bending and denting without sharp creases. The muffler tube extensions were crushed and flattened. The creases and folds of the metal were not cracked or broken.

Flight control system cable continuity was established from each control surface to the point of impact-related damage.

MEDICAL AND PATHOLOGICAL INFORMATION

A postmortem examination of the pilot was conducted under the authority of the Alaska State Medical Examiner, 4500 South Boniface Parkway, Anchorage, Alaska, on, February 6, 2002. The cause of death was attributed to multiple impact injuries.

A toxicological examination was conducted by the FAA's Civil Aero medical Institute (CAMI) on March 21, 2002, and was negative for drugs or alcohol.

TEST AND RESEARCH

On March 5, 2002, under the supervision of the NTSB investigator-in-charge, an engine teardown and inspection was conducted at Alaskan Aircraft Engines, Inc., Anchorage, Alaska. No evidence of any preimpact engine anomalies was discovered.

ADDITIONAL INFORMATION

The airplane was equipped with an avionics package provided by the Federal Aviation Administration's Capstone Program. The Capstone Program is a joint industry/FAA demonstration program that features, among others, global positioning system (GPS) avionics, weather and traffic information provided through automatic dependent surveillance-broadcast (ADS-B), traffic information service-broadcast (TIS-B) equipment, and terrain information depicted on a multifunction display (MFD) installed in the cockpit. The Capstone program can provide radar-like services to participating air carrier aircraft operating in a non-radar environment of Western Alaska. At the time of the accident, position information from Capstone equipped airplanes, to the Anchorage Air Route Traffic Control Center (ARTCC), Anchorage, Alaska, was provided by the ADS-B equipment in the airplane, and required ground based radio repeater sites to facilitate the transmittal of position data.

Terrain depiction information, based on GPS data, is one of several visual display options available to the pilot on the MFD. Other options include custom maps, VFR sectional charts with topographical features, IFR charts, flight plan and traffic information, and weather data. The airplane's position can be displayed in relation to its location over the terrain, and may include bearing and distance information to selected points. Selection of the terrain mode for display, provides the pilot with color shading, depicting areas of terrain that are black (2,000 feet below the aircraft), green (between 2,000 and 700 feet below the aircraft), yellow (between 700 and 300 feet below the aircraft), and red (at or within 300 feet of the aircraft). Accurate depiction of terrain (in the terrain mode) requires the pilot to manually set a barometric pressure setting in the multifunction display menu. The Capstone avionics equipment does not automatically receive barometric pressure data from the aircraft's altimeter. Selection of the map mode does not provide any terrain warning/awareness information. Damage to the accident airplane's MFD precluded a determination of the visual display option selected at the time of the accident.

The recorded ARTCC data were reviewed by National Transportation Safety Board investigators to determine the flight track of the accident airplane. The radar-like track from the accident airplane, identified as Yute 6HL, depicted the accident airplane's departure from the Bethel Airport area on a heading of approximately 300 degrees. While en route to Chevak, the airplane climbed to an altitude of about 1,800 feet msl. As the track continued in a northwesterly direction and approached the accident site, a gradual descent was noted. The radar-like track stopped at approximately 1040, about 1.8 miles east of the accident site, with a ground speed of approximately 108 knots, and an altitude of 1,475 feet msl. The accident site elevation was 42 feet msl.

WRECKAGE RELEASE

The Safety Board released the airplane wreckage to the owner's representative on February 6, 2002. On August 7, 2002, the FAA owned Capstone Program equipment, consisting of an Apollo GX-60 GPS, a Multifunction Display (MFD), and a Universal Access Transceiver (UAT), was returned to the Capstone Program office located in Anchorage, Alaska.

ANC02LA016

On February 24, 2002, about 1830 Alaska standard time, a wheel-equipped Cessna 208B airplane, N454SF, sustained substantial damage during taxi, after landing at the Tununak Airport, Tununak, Alaska. The airplane was being operated as a visual flight rules (VFR) cargo flight under Title 14, CFR Part 135, when the accident occurred. The airplane was operated by Grant Aviation, Inc. of Anchorage, Alaska. The solo certificated airline transport pilot was not injured. The flight originated at the Bethel Airport, Bethel, Alaska, about 1750.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on February 25, the director of operations for the operator reported that while en route to the Tununak airport the pilot had received a pilot report, stating that only half of the length of the 2,010 foot runway was plowed. When the pilot braked to a stop on the runway, the nose wheel of the airplane stopped on a snowdrift crossing the runway. When he released the brakes, the airplane started to roll backward off the snowdrift. When he reapplied the brakes to stop the roll, the airplane rocked rearward, pivoting on the main landing gear, and the tail struck the snow-covered ground. The pilot inspected the airplane and found that the tail tie down ring and the aft fuselage bulkhead were damaged.

During a telephone conversation with the IIC on March 4, the director of maintenance reported that the two furthest-aft fuselage bulkheads (Station 474.4 and 475.88), and the tail tie down ring and doublers, were replaced due to the damage received in the accident. He said the airplane had no known mechanical problems or damage prior to the accident.

ANC02LA019

On March 1, 2002, about 1435 Alaska standard time, a Cessna 207A airplane, N7373U, sustained substantial damage during landing at the Kotlik Airport, Kotlik, Alaska. The airplane was being operated as a visual flight rules (VFR) scheduled domestic passenger flight under Title 14, CFR Part 135, when the accident occurred. The airplane was operated as Flight 408, by Hageland Aviation Services Inc., Anchorage, Alaska. The commercial certificated pilot, and the four passengers, were not injured. Visual meteorological conditions prevailed. VFR company flight following procedures were in effect. The flight originated at the Mountain Village Airport, Mountain Village, Alaska, at 1338.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC) on March 1, the director of operations for the operator reported the pilot told him that he was on final approach for landing on runway 19 at Kotlik. The airplane was about 300 feet above the ground, with 15 degrees of flaps, and an airspeed of about 80 knots. The pilot said that the airplane's airspeed seemed too fast, so he reduced engine power. The airplane's airspeed then became too slow, so he increased engine power, but the airplane collided with terrain short of the runway threshold. The airplane received damage to the nose gear, propeller, and left wing.

Runway 19 at Kotlik has a gravel surface, and is 4,422 feet long, by 100 feet wide. The remarks section of the airport facility directory/Alaska Supplement for Kotlik states, in part: "Unattended. Runway condition not monitored, recommend visual inspection prior to landing. ...Runway 01-19 marked with reflective cones."

ANC02LA047

On June 11, 2002, about 1235 Alaska daylight time, a wheel-equipped Cessna 172 airplane, N7564G, sustained substantial damage when the right wing struck the paved runway during landing at the Bethel Airport, Bethel, Alaska. The airplane was being operated as a visual flight rules (VFR) cross-country positioning flight under Title 14, CFR Part 91, when the accident occurred. The airplane was operated by Hageland Aviation Services Inc., Anchorage, Alaska. The commercial certificated pilot, the sole occupant, was not injured. Visual meteorological conditions prevailed. VFR company flight following procedures were in effect. The flight originated at the Tuluksak Airport, Tuluksak, Alaska, about 1220.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on June 11, the pilot reported that he was landing on runway 18 at Bethel (runway 18 is paved, 6,398 feet long by 150 feet wide). The pilot said that during the landing roll, as he applied the airplane's brakes, the airplane suddenly veered to the left, and the right wingtip struck the runway surface. The airplane departed off the left edge of the runway. The pilot said the weather conditions at Bethel were clear, and the winds were light and variable. The airplane received damage to the right wingtip, the outboard wing nose rib, and the leading edge of the wing.

On June 20, the director of maintenance for the operator reported that the repair of the wing entailed replacement of the wingtip, nose rib, and the leading edge of the wing between wing stations 190 and 208. No mechanical malfunction was reported by the director of maintenance, or the pilot.

ANC02LA066

On June 30, 2002, about 1450 Alaska daylight time, a wheel-equipped Cessna 207 airplane, N7384U, sustained substantial damage when it landed short of the intended runway at the Chevak Airport, Chevak, Alaska. The airplane was being operated as a visual flight rules (VFR) nonscheduled domestic cargo flight under Title 14, CFR Part 135, when the accident occurred. The airplane was operated by Flight Alaska Inc., Anchorage, Alaska. The airline transport certificated pilot, and the sole passenger, were not injured. Visual meteorological conditions prevailed, and a VFR flight plan was filed. The flight originated at the Newtok Airport, Newtok, Alaska, about 1424.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on July 1, 2002, the director of operations for the operator reported the pilot was landing on runway 32 at Chevak. The pilot told the director of operations that the airplane encountered a downdraft during the landing approach. The airplane landed short of the gravel runway threshold. The nose landing gear assembly was torn off the airplane, and the left main landing gear was folded aft.

In the Pilot/Operator Aircraft Accident Report (NTSB form 6120.1/2) submitted by the pilot, the pilot indicated the weather conditions as clear with light turbulence. He reported the wind was 290 degrees at 8 to 10 knots.

The FAA's Airport Facility Directory/Alaska Supplement for Chevak, lists the runway as a gravel surface, 2,610 feet long by 40 feet wide. The remarks section of the directory states, in part: "Unattended. Caution: Runway condition not monitored. ...Caution: Strong crosswinds at this location. ...Runway is trough shaped, low in center and high at both ends."

Airport personnel at Chevak reported the airplane collided with the lip of the runway at the approach end of runway 32.

The closest official weather observation station is Hooper Bay, Alaska, which is located 16 nautical miles west of the accident site. At 1455, an automated weather observation system (AWOS) was reporting in part: Wind, 300 degrees (true) at 11 knots; visibility, 10 statute miles; clouds and sky condition, clear; temperature, 52 degrees F; dew point, 39 degrees F; altimeter, 29.88 inHg.

ANC02LA123

On September 20, 2002, about 0815 Alaska daylight time, a float-equipped de Havilland DHC-2 airplane, N144Q, sustained substantial damage during an in-flight collision with tundra-covered terrain during takeoff from a remote lake, located about 1 mile north of Bethel, Alaska. The airplane was being operated as a visual flight rules (VFR) local area instructional flight under Title 14, CFR Part 91, when the accident occurred. The airplane was being operated by Ptarmigan Air, Anchorage, Alaska. The first pilot, an airline transport certificated pilot/certificated flight instructor, seated in the right seat, and the second pilot, a commercial certificated pilot, seated in the left seat, were not injured. Visual meteorological conditions prevailed, and VFR company flight following procedures were in effect. The flight originated at the accident lake, about 0810.

During a telephone conversation with a National Transportation Safety Board investigator on September 20, the first pilot reported that he was providing flight instruction/familiarization training to the second pilot. The first pilot said that just after takeoff, as the airplane climbed to about 50 feet above the water, the airplane began to buffet, and the right wing dropped. The airplane descended and subsequently struck an area of tundra-covered marshy terrain. The airplane sustained substantial damage to the wings, fuselage, and empennage.

The first pilot reported that the accident flight was the first flight of the day. He added that a postaccident inspection of the airplane revealed an accumulation of frost on the wings.

ANC03LA005B

On October 22, 2002, about 1415 Alaska daylight time, a Piper PA-32 airplane, N76RL, collided with another Piper PA-32, N31657, as both airplanes were taxiing on the ramp area of the Bethel Airport, Bethel, Alaska. N76RL was being operated as a visual flight rules (VFR) cargo flight under Title 14, CFR Part 135, when the accident occurred. The airplane was operated by Bellair Inc., Fairbanks, Alaska, as Flight 400 from Bethel to Eek, Alaska, and received minor damage to the propeller and engine cowling. The airline transport certificated pilot, the sole occupant, was not injured. N31657 was operated by Larry's Flying Service Inc., Fairbanks, Alaska, as a VFR on-demand passenger flight under Title 14, CFR Part 135, from Russian Mission, Alaska, to Bethel. The airplane received substantial damage to the left wing. The commercial pilot and the four passengers were not injured. Visual meteorological conditions prevailed, and VFR company flight following procedures were in effect for both flights.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on October 22, a Federal Aviation Administration (FAA) inspector, Anchorage Flight Standards District Office (FSDO), reported that N31657 was taxiing from runway 03 toward its parking spot on the west ramp of the Bethel Airport. He said the two operators involved in this accident have loading areas adjacent to each other on the ramp, and that each pilot's view was blocked by a fuel truck that was positioned in front of N76RL. As N31657 was approaching its parking spot, the pilot began a right turn. The fuel truck pulled away, revealing N76RL beginning to taxi forward away from its parking spot. The pilot of N31657 tightened the right turn, but the propeller of N76RL sliced into the leading edge of N31657's left wing.

In the Pilot/Operator Aircraft Accident Report (NTSB Form 6120.1) submitted by the pilot of N76RL, the pilot indicated that he did not see the second airplane taxiing because the nose of his airplane was higher than his line of sight.

ANC03LA007

On October 28, 2002, about 2000 Alaska standard time, a Cessna 207 airplane, N91090, sustained substantial damage when it collided with terrain during cruise flight, about four miles southeast of Marshall, Alaska. The airplane was being operated by Grant Aviation Inc., Anchorage, Alaska, as a visual flight rules (VFR) positioning flight under Title 14, CFR Part 91, at the time of the accident. The solo commercial pilot received serious injuries. Night visual meteorological conditions prevailed, and company flight following procedures were in effect. The flight originated at the Marshall Airport about 1955, and was bound for Bethel, Alaska.

The accident airplane departed the 'new' Marshall airport (MLL). The 'old' Marshall airport (MLL) was decommissioned several days earlier. The new airport is 3 miles east-northeast of the old airport, and was not yet depicted on current navigation charts, nor listed in the current United States Government Flight Information Publication, Alaska Supplement.

When the flight failed to arrive at Bethel, a search was initiated. On October 29, about 0100, search personnel located the wreckage about 4 miles southeast of Marshall. The airplane was located about 1,200 feet msl, on the north side of a ridgeline that runs generally east to west. The ridge has a summit elevation of 1,714 feet msl.

The airplane was equipped with Capstone navigation and terrain avoidance avionics. The Capstone equipment uses GPS mapping technology and aircraft position information, in conjunction with a multifunction display in the instrument panel, to graphically represent the aircraft's position relative to terrain. Terrain that comes within set parameters for altitude and horizontal distance is displayed in color bands. Terrain depicted within the red color band is intended to warn the pilot of the close proximity of terrain to the aircraft.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on November 4, the pilot said he departed Marshall on runway 07, and made a climbing right turn at 80 knots indicated airspeed toward Bethel. He said the vertical speed indicator read in excess of 1,000 feet per minute rate of climb, that it was a very dark night, and there were no visible horizon or ground references discernible. He said his route was direct to Bethel at 1,200 to 1,400 feet msl, and that upon reaching his cruise altitude, there was a strong headwind and turbulence. He said just prior to impacting the terrain, his vertical speed indicator showed a high rate of descent, and his Capstone display was almost completely red. He further stated the airplane's GPS had not been reprogrammed to reflect the location changes for the old Marshall airport and the new Marshall airport. The pilot said he had made one flight into the old Marshall airport, and this was his second flight into the new Marshall airport. This was the first flight when he departed either airport after dark. He said there were no preimpact mechanical anomalies with the airplane.

Direct flight from either Marshall airport to Bethel requires crossing an east-west ridgeline on the north side of the Yukon River. The direct route from the old Marshall airport to Bethel crosses the western foot of the ridgeline at a point with an elevation of less than 500 feet msl. The direct route from the new airport to Bethel crosses the ridge at a point where the elevation of the ridge exceeds 1,200 feet msl.

During a telephone conversation with the NTSB IIC on November 6, the pilot of the Army helicopter that located the accident airplane said their initial attempts to locate the missing airplane were futile. He said they then flew to the new Marshall airport and attempted to recreate the accident flight by taking off into the wind, conducting a right down wind departure replicating the performance of the Cessna 207, and heading direct to Bethel. He said when they reached the ridgeline on the north side of the Yukon River they headed east up the ridge toward the summit (1,704 msl). They located the accident airplane within minutes at 1,200 feet msl. He said the airplane impacted near the crest of the ridge, with a shallow angle of attack. He also stated that all the major airframe components sustained substantial damage, and the engine had separated from the airplane. The helicopter pilot said after they landed he noted that the wind was strong out of the northeast, with gusts above 40 knots. He said during the time they were searching for the accident airplane they did not encounter turbulence.

The weather forecast for the Yukon/Kuskokwim Delta area at the time of the accident was scattered clouds at 3,500 feet msl, occasional broken clouds at 3,500 to 6,000 feet msl, with an outlook for VFR and windy conditions. The freezing level was at 1,500 feet msl, and no turbulence was forecast.

During the accident sequence the emergency locator transmitter (ELT) did not activate. The injured pilot removed the ELT from its holder, and took it with him into the empennage where he sheltered himself from the weather. He was not aware the ELT was not transmitting. Rescue personnel recovered the pilot and the ELT. The ELT was released to the operator who proceeded to functionally test the ELT until it activated. It is unknown why the ELT did not operate upon impact.

ANC03LA024

On January 21, 2003, about 1000 Alaska standard time, a wheel-equipped de Havilland DHC-6-200 airplane, N206EH, sustained substantial damage to the lower fuselage when it collided with a snow berm during the landing roll at the Kipnuk Airport, Kipnuk, Alaska. The Title 14, CFR Part 121 passenger flight was operated by Era Aviation, Incorporated, Anchorage, Alaska, as Flight 863, and departed Bethel, Alaska, en route to Kipnuk, about 0920. Neither the captain, the first officer, or any of the eight passengers, reported any injuries. Day visual meteorological conditions prevailed, and a visual flight rules flight plan was in effect.

According to the operator's director of safety, the captain related that he was landing the airplane on runway 33 during daylight conditions with a 15-knot crosswind from his right (about 050 degrees magnetic). During the landing roll, the airplane drifted too far to the left on the ice and frost-covered runway and encountered a snow berm. The collision with the snow berm fractured the nose wheel fork, and a portion of the fork subsequently damaged the fuselage just aft of the nose wheel. Field repairs were made at Kipnuk with the replacement of the nose wheel fork assembly, and the airplane was ferried to the operator's main repair base in Anchorage, Alaska.

The NTSB investigator-in-charge (IIC), another NTSB air safety investigator, the operator's director of safety, and the operator's chief maintenance inspector, inspected the airplane in Anchorage on January 24. Inspection disclosed substantial damage to several stringers and a longeron in the lower fuselage structure immediately aft of the nose wheel. Additionally, the radar dome, nose baggage door, and adjoining nose cone structure were damaged. The operator's chief maintenance inspector noted that the damage to the cone and baggage door would be repaired by replacing the entire nose cone, which is about 6 feet in length.

The captain was interviewed by the IIC on February 11 at the Anchorage NTSB office. He related that he was the pilot flying, and he made an uneventful approach and touchdown on runway 33. He said the touchdown was within the first 500 feet of the runway, and there was nearly a direct crosswind from the northeast at 15 to 20 knots. He described the landing surface of the 2,120 feet long by 35 feet wide runway as hard-packed gravel, covered mostly by ice and frost. During the landing, he said the first officer fully deflected the ailerons into the crosswind, while he manipulated the rudders, propellers, power to the engines, and nose wheel steering. He said as the airplane slowed, the rudder effectiveness diminished, and, in addition to right rudder input, he attempted to keep the airplane tracking straight on the runway by applying nose wheel steering to the right. He indicated the airplane did not respond to the steering inputs, and went toward the left side of the runway. The left main landing gear tire subsequently encountered snow left piled alongside the runway by a snowplow. The encounter with the snow berm pulled the airplane to the left, and into the snow-covered area outside the runway environment. During the excursion from the runway, the nose wheel became mired in the snow, the nose wheel fork fractured, and the airplane nosed down. The captain noted that the nose wheel steering tiller did not seem to rotate to the right as far as it should, and he was not certain the nose wheel was capable of full travel to the right. He said he did mention his concerns about the tiller to company management personnel sometime after the accident, but he did not make a postaccident entry into the airplane's flight log about the tiller movement, nor did he initially include his concerns in a postaccident written statement which was given to company management and the NTSB IIC.

On February 24, the captain contacted the NTSB IIC and gave him an additional written statement which outlined his concerns about a possible mechanical defect in the nose wheel steering mechanism. He also reiterated information from the previous interview about a lack of a winter area familiarization flight review that he feels should have been provided by the company. He said he had considerable experience flying the accident type airplane, but all of his recent winter flight experience had been to large, hard-surfaced runways at major terminals. He said his last area familiarization flight in the Bethel-Kipnuk area was June, 2002. The captain said the company should have provided him with a winter-specific familiarization flight in the Bethel area prior to assigning him to fly to short, narrow, and icy runways. The captain also amended a portion of his original written report submitted to the operator and the NTSB. The original statement read, in part: "At approximately 30 knots it appeared that the A/C was drifting left. Nose wheel steering had no effect as it was slowly applied to the right, the A/C continued drifting left." The captain amended the word "drifting" in the two preceding sentences to "sliding."

The first officer had a telephone interview with the NTSB IIC on March 6. He related that the captain was the flying pilot, and that the approach and touchdown at the accident site were uneventful. He described the gravel runway conditions as normal winter conditions, somewhat slick, with a roughed-up, ice-coated surface. He said he had flown the same airplane to the same site the day before, and the runway conditions were nearly identical. After touchdown, at the captain's direction, he compensated for the crosswind condition by turning the ailerons completely to the right, into the crosswind. He said the airplane began to drift to the left, and he waited for the captain to make a correction. The airplane continued to drift left, and the left main landing gear tire ran into the snow berm alongside the runway, which pulled the airplane off the runway into a snow field, where the nose wheel fork fractured. When asked if he was aware of any mechanical problems with the airplane that might have precipitated the accident, he said "no." He indicated that he thought the captain delayed his correction for the drift, and that the captain should have used the rudders sooner and more aggressively, instead of attempting to primarily steer the airplane back to the centerline with the nose wheel tiller. The first officer was asked by the NTSB IIC if he was aware of any concerns the captain had about the hydraulically-actuated nose wheel steering not operating satisfactorily. He responded that the captain noted later on, sometime after they had deplaned, that the tiller didn't seem to be working right. He said that the tiller is located only at the captain's station on the left side of the airplane, but that to him, it seemed to be working fine, that the captain he had flown with the day before did not complain about it, and there were no mechanical discrepancies noted in the airplane's daily maintenance logs in any previous flights. He noted that his preflight inspection of the accident airplane before departure from Bethel, discovered no hydraulic leaks near the nose wheel, or anywhere on the airplane, nor had he seen any hydraulic leaks on this particular airplane recently.

On May 7, the NTSB IIC contacted the company captain who was assigned to ferry parts to repair the accident airplane to Kipnuk, and to return the accident airplane to Bethel. He said he arrived about an hour after the accident, and walked the runway several times, looking at the tire tracks from the accident airplane and for anything unusual. When asked if he had discovered anything, such as any signs of hydraulic fluid, he said he saw none at all, and that it was his impression from looking at the tire tracks on the runway, that the wheels had been skidding, and that the nose wheel was deflected fully to the right.

The IIC also had a telephone interview on May 7 with the captain who flew the accident airplane the day before the accident. He was asked if he was aware of any mechanical problems with the airplane, and in particular, the nose wheel steering. He said he had flown the airplane frequently in the week or so preceding the accident, including the day before, and had not noticed any problems with the steering. He noted that the tiller always felt "a bit spongy" on the accident airplane, but that the nose wheel had always responded quickly, and completely, to a full 60 degree deflection. He also said that the accident captain would have had to made a hard, 90 degree right turn out of the ramp area at the beginning of the accident flight, and should have noticed any problem then.

The nose wheel steering mechanism of the accident airplane is hydraulically actuated. A tiller bar is located only at the captain's station (left seat). The tiller bar is connected via cable to the nose wheel steering actuator. The tiller bar normally rotates through approximately 90 degrees each direction from the horizontal, i.e., the tiller is centered at the nine o'clock position, and should rotate approximately to the twelve o'clock and six o'clock positions, with the twelve o'clock commanding a full right turn of the nose wheel (60 degrees from center), and the six o'clock a full left turn (also 60 degrees from center).

The airplane is maintained on a continuous airworthiness program (CAP). The IIC reviewed the airplane's maintenance records and flight logs for the previous 30 days. The airplane had completed a CAP 20 inspection on January 9, 2003. During the inspection, the hydraulic system, hydraulic system pressure accumulator, hydraulic system fittings, lines, and nose wheel actuator were tested, adjusted, and repaired as necessary. The airplane was also subjected to other routine inspections. The two most recent inspections prior to the accident flight occurred on January 15 and 18. During these inspections, the hydraulic accumulator pressure and hydraulic system fluid levels were checked, and determined to be within the manufacturer's specifications. No hydraulic fluid was added to the system, no leaks were detected, and no pressure was added to the accumulator.

A review of the flight and maintenance logs completed by the flight crews after each duty day, disclosed no mechanical discrepancies of any kind with the accident airplane during the month of January preceding the accident flight.

The nose wheel fork assembly and the nose wheel actuator were examined and bench tested by company maintenance personnel on March 4. The nose wheel actuator was found to extend and retract to full extension, but slightly faster than recommended specifications. The nose wheel steering actuator was sent to Avitech Engineering Corporation, Hayward, California, for overhaul.

On May 6, the IIC contacted the chief inspector, along with the vice president-general manager at Avitech via telephone. They said the nose wheel unit was initially tested as received from the operator prior to overhaul. They noted that although the nose wheel steering actuator was marginally outside of the acceptable test parameters in two categories, the unit functioned normally in its extension and retraction cycles, and moved full travel without impedance.

The IIC reviewed the operator's training practices and records, and discussed the first pilot's concerns about not receiving a winter familiarization flight, with the operator's director of safety, and the FAA's aviation safety inspector assigned as the company's principal operations inspector (POI). Both the POI and director of safety noted that the accident captain had met all requirements to act as pilot-in-command of the accident airplane at the time of the accident. They also noted that while not a regulatory requirement, a winter familiarization flight for pilots who did not have recent experience in the unique winter operating environment of the Bethel area would be desirable.

ANC03LA030

On January 30, 2003, about 0330 Alaska standard time, a Cessna 208B airplane, N1276P, sustained substantial damage when the airplane's tail impacted the ground during passenger loading at the Russian Mission Airport, Russian Mission, Alaska. The airplane was being operated as an instrument flight rules (IFR) medical patient transfer flight under Title 14, CFR Part 135, by Grant Aviation, Inc. of Anchorage, Alaska. The airline transport pilot, patient, and the three medical attendants were not injured. The intended destination was Bethel, Alaska.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on March 3, an FAA aviation safety inspector from the Anchorage Flight Standards District Office, said he was inspecting maintenance records at Grant Aviation, when he noticed a major airframe repair for unreported damage had been completed on the accident airplane.

During a telephone conversation with the IIC on March 3, the director of operations for the operator said the accident pilot told him that he (the pilot) did not place the tail stand under the tail of the airplane while loading a medical patient at Russian Mission on the morning of the accident. The pilot told him the tail of the airplane went down on the tail tie down ring because too many people were in the aft section of the airplane while loading the patient. The pilot said it was dark, and he did not see the damage to the tail section, and flew the airplane to Bethel.

In a telephone conversation with the IIC on March 5, a mechanic for the operator said the FS 427.88 bulkhead and tie down assembly were replaced due to the damage.

ANC03LA091

On August 8, 2003, about 1253 Alaska daylight time, a wheel-equipped Cessna 207A airplane, N6439H, sustained substantial damage when it nosed over during a forced landing following a loss of engine power about 8 miles northwest of Bethel, Alaska. The airplane was being operated as a visual flight rules (VFR) non-scheduled domestic cargo flight under Title 14, CFR Part 135, when the accident occurred. The airplane was operated as Flight 10-1 by Hageland Aviation Inc., Anchorage, Alaska. The commercial certificated pilot, and the sole passenger, who is the director of training for the operator, were not injured. Visual meteorological conditions prevailed, and VFR company flight following procedures were in effect. The flight originated at the Tuluksak Airport, Tuluksak, Alaska, about 1245, with a planned destination of Atmautluak, Alaska.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on August 8, the director of operations for the operator reported the airplane was carrying mail, and was in cruise flight about 1,000 feet agl. He said the pilot reported a complete loss of engine power, and made a forced landing in rough, tundra-covered terrain. During the landing, the airplane nosed over.

At 1253, an Aviation Routine Weather Report (METAR) at Bethel was reporting, in part: Wind, light and variable; visibility, 10 statute miles; clouds and sky condition, few at 6,000 feet, 20,000 feet scattered; temperature, 70 degrees F; dew point, 59 degrees F; altimeter, 30.27 inHg.

Examination of the engine maintenance records revealed that the engine was overhauled on July 18, 2002, by Aero Recip, Anchorage, Alaska. During the overhaul process, the engine case was reportedly welded by Divco Inc., Tulsa, Oklahoma, on March 28, 2002. The engine case was rebored to match original engine case specifications, and released as serviceable. The engine was then installed by the operator in the accident airplane.

At the time of the accident, the engine had accrued 4557.3 total service hours, 1090.9 hours since the overhaul, and 1 hour since its most recent approved airworthiness inspection program (AAIP) inspection. The engine also received a top overhaul in May, 2003, during which all 6 engine cylinders were replaced. The engine then accrued 279.9 hours before the accident.

On September 9, a postaccident examination of the engine revealed that the engine case was fractured under the left magneto. A portion of the number 2 piston connecting rod was visible, protruding through the case. Removal of the engine cylinders and separation of the engine case halves revealed that the lower half of the number 2 connecting rod cap and bearing had separated from the upper half. The connecting rod cap bolts were stretched and broken. The number 1 main bearing was deformed in its bearing saddle. Portions of the number 2 main bearing were deformed, flattened, fractured and fragmented, and were found in the engine case. The number 2 bearing saddle was extensively distorted and gouged. The engine crankshaft had a transverse shear fracture at the aft fillet radius of the number 2 main bearing, and the number 3 crankshaft cheek, adjacent to the main bearing surface. The fracture surface had areas of deep blue discoloration, and beach marks radiating inward from the outer edge of the crankshaft surface. The area of the number 2 engine bearing saddle, under the bearing insert, had several areas of cracking and exfoliation of the case material along the edges of the oil supply channel. No evidence of engine case fretting was observed during the examination. The oil filter contained numerous metal fragments.

On December 8, 2003, the engine case was examined by the manufacturer's metallurgical personnel at Teledyne Continental Motors, Mobile, Alabama. The report of examination stated that the case contained no signs of lubrication distress on the journals. The metallurgist stated that a determination of a weld repair at the number 2 main bearing support could not be made with a high degree of certainty, although there were several work order stamps on the crankcase indicating that it had been reworked.

Following the examination at Teledyne Continental Motors, the engine case was released to the owner's representatives on January 22, 2004.

ANC04LA032

On February 10, 2004, about 1652 Alaska standard time, a wheel-equipped Cessna 208B airplane, N1276P, sustained substantial damage when it collided with snow-covered terrain after it departed the runway and nosed over during the takeoff roll at the Toksook Bay Airport, Toksook Bay, Alaska. The airplane was being operated as a visual flight rules (VFR) scheduled passenger flight to Newtok, Alaska, under Title 14, CFR Part 135, when the accident occurred. The airplane was operated as Flight 2821 by Grant Aviation Inc., Anchorage, Alaska. The commercial certificated pilot, and the 6 passengers, were not injured. Visual meteorological conditions prevailed, and VFR company flight following procedures were in effect.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on February 12, the director of operations for the operator reported that the pilot was departing on runway 34. The runway surface had areas of packed snow and ice, and the director of operations indicated that he had received reports that a right crosswind was blowing from 070 degrees between 15 to 25 knots. According to the director of operations, the pilot said that about 300 feet after beginning the takeoff roll, between 30 to 50 knots airspeed, the airplane began to drift to the left, which he was unable to correct. The airplane departed off the left side of the runway and nosed over. The airplane received damage to the wings, fuselage, and empennage.

Runway 34 at Toksook Bay is 3,200 feet long and 60 feet wide.

According to the accident airplane's information manual, the maximum demonstrated crosswind velocity, takeoff or landing, is 20 knots.

ANC04LA059

On May 22, 2004, about 1605 Alaska daylight time, a Piper PA-31-350 airplane, N4105D, sustained substantial damage when it encountered severe turbulence while in cruise flight, about 5 miles west of Goodnews, Alaska. The airplane was being operated as a visual flight rules (VFR) cross-country positioning flight under Title 14, CFR Part 91, when the accident occurred. The airplane was operated by Grant Aviation Inc., Anchorage, Alaska. The airline transport certificated pilot, the sole occupant, was not injured. Visual meteorological conditions prevailed, and VFR company flight following procedures were in effect. The flight originated at the Goodnews Airport at 1600, and was en route to Bethel, Alaska.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC), on June 2, 2004, the director of operations for the operator reported that the pilot was returning to Bethel without any passengers or cargo after delivering mail to Goodnews, which is located on the coast of the Bering Sea. When the pilot arrived in Bethel, he informed the director of maintenance that during the flight, the airplane encountered turbulence and the appeared to have received damage to the wings.

On June 3, the director of maintenance reported that the airplane received structural damage that consisted of wrinkling and rippling of both of the upper wing surfaces, extending about 8 feet outboard from each engine nacelle. In addition, the elevator had wrinkling that extended about 6 inches inboard from each of the outboard hinge attach points. Due to the damage, the company removed the airplane from service.

During a telephone conversation with the NTSB IIC on June 3, the pilot reported that during his flight to Goodnews, the wind conditions were about 070 degrees magnetic at 25 knots, with gusts to 30 knots, and the airplane encountered turbulence over an area of low hills that are north of the airport. When the pilot departed on the accident flight, he said he utilized runway 05 and began a right turn over the bay. He initially climbed the airplane to about 1,200 feet, but as he approached an area of low hills west of the airport, he descended to about 700 feet. At an indicated airspeed of about 185 knots, the pilot said that the airplane encountered severe turbulence for about 30 seconds, during which his radio headset was dislodged. He continued toward the coast and then turned northbound toward Bethel. After arrival in Bethel, he noticed the damaged wing surfaces.

The closest official weather observation station is Cape Newenham Long Range Radar Station, which is located about 32 nautical miles south of the accident site. At 1555, an automated weather observation system (AWOS) was reporting in part: Wind, 110 degrees (true) at 17 knots, gusts to 27 knots; visibility, 7 statute miles; clouds and sky condition, 1,200 feet overcast; temperature, 52 degrees F; dew point, 46 degrees F; altimeter, 29.76 inHg.

ANC04IA078

On July 13, 2004, about 1630 Alaska daylight time, a Cessna 172M airplane, N1453V, sustained minor damage during an in-flight collision with terrain following a total loss of engine power during cruise flight, about 4 miles northwest of Aniak, Alaska. The airplane was being operated by Inland Aviation Services of Aniak as a visual flight rules (VFR) air taxi flight under Title 14, CFR Part 135 when the accident occurred. The airline transport pilot and sole passenger were not injured. Visual meteorological conditions prevailed, and company flight following procedures were in effect. The flight departed Holy Cross, Alaska, about 1610.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC) on July 13, the director of operations for the operator said when the airplane did not return from Holy Cross, an airplane was sent to look for it. He said the pilot of the search plane located the accident airplane on the tundra. The director of operations reported that the search pilot made radio contact with the pilot of the accident airplane who told him his engine had quit, necessitating an emergency landing.

During a telephone conversation with the NTSB IIC on July 16, an FAA aviation safety inspector who went to the crash site said the accident airplane's fuel system was intact showing no signs of leakage or spills. No fuel was found in the right wing tank, about two gallons of fuel were found in the left wing tank, and about 1/4 cup of fuel was found in the fuel lines and carburetor. The Pilot Operating Handbook (POH) indicates there is about 1.5 gallons of unusable fuel in each wing tank. The FAA inspector said the fuselage sustained minor damage during the emergency landing.

The flight consisted of takeoff and landings at three airports, and a return to the departure airport, or four total takeoffs and landings. The total distance covered by the flight was about 165 miles. The operator's fuel log indicated the pilot added 13.9 gallons of fuel to the tanks prior to the flight. The FAA inspector who went to the accident site and interviewed the pilot, said the pilot told him he looked in the tanks prior to adding fuel, but did not "dip" the tanks to ascertain the quantity of fuel remaining in the tanks. He also said the pilot told him he flight-planned the airplane's fuel burn at 5.5 gallons per hour (gph) for the trip. According to the airplane's POH, depending on the variables of runup, taxi, takeoff, and time to climb, the pilot should plan on the engine using an additional 1.0 to 2.6 gallons per takeoff. The POH indicates that the fuel burn at 65% cruise rpm, below 2,500 feet msl, is 7.2 gph, and at 75% cruise power, 8.2 gph. According to the POH, the cruise airspeed at 65% power below 2,500 feet msl, is 117 mph true airspeed (TAS), and at 75% power, 126 mph TAS. Accordingly, depending on the cruise power selected, for a distance of 165 miles with four takeoffs and landings in a no wind condition, the pilot should expect the engine to use between 14.1 and 21.1 gallons of fuel for the flight.

The FAA inspector said after the airplane was recovered, the engine was started and operated without difficulty. The pilot did not indicate any preincident mechanical anomalies with the airplane in the NTSB Pilot/Operator Aircraft Accident/Incident Report.

ANC05CA005

On October 11, 2004, about 0919 Alaska daylight time, a wheel-equipped Cessna 207 airplane, N5277J, operated by Hageland Aviation Services under Title 14, CFR Part 135 as scheduled commuter Flight 63, sustained substantial damage when it struck a bird while on final approach to land at the Chefornak airport, Chefornak, Alaska. The commercial pilot and two passengers were not injured. The flight departed Kipnuk, Alaska, about 0900, and was en route to Chefornak. Visual meteorological conditions prevailed, and a VFR flight plan was in effect.

During a telephone conversation with the operator's director of operations on October 14, he related that the accident pilot reported that a large bird, possibly a Ptarmigan, struck and penetrated the airplane's windshield. The pilot was able to continue the landing approach, and made an uneventful landing. The director of operations reported that due to the bird strike, the windshield had to be replaced.

6.2 Appendix B: Summarized Operating Data Tables

The operational data used in this report comes from several sources. These sources are the Department of Transportation's T-100 data bank, and the FAA's Air Traffic Activity Data System (ATADS).

The detailed origin and destination data within the Y-K Delta comes from the Department of Transportation's Bureau of Transportation Statistics Air Carrier Statistics data. This is also known as the T-100 data bank. The T-100 data bank contains domestic and international airline market and segment data on certificated air carriers. The U.S. air carriers report monthly air carrier traffic information using Form T-100. Foreign carriers having at least one point of service in the United States or one of its territories report monthly air carrier traffic information using Form T-100(f). This report has used the domestic segment reports. In Alaska only those operators with any scheduled operations are required to file monthly T-100 reports. This means that a charter operator operating under FAR Part-135 with no scheduled operations is not required to file a T-100 report.

The ATADS is the official FAA source of historical air traffic operations for center, airport, instrument and approach counts. Daily, monthly and annual counts are available by facility, state, region, or nationally. In Alaska there is one center (the Anchorage Center) and 8 airports that are covered by ATADS. Operation counts at the other 600+ airports and seaplane bases are not reported.

The following tables and figures are presented as examples of the data that can be retrieved from these databases. Table B-1 is from the T-100 database listing the numbers of flights between the Y-K Delta airports in 2004. Only those origin-destination pairs with more than 52 flights in a year are listed. Table B-2 lists the number of departures from the Y-K Delta airports in 2004.

From the ATADS database one can retrieve data on tower counts and instrument operations. Table B-3 shows the tower counts for the eight airports in Alaska that report these counts. Table B-4 shows the number of instrument operations at the six towers and one TRACON that conducts instrument approaches.

Table B-1 Origin and Destination Airport "T-100 Traffic" in the Y-K Delta in 2004

O-D	Flights	O-D	Flights
KSM-MOU	4378	SLQ-SRV	523
ANI-KLG	3880	KSM-MLL	521
BET-VAK	3400	OOK-WWT	472
BET-EEK	3085	AKI-KKI	459
BET-HPB	2878	KKI-KWT	451
BET-KWT	2585	AUK-BET	445
BET-OOK	2173	KOT-KSM	419
BET-SCM	2141	PKA-WNA	419
BET-MLL	2115	ANI-SRV	336
BET-KKI	2083	ANV-SHX	334
BET-TLT	2039	BET-PTU	310
HPB-VAK	2017	BET-SXP	310
BET-KWK	1905	KKI-TLT	276
BET-WNA	1805	KOT-MOU	250
AKI-BET	1744	AKI-KWT	241
HPB-SCM	1693	AUK-KSM	240
BET-WWT	1586	MOU-SCM	234
BET-PKA	1480	ANI-RDV	231
BET-KLG	1402	HPB-KSM	229
ANI-BET	1316	ANI-KSM	212
BET-RSH	1049	KSM-SCM	198
ANI-RSH	1030	KWT-TLT	184
BET-MOU	1017	KOT-SXP	182
AUK-SXP	981	KSM-VAK	146
KGX-SHX	935	AUK-MOU	139
ANI-SHX	922	KSM-RSH	136
KLG-RSH	911	MLL-MOU	133
MLL-RSH	887	HPB-MOU	127
ANV-KGX	869	RDV-SRV	123
BET-GNU	790	EEK-GNU	96
BET-KOT	772	KSM-SXP	91
ANI-KGX	687	VAK-WWT	83
AUK-KOT	624	AUK-SCM	81
ANI-ANV	611	ANI-TLT	75
BET-KSM	602	MOU-SXP	70
GNU-PTU	578	EEK-WNA	69
AKI-TLT	553	MOU-RSH	65
RDV-SLQ	542	EEK-PTU	60
SCM-VAK	537	MLL-TLT	58
ANI-SLQ	523	AKI-ANI	57
		KWT-PKA	52

Table B-2 Number of "T-100 Departures" from the Y-K Delta Airports in 2004

Airport	Departures
BET	20165
ANI	4862
KSM	3648
HPB	3450
KLG	3161
MOU	3145
VAK	3081
SCM	2458
RSH	2005
MLL	1916
EEK	1815
KWT	1794
KKI	1684
TLT	1624
AKI	1580
AUK	1440
OOK	1384
KGX	1271
WNA	1211
KOT	1108
SHX	1099
ANV	1068
PKA	1056
WWT	1047
KWK	959
SLQ	820
SXP	797
GNU	757
RDV	537
SRV	478
PTU	405

Table B-3 Tower Counts for Alaskan Airports

Year	Month	ADQ	AKN	ANC	BET	ENA	FAI	JNU	MRI	Total
2000	1	3541	1305	16783	9126	3257	5196	5426	6297	**50931**
	2	2061	1331	18895	13059	4611	7633	6921	13217	**67728**
	3	2363	1987	22465	12524	4508	10539	7420	15175	**76981**
	4	2660	2004	22542	12457	5513	13119	9994	19173	**87462**
	5	1753	2896	30629	14348	7347	14995	17512	22331	**111811**
	6	2453	3970	38181	12191	8068	15794	21678	23230	**125565**
	7	2715	4019	37276	10182	8841	15744	22204	19962	**120943**
	8	2637	2582	38132	11345	8096	15906	23502	19656	**121856**
	9	2330	2377	31577	12480	6792	12994	11996	16132	**96678**
	10	2403	1828	23630	12696	4620	10256	7542	15581	**78556**
	11	2268	1503	19155	13096	3850	8831	6068	11281	**66052**
	12	1730	1341	18498	11572	3555	7608	5832	8492	**58628**
2000 Total		**28914**	**27143**	**317763**	**145076**	**69058**	**138615**	**146095**	**190527**	**1063191**
2001	1	2306	1445	17233	7904	3687	7760	4987	8042	**53364**
	2	2039	1311	16859	6604	3298	7413	5349	9291	**52164**
	3	2608	1704	21407	7663	3822	9255	7051	13834	**67344**
	4	2580	1829	21512	8155	5306	10796	9442	17532	**77152**
	5	2111	2663	28474	10759	6600	14343	16557	18891	**100398**
	6	2528	3757	38374	9199	6657	15543	23277	22928	**122263**
	7	2709	3560	35018	8310	6132	14707	23118	21793	**115347**
	8	2903	2482	37206	9691	6132	16034	23935	23319	**121702**
	9	2484	2284	27622	8184	4335	13735	10473	17289	**86406**
	10	2639	2127	21223	11546	3603	9692	7258	11960	**70048**
	11	2904	1566	18063	10772	3185	7808	5723	9374	**59395**
	12	1892	1198	17175	7343	2144	6219	4083	4964	**45018**
2001 Total		**29703**	**25926**	**300166**	**106130**	**54901**	**133305**	**141253**	**179217**	**970601**
2002	1	2538	1311	16831	6369	2380	6976	4643	7257	**48305**
	2	1760	1312	16550	6131	2909	8138	4665	10446	**51911**
	3	2806	1545	21984	7691	3579	11123	6232	14913	**69873**
	4	3806	1682	21830	7607	3704	10967	8049	15836	**73481**
	5	2929	2660	29918	10285	5796	14596	14590	20467	**101241**
	6	2627	3153	36821	9411	5225	15164	22227	22479	**117107**
	7	2323	3351	38516	9283	5629	16585	21655	21765	**119107**
	8	2801	2344	37289	10187	4243	14495	19106	20372	**110837**
	9	2323	2156	28408	8801	3880	13755	12159	15034	**86516**
	10	2681	1686	24528	10824	3812	10319	5290	13972	**73112**
	11	2234	1397	19105	10353	3175	9643	5959	12430	**64296**
	12	2450	1468	17445	9199	3030	7714	3971	9699	**54976**
2002 Total		**31278**	**24065**	**309225**	**106141**	**47362**	**139475**	**128546**	**184670**	**970762**
2003	1	2091	1506	17448	7442	3627	6883	3957	12180	**55134**
	2	2317	1454	15564	5926	3585	7823	4005	12585	**53259**
	3	2016	1533	18789	8241	4513	10545	5196	14605	**65438**
	4	3176	2020	21077	9249	5597	11971	7183	20692	**80965**
	5	2668	2663	28052	10942	6726	13754	14424	22855	**102084**
	6	2788	3960	34607	9735	5869	15826	21794	23626	**118205**
	7	2870	3763	34470	9989	5918	15074	24237	22349	**118670**
	8	4391	2928	35055	10869	5879	15697	21010	22085	**117914**

Year	Month	ADQ	AKN	ANC	BET	ENA	FAI	JNU	MRI	Total
	9	3286	2523	29409	10356	5086	13915	11473	17618	**93666**
	10	3021	2328	23529	12234	3940	10766	6500	17837	**80155**
	11	2690	1715	17439	10087	3091	6501	4264	8607	**54394**
	12	1957	1432	17359	8118	2644	7701	4428	7239	**50878**
2003 Total		**33271**	**27825**	**292798**	**113188**	**56475**	**136456**	**128471**	**202278**	**990762**
2004	1	2722	1504	17044	6577	2862	5455	3883	8316	**48363**
	2	2182	1412	17521	6270	3569	7973	4930	12749	**56606**
	3	3277	1809	21183	7380	3959	9527	5389	13881	**66405**
	4	2335	2053	20948	10025	4780	11993	7262	18635	**78031**
	5	2730	3173	28634	9926	5329	14171	15305	21444	**100712**
	6	2382	4042	37568	9141	5448	15905	22168	22962	**119616**
	7	3050	4407	37907	9079	6559	14104	22853	23017	**120976**
	8	3383	2810	37853	9167	6706	10279	24227	22914	**117339**
	9	3237	2457	29480	9018	4353	10461	10614	16375	**85995**
	10	2851	2011	24762	8665	4449	8813	5373	14825	**71749**
	11	2745	1426	18049	8656	2614	7276	4473	8388	**53627**
	12	2061	1544	18511	7606	2730	6238	4035	8010	**50735**
2004 Total		**32955**	**28648**	**309460**	**101510**	**53358**	**122195**	**130512**	**191516**	**970154**
Grand Total		**156121**	**133607**	**1529412**	**572045**	**281154**	**670046**	**674877**	**948208**	**4965470**

Table B-4 Instrument Operations at Towers and TRACON in Alaska

Year	Month	A11	ADQ	AKN	BET	ENA	FAI	JNU	Total
2000	1	19485	465	590	875	910	4219	974	**27518**
	2	21617	513	427	758	683	3898	791	**28687**
	3	26275	576	583	909	554	6073	890	**35860**
	4	27350	488	583	810	324	8233	862	**38650**
	5	32653	427	548	836	478	8853	957	**44752**
	6	36573	682	1078	903	506	11046	1108	**51896**
	7	36877	676	1451	1024	173	11731	1383	**53315**
	8	37404	510	855	1527	658	11723	1384	**54061**
	9	32026	548	702	1061	592	9993	1072	**45994**
	10	27008	542	562	1471	633	8551	925	**39692**
	11	22552	513	403	711	525	8024	828	**33556**
	12	22212	488	442	689	579	7232	891	**32533**
2000 Total		**342032**	**6428**	**8224**	**11574**	**6615**	**99576**	**12065**	**486514**
2001	1	20871	543	477	697	622	6405	932	**30547**
	2	19517	428	380	727	632	6639	799	**29122**
	3	24139	497	393	823	597	8942	908	**36299**
	4	25520	476	463	1456	513	8786	845	**38059**
	5	29976	515	578	928	610	11113	1002	**44722**
	6	36332	535	972	1198	456	12345	1321	**53159**
	7	35349	684	1888	1524	966	12020	1634	**54065**
	8	35851	915	997	2112	717	12476	1499	**54567**
	9	27902	536	509	930	622	10530	1054	**42083**
	10	23668	492	486	841	732	9191	1008	**36418**
	11	20865	479	404	768	626	8015	870	**32027**
	12	19584	432	433	995	703	6491	1040	**29678**
2001 Total		**319574**	**6532**	**7980**	**12999**	**7796**	**112953**	**12912**	**480746**
2002	1	20299	493	585	1054	631	7389	965	**31416**
	2	19169	531	390	876	546	6969	810	**29291**
	3	24830	567	430	1165	337	8960	913	**37202**
	4	23850	471	434	1450	417	9164	814	**36600**
	5	30380	705	633	1369	424	11590	1042	**46143**
	6	35480	989	784	957	591	13118	1361	**53280**
	7	38088	708	1249	1422	825	13318	1559	**57169**
	8	36335	656	808	1006	773	12306	1536	**53420**
	9	27807	543	617	943	607	11093	1048	**42658**
	10	27175	664	492	1041	671	8302	1058	**39403**
	11	22963	503	395	885	551	7699	1055	**34051**
	12	21321	529	470	822	686	7369	904	**32101**
2002 Total		**327697**	**7359**	**7287**	**12990**	**7059**	**117277**	**13065**	**492734**
2003	1	21392	567	435	622	576	7167	906	**31665**
	2	19213	507	384	975	638	7002	874	**29593**
	3	22410	457	407	945	473	8888	866	**34446**
	4	25390	505	551	1228	484	8571	810	**37539**
	5	27844	521	566	1122	573	10532	982	**42140**
	6	32914	1007	962	979	690	13235	1256	**51043**

Year	Month	A11	ADQ	AKN	BET	ENA	FAI	JNU	Total
	7	33963	806	1476	1506	785	11825	1369	**51730**
	8	32732	643	973	1380	700	12174	1386	**49988**
	9	28280	500	549	859	523	11163	1065	**42939**
	10	27299	672	596	1402	576	8448	1047	**40040**
	11	20940	554	539	974	626	6644	882	**31159**
	12	20936	464	446	1138	777	8028	1002	**32791**
2003 Total		**313313**	**7203**	**7884**	**13130**	**7421**	**113677**	**12445**	**475073**
2004	1	20275	472	414	692	570	6554	881	**29858**
	2	20710	490	434	1100	483	7209	854	**31280**
	3	23988	446	422	1095	579	8191	842	**35563**
	4	26136	586	412	1013	535	8782	843	**38307**
	5	29579	564	617	952	588	9994	951	**43245**
	6	36765	806	1106	769	615	13131	1188	**54380**
	7	37272	859	1385	879	730	13847	1320	**56292**
	8	36588	756	1284	1029	749	13294	1400	**55100**
	9	28947	493	698	1088	660	10422	1065	**43373**
	10	26871	554	522	1128	578	8055	963	**38671**
	11	21693	541	453	984	602	7393	843	**32509**
	12	21602	517	570	873	609	6832	781	**31784**
2004 Total		**330426**	**7084**	**8317**	**11602**	**7298**	**113704**	**11931**	**490362**
Grand Total		**1633042**	**34606**	**39692**	**62295**	**36189**	**557187**	**62418**	**2425429**

6.3 Appendix C: Participating Operator and Aircraft Tables

Table C-1 Capstone Phase 1 Operator and Aircraft List

Operator	Type	N #	Status
Alaska Central Express	C207A	N9874M	Sold
Alaska Central Express	C207A	N9957M	Complete
Alaska Island Air	PA-32-300	N9304K	Complete
Alaska Island Air	PA-32-301	N8374T	Complete
Arctic Circle Air	C208	N5187B	Complete
Arctic Circle Air	C207	N9936M	Complete
Arctic Circle Air	C207	N6480H	Complete
Arctic Circle Air	C207	N9965M	Complete
Arctic Circle Air	C207	N73467	Complete
Arctic Circle Air	C207	N7305U	Complete
Arctic Circle Air	SC-7 Skyvan	N2088Z	Complete
Arctic Circle Air	C206	N456TA	sold
Arctic Circle Air	SC-7 Skyvan	N1906	Complete
Arctic Circle Air	SC-7 Skyvan	N101WA	Complete
Arctic Circle Air	C207	N916AC	Sold
Arctic Circle Air	C207	N917AC	Complete
Arctic Circle Air	C402C	N402ET	Complete
Arctic Circle Air	C402C	N419RC	Complete
Arctic Circle Air	C402C	N4630N	Complete
Arctic Circle Air	C402C	N6790B	Complete
Arctic Transportation Services	Casa212	N424CA	Complete
Arctic Transportation Services	Casa212	N437CA	Complete
Arctic Transportation Services	C207	N73217	Complete
Arctic Transportation Services	C207	N9475M	Complete
Arctic Transportation Services	C207	N26TA	Complete
Arctic Transportation Services	C207	N7605U	Complete
Arctic Transportation Services	Casa212	N287MA	Complete
Arctic Transportation Services	C207	N9829M	Complete
Arctic Transportation Services	C207	N73503	Complete
Arctic Transportation Services	C207	N9736M	Complete
Arctic Transportation Services	C207	N73789	Complete
Arctic Transportation Services	C402	N2719A	Complete
AvAlaska	C172	N813SP	INACTIVE
Baum Air	PA-18	N6996D	INACTIVE
BellAir	PA32-300	N4130R	Complete
BellAir	C-180	N2353C	Complete
BellAir	BE C45H	N401CK	inactive
BellAir	BE-D18S	N502CK	Complete
BellAir	PA-31-350	N31PR	Complete
BellAir	PA-32-300	N107TA	Complete
BRANDON LEARY	C-170B	N8325A	Complete

Operator	Type	N #	Status
Bristol Bay Air	C207A	N9943M	Complete
Cape Smythe Air	PA-31-350	N3516A	Complete
Carl McIntyre Jr.	C172	N19771	Complete
Civil Air Patrol	C182	N9803H	Complete
Civil Air Patrol	C182	N9484X	Complete
Craig Air	C172	N20109	Complete
Craig Air	C207	N91170	Complete
Craig Air	C182	N6736M	Complete
Craig Air	C207	N91190	Complete
Craig Air	C207	N90193	Complete
Craig Air	C185	N1598H	Complete
Cub Drivers	C185	N2658S	Complete
ERA Aviation	DHC-6	N203EH	Complete
ERA Aviation	DHC-6	N201EH	Complete
ERA Aviation	DHC-6	N302EH	Complete
ERA Aviation	DHC-6	N206EH	Complete
ERA Aviation	DHC-6	N885EA	Complete
Flight Alaska	Casa212	N203FN	Transferred
Flight Alaska	Casa212	N202FN	Transferred
Flight Alaska	C207	N7394U	Complete
Flight Alaska	C207	N7336U	Complete
Flight Alaska	C207	N1704U	Complete
Flight Alaska	C206	N756HL	INACTIVE
Flight Alaska	C207	N6470H	Complete
Flight Alaska	C207	N7384U	INACTIVE
Flight Alaska	Casa212	N205FN	Complete
Flight Alaska	Casa212	N204FN	Transferred
Flight Alaska	C207	N775AB	Complete
Frontier Flying Service	PA-31-350	N3536B	Complete
Frontier Flying Service	C207	N1785U	Complete
Frontier Flying Service	PA-31-350	N4301C	Complete
Frontier Flying Service	PA-31-350	N4501B	Complete
Frontier Flying Service	PA-31-350	N200AK	Complete
G&L Air Service	C185	N1576H	Complete
Grant Aviaiton	C207	N54GV	Complete
Grant Aviation	C207	N1581U	INACTIVE
Grant Aviation	C207	N9651M	Complete
Grant Aviation	C172	N12721	Complete
Grant Aviation	C207	N91090	INACTIVE
Grant Aviation	C207	N8NZ	Complete
Grant Aviation	C207	N562CT	INACTIVE
Grant Aviation	PA-31-350	N77HV	Complete
Grant Aviation	C172	N4265Q	Complete
Grant Aviation	C208B	N454SF	Complete
Grant Aviation	C208	N1276P	INACTIVE
Grant Aviation	C207	N9973M	Complete

Operator	Type	N #	Status
Grant Aviation	PA-31-350	N4105D	Complete
Grant Aviation	C207	N48CF	Complete
Grant Aviation	PA-31-350	N78GA	Complete
Grant Aviation	C207	N207EX	Complete
Grant Aviation	C207	N207DF	Complete
Grant Aviation	C207	N2162C	Complete
Grant Aviation	C207	N9728M	Complete
Grant Aviation	C208	N1229C	Complete
Grant Aviation	C207	N207VA	Complete
Grant Aviation	PA-31-350	N417PM	Complete
Grant Aviation	BE65A901	N70841	Complete
Guardian Flight	PA32	N8698N	Complete
Hageland	C207	N7389U	Complete
Hageland	C207	N1668U	Complete
Hageland	C207	N7320U	Complete
Hageland	C207	N6314H	Complete
Hageland Aviation	C402	N402QA	Complete
Hageland Aviation	C208	N410GV	Complete
Hageland Aviation	C207	N747SQ	Complete
Hageland Aviation	C207	N6207H	Complete
Hageland Aviation	C208	N1232Y	Complete
Hageland Aviation	C208	N411GV	Complete
Hageland Aviation	C207	N9869M	Complete
Hageland Aviation	C207	N23CF	Complete
Hageland Aviation	C208	N303GV	Complete
Hageland Aviation	C207	N7373U	Complete
Hageland Aviation	C207	N327CT	Complete
Hageland Aviation	C207	N17GN	Complete
Hageland Aviation	C207	N7340U	Complete
Hageland Aviation	C207	N5277J	Complete
Hageland Aviation	C207	N6439H	sold
Hageland Aviation	C207	N73067	Complete
Hageland Aviation	C207	N207SE	INACTIVE
Hageland Aviation	C207	N104K	Complete
Hageland Aviation	C208	N407GV	Complete
Hageland Aviation	C207	N9400M	Complete
Hageland Aviation	C208	N715HE	Complete
Hageland Aviation	C172	N7564G	Complete
Hageland Aviation	F406	N6591L	INACTIVE
Hageland Aviation	F406	N6591R	Complete
Hageland Aviation	C207	N9399M	Complete
Hageland Aviation	F406	N406GV	Complete
Hageland Aviation	F406	N6590Y	Complete
Hageland Aviation	C-180	N91361	Complete
Hageland Aviation	C208B	N717PA	Complete
Hageland Aviation	208B	N1275N	Complete

Operator	Type	N #	Status
Hageland Aviation	C207	N7384U	Complete
Husky Aviation	A-1B	N711HY	Complete
Inland Aviation	C207	N91099	Complete
Inland Aviation	C207	N91002	Complete
Inland Aviation	C207	N1754U	Complete
Inland Aviation	C207	N1701U	Complete
Inland Aviation	C172	N1453V	Complete
Inland Aviation	C172	N73788	Complete
Inland Aviation	C207	N1673U	Complete
JAMES CHARLES	C172N	N7348E	Complete
Johnson Services	PA-31-350	N4466T	Sold
Johnson Services, LLC	C207	N73036	Complete
Larry's Flying Service	C207	N1824Q	Complete
Larry's Flying Service	C207	N9996M	Complete
Larry's Flying Service	PA-32-300	N31657	Complete
Larry's Flying Service	PA-32-300	N27501	Complete
Larry's Flying Service	PA-32-301	N9243K	Complete
Larry's Flying Service	C172	N739PD	Complete
LJ DAVIS	C-180G	N180YP	Complete
M.A.R.C.	PA-31-310	N16SC	Complete
M.A.R.C.	PA-31-310	N62MR	Complete
M.A.R.C.	PA-31-310	N65MR	Complete
MIKE HOFFMAN	C-185F	N53032	Complete
MIKE REARDON	C-180H	N2722X	Complete
MYRON ANGSTMAN	C172K	N758TG	Complete
Neitz Aviation	C185	N4710Q	Complete
Nelson Air	PA-31-350	N888YA	Complete
North Star Aviation	PA18	N8976D	Complete
Northern Air Cargo	DC-6	N1377K	Complete
Northern Air Cargo	DC-6	N779TA	Complete
Northern Air Cargo	DC-6	N43872	Complete
Northern Air Cargo	DC-6	N2907F	Complete
Northern Air Cargo	DC-6	N867TA	INACTIVE
Northern Air Cargo	DC-6	N99330	Complete
Paklook Air	PA-31-350	N509FN	Complete
PAUL O'BRIEN	C206	N9123M	Complete
Peninsual Airways	C208B	N444FA	Complete
Peninsula Airways	PA32	N8259V	Complete
Peninsula Airways	PA31	N27987	Sold
Peninsula Airways	C208	N9530F	INACTIVE
Peninsula Airways	PA32	N82455	Complete
Peninsula Airways	C208B	N750PA	Complete
Peninsula Airways	PA-31-350	N28KE	Complete
Peninsula Airways	C208B	N9820F	Complete
Peninsula Airways	C208B	N9304F	Complete
Peninsula Airways	PA-31-350	N15PR	Complete

Operator	Type	N #	Status
Peninsula Airways	C208	N9481F	Complete
Poe Air	PA-32-300	N43551	Complete
Poe Air	PA32	N4811T	Complete
Ptarmigan Air	DHC-2	N734Q	Complete
Shannons Air Taxi	C207	N1549U	Complete
Smokey Bay Air	C206	N7353Q	Complete
SONNY HOFFMAN	C185F	N4870C	Complete
Talkeetna Air Taxi	DHC-2	N144Q	Complete
Tanana Air Service	PA32	N4798S	Complete
Tanana Air Service	PA32	N4803S	Complete
Tanana Air Service	PA32	N97CR	Complete
Tanana Air Service	PA32	N7748J	Complete
Tanana Air Service	PA31-350	N316HA	Complete
Tanana Air Service	PA32-300	N31606	Complete
Tanana Air Service	PA32	N8506F	Complete
Tom Lapp	C172	N79169	Complete
University of Alaska	C180	N4UA	Complete
US Fish & Wildlife	C185	N9344N	Complete
US Fish & Wildlife	C206	N740	Complete
US Fish & Wildlife	C185	N1055F	Complete
Village Aviation	Casa212	N393DF	Complete
Villiage Aviation	Casa212	N316ST	Complete
Wade Renfro	PA18	N7513K	Complete
Yukon Aviation	C185	N29970	Complete
Yukon Aviation	C207	N91060	Complete
Yukon Aviation	C207	N7318U	Complete
Yukon Aviation	C172	N5246D	Complete
Yukon Aviation	C172	N4810G	Complete
Yukon Aviation	Bell 206B3	N150HH	Complete

6.4 Appendix D: The Impact of Capstone on Air Traffic Control

To assess the impact of Phase 1 Capstone on air traffic control, we focused on the controllers at the Anchorage Center and the Bethel Tower. The controllers at the tower were interviewed on 6 December 2004. The controllers at the Anchorage Center were interviewed during the week of 28 February 2005. Subsequent to the center interviews, another data collection effort was made during the week of 20 June 2005.

Bethel Tower

The Bethel Tower is a contract tower handling on the order of 100,000 operations annually. Six controllers were interviewed for their opinions of Capstone. The interviews were informal and asked the controllers what was positive and what was negative about the Capstone equipment. Other demographic information was also obtained. Table D-1 presents the information gained from the controllers.

Anchorage Center

At the Anchorage Center there have been approximately 50 controllers who have been exposed to ADS-B in the Bethel area. Of those, 30 controllers currently work in that sector. Of the 30, five controllers were on leave the week the questionnaire was administered. Of the remaining 25, 14 filled out the questionnaire. There were 3 controllers that filled out the questionnaire who do not currently work the sector. We also heard from a few others that, even though they did not fill out a questionnaire, had opinions about Capstone. The questionnaire is shown in Table D-2. The results are shown in Table D-3.

There was a consensus that the ADS-B technology was good. The ADS-B returns were accurate, the acquisition of the track was quick, and the technology provided target information where none was previously available with radar. Although the question about being pleased with the implementation of ADS-B in the Anchorage Center drew a range of responses, the controllers who were most familiar with the Capstone program were generally less pleased with the implementation. Those controllers, in discussions after the questionnaire was filled out, expressed the feeling that providing ADS-B to the controllers was an afterthought. As examples of this they referenced certain interactions between the ADS-B messages and the Micro EARTS radar processing system that caused them problems. In general, these controllers characterized the introduction of this technology as being less smooth than the introduction of other technologies at this center. In fact, several controllers indicated that the Capstone program office took too long in recognizing the short comings of the implementation at the center.

It is ironic that as upgrades to the avionics, the ground based transceivers (GBTs), and the Micro EARTS code were being made in the spring of 2005, controllers lost their ability to see these ADS-B targets. In effect, upgrading the system temporarily reduced ATC service to those in the Bethel area. The reason for this is that there were schedule slips between commissioning of the new GBTs and the installation of the new avionics.

Table D-1 Bethel Tower Controller Interviews

	Controller 1	Controller 2	Controller 3	Controller 4	Controller 5	Controller 6
Time at facility	3 mo	4.5 yrs	2 yrs	2 yrs	4 yrs	5 mo
Capstone Familiarity	Yes	Yes	Yes	Yes	Yes	Yes
Cockpit Experience	Not pilot, no experience in cockpit	Not pilot, not much experience in cockpit	Pilot for 10 years	Not pilot, some experience in cockpit	Not pilot, significant experience in cockpit	Not pilot, some experience in cockpit
Positive	• Increase in situational awareness for controllers. Horizon is so flat, easier to depict traffic over the horizon because they know where to look • Makes it a little easier to call traffic for pilots. Although the display is not certified, it allows them a better understanding of where the aircraft are out the window if they can be seen on the display.	• Overall opinions given by pilots in the area have been good. • With Capstone equipped aircraft you don't automatically have to call all traffic in the area. You can wait to see if they will really be a factor before reporting. • Helps with sequencing. You can tell who is 1st, 2nd and 3rd. If not, you can look out the window and see aircraft right where the display depicts they should be.	• The displays that the pilots have in the cockpit provide the call-signs of the aircraft which helps pilots get a better picture of what is going on by listening to the radio transmissions. • Pilots are able to help themselves by adjusting speed and turns to fit the pattern and instructions given by controllers to fit into the pattern. • Capstone helps to differentiate between aircraft when several call at the same time from one area. • In order for there to be great benefit, most of the aircraft in the pattern, or being worked need to be Capstone equipped. That way they see each other.	• The only way Capstone is a real benefit is if there are at least some equipped aircraft being worked at the same time. That way they can see each other. • Capstone increases the possibility of pilots seeing each other. If they don't see the traffic, at least they know exactly where it is. • Allows pilots to self-adjust to suit the traffic pattern and flow. • If an aircraft is not Capstone equipped, it may take longer to get them adjusted to fit the pattern/flow. • Capstone is a lot more reliable than radar-no coasting.	• Noticed a significant change when Capstone was implemented. All of a sudden the pilots could actually 'see' each other. The traffic calls made sense b/c the traffic was being displayed in the cockpit. • The majority of aircraft being worked need to have Capstone in order for it to be really advantageous. • Helps with controller's situational awareness which in turn can help planning ahead.	• Capstone provides a bigger picture. • You can see problems developing before they happen and are able to adjust for those issues. • Can adjust the pattern and workload. • If pilots can see each other, although traffic calls are still needed, it doesn't take as much time and phraseology to have pilots understand the traffic around them. • You are able to turn more of your attention to non-Capstone equipped aircraft who might not have a good understanding of where they are in the pattern.

Table D-1 Bethel Tower Controller Interviews (Concluded)

	Controller 1	Controller 2	Controller 3	Controller 4	Controller 5	Controller 6
Negative	• Cannot give radar traffic calls because it is not certified. • No call-signs on the display. Only codes. • For those who do not have Capstone, it is harder to get pilots to understand where they are in relation to other aircraft as well as in relation to the airport.	• Call-signs should be depicted instead of codes. Of course you eventually get familiar with the codes and who they correspond to but when there is a large number of aircraft flying in one area it doesn't help to have the codes.	• Call-signs are not displayed in the Cab. • Pilots complain of too many traffic calls. Traffic calls are very general b/c the display is not certified. • It is very possible that the pilot is well aware of the traffic b/c it is being displayed in the cockpit but controllers need to give traffic anyway.	• In one instance the entire Capstone display in the cockpit was ¼ mile off. • In another instance the leader line for one aircraft was ½ mile from another aircraft. • Solar flares are the only real interference problem that could be resolved. • Pilots can't stand the traffic calls for them even if the aircraft clearly won't be a factor. • Can't give altitude in traffic calls b/c the display is not certified.	• Call-signs are not displayed in the Cab.	• Non-Capstone equipped aircraft are more likely to enter the pattern in the wrong place as well as miss reporting points and are not seen on the display or by other aircraft. To combat this, controllers give non-equipped aircraft reporting points a little further out. • Can't give traffic calls with altitude because display is not certified.
Overall Opinion	• Capstone does not impede on anything. Some days it helps greatly, other days you don't notice it because it is so reliable. It's the days that it doesn't work that you notice how much you use it.	• Capstone can only help. It isn't much different from using radar although it seems to be more reliable. • Has seen marked improvement since installment in 2000.	• Capstone is another set of eyes not only looking from pilot to pilot but from tower to aircraft. • Capstone helps identify aircraft calling. • It does not impede operations, it can only help.	• Capstone is a great help. • It is the greatest help to the pilots who are flying, but also helps controllers have a better understanding of the position of aircraft in the airspace.	• Capstone provides an extra set of data that can help controllers and pilots handle situations better. • The more information you have the better off you are.	• Capstone helps the situational awareness overall both with pilots and controllers. It would be a more significant help if the display was certified.

Table D-2 Anchorage Center Capstone Questionnaire

ANCHORAGE CENTER CAPSTONE QUESTIONNAIRE

Thank you for agreeing to complete this survey! The purpose of gathering this information is to evaluate the effectiveness of the FAA's Capstone Program in improving safety in the Y-K Delta area. Results will be published only in aggregate form; your individual answers will be kept confidential, and not released in any way that could be identified as yours.

BACKGROUND

~ Years as controller ___________

~ Years as controller at the Anchorage Center __________

~ When did you start/stop working the ADS-B sector? ________________________

~ Percentage of time working the ADS-B sector? ___________

~ Average number of ADS-B aircraft active in sector? __________

ATC OPS

What is the impact of Capstone on your relationship with Bethel tower? (circle one)

1	2	3	4	5
(Very negative)		(Same)		(Very positive)

What is the impact of Capstone on SVFR operations in the Bethel area? (circle one)

1	2	3	4	5
(Very negative)		(Same)		(Very positive)

Has Bethel tower ever questioned your use of the surface area since the implementation of Capstone technology in the tower? (circle one)

1	2	3	4	5
(Never)		(Sometimes)		(Always)

Has Bethel tower ever questioned your release of an aircraft since the implementation of Capstone technology or procedures? (circle one)

1	2	3	4	5
(Never)		(Sometimes)		(Always)

Table D-2 Anchorage Center Capstone Questionnaire (Continued)

Has Bethel tower ever questioned your holding of an aircraft on the ground (i.e. not releasing an aircraft) for departure since the implementation of Capstone technology and procedures? (circle one)

1	2	3	4	5
(Never)		(Sometimes)		(Always)

How often do you hold IFR aircraft for SVFR operations in the Bethel area? (circle one)

1	2	3	4	5
(Never)		(Sometimes)		(Always)

Has the amount of time you hold IFR traffic for SVFR traffic changed since the implementation of Capstone equipment? (circle one)

1	2	3	4	5
(Decreased)		(Unchanged)		(Increased)

How frequently do you interrupt SVFR operations (stop Bethel tower from using the surface area) for an IFR arrival or departure? (circle one)

1	2	3	4	5
(Never)		(Sometimes)		(Always)

Has the number of interrupted SVFR operations changed since the implementation of Capstone technology and procedures? (circle one)

1	2	3	4	5
(Decreased)		(Unchanged)		(Increased)

PILOTS

What is the impact on your interactions with pilots after the introduction of Capstone? (circle one)

1	2	3	4	5
(Very negative)		(Same)		(Very positive)

Have your interactions with pilot changed with the implementation of Capstone? (circle one)

Yes No

What is the impact of pilot use of Capstone-based flight deck equipment? (circle one)

1	2	3	4	5
(Very negative)		(Same)		(Very positive)

Table D-2 Anchorage Center Capstone Questionnaire (Continued)

Do you feel pilots are informed about other traffic since the implementation of the Capstone equipment? (circle one) 1 2 3 4 5 (Less informed) (Unchanged) (More informed)
Do you feel pilots are informed about the weather when they contact you since the implementation of the Capstone equipment? (circle one) 1 2 3 4 5 (Less informed) (No change) (More informed)
Has the Capstone equipment changed the pilots' ability to separate themselves? (circle one) 1 2 3 4 5 (Decreased ability) (Unchanged) (Increased ability)
Has the implementation of Capstone equipment changed the amount of time that you spend on separation services when the weather is poor? (circle one) 1 2 3 4 5 (Decreased) (No change) (Increased)
Have you noticed a change in the number of IFR airfiles ("pop-up's") since the implementation of Capstone equipment? (circle one) 1 2 3 4 5 (Decreased) (No change) (Increased)
Have you noticed a change in the amount of SVFR since the implementation of Capstone technology? (circle one) 1 2 3 4 5 (Decreased) (No change) (Increased)
Have you noticed a change in the number of IFR flight plans being filed since the implementation of Capstone technology? (circle one) 1 2 3 4 5 (Decreased) (No change) (Increased)
Different phraseology is necessary for complete clarity when communicating with pilots using ADS-B equipment (e.g., radar contact, radar service terminated). (circle one) 1 2 3 4 5 (Strongly disagree) (Neutral) (Strongly agree)

Table D-2 Anchorage Center Capstone Questionnaire (Continued)

Have pilots asked you for vectors for final at Bethel? (circle one)

Yes No

Do you feel the pilots understand why you are unable to provide vectors for final at Bethel? (circle one)

Yes No

Are pilots asking for deviations for traffic or weather, or are they just adjusting for traffic and avoiding weather on their own?

1	2	3	4	5
(Asking)		(Don't know)		(Adjusting on own)

TECHNOLOGY ISSUES

It is better to see the aircraft on your scope regardless of the technology or system being used in the aircraft? (circle one)

1	2	3	4	5
(Strongly disagree)		(Neutral)		(Strongly agree)

The targets associated with ADS-B are an improvement over targets associated with radar. (circle one)

1	2	3	4	5
(Strongly disagree)		(Neutral)		(Strongly agree)

Do you think it is important that the update rate is similar to that which the radar uses? (circle one)

Yes No

Do you think the ADS-B targets are more accurate than radar targets? (circle one)

Yes No

What has been your level of involvement in the Capstone project as a user of the technology? (circle one)

1	2	3	4	5
(Low)		(Medium)		(High)

Table D-2 Anchorage Center Capstone Questionnaire (Concluded)

If you had a choice, would you prefer to use ADS-B or radar to separate aircraft? (circle one)

ADS-B Radar

Do you feel that the ATC needs were considered in developing the Capstone technology, or only the needs of the pilots?

1	2	3	4	5
(Pilots only)		(Both)		(ATC only)

OVERALL

The overall safety of my operation after the implementation of Capstone is…

1	2	3	4	5
(Greatly reduced)		(Same)		(Greatly increased)

The overall efficiency of my operation after the implementation of Capstone is…

1	2	3	4	5
(Greatly reduced)		(Same)		(Greatly increased)

I am pleased with the implementation of ADS-B on MEARTS at Anchorage Center.

1	2	3	4	5
(Strongly disagree)		(Neutral)		(Strongly agree)

What I like best about the Capstone capability

What I would improve in the Capstone capability

Table D-3 Results of Anchorage Center Controller Questionnaire

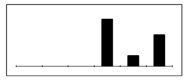
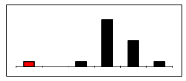
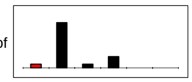
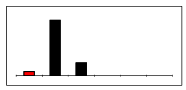
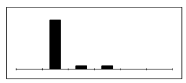
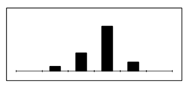
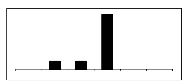
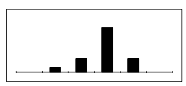
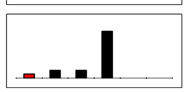
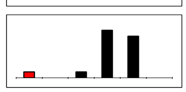
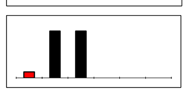
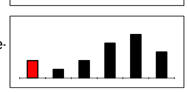
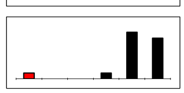
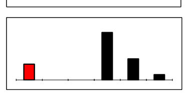
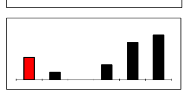
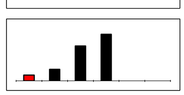
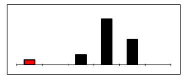
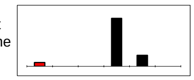
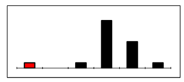
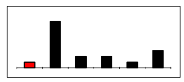
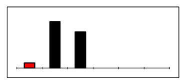
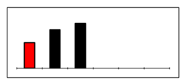
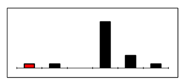
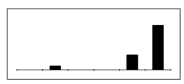
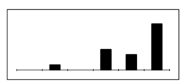
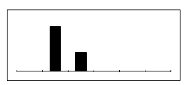
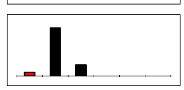
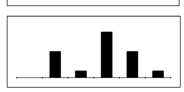
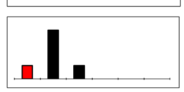
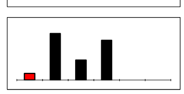
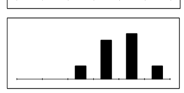
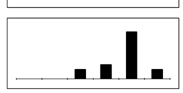
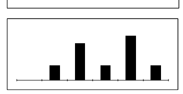
	NR Neg 1 Pos 5	Mode	Mean	StdDev	Min	Max
1. What is the impact of Capstone on your relationship with Bethel tower?		3	3.8	0.95	3	5
2. What is the impact of Capstone on SVFR operations in the Bethel area?		3	3.4	0.72	2	5
3. Has Bethel tower ever questioned your use of the surface area since the implementation of Capstone technology in the tower?		1	1.4	0.81	1	3
4. Has Bethel tower ever questioned your release of an aircraft since the implementation of Capstone technology or procedures?		1	1.2	0.40	1	2
5. Has Bethel tower ever questioned your holding of an aircraft on the ground (i.e. not releasing an aircraft) for departure since the implementation of Capstone technology and procedures?		1	1.2	0.53	1	3
6. How often do you hold IFR aircraft for SVFR operations in the Bethel area?		3	2.8	0.75	1	4
7. Has the amount of time you hold IFR traffic for SVFR traffic changed since the implementation of Capstone equipment?		3	2.6	0.70	1	3
8. How frequently do you interrupt SVFR operations (stop Bethel tower from using the surface area) for an IFR arrival or departure?		3	2.9	0.78	1	4
9. Has the number of interrupted SVFR operations changed since the implementation of Capstone technology and procedures?		3	2.6	0.72	1	3
10. What is the impact on your interactions with pilots after the introduction of Capstone?		3	3.4	0.62	2	4
11. Have your interactions with pilot changed with the implementation of Capstone?		2	1.5	0.52	1	2
12. What is the impact of pilot use of Capstone-based flight deck equipment?		4	3.5	1.19	1	5
13. Do you feel pilots are informed about other traffic since the implementation of the Capstone equipment?		4	4.4	0.62	3	5
14. Do you feel pilots are informed about the weather when they contact you since the implementation of the Capstone equipment?		3	3.4	0.65	3	5
15. Has the Capstone equipment changed the pilots' ability to separate themselves?		5	4.1	1.14	1	5
16. Has the implementation of Capstone equipment changed the amount of time that you spend on separation services when the weather is poor?		3	2.4	0.72	1	3

Table D-3 Results of Anchorage Center Controller Questionnaire (Concluded)

Question	NR Neg 1 — Pos 5	Mode	Mean	StdDev	Min	Max
17. Have you noticed a change in the number of IFR airfiles ("pop-up's") since the implementation of Capstone equipment?		3	3.2	0.66	2	4
18. Have you noticed a change in the amount of SVFR since the implementation of Capstone technology?		3	3.2	0.40	3	4
19. Have you noticed a change in the number of IFR flight plans being filed since the implementation of Capstone technology?		3	3.4	0.72	2	5
20. Different phraseology is necessary for complete clarity when communicating with pilots using ADS-B equipment (e.g., radar contact, radar service terminated).		1	2.3	1.62	1	5
21. Have pilots asked you for vectors for final at Bethel?		1	1.4	0.51	1	2
22. Do you feel the pilots understand why you are unable to provide vectors for final at Bethel?		2	1.5	0.52	1	2
23. Are pilots asking for deviations for traffic or weather, or are they just adjusting for traffic and avoiding weather on their own?		3	3.2	0.83	1	5
24. It is better to see the aircraft on your scope regardless of the technology or system being used in the aircraft?		5	4.5	1.01	1	5
25. The targets associated with ADS-B are an improvement over targets associated with radar.		5	4.1	1.17	1	5
26. Do you think it is important that the update rate is similar to that which the radar uses?		1	1.3	0.47	1	2
27. Do you think the ADS-B targets are more accurate than radar targets?		1	1.2	0.40	1	2
28. What has been your level of involvement in the Capstone project as a user of the technology?		3	2.8	1.24	1	5
29. If you had a choice, would you prefer to use ADS-B or radar to separate aircraft?		1	1.2	0.43	1	2
30. Do you feel that the ATC needs were considered in developing the Capstone technology, or only the needs of the pilots?		1	1.9	0.93	1	3
31. The overall safety of my operation after the implementation of Capstone is		4	3.5	0.87	2	5
32. The overall efficiency of my operation after the implementation of Capstone is…		4	3.7	0.85	2	5
33. I am pleased with the implementation of ADS-B on MEARTS at Anchorage Center.		4	3.1	1.30	1	5

From the responses to the questionnaire it was noted that the controllers felt that the overall efficiency of the operations was improved by Capstone (question 32). Furthermore, the controllers thought that Capstone decreased the amount of that the controller spends on separation services when the weather is poor (question 16). Upon further questioning of the controllers it was learned that without surveillance arriving aircraft need to be stepped down in altitude. If there is surveillance, that is not necessary. Every time that a stepped down is required, it means that the controller has to communicate with the pilot. Reducing the communications workload is one of the primary factors in improving the efficiency of the operations.

To assess how large an impact this might be, an analysis of flight progress strips was conducted during the week of 20 June 2005 at the Anchorage Center. Flight progress strips covered the period from 10 May 2005 through 6 June 2005 were collected. However, several days of flight strips were missing within this period.

Since all of the flight strips from the center were saved, the first action was to select out those that were from sectors that controlled ADS-B targets. Those sectors were 13, 3 and 9. Sectors 3 and 13 are in the North area (and are sometimes combined) and sector 9 is in the South area. These sectors are shown in Figure D-1

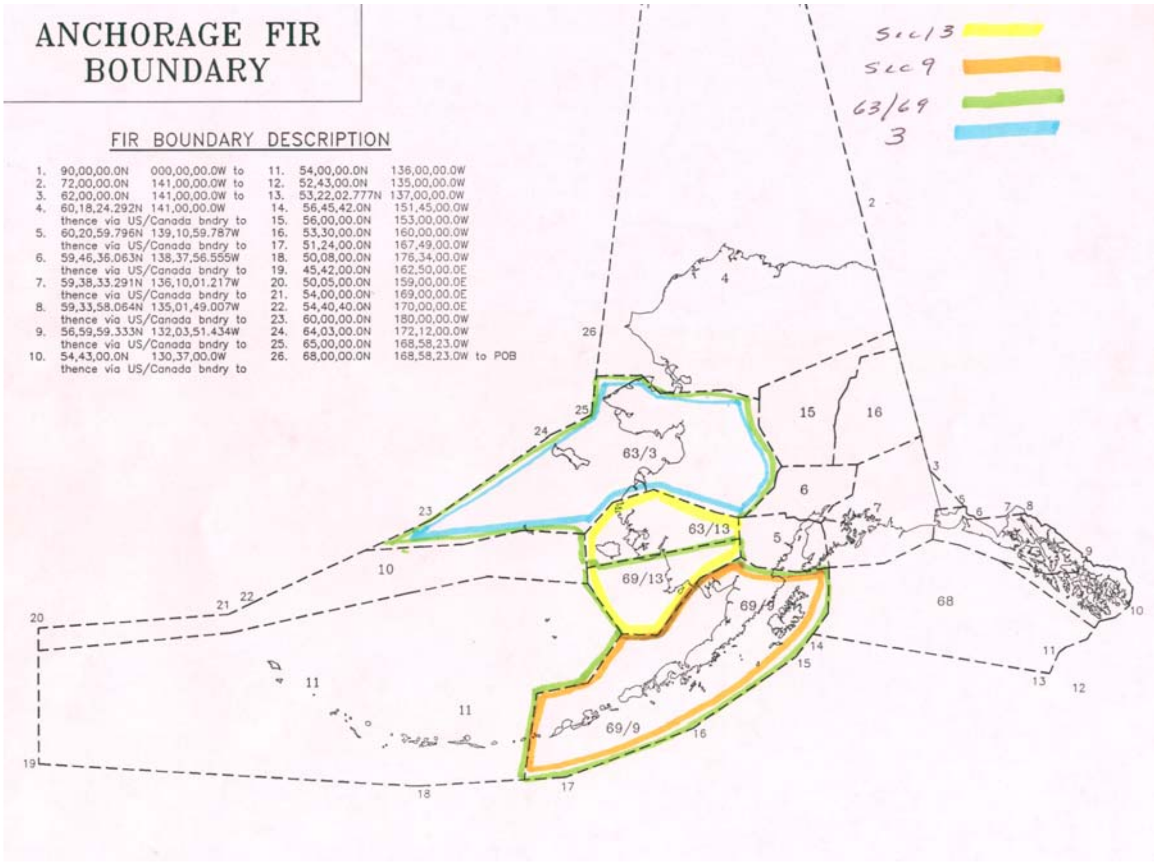


Figure D-1 Anchorage Center Sectors

Since we were interested in conditions that represented poor weather, we consulted the local meteorologist to find out the days with IMC conditions (i.e., less than 1000 foot ceiling or less than 3 miles visibility). Those time periods for Bethel are shown in Table B-4.

Table D-4 IMC Conditions at Bethel

Airport	Date	Time Period (Local)
BET	5/15/05	0600-0900
	5/16/05	0300-1400
	5/17/05	0100-1400
	5/18/05	0330-1300
	5/19/05	0500-1100
	5/20/05	0500-1300
	5/21/05	0030-1400
	5/23/05	0400-1300
	6/5/05	0500-0630

We selected the flight progress strips from Sector 13 on 16 May.

At this point we enlisted the help of a few center controllers who have worked Sector 13 to interpret the flight strips with us. The controllers told us that not withstanding the upgrades to the avionics, the ground based transceivers, and the micro EARTS, the system was still not working properly. They told us the reason was that now the pilot had to input his assigned beacon code not only into his transponder but also into his DLG-90 (the ADS-B avionics). The controllers said that the pilots, in general, were not entering the beacon code into there ADS-B avionics, thus causing them to look like VFR flights. When the aircraft ascends into radar coverage, self induced conflict alerts happen. Therefore, the controller has to realize this is what is happening and walk the pilot through the fix in order to process the flight as an IFR flight. It was either that or treat the aircraft as an unequipped IFR aircraft. This meant that a direct comparison of the flight progress strips from ADS-B equipped aircraft with those from aircraft that were not equipped would be unlikely in the May timeframe.

From the flight progress strips from 16 May, eight were chosen that represent about an hour's worth of traffic at Bethel that the center controlled. These flight strips are shown in Figure B-2. It was then assumed that none of these aircraft were equipped, or at least their pilots were not properly inputting the 4096 code, although four of the aircraft were known to be equipped and upgraded. Next, the controllers were asked them to estimate the number of transmissions the controller would have made to the aircraft as shown by the markings on the strips. Then, the controllers were asked to estimate the number of transmissions that would have been made to the ADS-B equipped aircraft had they been properly using their equipment. These estimates took into account a number of factors, including how many aircraft were vying for services at the same time. Finally, the controllers were asked to estimate the number of controller transmissions would have been given if all of the aircraft had been equipped with ADS-B. The Table D-5 shows the results.

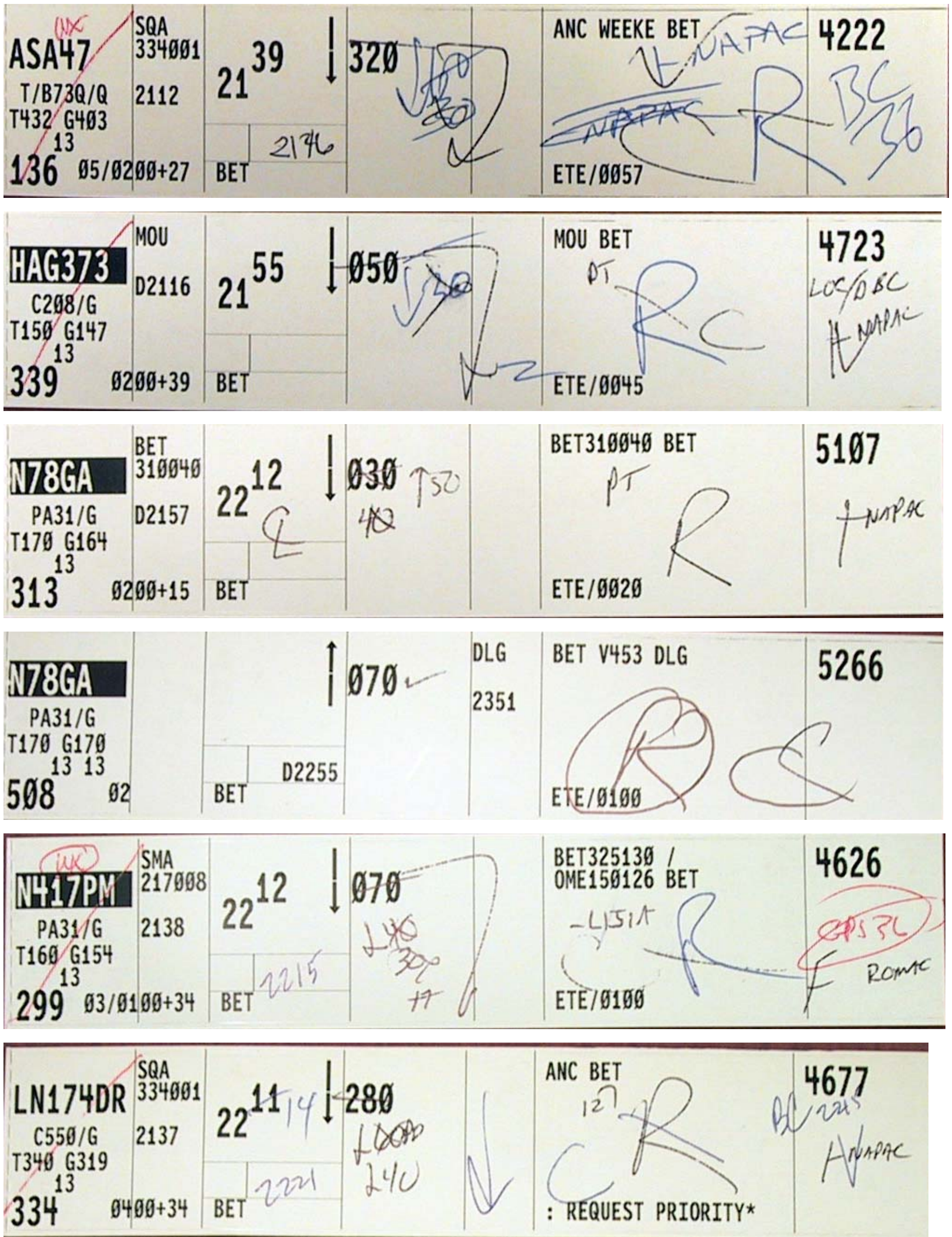


Figure D-2 Flight Strips Chosen for Analysis

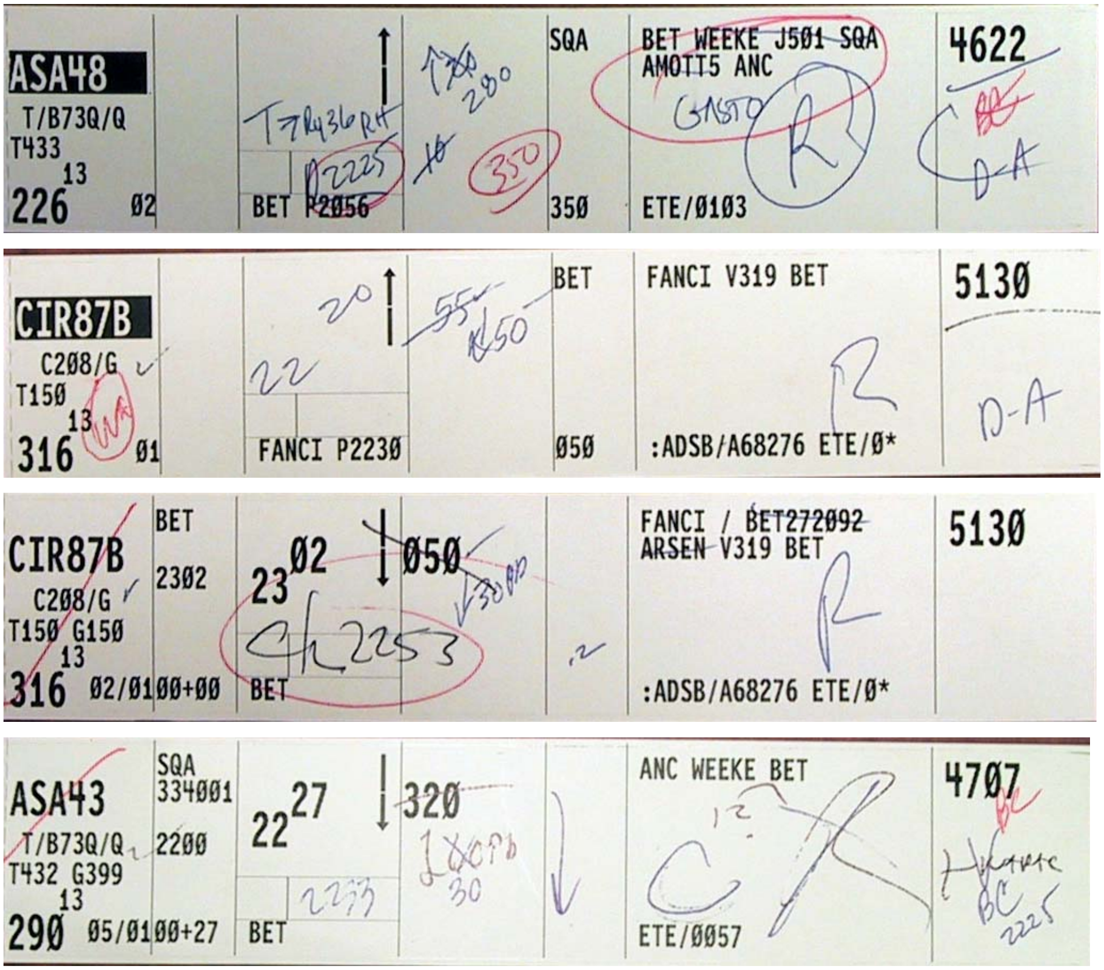


Figure D-2 Flight Strips Chosen for Analysis (Concluded)

Table D-5 Results of the Communications Analysis

Flight	ADS-B Equipped	Comm Change	Number of Transmissions	Transmissions of Equipped AC	Transmissions of All AC Equipped
ASA47		1	4	4	2
HAG373	✓	1	3	2	2
N78GA	✓	1	3	2	2
N417PM	✓		5	2	2
LN174DR		1	3	3	2
ASA48		1	3	3	2
CIR87B	✓		3	2	2
ASA43		1	4	4	2
Total		6	28	22	16
Total with comm. Changes			34	28	25*

* 3 transmissions were added to be conservative

These flight progress strips showed that 34 controller transmissions took place with these aircraft. For each controller transmission there would be a responding pilot transmission. If only the equipped aircraft were assumed to receive less communications because of the ADS-B equipment, then the transmissions would decrease to 28. This would be an 18% decrease in the communications workload. If all of the aircraft were assumed to be ADS-B equipped, then the transmissions would decrease to 25. This represents a 26% decrease in the communications workload.

If the flight strip examined showed 34 transmissions, then if the transmissions decrease to 28 considering the equipped aircraft this is an 18% decrease in the communications workload. If the transmissions decrease to 25 then this represents a 26% decrease in the communications workload.

6.5 Appendix E: Airline Surveys

E.1 Pilot Responses

E-1.1 Introduction

This survey was part of a larger effort to collect information about qualifications, practices and attitudes of pilots, aviation operators, business leaders, city officials and village leaders in the Y-K Delta region towards the installation and operation of Capstone equipment on the ground and in the cockpit.

The survey population is relatively small and homogenous. For example, pilots generally fly for airlines of similar size and equipage and within the same geographic area and face the same weather, terrain, and other challenges. Given the small size and homogeneity of the population, surveyors did not use random sampling techniques. Instead surveyors traveled several times to Bethel, the transportation and economic hub of the region, to interview as many subjects as possible. Initially, some subjects were asked to complete a questionnaire and return it when convenient, but the response rate was very low. As a result, the vast majority of questionnaires were completed during one-on-one interviews.

The initial set of surveys was administered by the Institute of Social and Economic Research (ISER) of the University of Alaska Anchorage. The development of the questions and the methodology is described in their 2001 report.[8] Follow-up surveys were made in 2003 and 2004 to gauge any change in the knowledge or acceptance of the Capstone equipment. These follow-up surveys were administered by Aviation Technology Division of the Community and Technical College of the University of Alaska Anchorage.

The following sections report the detailed responses to the initial survey (Section E-1.2) and the two follow-up surveys (Section E-1.3).

[8] Capstone Phase 1 Interim Safety Study 2000/2001, Institute of Social and Economic Research, University of Alaska Anchorage, December 2002. http://www.alaska.faa.gov/capstone/docs/2001%20UAA%20report.pdf

E-1.2 Initial Pilot Survey Results

CP1. Have you received formal training to use the Capstone equipment?

15	No
90	Yes
1	NR

CP2. If you received **Capstone classroom training**, please tell me how many hours you received and who provided the training. If you received **classroom with Capstone simulator** training, how many hours did you receive? who provided the training? How about **flight or Capstone equipped flight simulator** training?

Type of Training	**Hours**	**Training was taught by**		
		UAA Personnel	**Someone in your company**	**Someone Else (please specify)**
a. Classroom	41 – None 15 – 4 hrs 16 – 8 hrs 9 others 1-16 hrs 12 - NR	22	25	1 – another company 2 – combination 1 - NR
b. Classroom with Capstone simulator	36 – None 20 – 8 hrs 25 others 1-24 hrs 12 - NR	32	20	1 – combination 4 -- NR
c. Flight or Capstone equipped flight simulator	40 – None 24 – 1 or 2 hrs 13 – 8 hrs 4 others .3-24 hrs 2 trainer @ 400 hrs 10 - NR	14	37	3 -- NR

CP3. How useful is the GPS Capstone equipment? Is it very useful, somewhat useful, or not useful? How useful is MFD equipment? What about radar-like services?

	Very Useful	**Somewhat Useful**	**Not Useful**
GPS	92	14	0
MFD	87	17	1
Radar-like Services	65	11	22

CP4. Which of the following functions of the Capstone avionics do you routinely use? Do you use flight planning? (CONTINUE READING LIST AND MARK ALL THAT APPLY)

53 Flight Planning
104 Navigation
88 Traffic Avoidance
80 Terrain avoidance
51 Radar-Like Services
2 None
9 Other (please specify): **_data link, FIS, WX, GPS approaches**

CP5. Which functions do you like best about Capstone avionics?

CP6. What do you dislike the most about Capstone avionics?

CP7. How often do you use the new GPS-based instrument approaches atremote airports? Do you use it daily, weekly, monthly, less than monthly, or never (IF NEVER, PROBE:) Is that because you don't fly to those airports or never use instrument approaches) (NOTE: NEW GPS-BASED APPROACHES ARE AT HOLY CROSS, KALSKAG, KIPNUK, KOLIGANEK, MOUNTAIN VILLAGE, PLATINUM, RUSSIAN MISSION, SCAMMON BAY, ST. MICHAEL)

12 Daily
31 Weekly
19 Monthly
14 Less than monthly

10 Never, we don’t fly to those airports
20 Never, we never use instrument approaches

CP8. I am going to read a list of possible benefits that you may have experienced from the Capstone program in the Bethel area. Please tell me if you have experienced **fewer cancelled flights due to new instrument approaches at remote airports** and, if so, was the benefit very small, of some benefit, significant, or a major benefit? (CONTINUE READING LIST AND MARK A BOX IN EACH ROW)

	Doesn't Apply	No Benefit	Very Small Benefit	Some Benefit	Significant Benefit	A Major Benefit
a. Fewer cancelled flights due to new instrument approaches at remote airports	18	25	22	19	13	0
b. Safer operations at remote airports due to new instrument approaches	18	18	21	24	16	0
c. Safer flying in minimum legal VFR conditions	15	1	12	41	15	15
d. Fewer near mid-air collisions	15	10	5	31	20	18
e. More useful weather information	15	7	22	31	20	4
f. Better knowledge of other aircraft and ground vehicle locations when taxiing	15	17	18	12	27	9
g. Improved SVFR procedures due to better pilot and controller knowledge of aircraft locations	15	16	1	18	33	15
h. Easier in-flight diversions or re-routes	15	4	28	30	16	5
i. Time savings from more direct flight routes	15	5	33	17	19	9
j. Improved terrain awareness for pilots	15	0	1	9	44	28
k. Improved search and rescue capabilities	15	3	27	19	17	15

CP9. If you feel there are other benefits that Capstone provides, will you please tell me about them?

CP10. You may have experienced some problems with the Capstone program in the Bethel area? Have you had less heads-up time? (IF R ANSWERS NO, MARK "NO PROBLEM" AND CONTINUE READING LIST. IF R ANSWERS YES, ASK THE FOLLOWING:) Was this a very small problem, a minor problem, a significant problem, or a major problem?

	Doesn't Apply	**No Problem**	**Very Small Problem**	**Minor Problem**	**Significant Problem**	**Major Problem**
a. Less heads-up time	16	25	19	18	20	0
b. Heavier workload in the cockpit	15	29	18	27	0	8
c. More aircraft flying in the same airspace because they are using GPS point to- point routing	15	15	30	32	4	1

CP11. If you feel there are other problems that Capstone may cause or add to, will you please tell me about them?

CP12. When you fly for <COMPANY>, how often is the aircraft Capstone equipped? Is there **always, usually, sometimes, rarely, or never** Capstone equipment installed?

43 Always **29** Usually **17** Sometimes **16** Rarely **0** Never

CP13. When your aircraft **is** Capstone-equipped, how often do you use that equipment? Always, usually, sometimes, rarely, or never?

75 Always **21** Usually **0** Sometimes **7** Rarely **0** Never

CP14. How much does the Capstone equipment help you to make go/no go decisions under the following conditions? Under low-ceiling conditions, does it help you a small amount, a great deal, or not at all? (CONTINUE READING LIST AND MARK A RESPONSE FOR EACH.)

	Doesn't Apply	Not at all	A small amount	A great deal	Don't know/no answer
a. Low ceilings	0	43	42	10	11
b. Low visibility	0	44	38	13	11
c. High winds	0	75	16	4	11
d. Icing potential	0	78	10	5	13

CP15. There might be some reasons why pilots choose not to use Capstone equipment? Would one reason be that it is too distracting? too difficult to use? (CONTINUE READING LIST AND MARK A RESPONSE IN EACH ROW.)

	Yes	No	Don't Know / No Opinion / No Answer
a. Too distracting	37	51	18
b. Too difficult to use	28	63	14
c. Don't want company watching aircraft location at all times	52	30	24
d. Don't trust equipment to provide reliable information	4	78	24
e. Concerned that equipment might break	4	77	26

CP16. If there are other reasons you believe pilots might choose not to use Capstone equipment, will you tell me about them?

The next five questions ask about potentially dangerous situations that pilots sometimes encounter. Capstone equipment might be helpful in preventing or coping with these particular problems. Therefore, we're interested in how often pilots in the Yukon Kuskokwim Delta encounter these problems. For each situation I read, think about how often in the last 12 months you've encountered it; has it been daily, weekly, monthly, less often than monthly, or never? (READ EACH QUESTION CP17 THROUGH CP21 AND RECORD RESPONSE.)

	Daily	**Weekly**	**Monthly**	**Less often than monthly**	**Never**	**Don't Know/ No Answer**
CP17. How many times during the past year have inaccurate weather forecasts caused you to encounter instrument meteorological conditions when you didn't expect to?	4	30	24	23	1	24
CP18. How many times during the past year have deteriorating ceilings or visibility made you unsure of your own position relative to the surrounding terrain?	2	14	13	27	15	35
CP19. During the past year, how many times have you unexpectedly seen other aircraft close enough to you that you felt it created a collision hazard?	0	10	20	43	4	29
CP 20. During the past year, how many times have you been cleared into SVFR when the separation between aircraft in the pattern made you uncomfortable?	0	10	14	36	10	36
CP21. During the past year, how many times might your go/no go or routing decisions have been improved if you would have had access to real time weather or Special Use Airspace status?	4	9	34	31	1	27

CP22. How do you think the Capstone program has affected flight safety in the Yukon Kuskokwim Delta? Has it made flying much less safe, somewhat less safe, had no effect on safety, made flying somewhat safer, or much safer?

0 Much less safe
8 Somewhat less safe
17 No change in flight safety
30 Somewhat safer
38 Much safer
14 No Answer

CP23. And finally, is there anything else that you would like us to know about Capstone, safety, or about flying in the Yukon Kuskokwim Delta?

Thank you for your time. All information you have provided is confidential and cannot be used for enforcement purposes.

E-1.3 Pilot Survey Results from 2003 and 2004

CPRepeat. Have you completed this survey before?

❍ No➔ ❍ Yes: When? ________________

		NR	2002	2003	2004		Total
2003	Yes		1	7			8
	No					15	15
	NR					2	2
2004	Yes	2		4	1		7
	No	1				13	14
	NR						
	Total	3	1	11	1	30	46

Demog1. Are you ❍ Male ❍ Female

Demog2. How old are you: ___________

		20-29	30-39	40-49	50-59	60-69	Total
2003	Male	6	9	4	4	2	25
	Female						
2004	Male	2	11	5	1	1	20
	Female			1			1
	Total	8	20	9	5	3	46

Demog3. Please check below all the pilot ratings that you hold:

❍ Commercial ❍ ATP
❍ Instrument ❍ Rotary Wing

Please check below all the FAR parts under which you ***routinely*** fly:

❍ Part 91 ❍ Part 121
❍ Part 135 ❍ Other (specify) _________

Information is irretrievable

FltHrTot. Please estimate your ***total*** flight time: _________hours

FltHrAk. How many hours have you flown in ***Alaska***: _________hours

2003

Hours Flown in Alaska

Total Hours Flown	≤1000	≤2000	≤3000	≤4000	≤5000	≤10000	≤20000	≤30000	Total
≤1000	0	0	0	0	0	0	0	0	0
≤2000	2	1	0	0	0	0	0	0	3
≤3000	1	1	3	0	0	0	0	0	5
≤4000	0	1	1	3	0	0	0	0	5
≤5000	0	0	0	1	2	0	0	0	3
≤10000	0	1	1	0	0	3	1	0	6
≤20000	0	0	0	0	1	0	1	0	2
≤30000	0	0	0	0	0	0	0	0	0
≤40000	0	0	1	0	0	0	0	0	1
Total	3	4	6	4	3	3	2	0	25

2004

Hours Flown in Alaska

Total Hours Flown	≤1000	≤2000	≤3000	≤4000	≤5000	≤10000	≤20000	≤30000	Total
<1000	1	0	0	0	0	0	0	0	1
<2000	2	3	0	0	0	0	0	0	5
<3000	1	1	3	0	0	0	0	0	5
<4000	0	0	0	1	0	0	0	0	1
<5000	0	0	0	0	1	0	0	0	1
<10000	0	1	0	0	0	1	0	0	2
<20000	0	0	0	1	0	0	4	0	5
<30000	0	0	0	0	0	0	0	1	1
Total	4	5	3	2	1	1	4	1	21

FltHrYr: How many hours have you flown ***in the last 12 months***? ______hours?

FltHrIFR. How many ***instrument*** hours have you flown in the last 12 months? _____

2003

Hours Flown IFR

Total Hours Flown	0	≤50	≤100	≤150	≤200	≤250	≤750	Total
≤400	1	4	1	0	0	0	0	6
≤800	1	11	1	1	0	1	1	16
≤1200	0	1	2	0	0	0	0	3
Total	2	16	4	1	0	1	1	25

2004

Hours Flown IFR

Total Hours Flown	0	≤50	≤100	≤150	≤200	≤250	Total
<400	1	2	1	0	0	0	4
<800	5	6	1	0	0	0	12
<1200	0	2	1	0	1	1	5
Total	6	10	3	0	1	1	21

FltHrCap. About how many hours have you flown ***Capstone-equipped aircraft?***

__________hours

Hours Flown in Capstone Equipped Aircraft

	≤50	≤250	≤500	≤1000	≤1500	≤2000	≤2500	≤3000	≤3500	Total
2003	2	2	4	5	4	3	2	3	0	25
2004	2	2	4	1	3	5	0	3	1	21
Total	4	4	8	6	7	8	2	6	1	46

FltHrGPS About how many hours had you flown using other GPS equipment for aerial navigation before Capstone? Hours ? ______________________________.

Hours Flown in GPS Equipped Aircraft

	0	≤100	≤500	≤1000	≤2000	≤3000	≤4000	≤5000	≤10000	≤20000	Total
2003	1	3	9	3	3	2	0	1	4	0	25
2004	2	3	2	2	6	1	1	1	2	1	21
Total	3	6	11	5	9	3	1	2	6	1	46

CP1. Have you received formal training to use the Capstone equipment? (Include all training, initial, recurrent, etc.)

❍ No➔ **Skip to Question CP3**

	2003	2004
No	24	16
Yes		4
NR	1	1
Total	25	21

❍ Yes
🡻

CP2. For each type of Capstone training, please write how many hours you received and check who provided the training.

2003

Type of Training	Hours	Training was taught by			
		UAA personnel	Someone in your company	Someone else (please specify)	NR
a. Classroom no simulator	0 16 ≤2 3 ≤10 2 ≤15 1 NR 3	2	4	2	17
b. Classroom with desktop Capstone simulator	0 2 ≤2 2 ≤10 15 NR 6	5	13	3	4
c. Flight or Capstone-equipped flight simulator (C-208)	0 16 ≤2 3 ≤10 4 NR 6	1	7	0	17

2004

Type of Training	Hours	Training was taught by			
		UAA personnel	Someone in your company	Someone else (please specify)	NR
a. Classroom no simulator	0 18 6 6 8 1 NR 1	1	2	0	18
b. Classroom with desktop Capstone simulator	0 3 <10 15 16 2 28 1	4	11	0	6
c. Flight or Capstone-equipped flight simulator (C-208)	0 15 <10 4 10 1	0	4	0	17

CP3. How useful is each feature of the Capstone equipment?

		Very useful	Somewhat useful	Not useful	NR
2003	GPS	22	2	0	1
	MFD	21	3	0	1
	ADS-B	19	4	1	1
2004	GPS	21	0	0	0
	MFD	20	1	0	0
	ADS-B	14	5	0	2

CP4rev For each of the functions of Capstone avionics listed below, please tell us how often you use that feature, how easy it is to use, and how helpful it is to you.

2003

	CP4_1. **How often** do you use this feature?		CP4_2. Compared to other avionics you use, **how easy** is this feature to use?		CP4_3. **How helpful** has this feature been to you as a pilot?	
a. Traffic Avoidance	20	Routinely	13	Easier	1	Not helpful
	2	Rarely	6	About the same	4	Somewhat helpful
	0	Never	2	Harder	18	Very Helpful
	3	NR	4	NR	2	NR
b. Terrain Avoidance	11	Routinely	13	Easier	2	Not helpful
	10	Rarely	9	About the same	2	Somewhat helpful
	0	Never	0	Harder	19	Very Helpful
	4	NR	3	NR	2	NR
c. Flight Planning	11	Routinely	7	Easier	3	Not helpful
	8	Rarely	11	About the same	11	Somewhat helpful
	0	Never	2	Harder	8	Very Helpful
	6	NR	5	NR	3	NR
d. Navigation	23	Routinely	13	Easier	0	Not helpful
	0	Rarely	7	About the same	1	Somewhat helpful
	0	Never	2	Harder	21	Very Helpful
	2	NR	3	NR	3	NR
e. Access to weather info while flying	1	Routinely	8	Easier	6	Not helpful
	14	Rarely	5	About the same	8	Somewhat helpful
	0	Never	6	Harder	5	Very Helpful
	10	NR	6	NR	6	NR
f. Access to PIREPs, airspace info etc., while flying	5	Routinely	8	Easier	5	Not helpful
	12	Rarely	8	About the same	11	Somewhat helpful
	0	Never	3	Harder	4	Very Helpful
	8	NR	6	NR	5	NR
h. GPS approaches	5	Routinely	7	Easier	4	Not helpful
	5	Rarely	6	About the same	2	Somewhat helpful
	0	Never	5	Harder	13	Very Helpful

	15 NR	7 NR	6 NR

2004

	CP4_1**. How often** do you use this feature?	CP4_2. Compared to other avionics you use, **how easy** is this feature to use?	CP4_3**. How helpful** has this feature been to you as a pilot?
a. Traffic Avoidance	20 Routinely 0 Rarely 1 Never 0 NR	14 Easier 4 About the same 0 Harder 3 NR	0 Not helpful 5 Somewhat helpful 18 Very Helpful 1 NR
b. Terrain Avoidance	14 Routinely 7 Rarely 0 Never 0 NR	11 Easier 8 About the same 0 Harder 2 NR	0 Not helpful 7 Somewhat helpful 14 Very Helpful 0 NR
c. Flight Planning	13 Routinely 6 Rarely 0 Never 2 NR	5 Easier 13 About the same 1 Harder 2 NR	2 Not helpful 9 Somewhat helpful 8 Very Helpful 2 NR
d. Navigation	19 Routinely 0 Rarely 0 Never 2 NR	13 Easier 6 About the same 0 Harder 2 NR	0 Not helpful 0 Somewhat helpful 19 Very Helpful 2 NR
e. Access to weather info while flying	6 Routinely 5 Rarely 2 Never 9 NR	4 Easier 3 About the same 3 Harder 11 NR	2 Not helpful 2 Somewhat helpful 6 Very Helpful 11 NR
f. Access to PIREPs, airspace info etc., while flying	1 Routinely 6 Rarely 2 Never 12 NR	3 Easier 4 About the same 1 Harder 13 NR	6 Not helpful 2 Somewhat helpful 1 Very Helpful 12 NR
h. GPS approaches	3 Routinely 5 Rarely 11 Never 2 NR	5 Easier 6 About the same 1 Harder 9 NR	3 Not helpful 3 Somewhat helpful 6 Very Helpful 9 NR

CP5. What functions do you like best about Capstone avionics? Why?

2003

- Ability to combine traffic & terrain avoidance on same page. Also the Direct, Direct function for runway alignment.
- ADS-B traffic. ADS-B hexadecimal code for ATC radar. I like information on other traffic around my aircraft; ADS-B in IFR environment is much easier than primary radar and saves time.
- Big MFD helps keep position of airport relative to A/C position during approaches or ops during IFR conditions. Situational awareness much greater w/Capstone than any other GPS I've used. Traffic/Terrain probably best feature on this 4-part.
- Collision avoidance. SVFR holding allows for traffic separation when holding.
- Direct to function-the 1 punch info feature for runway info, and the direct direct feature. They allow quick info access and the Dir Dir feature is very helpful in whiteout and low vis conditions.
- It is fairly intuitive--easy to use. The MX20 provides incredible situational awareness. IFR approaches nice to have for emergency use for [illeg] IFR pilots.
- MFD and traffic
- MFD w/flight plan course information. GPS approach course visual info. This unit is supplemental to aircraft-s main GPS unit and great for situational awareness and flight planning.
- MFD/GPS interaction with all of the flight info on one screen. Traffic is nice.
- Moving map display for situational awareness. Setting a direct bearing; ie bearing off VOR useful for SVFR holds. Traffic display to see who is where, what conditions are in that location.
- Moving map--good details; traffic--very accurate
- None recorded
- Situational awareness on an IFR flight plan is excellent via moving map display. Approach monitoring is valuable asset in low IFR conditions.
- Terrain avoidance displayed in an easy-to-use format.
- Terrain avoidance in inclement weather; traffic for avoidance of traffic.
- Terrain feature helps pick lowest route for terrain clearance in low weather. "Follow the yellow brick road." Traffic avoidance. Lots of airplanes going to and from on the same line.
- Traffic
- Traffic and Terrain; large display; for FIS awareness.
- Traffic avoidance safety; ground mapping situational awareness; airport info. Less time than digging for charts or AFDs; more time to fly. Less time flying in muck knowing what weather is ahead.
- Traffic avoidance, runway information, CTAFs, nav info.
- Traffic feature
- Traffic info/display; terrain info/display. Nav functions.
- Traffic information; aircraft are easier to identify.
- Traffic!!
- Traffic/terrain info: It was basically see and avoid before Capstone. Much higher accuracy of spotting traffic.

- Traffic avoidance;
- Able to see other aircraft out 80 miles and use this to get up to date weather info. I can get N# 's, and who they are.
- ADS-B; WX dataline; PAN Function "Tag targets" in traffic mode; Flight planning, planning fuel &loads for next leg while in bound; Terrain mode; ARC assist; Accurate fuel computation in flight plan mode saves company $$
- Extending runway.
- Flight Planning; Track up Arc on map display allows more precision; Terrain; Traffic
- GPS, flight display, helpful in situational awareness and all of the flight display equipment is easy to read and gives info in one display.
- I like the customizing functions. I can display terrain when it's a factor. I can display traffic when approaching. I can combine the two if necessary. Overall, it enhances situational awareness severely.
- Map mode on MFD; Info about the airports; Traffic display: Terrain feature while in map mode.
- MDF the moving map is a valuable tool as well as traffic and terrain.
- MDF-Situation awareness. Traffic advisories.
- MFD (MX20 w/all features); Traffic
- Navigation, able to find best way to an airport, Mt., etc.
- Navigation, traffic avoidance and terrain.
- Terrain avoidance; collision avoidance.
- Terrain, traffic Safety. GPS approaches - positional awareness.
- Traffic and zoom level.
- Traffic avoidance is by far the best feature for the Bethel area. With so many operators in the Y/K Delta… pretty much says it all.
- Traffic Avoidance, terrain(hills, mountains). Traffic info.
- Traffic -info, terrain-info, FIS, These features are excellent in low vis conditions.
- Traffic.

CP6. What do you dislike the most about Capstone avionics? Why?

2003

- GX60 is unhandy to set up and use for GPS approaches. Entire flight plan must be dumped and approach airport entered as a waypoint. After approach, remaining fight plan must be reentered.
- I would like weather page to work all the time. It usually works out of Bethel, but rarely in the villages or on return trip to Bethel.
- It's all great.
- Just need to figure out how to prevent interference from marine radios from knocking Capstone offline. Happens only in 207s, not CASAs.
- MSG cue every 10 min. telling me unit is configured for special terrain. I only need to know this once per flight. During GPS approaches, unit won't accept (2) IAF pts for transitioning to final approach fix; i.e., transition & final approach.
- Not working all the time
- Only that other regions (Kotzebue, Nome) do not have program. FIS is rarely available.
- Operator proficiency requires frequent training and currency to maintain level of proficiency in correct system operation and use of full capability.
- Re Cabs software: often check to see if other a/c getting through to their destination when weather is questionable. Company software often contains altitude errors. [remarks continue on hard copy]
- Reliability--is often broken; FIS and Wx never (rarely) work.
- Some AWOS reports show up; most don't; no nexrad.
- System automatically sequences to next waypt when multiple destination flight plan active and you get close to airport even when still needing help finding previous airport.
- The fact that FIS rarely works, even close in to Bethel.
- The GX60 is most user UNfriendly GPS on market in my opinion. Weather (FIS) info is sporadic, and Nexrod never works.
- The need to change data cards monthly in AVFR environment. It is not necessary.
- The only problem comes when we are dealing with non-Capstone-equipped planes in Special VFR hold and poor weather. Also, there is wrong info for several airports.
- Too many key strokes for many functions; GPS (GX60) is NOT user friendly.
- Too much button pushing.
- Traffic information is lacking. Would like to see a Resolution Advisory like TCAS.
- Weather availability not available in some areas.
- When flying a precise line, unit sometimes lags, jerky. Every time you shut down, you have to run the sequence to get going. Tend to look in plane more than usual.

2004

- Apollo GPS-Unit OK but perhaps Garmin units. Would like to be able to -- GX60 screen.
- FIS is not always working. I use the weather page a lot, more so when the weather is low.
- I have not used Capstone long enough. I am new to the system and the YK region.
- Inability to control next waypoint in FLT planning mode when arrival at airport; On FIS WX goes to graphic first, should go text and then able to select graphic.
- Mx20 LAG; Repetitive prompts; Too many keystrokes to access most utilized functions; Discrepancies between runway location and database runway location, VOR; Kuskokwim river not displayed east of Aniak; If I have a flight plan loaded, and want to load a G
- Not being able to get weather on the MX20 equipment it's self is great.
- Nothing from pilot standpoint. From mechanic standpoint sometimes a hassle to get parts paper work issue.
- Once in a while some Capstones start having colorful lines streaking up and down, and some get very dim.
- Some small details like zoom level on MDF is different between terrain & custom MAP modes; having to go through startup messages and no way of selecting "upon startup, display custom MAP". If I change baro altimeter setting, the system may ask to confirm it
- The FIS not working all the time. Would be nice if Kipnuk, Platinum and Russian Missions METAR's would upload into the system.
- The message light flashing to tell you there are no messages.
- The MFD seems to be the weakest component as far as failing more often.
- The updates are too slow!
- Weather never works around Aniak.
- Wish there was a way on 1 screen to show all features rather than split screen.

RLS1. Are you familiar with the capabilities of "Radar-Like Services" available for Capstone-equipped aircraft?

No ➔ *describe with standard definition, below and skip RLS2*
Yes

	2003	2004
No	21	11
Yes	3	8
NR	1	1

Capstone's ADS-B transmits the aircraft's location to ground stations, which forward it to Air Traffic Control computers. Those computers display the locations along with aircraft locations from radar and transponders. This allows controllers to provide flight-following and surveillance-based separation services in the Y-K Delta.

RLS2. Do you know how to obtain those services?

No (Skip to CP8)
Yes

	2003	2004
No	16	7
Yes	8	9
NR	1	4

RLS3. On how many flights in the last 12 months have you requested radar-like services?

2003

# Flights	# Requests
0	4
≤10	3
≤50	5
≤100	1
≤900	0
≤1000	3
NR	9

2004

# Flights	# Requests
0	2
3	1
5	1
9	8
20	1
40	1
300+ via flying ADS-B cube on regional.	1
The controllers use it like radar, we don't have to request it.	1

RLS3b. On how many of these flights have you received the requested radar-like services?

2003

# Flights	Received Radar-Like Services
0	1
≤10	4
≤100	2
≤900	0
≤1000	5
NR	13

2004

# Flights	Received Radar-Like Services
0	1
3	1
5	1
9	7
35	1
All of them	1
ATC usually request the Capstone hexadecimal code if I haven't already filed it with my IFR flight plan.	1
I've been vectored fewer times at alt. lower than radar coverage.	1
None	1

CP8. What benefits have you experienced from the Capstone program in the Bethel area?

2003

	No Benefit	Very Small Benefit	Some Benefit	Signifi-cant Benefit	A Major Benefit	NR
a. Fewer cancelled flights due to new instrument approaches at remote airports	11	4	2	2	0	6
b. Safer operations at remote airports due to new instrument approaches	9	3	2	4	0	7
c. Safer flying in minimum legal VFR conditions	2	1	1	3	16	2
d. Fewer near mid-air collisions	1	1	3	3	14	3
e. More useful weather information	8	5	5	2	2	3
f. Better knowledge of other aircraft and ground vehicle locations when taxiing	3	3	6	3	8	2
g. Improved SVFR procedures due to better pilot and controller knowledge of aircraft locations	4	1	1	3	14	2
h. Easier in-flight diversions or re-routes	3	0	4	6	10	2
i. Time savings from more direct flight routes						
j. Improved terrain awareness for pilots	0	1	0	8	14	2
k. Improved search and rescue capabilities	5	1	5	3	8	3

2004

	No Benefit	Very Small Benefit	Some Benefit	Signifi-cant Benefit	A Major Benefit	NR
a. Fewer cancelled flights due to new instrument approaches at remote airports	9	1	4	1	1	5
b. Safer operations at remote airports due to new instrument approaches	7	2	2	3	2	5
c. Safer flying in minimum legal VFR conditions	0	1	0	4	14	2
d. Fewer near mid-air collisions	0	0	3	1	15	2
e. More useful weather information	1	2	0	1	3	14
f. Better knowledge of other aircraft and ground vehicle locations when taxiing	2	6	7	1	2	3
g. Improved SVFR procedures due to better pilot and controller knowledge of aircraft locations	0	0	0	4	15	2
h. Easier in-flight diversions or re-routes	2	0	0	4	11	4
i. Time savings from more direct flight routes	0	1	4	5	9	2
j. Improved terrain awareness for pilots	0	0	2	5	12	2
k. Improved search and rescue capabilities	1	0	3	1	11	5

CP9. If there are other benefits you believe that Capstone provides, please list them.

2003

- Capstone provides me with knowledge that I have technology available that makes flying in western AK safer, more efficient. Greater confidence in getting job done in very high level of safety.
- Drastic improvement in special VFR efficiency in Bethel area. Having returned to Bethel recently after 6-yr absence, difference is amazing; makes whole new ballgame. Also, low vis operations in apt. vacinity are enhanced greatly.
- Gives good sense of traffic over very wide area so pilot can plan sequencing to/from airport.
- Improved situational awareness on IFR flight plan (ie relation to route, approach segment, terrain)
- Mainly weather information
- Obtaining PIREPS from distant locations by contacting aircraft in that region.
- Takes the stress out (reduces) when in bad weather.
- We use our aircraft for wildlife surveys. The MX20 coupled with GPS makes transect searches for wildlife simpler, similar to SAR use.

2004

- S&R (k) implies downed A/C. If a pilot is out of radio range/off company freq., it is easy to zoom and find the location, notify dispatch and assist in arranging pickups etc. Based on A/C location & ground speeds.
- Believes Capstone benefits passengers without them even knowing. Fewer delays, greater time & fuel savings than pre Capstone- more e they fficeint. Safety greatly enhanced.Pilots are now where they say they are.
- Capstone provides the ability to see other capstone equipted aircraft flying. With their aircraft number, I can call them to request pipers which have proven to be very useful. I also have used the weather Datalink to avoid thunderstorms last summer.
- Did not change the way I fly, just enhanced the safety of the way I fly. Better weather and radio comm in area. Better approaches.
- Look at other A/C & ASIL for weather consideration from other pilots.
- When goes--will be great.

CP10. What problems have you experienced with the Capstone program in the Bethel area?

2003

	No Problem	Very Small Problem	Minor Problem	Signifi-cant Problem	Major Problem	NR
a. Less heads-up time	6	8	7	2	0	2
b. Heavier workload in the cockpit	13	6	3	1	1	2
c. More aircraft flying in the same airspace because they are using GPS point-to-point routing	5	7	5	5	1	2
d. More complexity than needed for VFR flight	17	2	2	2	0	2

2004

	No Problem	Very Small Problem	Minor Problem	Signifi-cant Problem	Major Problem	NR
a. Less heads-up time	7	5	5	1	0	3
b. Heavier workload in the cockpit	8	8	2	0	0	3
c. More aircraft flying in the same airspace because they are using GPS point-to-point routing	7	5	5	1	0	3
d. More complexity than needed for VFR flight	13	4	1	0	0	3

CP11. Please list any other problems you believe that Capstone may cause or add to.

2003

- Bethel, Quinhagak A/C spacing point to point. No-one is tracking a/c 1/2 m off <that course>
- Capstone does not add problems. If you know equipment, programming is easy and fast. Time spent inside with Capstone is less than what you would spend inside with equipment with fewer capabilities.
- Complacency in the cockpit; navigation problems when unit fails
- Continuing flight into deteriorating conditions, like most VFR-only GPS systems.
- Idiots flying in IFR with moving map where they shouldn't be.
- Increases "head down time" when operating equipment.
- It could lead to complacency in the VFR pilot, encouraging ops in subacceptable weather conditions.
- Like any new aid, there is danger of over-reliance on technology. Basic skills of traffic avoidance must be consciously honed.
- More potential aircraft in SVFR holds, incl non-equipped aircraft. consider leaving one holding area for non-equipped planes. CNTRs lack of use of USB code for SVFR aircraft.
- None. Just keep improving.
- Pilots probably get complacent about traditional navigation and only rely on Capstone.
- Pilots use altitude given on MX-20 as 100% and do not deviate course or altitude. I've made many deviations even when the rules of the road are in my favor.
- Some of our airplanes have VHF radios installed and use of those radios causes the MX20 to reset itself after transmitting on VHF.
- Too much reliance on electronics; not enough common sense.
- We all tend to believe everyone has Capstone, which is not the case. Need to remember that and keep eyes out of the cockpit.
- When was the last time a pilot looked at a VFR sectional?
- Works great for separation as long as everyone has a Capstone.

2004

- Fooling with it too much. Thinking they are seeing all traffic when not.
- Getting too---or -- upon equipment.
- Over reliance on the equipment; Bootleg IFR.
- Starting up and trying to get going to keep the vacate a small ramp the MDF+GX60 take time to set up (confirm baro setting clear"special terrain mode message, switching to custom map). That time is better spent with eyes outside cockpit. Taking off & waiting
- Subject to abuse; Has capability to make pilots push it too far.
- Too much reliability on this system.
- Without good initial training the Capstone could give less head-up-time.(training is every things)

CP12. When you fly for <your employer>, how often is the aircraft Capstone equipped?

	Always	Usually	Sometimes	Rarely	Never	NR
2003	15	7	0	1	0	2
2004	14	5	0	0	0	2

NOTE: CP13 not used in 2003 and 2004.

CP14(Rev). How much does the capability of the Capstone equipment help you to make go/no go and diversions or re-routing decisions ?

2003

	Not at all	A small amount	A great deal	Don't know	NR
a. Go/No Go Decisions	13	4	6	1	1
b. Diversions/Re-outing Decisions	9	7	6	1	2

2004

	Not at all	A small amount	A great deal	Don't know	NR
a. Go/No Go Decisions	4	8	6	1	2
b. Diversions/Re-outing Decisions	2	3	13	1	2

CP15. For what reasons might pilots choose not to use some Capstone equipment?

2003

	Yes	No	Don't Know/ No Opinion	NR
a. Too distracting	4	14	6	1
b. Too difficult to use	3	17	4	1
c. Don't want others watching aircraft location at all times	12	9	3	1
d. Don't trust equipment to provide reliable information	1	19	4	1
e. Concerned that equipment might break	3	17	4	1

2004

	Yes	No	Don't Know/ No Opinion	NR
a. Too distracting	5	10	4	2
b. Too difficult to use	5	12	2	2
c. Don't want others watching aircraft location at all times	12	4	3	2
d. Don't trust equipment to provide reliable information	5	10	4	2
e. Concerned that equipment might break	7	9	3	2

CP15b. If you answered yes, above, please explain:

2003

- (c) Fear of Feds; (d) Sometimes terrain page is inaccurate; (e) breaks constantly, MX20 resets at the most inopportune time.
- Fear of Feds
- I have heard people (mostly older pilots) worry about being watched. But most feel the benefit outweighs the problem.
- I know of some pilots that turn off ADS-B because they don't want to be seen (put on stby in traffic mode); they still want to see other guys.
- I know some pilots feel that it is a violation to be viewed all the time. Also feel the FAA might use info against them.
- Moving/flickering objects sometimes distract eyes; unless you are very familiar with equipment you may find yourself searching for information on the MFD instead of flying
- MSG alert flashing; altimeter update
- Other pilots turning off ADS-B
- Over-reliance on pt-to-pt. nav or loss of scan
- Pilot not using equipment on continual basis may have to devote extra time to obtain desired info; need to review operation if not using on continued basis.
- Some more "experienced" crew believe the ADS-B service may be used to "trap" them with some sort of violation; some are opposed to "heads-down" time.
- Some pilots just do.
- Some pilots nervous about "big brother" aspect & turn equipt off when it's most needed. I know of several areas (around Nome & Otz) that terrain data is unreliable.
- Sometimes people don't want the "feds" watching. Same concern pilots have had for years--different way for "big brother" to watch.
- The GX60 is sometimes more hassle than it's worth for some very short legs, OOK-TNK, etc
- There is some distrust of FAA by some pilots, and they believe that FAA is monitoring illegal activities--a misplaced view, but one that exists.
- We all know that bush flying can be incriminating if you are constantly monitored.

- a) Specifically when new to it or have not used it much. c) Some times. d) After some experience.
- a) Don't take tike time to learn it; b) Same, don't take time; c) FAA.
- c) Pilots are afraid of getting violated during MFVR; d) Terrain not very accurate in the mountains.
- c) Some pilots don't like the fact that "Big Brother" is watching. d) Don't trust the terrain mode. e) I have experienced on numorous occasions the system shutting down and re-booting from time to time.
- c. Hypothetically, if one had to climb into the clouds because the weather goes down and the terrain ahead is hilly. This hypothetical violation of the FARs would not go unmissed. This might make the pilot less inclined to do the safe things and climb.
- Electric failure.
- I don't think it's too different, but some of the old timers might.
- It is like anything else. It is electronics. In a very Wx climate only a matter of time before it fails.
- Maintenance; Don't trust it to be correct; Don't trust new technology; not familiar.
- Older pilots reluctant to change.
- Response is regarding other, mostly new pilots. This pilot uses all the time and for him all answers would be No/2.
- The thought of someone waiting is always present; At times, that prevents pursuing weather(flying lower) or other less than legal operations(caravan flying over water, etc.) However most observers would not be aware of Pt. 91/135 rule a particular flight
- Who wants to be watched ALL the time.

CP16. Please list any other reasons you believe pilots might choose not to use some Capstone equipment.

2003

- Big brother watching; violations.
- Can't think of any reason. Once you use Capstone and learn it, the equipment becomes very useful.
- In case of a possible violation for any reason.
- Knowledge that their actions are viewable by third parties.
- Like GPS, abbreviated checklist isn't user friendly. It's a lot easier to use than INS & provides great deal of information.
- Profile mode and terrain mode. Profile mode needs an adjustable scale. Present great for Rocky Mts but useless in Delta. Terrain mode might be better served by showing terrain in more definite colors in VFR model.
- They may not be interested in learning about the many capabilities Capstone provides. Maybe no motivation to learn or see it as too hard. Once you learn about its capabilities, it's best tool a pilot can have in interest of safety.
- To better learn an area; to not be found in violation; "back to basics" flying.
- Too much reliance on it? I'm not sure. I really like it.
- Too much reliance on technology. Pilot may not learn terrain feature; unable to fly based on dead-reckoning.
- WX function very unreliable; only able to receive wx 2 times during 300 hrs of flying. Traffic function seems unreliable; traffic msg flashes but unable to see any targets.

2004

- Any good pilot would appreciate the capabilities of the Capstone equipment
- Flying low to avoid low ceilings
- Passengers watching & asking questions (why is there no magenta line or why is there a red cross over A/C symbol.)
- Redundant.
- To sharpen skills in other forms of navigations. To keep their heads up out of the cockpit.

The next five questions ask about potentially dangerous situations that pilots sometimes encounter. Capstone equipment might be helpful in preventing or coping with these particular problems. Therefore, we're interested in how often pilots in the Yukon Kuskokwim delta encounter these problems. For each situation, think about how often in the last 12 months you've encountered it.

2004

	Daily	Weekly	Monthly	Less often than monthly	Never	NR
CP17. How many times during the past year have inaccurate weather forecasts caused you to encounter instrument meteorological conditions when you didn't expect to?	0	2	1	9	4	5
CP18. How many times during the past year have deteriorating ceilings or visibility made you unsure of your own position relative to the surrounding terrain?	0	1	1	7	8	5
CP19. During the past year, how many times have you unexpectedly seen other aircraft close enough to you that you felt it created a collision hazard?	0	2	0	11	3	5
CP 20. During the past year, how many times have you been cleared into SVFR when the separation between aircraft in the pattern made you uncomfortable?	1	0	3	3	9	5
CP21. During the past year, how many times might your go/no go or routing decisions have been improved if you would have had access to real time weather or Special Use Airspace status?	2	4	5	2	3	5

CP22. How much do you think the Capstone program has affected the safety of flight in the YK Delta?

	Much less safe	**Somewhat less safe**	**Non change in flight safety**	**Somewhat safer**	**Much safer**	**NR**
2003	0	0	0	8	16	1
2004	0	0	0	2	15	4

CP23. Please add your comments about the relationship of Capstone to aviation safety, or about the safety challenges of flying in the YK Delta.

2003

- All of Alaska should have this equipment. Low weather conditions using the moving map system help in situational awareness.
- Biggest thing is terrain & collision avoidance. Capstone equipment is priceless in both areas. Pilots went direct before Capstone; now most of us can see each other. [remarks continue on hard copy]
- Capstone equipment is tremendous boost to situational awareness in IFR environment. As for flying in YK in general, it is small contribution to myriad of challenges present.
- Capstone improves aviation safety if pilot knows how to obtain required data.
- Capstone, I believe, is a major improvement for safety. Weather in wInter is often marginal, whiteouts; Capstone is wonderful.
- Definite increased safety level & situational awareness; also great sense of search/rescue capabilities.
- Flying in bad weather in this area. Safety is all about knowing where you are and where other planes are. This equipment provides that information.
- I feel there is 100% improvement in safety.
- I think for VFR aircraft flying in MVFR conditions, terrain awareness and traffic avoidance features are most useful functions of Capstone.
- I think some single-engine operators are using it illegally in non-VFR conditions (actually I know this is happening).
- Incredible service to have for all phases of flying and safety. You know where, when, and how planes are flying; terrain avoidance also VFR holding at Bethel; you know where a pilot is and where he/she is in the hold.
- It adds some safe elements, but knowledge also adds some risk. The machine is so good that it seems folks fly in weather they wouldn't without Capstone.
- It is acting like an additional set of eyes.
- It would be nice if the tower here and approach in Anchorage would work together to speed up special VFR, especially with Capstone-equipped aircraft.
- None recorded
- Program is biggest boon for safety in region that I have seen. For sake of safety, please continue to fund/expand program.
- Safety challenges in the Delta are usually weather related. In deteriorating conditions, Capstone is a valuable tool to safely navigate home. But also provides a level of false safety leading to extended flights in worsening conditions.
- Seems like there are lots of people trying to get the job done in marginal weather. Seems like some people are willing to push it further with the "magic box."
- Situational awareness is always present with Capstone. Navigating with precision is effortless.
- SVFR-CNTR should use USB codes better. SVFR planes could be safely sequenced between IFR arrivals. All too often VFR pilots left circling min. wx conds. Potential icing. [extensive remarks continue on hard copy]
- Traffic and terrain feature makes this system very safe.
- Younger pilots experience; Capstone has increased safety immensely.

2004

- 2 thumbs up for Capstone!
- Capstone and aviation safety go hand in hand. Who knows how many lives have already been spared from your hard work and dedication. You people deserve an award of significant proportions.
- Capstone has helped me a lot.
- Don't change a thing, the only thing I wish is, I wish private planes had Capstone in the YK delta.
- Flying in the YK delta can be challenging with the changing weather. A good pilot needs to not fly in bad weather unless the aircraft is equipped for IFR flight. Capstone is a great navigation tool-it won't help you in bad weather situations. Again good try
- Great product. Please improve updates. They are slow.
- Greatly enhanced safety.
- Once Capstone is fully relearned into entire aviation community, accidents will be dramatically reduced.
- Only in the area for few weeks. Just bought the business. Keep it going-improve all you can--------
- Outfit pt 91 operations.
- The Capstone project in the Y/K Delta id definitely a great navigational tool. Without a doubt it has saved at least one life and in my mind it is worth every penny. It gives everyone a known out if anything unexpected happens.

Thank you for your time. All information you have provided is confidential and cannot be used for enforcement purposes.

E.2 Management and Dispatch Responses

Methodology
Researchers conducted surveys and interviews of pilots, airline managers and owners, airline dispatchers, business leaders and employees, city officials, and village leaders. The survey population is relatively small and homogenous. For example, pilots generally fly for airlines of similar size and equipage and within the same geographic area and face the same weather, terrain, and other challenges. Village and business leaders in the Y-K Delta all face common challenges relating to aviation in managing their civil area or business.

Given the small size and homogeneity of the population, surveyors did not use random sampling techniques. Instead surveyors traveled several times during the year to Bethel to interview as many subjects as possible. Initially, some subjects were asked to complete a questionnaire and return it when convenient, but the response rate was very low. As a result, the vast majority of questionnaires were completed during one-on-one interviews. Many of the most useful comments cited in the report were the result of follow-on questions asked during these interviews.

Interviews
The following were the interview questions to (1) determine the changes in Safety Posture (or Safety Culture) at the Capstone operators and (2) more general questions for the operators and customers regarding improvements overall, such as economic, business practices, etc, since the start of the Capstone Program. The number in ***Bold Italic*** represents the number of respondents. Where comments are presented they are in ***Bold Italic*** as well. Not all interviewees responded to every question.

Questions for Senior Management (the Owner/General Manager/Chief Pilot)

1. Since the start of the Capstone Program, has your company made changes to its overall programs, procedures or operations to distinctly improve safety awareness or safety programs? ***Yes - 7, No – 5, and No Answer - 2***

2. Since the start of the Capstone Program, has your company revised, issued or done any of the following for the purpose of improving safety or safety awareness?
   3 - Operations or Policy Manual Revisions regarding safety
   5 - All employee (or all specific group) safety letters
   3 - Written a safety policy document
   4 - Set or revised safety goals
   2 - Conducted a safety review or audit
   4 - Established a hazard, accident or incident reporting program
   2 - Developed a specific safety program or assigned a Safety Office

3. In your opinion, has the company's Safety Posture or Safety Culture changed during the Capstone Program? ***Yes – 9, No - 1***

Please describe those changes.

1. Not to use Capstone to "Get In" during Weather

2. Increased awareness of terrain hazards, collision hazards and knowledge that flight was being monitored, operation has become more professional.

3. Pilot ease and transition direct to destination awareness and new aircraft

4. Ability to see and avoid traffic in a safer manner

5. Better dispatch awareness

6. Better situational awareness and better flight following ability.

7. There have been changes to our program and culture, but we cannot quantify which change, if any, has resulted directly from the Phase I program. However, Phase II is resulting in a monumental change to the safety culture, as all Twin Otters equipped with the Chelton equipment will receive standardized instrument panels, a first in the Twin Otter fleet at Era Aviation.

8. The unit is a very good CFIT tool. It has served to locate more quickly airplane(s) that made unscheduled landings off-airport. Since all crews use the unit's communication regarding position reporting is more accurate in reference to known traffic which is also more reliably located.

4. Has Capstone changed or improved the economics of your operation?

6 - No Change
5 - Improved
0 – Deteriorated
3 – No Answer

Please provide any comments regarding those economic changes.

1. Better knowledge of aircraft location and progress.

2. Improved efficiency due to increased position awareness.

3. Better knowledge of aircraft position, when out of range of radio, able to contact.

4. All of our A/C already had GPS.

5. The only changes economically to our operation were the resulting increase in GPS checks required for pilots who were either non-GPS qualified or after becoming GPS qualified, were required for operational

purposes to be "dual qualified". A well "worth it" trade for the increased situational awareness the Phase I equipment provided our flight crews.

6. Better completion ratio due to improved navigation resource.

7. Improves somewhat due to more info available for dispatching aircraft and providing flight following and planning capabilities.

5. Please provide any comments you wish regarding changes in the company that have had an impact on safety during the Capstone program.

1. Part 91 should be outfitted. Ability to see other traffic and terrain.

2. The training program at initial startup and the video training and the training of pilots.

3. Awareness that avionics upgrades have a positive impact on safety.

4. High density traffic in the Bethel area is immeasurably safer because of traffic awareness.

Senior Management - Training:

1. Now that you have gained experience with the Capstone Program, do you feel the initial training your pilots received was adequate to allow them to fully utilize the equipment? ***Yes – 4, No - 0, and No Answer - 9***

2. Based on your experience, do you foresee any changes to your pilot training program? If so, what? ***Yes – 3, No – 2, No Answer - 10***

Please provide any comments:

1. More interactive computer based training.

2. If we were continuing to participate in Phase I (we are moving on to Phase II), company owed simulators would ease scheduling and provide for more "hands-on" training for each student. We are actively working on this improvement for our Phase II course.

3. More direct navigation flying. Integration with TCAS and TAWS equipment to eliminate conflict or confusion and take advantage of the best resource.

3. Do others, such as dispatchers or station agents receive training on the Capstone Program? If so, what portions? ***Yes – 2, No – 1, No Answer – 11***

Please provide any comments:

1. Flight following.

2. Dispatchers – Dispatchers participate in the initial part of training involving the Capstone Safety initiative, GPS (the constellation and how to check for outages), and the UAT (for flight following purposes).

4. Overall, how do you rate the effectiveness of your training program? (excellent, good, minimum satisfactory, poor, no opinion.)

0 – Excellent
2 – Good
0 – Minimum Satisfactory
0 – Poor
12 – No opinion

Please provide any comments:

1. Good. We are still working on standardizing a training outline for entire program because now we will be utilizing Capstone throughout the entire Twin Otter program. Additionally, as mentioned before, the availability of more simulators will also enhance the effectiveness of our program.

6.6 Appendix F: Business and Civil Leaders View of Capstone

F.1 Business Leader Responses

Methodology

Researchers conducted surveys and interviews of pilots, airline managers and owners, airline dispatchers, business leaders and employees, city officials, and village leaders. The survey population is relatively small and homogenous. For example, pilots generally fly for airlines of similar size and equipage and within the same geographic area and face the same weather, terrain, and other challenges. Village and business leaders in the Y-K Delta all face common challenges relating to aviation in managing their civil area or business.

Given the small size and homogeneity of the population, surveyors did not use random sampling techniques. Instead surveyors traveled several times during the year to Bethel to interview as many subjects as possible. Initially, some subjects were asked to complete a questionnaire and return it when convenient, but the response rate was very low. As a result, the vast majority of questionnaires were completed during one-on-one interviews. Many of the most useful comments cited in the report were the result of follow-on questions asked during these interviews.

Interviews

Before being contacted for this interview, were you familiar with the Capstone Program?

All respondents were except one was aware of the Capstone program.

Do you feel there have been changes in Air Service since Capstone implementation?
Responses:

1. Better aircraft and terrain avoidance than was available before program.

2. Haven't seen fatalities in recent year past.

3. Air travel has become slower. Flights are watched now for flying under mins. Has caused pilots to really look close at getting into villages.

4. Less aircraft accidents or incidents.

5. I'm certain that there have been positive changes since Capstone implementation.

6. Positive changes, travelers are most confident in the air taxi operations, the pilot and the aircraft.

7. Reduced air traffic incidents resulting in fatalities.

8. Safer travel-pilots being more aware of other aircraft location, terrain and more direct travel to villages even in marginal weather. In past, pilots flew more visually and were not aware of other aircraft locations.

9. It is a great tool for airplanes and to passengers especially with an area where aviation is the only means of transportation to and from villages.

10. Better attitude towards safety(increased awareness)

11. Made travel safer. More confident with aircraft equipped with Capstone.

12. "Buzz" about it at airport/seems like more flights will occur.

13. I believe pilots are more confident and assured of their situational awareness therefore they can concentrate on flying the aircraft.

14. Safer operations through increased situational awareness.

15. I am not familiar with any changes.

16. The Capstone aircraft have helped. We can get to more airports on time than before Capstone.

17. I believe pilots are feeling safer making the passengers more comfortable.

18. New pilots to this area seem to be more confident in knowing where they are going. They don't have to ask passengers which direction they need to go.

19. Flying has become much safer on the Delta.

Have these improvements had an impact (economic, social, or other) on your village or business? **Responses:**
1. I believe air safety has been improved. I personally feel much safer with the equipment installed.
2. Aviation is safer from consumer stand point.
3. Mail has slowed dawn getting to villages. In marginal weather do not go.
4. Mail takes longer to deliver.
5. Accidents down. People feel safer flying which means more people in town to shop at my store.
6. I don't know.
7. Very much so. Travel between the villages and Bethel is clearly safe for the purpose of goods sold here, visits to hospital are more consistent and travel to the hub for jet service is dependable.
8. Better knowledge of arrival time to villages, more informed on other aircraft and terrain when weather if foggy or cloudy. Safer all around, less accidents are noted as result of Capstone.
9. It is comforting to know other aircraft in vicinity and the terrain especially when conditions are just above minimums and provide for safer operations to everyone involved. Thus it has improved our travel and ability to get in and out of villages.
10. We are a field office for 37 villages and we fly commercial aircraft almost daily. Capstone is a safety measure in the commercial aircraft that we have become accustomed to having.
11. More people will go travel.
12. If more do occur do occur our impact will be more significant; however, due to our lag time of job costs/invoicing/etc. the impact won't be known for awhile.
13. I believe people have more confidence in aircraft and pilots when Capstone is installed.
14. It is difficult to quantify this, because we all tend to take things that we depend on for granted. I can definitely say that it increases logistical support efficiency.
15. I am not aware of any differences.

16.	We spend more time at the jobs and not as much sitting in the airports.
17.	Staff members are more comfortable traveling to remote villages. They feel safer.
18.	Flying in marginal weather in the spring and fall has gotten much more reliable.

Please provide any comments you wish regarding changes you have noted during the Capstone Program. **Responses:**
1. I believe the program is awesome with one caveat. It only offers the aircraft that HAVE IT. I personally don't like flying my personal plane around Capstone equipped planes because I feel that those folks flying those planes get to tied into the Capstone screen and don't watch out for those non equipped planes. I think that at the least, a Capstone ADS-B transponder should be made available to aircraft operating in a Capstone flying area.
2. We don't do any underwritings for aircraft.
3. Some pilots are watching Capstone too close and forgetting how to fly, depending too much on instruments.
4. Pilots rely upon Capstone too much. What if your Capstone equipment in your aircraft goes out.
5. Please continue the program.
6. Must be maintained. All upgrades to continue. Well-received system that people support.
7. As noted above, there seems to have been a reduction in fatal air travel incidents, which I think has improved the comfort level of those traveling to and from villages for business.
8. Enjoy flying more, map of area we fly over is visual on map with more detail. Direction to villages is more precise, despite weather. Pilots have better alternatives for their flying conditions encountered. A pilot who is relative use the Capstone for safety purpose when he encountered bad weather noting the terrain.
9. Make it affordable so private pilots can install and use them. Our organization serves 48 villages only accessible by small aircraft and this system has provided more safe travel for our staff.
10. As frequent travelers by commercial aircraft we would encourage to continue to fund and develop Capstone not only in the Y- K Delta, but other areas of rural Alaska.
11. Continue program, plus put in all aircraft.
12. Too soon to have much quantitative data from consumers.
13. More all aircraft should have Capstone.

14. The Capstone have saved use of lots of time and money. Please keep it up. We feel much safer in our travels. Thank you.
15. The equipment should be in all the planes. I feel it does make flying safe. We need zero crashes.
16. I don't see any need for changes. I think it is a great program.
17. I have known of the program but do not know much about it.

F.2 Village Leader Responses

Methodology

Researchers conducted surveys and interviews of pilots, airline managers and owners, airline dispatchers, business leaders and employees, city officials, and village leaders. The survey population is relatively small and homogenous. For example, pilots generally fly for airlines of similar size and equipage and within the same geographic area and face the same weather, terrain, and other challenges. Village and business leaders in the Y-K Delta all face common challenges relating to aviation in managing their civil area or business.

Given the small size and homogeneity of the population, surveyors did not use random sampling techniques. Instead surveyors traveled several times during the year to Bethel to interview as many subjects as possible. Initially, some subjects were asked to complete a questionnaire and return it when convenient, but the response rate was very low. As a result, the vast majority of questionnaires were completed during one-on-one interviews. Many of the most useful comments cited in the report were the result of follow-on questions asked during these interviews.

Interviews

Before being contacted for this interview, were you familiar with the Capstone Program? All respondents were aware of the Capstone program.
Do you feel there have been changes in Air Service since Capstone implementation? Responses:
1. I feel the changes made have greatly affected the accident rate of Aviation aircraft in Rural Alaska. I feel that the accidental rate of aircraft has decreased due to the technological advantages offer by the Capstone Project but don't really know by how much. In my capacity with AVCP Regional Housing Authority, I have virtually traveled to every village in the AVCP/Calista Region and am aware of the hazards.
2. I travel quite frequently in the Y-K Delta and other remote locations in Alaska. My personal opinion is that the Capstone Project has made a significant positive impact on travel in the remote locations in Alaska and has contributed immensely to passenger safety.
5. People are more confident to travel. Only thing I remember, of an incident of an accident of two aircraft that collided near Nunapitchuk. People had fear of flying for a while but now have confident to travel by air again.
6. Less flight delays due to weather.
7. I think it made a significant impact on the safety of air travel in the Delta, due in patrt to the unpredictable weather we encounter in this region.

8. I feel that there has been changes since the airlines have started using Capstone. I feel it is safer for both the pilots and passengers with a Capstone installed on the plane. Less accidents.
9. Seen Capstone in planes that I have flown with. Was a new instrument for me. Can see where you are at, see other planes and know where they are. Feel safer because a better instrument is on the plane.
10. Its' like a highway where you and others know where you are and where you are headed.
11. You can "see" other aircraft and know their location even when the human eye can not see which reduces in air collisions. Poor visibility or low ceilings do not pose as factors in emergency situations like they use to.
12. Other planes now are aware of other planes in their immediate vicinity.
13. I feel safer when I travel knowing the terrain and other aircraft features are on and will warn when we are in immanent danger.

Have these improvements had an impact (economic, social, or other) on your village or business? **Responses:**
1. My position with my employer requires travel and the weather here can change within hours. Many villages depend on small aircraft for basic necessities and health issues. If village people need medical attention, the only way to get it is by small aircraft.
2. It provides the pilot and passengers with information regarding the terrain, locations of other aircraft, estimated time of arrival, altitude of other aircraft, speed, airport information including alignment and radio contact information.
5. In past village stores would run short of supply due to weather, and would be sometimes for a week or so.
6. Mail groceries are delivered more frequently because flights into the community are made due to new technology.
7. The program makes it safer to fly in this region especially in bad weather.
8. I have heard that people feel more comfortable flying since Capstone has been used. The passengers feel a little safer than when it wasn't being used.
9. Not quite sure. People fly when they need to fly (hospital appointments, business travel, or shopping when they can afford it).
10. Scheduled flights are not disturbed as often as they used to.
11. This spring late at night and with a low ceiling, I noticed a Grant Aviation aircraft take off and leave Bethel. (Grant Aviation Caravans are the Medivac planes) But the Medivac was able to leave despite low ceiling. There have surely been a lot of other occasions which this happened.
12. I feel safer now, as they are able to be aware of other planes, and gives directions that would not be possible with other visual instruments.
13. Socially, yes. Air travel seems safer and people are more willing to travel to other towns to shop and visit.

Please provide any comments you wish regarding changes you have noted during the Capstone Program. **Responses:**
1. The changes I feel need to be made on the use and operation of the capstone project equipment. I am aware of two fatal crashes in the region that could have been prevented. The first one is the crash of local pilot Chris Murphy in 1998? Mr. Murphy had just had his Cessna 185 upgraded with the Capstone equipment when it first came out, I don't think he had any training in it and may have used his classroom skills to fly or not to fly, anyway, I think he had the wrong barometric setting. He crashed outside Scammon Bay with another passenger. The second one is the accident that happened in Pre-Capstone with local air carriers Yute Air and Arctic Circle Air. The Yute Air 207 was returning from one of the coastal villages in SW Alaska ant the sky van owned by Arctic Circle Air took off from the village of Atmauthluk west of Bethel. The sky van was in the process of gaining altitude and headed for Bethel. The Yute Air 207 at a level altitude and was also headed for Bethel. It was reported that the 207 rammed into the sky van as they both were returning to Bethel.
2. The only issue that I can see for improvement is providing the unit to private airplane owners. Once in a while, these private planes pop-up without warning and they can pose a safety situation for airplanes that have the capstone unit. If providing the unit is not possible, perhaps mandatory position, altitude, and direction of travel reporting would make travel safer. I, for one of the frequent travelers, really appreciate the Capstone Project.
3. I routinely travel to villages and remote locations throughout the Yukon-Kuskokwim Delta. Integrating GIS/GPS technology through Capstone has been a tremendous benefit out here and I'm sure it has made air travel much safer the last couple of years.
4. I am very concerned that the terrain avoidance feature on the Phase I Capstone installations is based on barometric pressure, and not GPS/WAAS altitude. During winter, when whiteout conditions and flat light are most prevalent, we also experience cold temperatures, very much colder than a standard atmosphere. This causes barometric altitude read higher than true altitude, creating an unsafe condition with the pilot being closer to the ground than he thinks he should be. In very cold temperatures and at altitudes of 10,000 to 12,000 feet, easily reachable by small aircraft, I have seen errors approaching 2000 feet, clearly an unacceptable number. At milder temperatures and altitudes of 3000 to 5000 feet, I have seen errors of over 500 feet, again with the barometric altitude reading higher than the actual aircraft altitude, putting the aircraft in jeopardy due less terrain clearance than the pilot believes he should have. Unfortunately, due to pooling of the coldest air on and near the surface,much of this error takes place at low altitudes, in and just above the air inversion. Many times I have watched the altitudes measured on my GPS units diverge from my barometric altimeter as I climb during the winter months, and again converge as I descended for landing. I have confirmed that the GPS altitude was in every case I tested, correct as based on mapped terrain information I had at my disposal in the cockpit. This was done by flying next to a mountain peak of known height. It is quite routine to see 600+ foot errors, on my barometric

altimeter, even down to quite low altitudes just above the air inversion. It is my opinion that the Capstone program needs to change the terrain avoidance feature to be based on GPS altitude information rather than barometric altitude information. This should be done as soon as possible to avoid an accident which could be caused by dependence on too high of confidence on the terrain information given to the pilot by the MX-20 display. It should be noted that a nicely working Capstone system was left partially crippled after conversion to the GDL-90 UATs in the spring of 2005. Some systems experienced problems and errors after the work was completed, wherein there were minimal problems prior to the conversions. To get the systems working again, it was sometimes necessary to change antennas, at considerable expense and down time to the operators. Other delays were reported due to static system problems. While undoubtedly there were equipment problems with the new UATs and installed equipment in the aircraft, the contractor seemed ill equipped and not knowledgeable, compounding the issues. To this date, there are evidently a number of airborne systems still inoperative or unreliable.
5. I know that I for one have been thankful from the new technology that improved flying.
6. As airline travel is the main means of transportation in the Y-K Delta we are happy that the use of new technology is being applied in our region and used to better improve the lives of the residents of the region.
7. I have flown as a passenger, all over this region, and it makes me feel safe to see this type of instrument in the airplane knowing that it could save lives as well as making traveling much safer. For people who depend on airplanes to get where ever they are going to. Air travel is the only link to some of the villages in this region, and it makes it a must have safety equipment to anyone who rely on air travel.
9. Just noticed less accidents & if there was an accident, can locate the plane faster. Planes know where other planes are and can keep an eye out when other planes are close by. Overall- good instrument!!
10. For this area where we so dependent on air transport daily, Capstone program made air traffic safer.
11. I think passengers have an ease of knowing where other planes are at and the location of tall structures as well as high terrain areas. Some passengers even monitor the Capstone and keep an eye out for other aircraft on their own.
12. Safer, less accidents with other planes.
13. Air travel seems safer watching and knowing the safety features are on.

6.7 Appendix G: Search and Rescue Benefits of Capstone

Summary

The Capstone Phase 1 program has provided an improved SAR capability to locate aircraft equipped with ADS-B that may be in distress, overdue or down, and to quickly reach a crash site and affect a rescue of survivors. This improved capability effects both the cost and effectiveness of SAR by reducing the time for notification of missing or overdue Capstone aircraft, and by providing reliable track data to the point of last transmission, thereby permitting the launch of appropriate SAR assets to that location, without the costly and time consuming step of initiating a search mission to locate the crash site.

The Capstone Program provides an overall emphasis on improved air safety, which has translated into fewer needs for SAR in the Y-K Delta. Together with putting into the hands of pilots the avionics to navigate precisely and avoid accidents, the ADS-B has placed into the hands of operators the ability to follow their aircraft, and immediately detect when a Capstone aircraft is in distress or down. This translates into a level of confidence in pilots that SAR help will be dispatched in the event of a mishap, not dependent upon an Emergency Locator Transmitter (ELT) beacon that may not operate, or upon ability to communicate.

This improved capability was clearly demonstrated on the night of October 28, 2002, in an instance where a Capstone equipped aircraft crash did not result in the activation of the aircraft ELT beacon, and the pilot was injured and unable to communicate. Based on ADS-B data, the SAR Rescue Coordination Center (RCC) directed a military helicopter, with rescue personnel, to the point of last transmission. The crash site was identified and the rescue was accomplished, with the aid of night-vision equipment, resulting in the saving of the pilot's life.

Insufficient data on the cost and time factors relating to SAR was available to perform a definitive cost/benefit analysis of Capstone, but there is agreement by SAR persons at the RCC that any data that assists in reducing the time to initiate SAR actions, or accelerates the process of locating and reaching survivors has the potential benefit in saving lives.
To address the cost/benefit of the ADS-B component of the Capstone avionics set in the future involves particularly the changes that are occurring in the area of ELT capability.
The unreliability of 121.5 MHz ELT beacons, and their high false-alarm rate, has resulted in much time wasted, and massive searches for missing aircraft. 406 MHz ELT beacons, designed to solve this problem, are now available and in use. Soon NOAA satellites will no longer relay distress signals from the older ELT beacons. This will not eliminate the value of ADS-B data, but suggests the potential increased benefits to SAR of a combination of these systems.

Overview

The search and rescue (SAR) system relating to missing and downed aircraft in Alaska involves both federal and state agencies, including the Alaska Air National Guard (ANG), the US Coast

Guard (CG), the FAA, the National Oceanic and Atmospheric Administration (NOAA), the Alaska State Troopers (AST), and the Alaska Civil Air Patrol (CAP). In the area of northern Alaska, which includes the Y-K Delta, the coordination of SAR missions is the responsibility of the Alaska Rescue Coordination Center (RCC), manned continuously by ANG personnel.

The RCC reacts to notification of missing or downed aircraft from individuals, the FAA and other agencies, including NOAA, which reports the receipt of distress signals from Emergency Locator Transmitter (ELTs) carried aboard aircraft. The resources of the ANG and/or the CAP are directed to initiate the search to verify the authenticity of ELT reports and to initiate a search to locate the aircraft. AST aircraft and ground search teams participate in many searches. ANG helicopters perform the majority of rescues of survivors at crash sites.

Historically, large and lengthy searches for missing aircraft have been frequent in Alaska. Lacking modern navigation and communication equipment, flying visually in unpredictable weather, and leaving little information upon which to base the search , many aircraft vanished. Even with information concerning the pilot's intended route of flight, searches were often unsuccessful. Reducing this uncertainty, shortening the search phase required to locate downed aircraft, and increasing the chance of the successful rescue of survivors, has been a continuing SAR objective.
.
As a result of a massive, but unsuccessful, search for prominent figures who were lost on an Alaskan flight, the installation of ELTs was directed by the FAA.
These ELTs were designed to transmit a distress signal, upon impact of the aircraft, to alert other aircraft flying overhead. To provide a better receiving source for these signals, and better location data, a system of search and rescue satellites (SARSAT) was deployed, which is managed by NOAA. The SARSAT system is now part of an international system designed to locate aviators, mariners, and other users in distress. This system has serious limitations, and is currently undergoing change. ELTs activate properly in only a limited number of aircraft crashes. Hence, not all searches are based on ELT data.

The component of the Capstone airborne system that is most relevant to SAR is the Automatic Dependent Surveillance-Broadcast (ADS-B) function. An onboard Universal Access Transceiver continuously broadcasts the GPS- based position of the aircraft and other information through ground stations to the Anchorage Center and other aircraft, and is available to operators for flight following. The potential for monitoring the location of Capstone equipped aircraft, and noting the loss of ADS-B data, could initiate the SAR process, whether or not the onboard ELT functions, and track data can also be retrieved by the Anchorage Center if the aircraft is reported missing or overdue, to determine the last known position (LKN). This potential has been demonstrated in an accident during the Capstone Phase 1 Program, involving the saving of a Capstone pilot's life.

Search and Rescue Satellite-Aided Tracking

The Search and Rescue Satellite-Aided Tracking system (SARSAT), which is part of the international Copas-Sarsat Program, uses NOAA satellites in low-earth and geostationary orbits to detect and locate aircraft, ships and individuals in distress. The aircraft component of this system is based on distress signals from ELT beacons. NOAA satellites relay these signals through a network of ground stations to the U.S. Mission Control Center (USMCC) in Suitland, MD, which dispatches the distress signals to the appropriate SAR authorities, in Alaska, these are either the Alaska Air Guard RCC (in the north) or the US Coast Guard(in the south).

Emergency Locator Transmitters

It is the stated purpose of SARSAT to take the search out of search and rescue. This is a work in progress, heavily dependent on the acceptance and installation of a new generation of ELTs. The older generation of ELTs transmit distress signals by a beacon on a frequency of 121.5 MHz The newer generation of ELTs transmit distress signals by a beacon on a frequency of 406 MHz.

NOAA concludes that the approximately 170,00 older generation in service have been proven to be highly ineffective, based on a 97% false alarm rate, and indications that they activate properly only 12% of the time. NOAA anticipates many improvements in SAR with a switch to the 406 MHz beacons, including putting assets on scene sooner, by dispatching rescue assets on first alert. The average saving in time for inland SAR is estimated to be six hours, Further, an FAA study concluded that 134 lives and millions of dollars in SAR resources could be saved per year by mandating the 406 MHz ELTs. All pilots are highly encouraged to make the switch to the more expensive ELTs,

NOAA has made a decision to phaseout 121.5 MHz satellite alerting on February 1, 2009, after which time the continued use of the older generation ELTs will either not be supported, or will require the maintenance of SAR search assets, such as the CAP. This is a crucial decision, which will effect the cost of SAR and relate to the potential benefit of Capstone-like equipment to facilitate the location of missing aircraft.

Search and Rescue Assets

The Alaska Air National Guard 11tth Rescue Coordination Center (RCC) is equipped and staffed continuously to processes alerts relating to missing aircraft and aircraft in distress over the land mass of northern Alaska, including the Y-K Delta area. The US Coast Guard, has responsibility for coordinating off- shore water SAR activities The SAR assets at the disposal of the RCC include those of three ANG rescue squadrons, and the assets of the Alaska Civil Air Patrol (CAP).

SAR assets of the Alaska Air National Guard (ANG) stand 24-hour alert, as does the RCC. They are located at Kulis ANG Base in Anchorage, Alaska . The 210th Rescue Squadron is equipped with C-130 type aircraft, the 211th Rescue Squadron is equipped with C-130 aircraft, and the 212th Rescue squadron is composed of specially trained para-rescue personnel. In combination, ANG aircraft, helicopters and personnel are capable of performing all-weather, night, long-range SAR missions. As military units, they are subject to deployment to other locations where their SAR capability is required.

The Civil Air Patrol was formed at the onset of WW II to patrol the East coast and the Gulf of Mexico for enemy submarines, which were menacing shipping. After the war, its primary role became searching for missing aircraft, civil and military. The CAP is an Auxiliary of the USAF, which provides it aircraft and limited funding to defer the costs for SAR and related training. All aircrews are volunteers, and they operate primarily single-engine aircraft suitable for search missions, including Beavers, some equipped with skis or floats. A CAP squadron is located in Bethel, Alaska, where at least one Capstone equipped Cessna 180 is always available for search missions tasked by the RCC.

The precise navigational capability, and search pattern feature of the Capstone avionics, has supported more efficient performance of search missions. The CAP reports that the ability to monitor Capstone equipped search aircraft permits their redeployment and enhances the safety of SAR searches.

Search and Rescue Costs

The costs for SAR search missions vary as a function of the time spent on the mission and the operating expenses of the equipment used. One reason for the continued use of CAP aircraft for search missions is the lower costs to employ them over military assets, when the circumstances are appropriate, such as in large, extended, daytime searches for missing aircraft. Conversely, night searches and those over long distances, or requiring the use of specialized equipment (FLIR, night vision gear), are normally assigned to ANG C-130 aircraft, and, when sufficient information is available, ANG helicopters with para-rescue jumpers are dispatched to locate and rescue survivors.

Cost and mission times were not available from the RCC. The Alaska CAP Wing provided the information in Figure G-1, which compares the hourly operating expenses of a CAP aircraft and crew with the estimated costs for fuel and crew of ANG, Alaska State Trooper and fixed base operator (FBO) rental aircraft. The comparison of total costs are based on the number of hours (632) flown by the CAP on SAR missions during a recent year.

The overall costs for SAR in Alaska are shared by the State of Alaska and the federal government. Agencies that perform SAR related to aircraft also have responsibilities for other activities, which are part of SAR in a broader sense. Notification of a missing snow machiner, or the urgent need for fuel to operate a power plant at a remote village in sub-zero weather, are responded to with the same assets as for missing or downed aircraft.

Search and Rescue Missions

During the period 1999-2004, a total of 1179 RCC missions SAR missions occurred. Of these missions, 949 (80%) were initiated on the basis of ELT distress signals. Air searches were involved in 581 (61%) of ELT searches, while 368 (39%) were determined to be false alerts by CAP ground search teams. In 73 (13%) of ELT air searches, the RCC awarded lives saved or assisted by SAR aircrews. During this same period, 230 non-ELT missions involving air search were conducted (20% of the total RCC missions). In 86 (37%) of these missions, the RCC awarded lives saved or assisted by SAR aircrews.

The distribution of SAR mission categories in each of the years 1999 – 2004 is presented in Figures G-2 through G-7. The trends in SAR activity over this same period are presented in Figures G-8 through G-11.

There has been s general decrease in the number of SAR missions (31%). The total number of ELT missions involving air search declined by 39%. The overall decrease in the ELT false alarm rate (48%) shows the most variability, which is consistent with the unreliability of the older generation of ELTs. The number of non-ELT missions involving air search decreased by 33%.

The decrease in the number of SAR missions, most notably the reduction in non-ELT missions, is consistent with the reduction in aviation accidents during the Capstone Phase 1 Program. Collectively, these figures indicate the SAR mission categories where the capabilities of Capstone equipment could have benefited SA.R. In the ELT mission category, Capstone data could have assisted in more quickly locating downed aircraft; in the non-ELT mission category, it had an even greater potential for shortening the search process, and for reaching survivors in the critical time available to save lives.
.
A successful SAR mission for a downed, Capstone equipped aircraft occurred on the night of October 28, 2002 near Marshall, Alaska. The Alaska RCC Commander provided the following information on this mission:

"The accident happened on 28 Oct 02. There is no ELT information in our mission folder, suggesting no signal was ever emitted/received. The C-107 aircraft was on a VFR flight plan, probably on file with (the operator). The aircraft departed Marshall at 1950L, headed for Bethel. The aircraft was reported overdue to the RCC by the Alaska State Troopers (AST) at 2220L .Approx. 30 minutes after being notified by AST, we received last known position (LKP) information from Anchorage Center: N61-51.275, W161-51.275. A search asset (ANG helicopter) was tasked and airborne at 2330L with AST and medical personnel on board. At 0050L, the RCC received a report that the aircraft had been located, and the pilot's injuries were being stabilized prior to being airlifted to Bethel. Actual crash position was N61-48.928, W162-00.742, about 6 miles from the LKN from Anchorage Center. No mention of Capstone in our mission folder, but I'm guessing that's how Anchorage Center got their information, which was a great help in locating the downed aircraft, since there was no ELT signal."

As will be noted in the RCC Commander's report, information concerning the source of the data on which the LKP report was based was not in the RCC mission folder. By interview, it was determined that this is not an exception, but that RCC records do not indicate whether missing or overdue aircraft are Capstone equipped. As to the potential benefits of ADS-B data, the Commander and the Operations Officer stated: "anything that narrows the search area has a value in saving search time in locating the crash, and improving the chance of saving lives. Unfortunately, our database does not show the number of fatalities found, nor if there were survivors in a crash that subsequently died during the search effort. We only track saves and assists."

Conclusions

The Capstone program has contributed to an improved safety climate in the Y-K Delta. The accident rate has been reduced, and the requirements for SAR have diminished. The ability of Capstone ADS-B data to be used to support the initiation of SAR actions in the event of an accident has been a benefit to pilots and passenger each time a Capstone aircraft flies. Together with putting into the hands of pilots the avionics to navigate precisely, clear terrain safely and avoid accidents, the ADS-B provides operators the ability to follow their aircraft and immediately detect when one is in distress or down. This translates into a level of confidence that SAR help will be dispatched, independent of whether the ELT activates properly, or communication is possible.

This benefit has been realized in at least one instance, resulting in the saving of a pilot's life. Based on the ADS-B track data trail, which was available to the Anchorage Center, the coordinates of the last transmission of a Capstone reported as overdue served as the reference point for dispatching SAR assets. The elapsed time from the notification to the RCC of this accident until the pilot was receiving medical treatment was 2 hours and 30 minutes, a remarkable SAR mission.

The phases of the SAR process begin with the notification to the RCC that an aircraft is missing, overdue or down, followed by the search phase, which varies in length as a function of the uncertainty involved. The greatest potential for affecting the outcome of SAR occurs in the search phase. Time is the most important factor in locating and rescuing survivors. The objective is to shorten this phase by providing the most accurate location information possible on the downed aircraft to the RCC at the outset. The value of ADS-B data increases in accidents where there is no ELT signal. Current ELTs have a high false alert rate, and provide uncertain location information; ADS-B data can assist the RCC in resolving this uncertainty.

Newer generation ELTs are expected to remove the uncertainty associated with the older generation of ELTs. These expectations may not be totally realized. In any event, The ELT concept is for emergency use only, while the ADS-B system operates continuously. One would operate until an accident, and the other initiates operation at this point, and. will not provide the other benefits of the ADS-B system. This concept which may emerge may be that of redundancy, or the two technologies may be integrated. The cost of a newer generation ELT is forecast to be $1,500.

In the meantime, procedures relating to the monitoring of ADS-B data from Capstone equipped aircraft and its use to expedite the SAR process may be refined, to the benefit of the survivors of any future Capstone accidents.

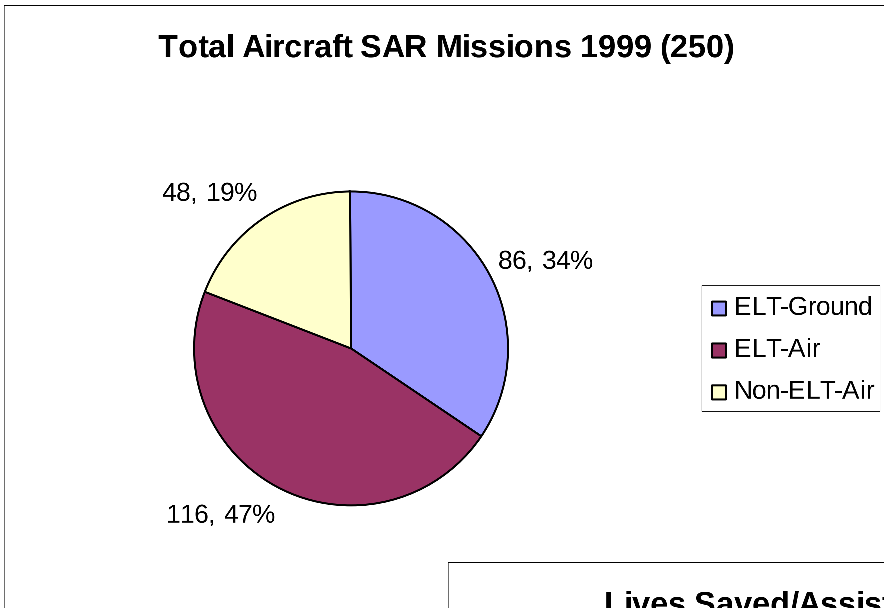
Figure G-1

Comparison of Alaska SAR Aircraft Costs

Civil Air Patrol	HC-130N – if available	HH-60 – if available	State Helo – if available	F.B.O. Aircraft – if available
Average cost per hour with fuel & a Volunteer Crew $85	Average cost per hour with fuel & Crew $5500 (OR 65 CAP AIRCRAFT)	Average cost per hour with fuel & Crew $2,700 (OR 32 CAP AIRCRAFT)	Average cost per hour with fuel & Crew $1,600 (OR 19 CAP AIRCRAFT)	Average cost per hour with fuel & Crew $305 (OR 4 CAP AIRCRAFT)
x 632 hours $53,720	$3,476,000	$1,706,400	$1,011,200	$192,760

Figure G-2

Alaska SAR Aircraft Missions
- 1999 -



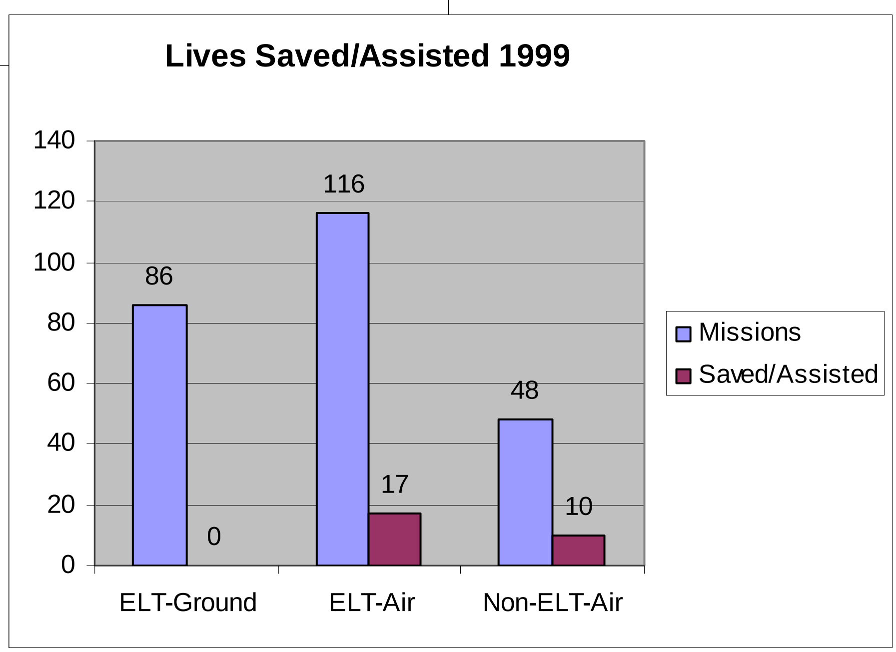
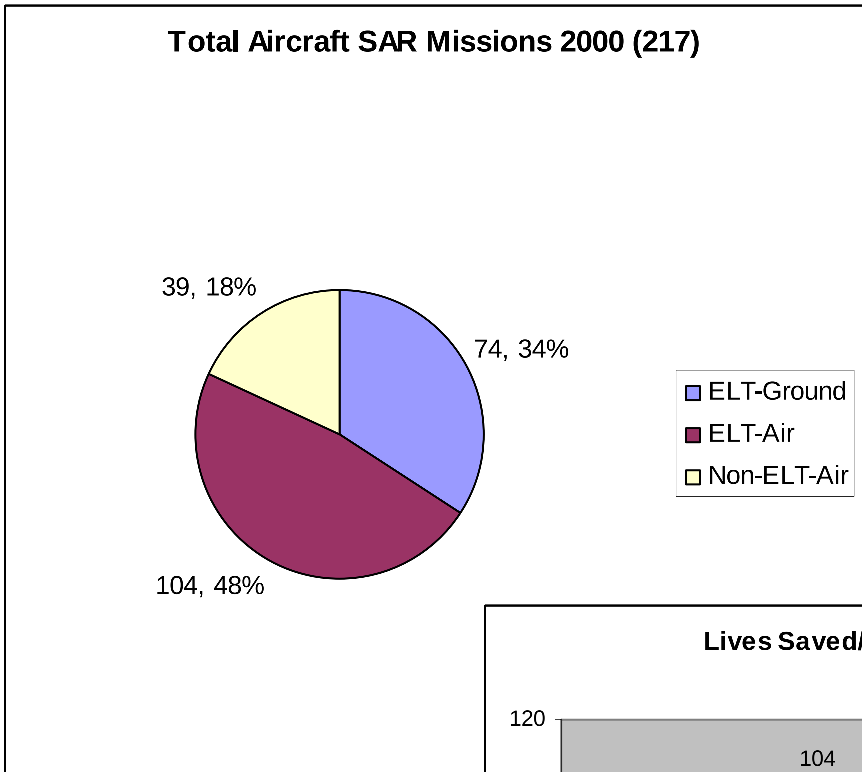


Figure G-3

Alaska SAR Aircraft Missions
- 2000 -



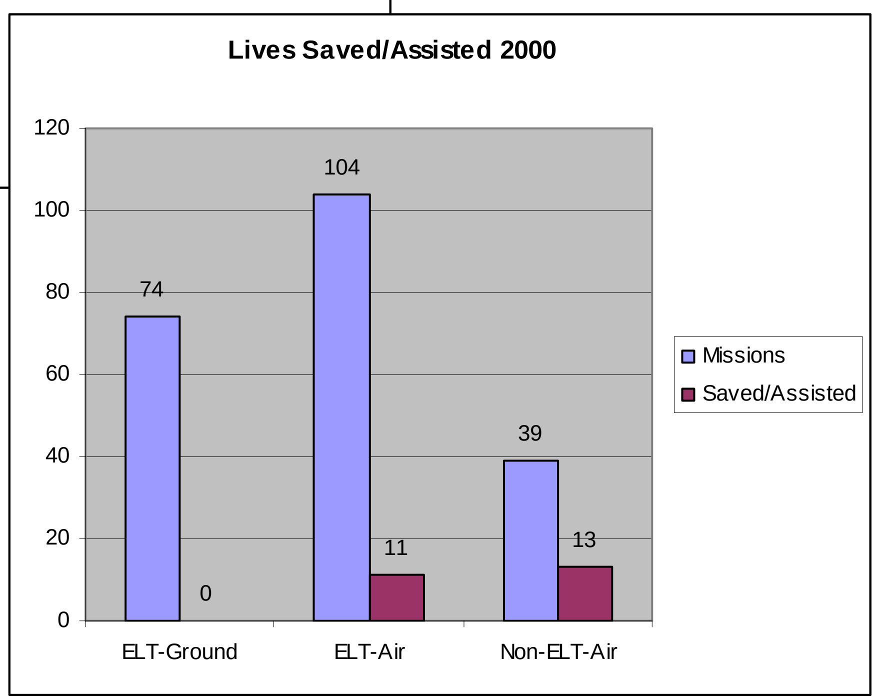
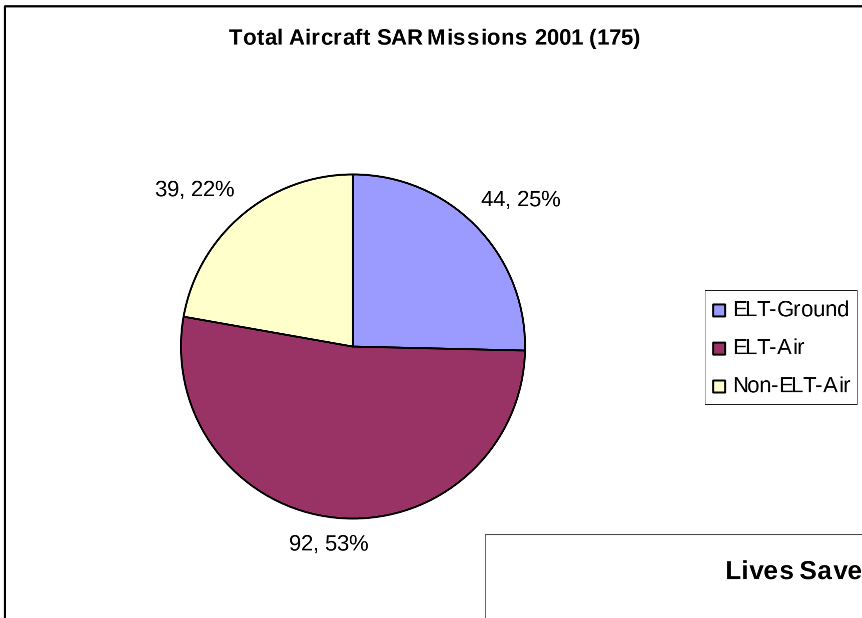


Figure G-4

Alaska SAR Aircraft Missions
- 2001 -



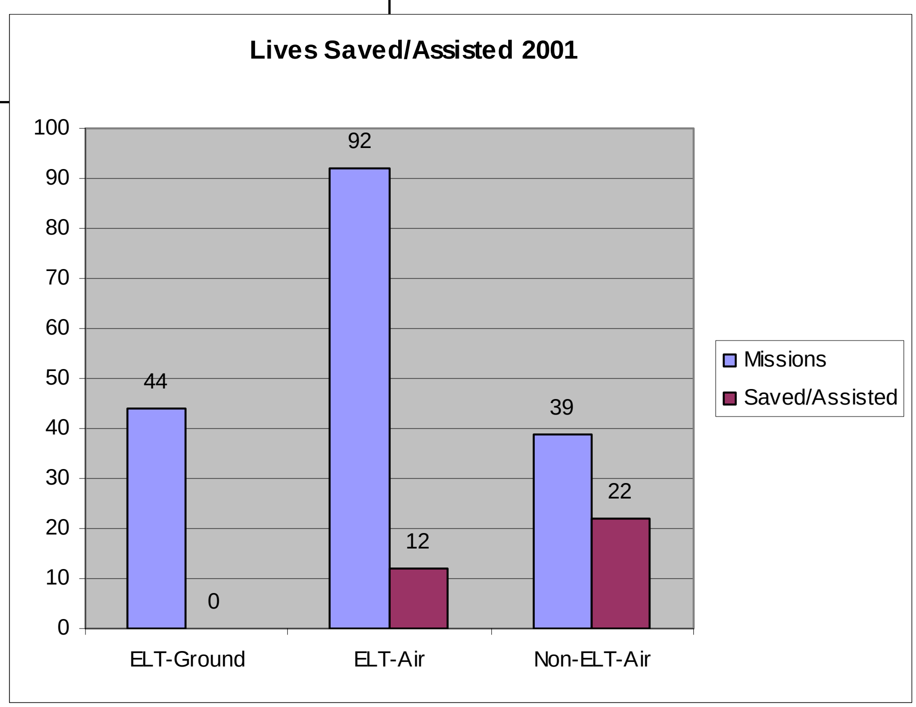
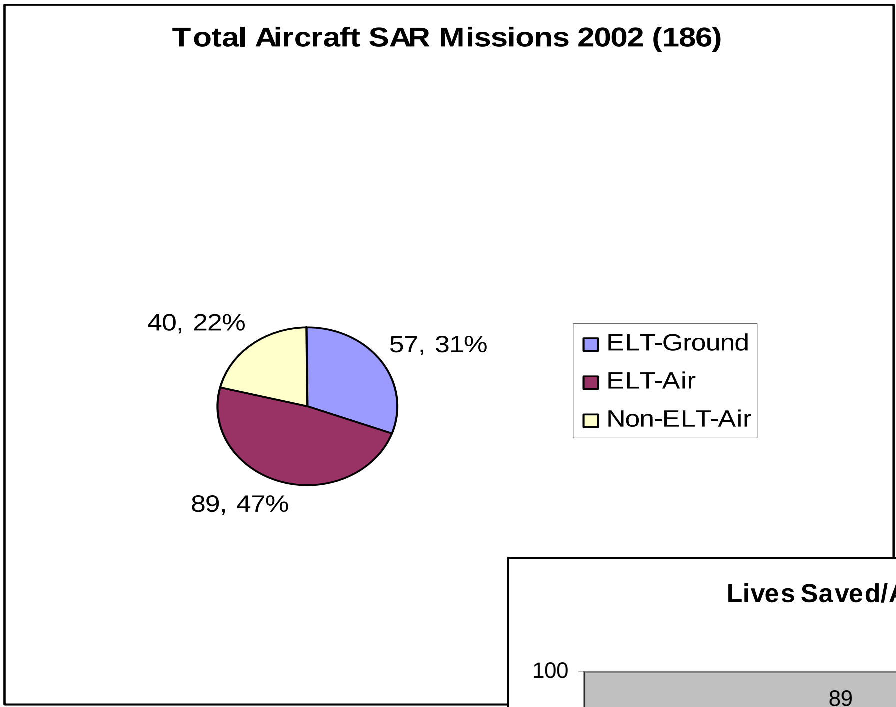


Figure G-5

Alaska SAR Aircraft Missions
- 2002 -



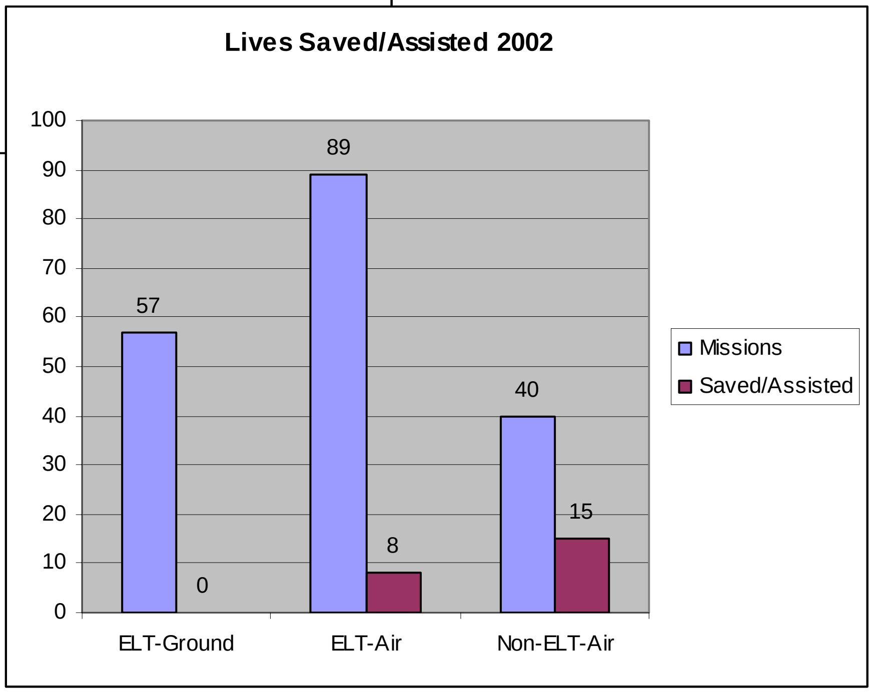
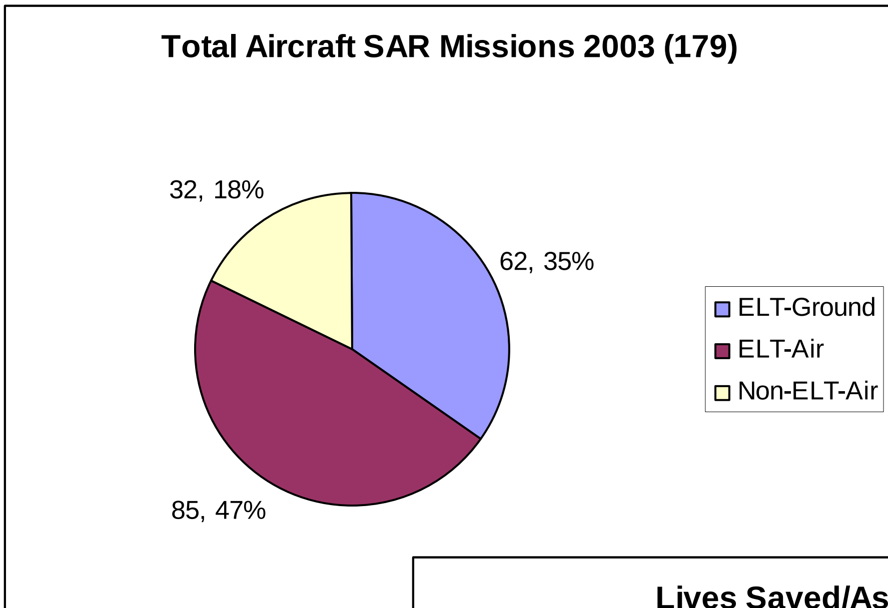


Figure G-6

Alaska SAR Aircraft Missions
- 2003 -



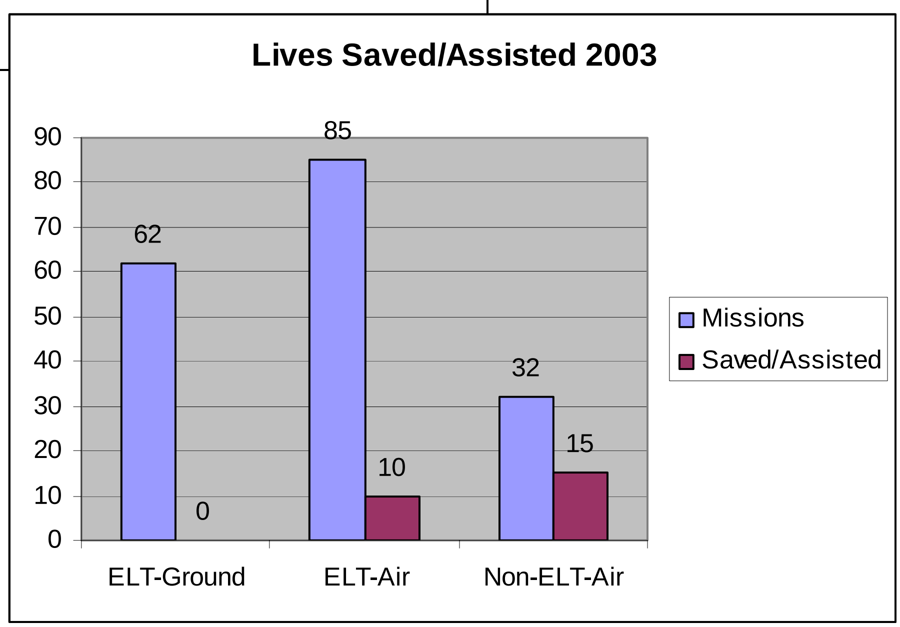
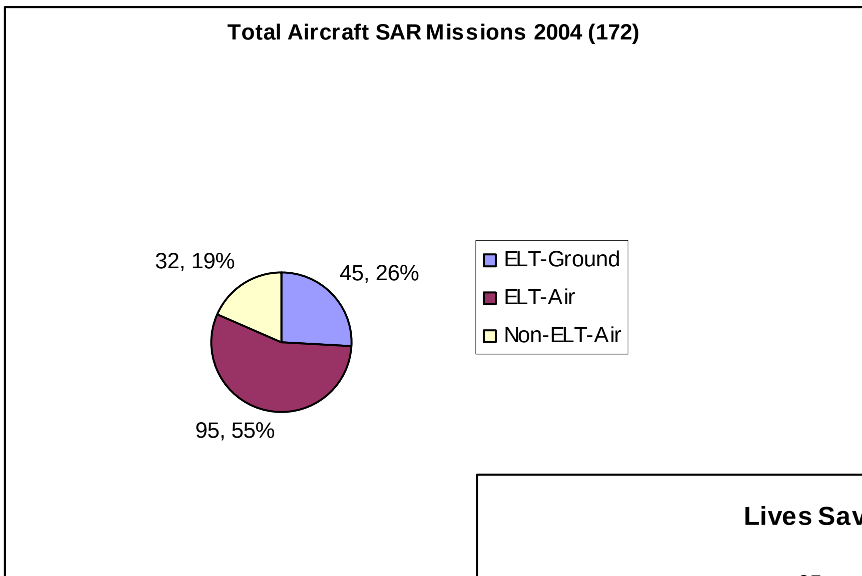


Figure G-7

Alaska SAR Aircraft Missions
- 2004 -



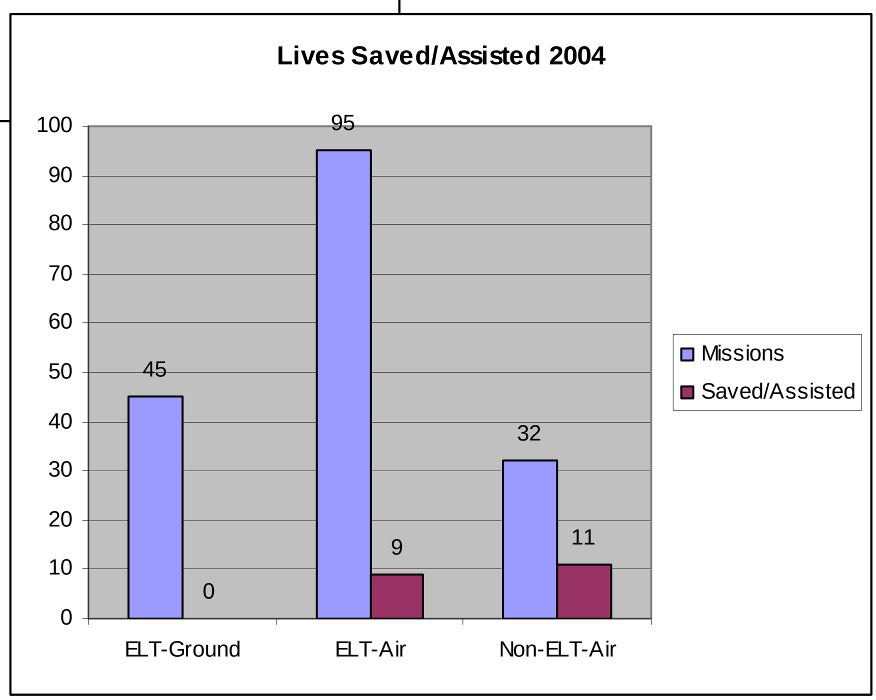


Figure G-8
Total SAR Aircraft Missions

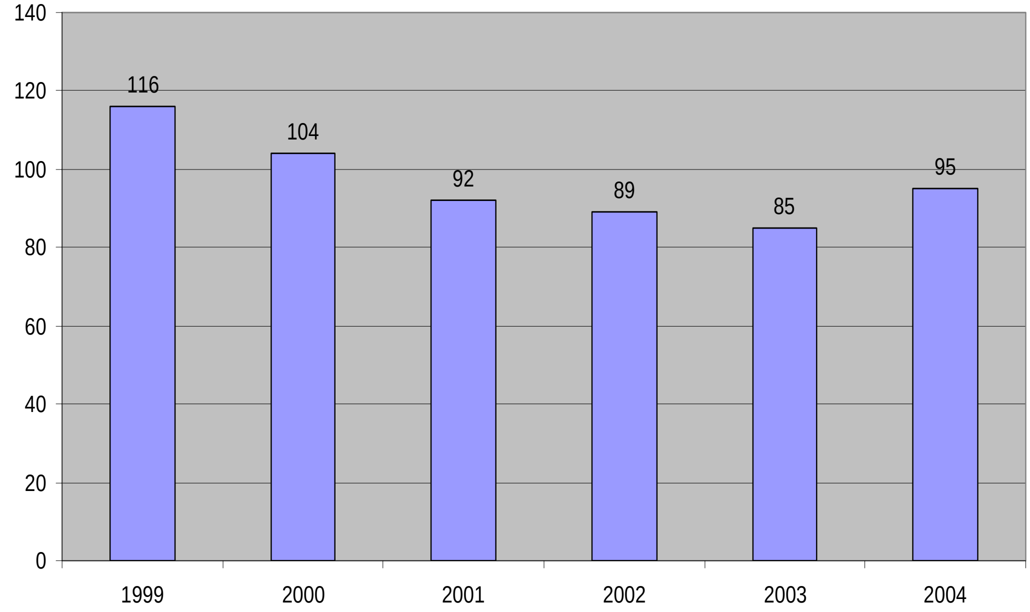


Figure G-9
ELT Missions Involving Air Search

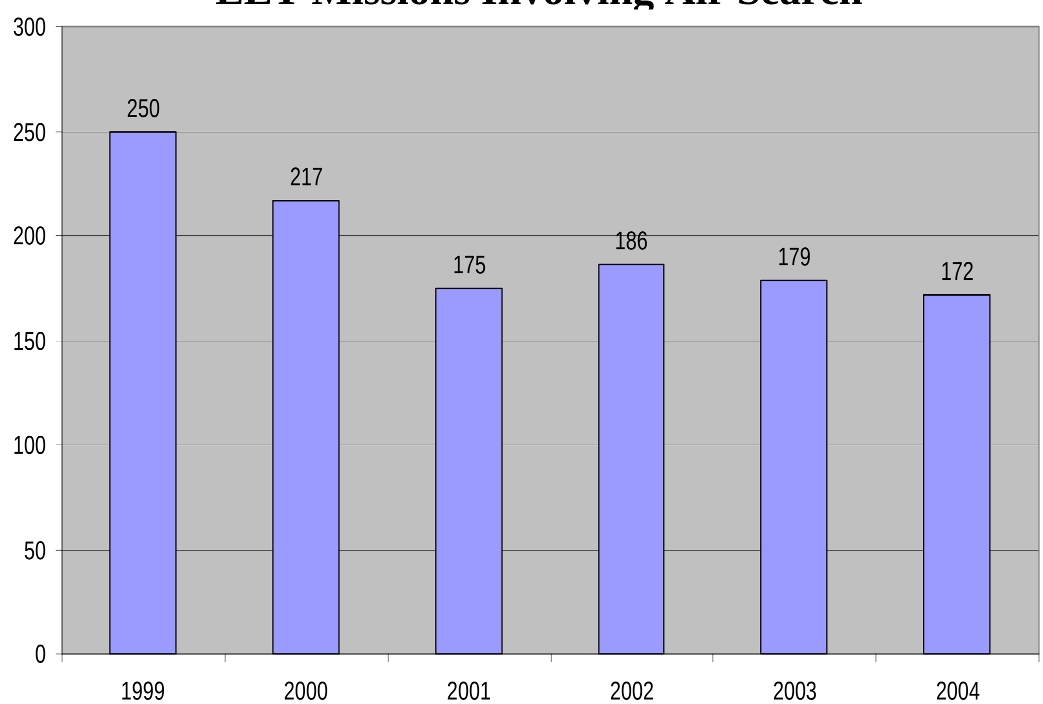


Figure G-11

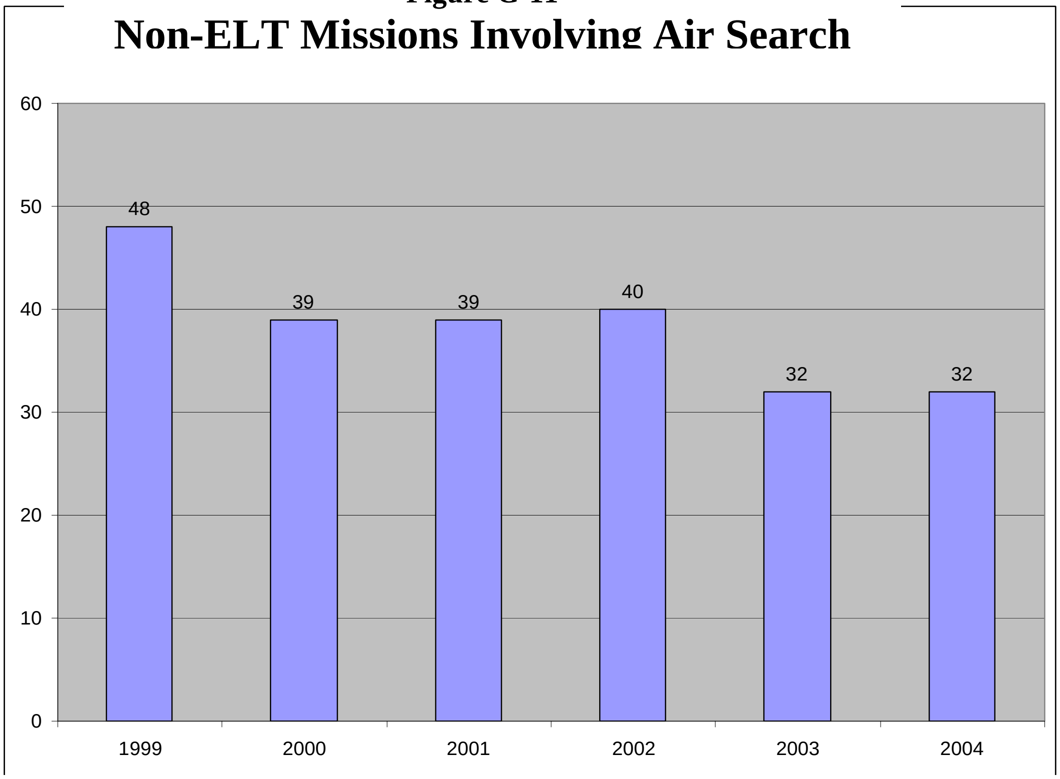
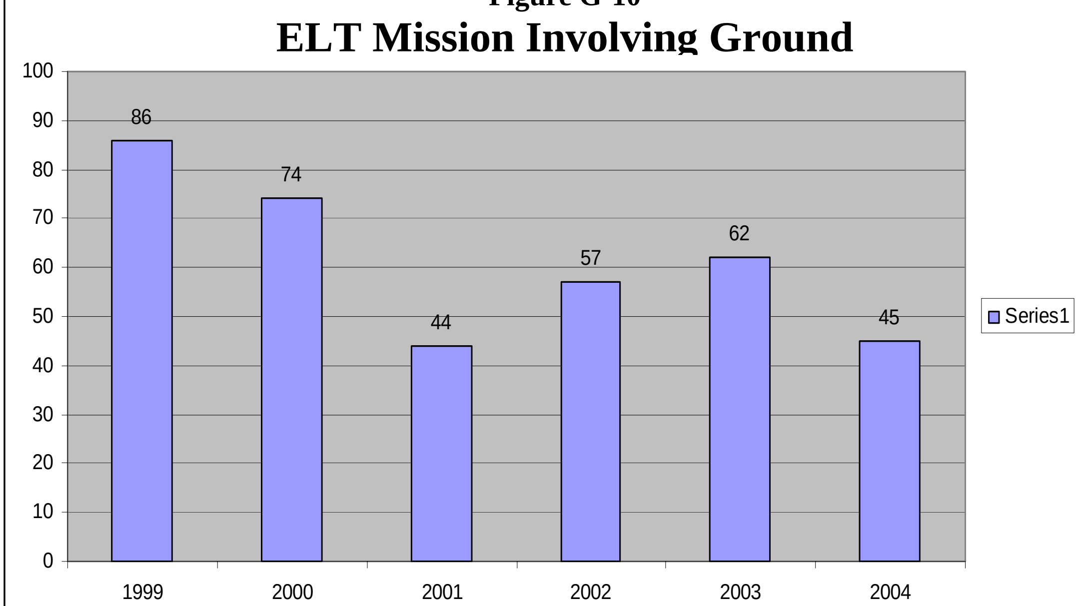


Figure G-10



6.8 Appendix H: Acronyms

ADS-A	Automatic Dependence Surveillance-Addressed
ADS-B	Automatic Dependence Surveillance-Broadcast
AF	Airways Facilities
AIM	Aeronautical Information Manual
ANICS	Alaska NAS Interfacility Communications System
AOPA	Aircraft Owners and Pilots Association
ARINC	Aeronautical Radio Inc.
ARTCC	Air Route Traffic Control Center
AT	Air Traffic
ATC	Air Traffic Control
ATCT	Air Traffic Control Tower
AWOS	Automated Weather Observation System
CCCS	Capstone Communication Control Server
CNS	Communications, Navigation, and Surveillance
CSSPP	Capstone System Safety Program Plan
CSSWG	Capstone System Safety Working Group
DT&E	Developmental Test and Evaluation
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FDN	Functional Description Narrative
FIS-B	Flight Information Services-Broadcast
GBT	Ground Broadcast Transceiver
GPS	Global Positioning System
HBAT	Handbook Bulletin for Air Transportation
HBAW	Handbook Bulletin for Air Transportation and Continuous Airworthiness
ICD	Interface Control Document
IDS	Interim Design Specification
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
IOC	Initial Operational Capability
LMATM	Lockheed Martin Air Traffic Management
MASPS	Minimum Aviation System Performance Standards
MFD	Multi Function Display
Micro-EARTS	Micro Enroute Automated Radar Tracking System
MOPS	Minimum Operational Performance Standards
MOU	Memorandum of Understanding
MSAW	Minimum Safe Altitude Warning
NAS	National Airspace System
NATCA	National Air Traffic Controllers Association
NCP	NAS Change Proposal
NOTAM	Notice to Airmen

NTSB	National Transportation Safety Board
OT&E	Operational Test and Evaluation
PHA	Preliminary Hazard Assessment
PTRS	Problem Trouble Reporting System
SER	Safety Engineering Report
SF21	Safe Flight 21
STC	Supplemental Type Certificate
TEMP	Test and Evaluation Master Plan
TIS-B	Traffic Information Services-Broadcast
TSO	Technical Standard Order
UAA	University of Alaska-Anchorage
UAT	Universal Access Transceiver
UPS AT	United Parcel Service Aviation Technologies
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
WJHTC	William J. Hughes Technical Center
Y-K	Yukon-Kuskokwim
ZAN	Anchorage Air Route Traffic Control Center