Alaska Aerospace Corporation Business Plan

Prepared for

Alaska Aerospace Corporation

March 2016

Northern Economics

Wisdom • Trust • Relevance • Innovation

Alaska Aerospace Corporation Business Plan

AAC: Proprietary and Confidential

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Prepared by

Northern Economics

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Contents

Section		Page
Abbreviations		**iv**
Executive Summary		**1**
1	**Introduction**	**1**
1.1	Objectives	2
1.2	Approach	2
1.3	Schedule	3
1.4	Report Layout	3
2	**AAC: Mission, Background, and Capabilities**	**4**
2.1	Mission	4
2.2	Background	4
2.2.1	Launch History	5
2.3	Payload Categories, FAA	5
2.4	Capabilities	6
2.4.1	Launch to Polar Orbit	8
2.4.2	Unobstructed Down Range Flight Path	8
2.5	Emerging Markets	9
3	**Aerospace Markets**	**10**
3.1	Small Imaging Satellites	11
3.1.1	Skybox Imaging	11
3.1.2	Planet Labs	12
3.1.3	OneWeb	13
3.1.4	World View	13
3.1.5	Surrey	13
3.2	Launch Vehicles	14
3.2.1	Rocket Lab Electron	14
3.2.2	Firefly Alpha	14
3.2.3	Super Strypi XBow.	14
3.3	Shift to Low Costs, More Frequent Launches	15
3.4	Spaceflight Market Prices, November (2015)	15
3.5	PSCA Capabilities	16
3.6	Standard Launch Services	17
3.6.1	Orbital ATK	17
3.6.2	Lockheed Martin	17
3.6.3	Missile Defense Agency	17
3.6.4	Potential: Blue Origin	17
3.6.5	Potential: SpaceX	18
3.7	Test Missions	18

3.7.1 Terminal High Altitude Area Defense 18
3.7.2 Raytheon 18
3.8 Mobile Range Safety and Telemetry System Services 18
3.8.1 Space Florida 18
3.8.2 Rocket Lab 19
3.9 Other, Emerging Markets 19
3.9.1 Joint Venture Services 19
3.9.2 Unmanned Aircraft Systems 19
3.9.3 Other Markets 21

4 AAC Strategic Analysis 22
4.1 Strengths 22
4.2 Weaknesses 23
4.3 Opportunities 24
4.4 Threats 25

5 Financial Operations 27
5.1 Operations, Budget, FY2014 to FY2016 27
5.2 Potential Operations 27
5.3 Pro Forma Revenue Estimates 27
5.3.1 Projected Launches, Contracts, Missions 28
5.3.2 Revenue Pro Forma 29
5.3.3 Cumlative Revenue Forecast 29
5.4 Pro Forma Costs 30
5.4.1 FY2015 Costs 30
5.4.2 Fixed Cost Base 31
5.4.3 Break-even Analysis 31
5.5 Sensitivity Analysis 31
5.5.1 Direct Funding 31
5.5.2 Missions, Revenues, and Costs, FY2016–FY2021 31
5.5.3 Sensitivity Results 32

6 Conclusions 33
6.1 Market Changes 33
6.2 AAC Organizational Changes 33
6.3 Financial Feasibility 33
6.4 Probability of Success 33

7 References 34

Table **Page**

Table ES-1. Base Launches, Contracts, Missions, Forecast, AAC, FY2016 to FY2021 4
Table ES-2. Base Revenue Forecast, AAC, FY2016 to FY2021 4
Table ES-3. Cumulative Revenue Forecast, AAC, FY2016 to FY2021 5
Table ES-4. Pro Forma Operating Income, AAC, FY2016 to FY2021, Sensitivity Analyses 5

Table 1. PSCA Orbital Launch Vehicles 5
Table 2. Public Pricing by Orbit and Payload Mass, November 2015 16
Table 3. AAC, Operating Results for Two Years, FY2016 Budget 27
Table 4. Potential AAC Revenue by Launch or Mission 28
Table 5. Base Launches, Contracts, Missions, Forecast, AAC, FY2016 to FY2021 28
Table 6. Base Revenue Forecast, AAC, FY2016 to FY2021 29
Table 7. Cumulative Revenue Forecast, AAC, FY2016 to FY2021 29
Table 8. Pro Forma Operating Income, AAC, FY2016 – FY2021, Sensitivity Analyses 32

Figure **Page**

Figure ES-1. Alaska Aerospace Corporation, SWOT Analysis Summary 3

Figure 1. Kodiak, Narrow Cape, General Location Map 1
Figure 2. Pacific Spaceport Complex, Narrow Cape, Alaska Aerospace Corporation 2
Figure 3. Pacific Spaceport Complex, Kodiak 3
Figure 4. Kodiak Launch Complex, Overview 7
Figure 5. PSCA Launch Azimuths and Inclinations 9
Figure 6. Six CubeSats and Deployment Systems. 11
Figure 7. Small Imaging Satellites 12
Figure 8. Svalbard Ground Station 13
Figure 9. PSCA Capabilities, Grouped 16
Figure 10. Forecast of Unmanned Aircraft, 2016 to 2020, in Millions, by Type 20
Figure 11. SWOT Analysis Summary 22
Figure 12. FY2015 Expenses, by Type and Amount, in Percent 30

Abbreviations

AAC	Alaska Aerospace Corporation
AIDEA	Alaska Industrial Development and Export Authority
ARRC	Alaska Railroad Corporation
FAA	Federal Aviation Administration
FY	Fiscal Year
ISS	International Space Station
KSAT	Kongsberg Satellite Services (Norway)
LP	Launch Pad
MDA	Missile Defense Agency
NASA	National Aeronautics and Space Administration
P3	Public-Private Partnership
PFF	Payload Processing Facility
PSCA	Pacific Spaceport Complex Alaska
RLV	Recoverable Launch Vehicle
RSTS	Range Safety and Telemetry System
SMC	U.S. Air Force Space and Missile Systems Center
SSTL	Surrey Satellite Technology Ltd.
STARS	Strategic Target System
SWOT	Strengths, Weaknesses, Opportunities, Threats
THAAD	Terminal High Altitude Defense
UAS	Unmanned Aircraft Systems
ULA	United Launch Alliance (Lockheed Martin, Boeing)
VAR	Value Added Reseller

Executive Summary

Northern Economics believes the Alaska Aerospace Corporation (AAC) is well positioned to meet market trend for smaller satellites that are launched more frequently, and on a low cost-controlled basis, especially for those orbits needed for full global coverage: images, sun synchronous orbits, and post-launch data tracking of high latitude satellites.

In addition, AAC has moved towards a Public-Private Partnership organization. This allows AAC to expand beyond Alaska and, as an example, it has recently formed a Joint Venture to market its Range Safety and Telemetry System. Other emerging markets include unmanned aircraft systems, especially for commercial models, and a varied of services related to data downlink operations and maintenance.

Background

In September 2015 AAC, based in Anchorage, Alaska, asked Northern Economics Inc., to assist the corporation with development of a business plan. AAC is a State of Alaska corporation, formed in 1991 to serve as a west coast launch facility for commercial, government, and military customers.

Since its inception, AAC has launched 17 rockets for the U.S. government until October 2014 when a U.S. Army rocket was destroyed for safety reasons. An estimated $34 million of repairs and replacement are being made to bring the Pacific Spaceport Complex – Alaska (PSCA) back into operational status at Near Cape, south of the City of Kodiak, on Kodiak Island. AAC expects the facility to be fully functional in mid-2016.

Previously, PSCA's primary customer was the U.S. Missile Defense Agency. The agency discontinued its Kodiak launches in 2009 and PSCA subsequently requested State of Alaska operating funds, for the first time, in Fiscal Year (FY) 2011. A total of $30 million was received in phases: two years at $4 million (FY2011, FY2012), another two years at $8 million (FY 2013, FY2014), and a final, single, year at $6 million (FY2015). No further state funding is planned (or expected).

In addition to this business plan, AAC has worked with attorneys to transition the state-owned corporation into a Public-Private Partnership (P3). This type of organization would allow AAC to expand beyond State of Alaska boundaries as well as secure contracts and obtain additional financing, perhaps through a joint venture or other types of business arrangements that were excluded due to state ownership.

Diversification

AAC's Board of Directors approved the corporation's request to seek P3 status, allowing it to diversify beyond the State of Alaska, to enter into Joint Ventures, and to position itself as a customer-oriented firm with substantial aerospace assets. One current example is the Board's approval (Resolution #16-02, February 2016) to enter into a joint venture for world-wide marketing and operations of the Range Safety and Telemetry System (RSTS).

Another emerging market for Alaska is the very rapid growth of Unmanned Aircraft Services (UAS). While the most explosive growth is forecasted for small, hobbyist systems, the Federal Aviation Administration (FAA) suggests commercial unmanned aircraft up to 55 pounds, costing an estimated average price of $40,000, will grow steadily.

AAC has the ability to access the FAA's UAS database and secure permission of UAS operations on a mission by mission basis. This service could be an entry into data tracking and processing, or even aerial photography for commercial and government use.

Business Plan Objectives

This business plan, prepared by analysts at Northern Economics working with officers and staff at AAC, provides additional research on current and potential markets, as well as projected (pro forma) operating statements for the years FY2016 through FY2021.

A key objective was helping to determine whether or not AAC has a strong chance to succeed as a P3 organization under current and near-term market conditions.

AAC does not have any long-term debt. Officers and staff have suggested AAC could seek Board permission to enter into capital expansion projects that would serve immediate market needs and generate revenue along with increased market share.

One possible use of this business plan is locating partners who could provide market entry into markets in much the same way as the joint venture now seeking RSTS projects.

Market Shifts

There are major changes occurring in the aerospace industry, including the following:

1. There is a market shift from large, heavy payloads to smaller rockets with medium to smaller sized payloads (satellites).
2. There is more emphasis on costs and cost containment, one that arguably started with SpaceX and its Falcon rockets in 2002.
3. The Department of Defense is shifting focus towards small satellite lift capacity.
4. There is a rapidly emerging market of small, low-cost, commercial rockets from developed space firms, as well as start-up companies., such as the Electron rocket by Rocket Labs and the Alpha rocket by Firefly.
5. For most of the market, there is increased launch frequency to meet the shorter lives of smaller, low earth-orbit satellites.

AAC is actively contacting firms and agencies as well off-shore aerospace organizations. Marketing staff are keeping potential customers aware of progress at the PSCA, where full operations are planned for mid-2016.

SWOT

Northern Economics conducted a SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) with results shown in Figure ES-1.

Figure ES-1. Alaska Aerospace Corporation, SWOT Analysis Summary

Strengths	Weaknesses
• Location—Launch site • Location—Launch corridor • Secure, Off-road • Sole U.S.-licensed, high latitude full service commercial spaceport • Cost-competitive operations • Launch availability • Federal Aviation Administration (FAA) licensed	• Location—PSCA limited to polar orbits • Remote • Logistics expense • Ownership by state • Funding support removed • Rebuilding from August 2014 anomaly • Staffing reduced • Lack of current customers • Lack of diversification
Threats	**Opportunities**
• Competition—Vandenberg • Competition—for suborbital • Competition—Non-U.S. sites • Competing horizontal launch vehicles • Minimum support staff • Limited local support • No Alaska government support • Political interference • Foreign launch site development	• P3 reorganization • High demand for small, low cost, satellite operations • Lower cost small-medium launch vehicles • Provide test range services • Provide mobile range services • Provide other support services (image, data downlink) • Logistics support with FedEx • Public process—education • Provide runway for direct air support • Unmanned aircraft system (UAS) growth • Demand for high latitude earth station • New spaceport development in U.S.

Source: Northern Economics, AAC

PSCA has several strengths, with many related to its high latitude location and wide downrange safety corridor. It is an FAA-licensed launch site and has an operating history that extends back to the early 1990s.

Current weaknesses relate to launch site reconstruction along with terminated state financial support. At the same time, AAC has a well-trained staff that can market mobile test and range safety services to other space ports, agencies, and firms. The P3 organization can help it overcome competition (primarily from Vandenberg Air Force Base in California) as AAC becomes more independent.

Pro Forma Operating Statements, FY2016 to FYT2021

Table ES-1 illustrates the estimated number of launches, contracts, and test missions, from FY2016 to FY2021. These estimates form the basis for projected revenues through FY2021 and are considered conservative but realistic.

Table ES-1. Base Launches, Contracts, Missions, Forecast, AAC, FY2016 to FY2021

Launch Type	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021
Standard Launches	0	0	1	0	1	0
Low Cost Launches	0	0	1	1	1	1
Range Safety, Telemetry System	0	1	2	4	4	4
Test Missions	0	2	2	3	4	4

Source: AAC, 2016

Operating revenues, expenses, and net income are shown in the tables below. These estimates are based on current operations, expected funding (especially funding for non-federal spaceports under the National Space Policy program), and a conservative market estimate for launches and services. Table ES-2 is a base revenue forecast for the years FY2016 to FY2021.

Table ES-2. Base Revenue Forecast, AAC, FY2016 to FY2021

	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021
Type			**($1,000)**			
Federal	2,550	2,000	2,500	2,500	2,500	2,500
General Fund	0	0	0	0	0	0
Capital	0	0	0	0	0	0
Subtotal	**2,550**	**2,000**	**2,500**	**2,500**	**2,500**	**2,500**
Standard Launches	0	0	2,500	0	2,500	0
Low Cost Launches	0	0	500	500	500	500
Subtotal	**0**	**0**	**3,000**	**500**	**3,000**	**500**
Range Safety, Telemetry	0	250	500	1,000	1,000	1,000
Test Missions	0	1,500	1,500	2,250	3,000	3,000
Subtotal	**0**	**1,750**	**2,000**	**3,250**	**4,000**	**4,000**
Imaging Sales	0.1	0.5	0.5	0.7	0.7	0.8
Downlink Sales	0.0	0.1	0.2	0.3	0.4	0.5
UAS Sales	0.0	0.1	0.3	0.5	0.5	1.0
Services & Studies	0.1	0.2	0.2	0.2	0.2	0.2
Subtotal	**0.2**	**0.9**	**1.2**	**1.7**	**1.8**	**2.5**
Total Revenue	**2,550.2**	**3,750.9**	**7,501.2**	**6,251.7**	**9,501.8**	**7,002.5**

Source: Northern Economics, AAC, 2016

Table ES-3, on the following page, summarizes estimated revenue by type and amount, along with a cumulative total from FY2016 to FY2021.

Table ES-3. Cumulative Revenue Forecast, AAC, FY2016 to FY2021

	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021
Estimated Revenue			**($1,000)**			
Current	2,550	2,000	2,500	2,500	2,500	2,500
Launch	0	0	3,000	500	3,000	500
Range Safety, Telemetry System	0	250	500	1,000	1,000	1,000
Test Range	0	1,500	1,500	2,250	3,000	3,000
Other	0.2	0.9	1.2	1.7	1.8	2.5
Total Revenue (rounded)	**2,550**	**3,751**	**7,501**	**6,252**	**9,502**	**7,003**
Total Expenses	4,613	4,300	4,100	4,500	4,700	4,700
Operating Income (Loss)	-2,063	-549	3,401	1,752	4,802	2,303
Cumulative Income (Loss)	**-2,063**	**-2,612**	**789**	**2,541**	**7,343**	**9,645**

Source: Northern Economics, AAC

Recently, AAC signed a Joint Venture agreement with a Florida firm to provide Range Safety and Telemetry System services. Revenues are included in the estimates shown above.

Sensitivity

Northern Economics conducted a sensitivity analysis with 10,000 randomized calculations of revenues, costs, and funding, using a series of assumptions more fully explained in the main report. Table ES-4 summarizes results by percentile of likelihood for the years FY2016 to FY2021.

Table ES-4. Pro Forma Operating Income, AAC, FY2016 to FY2021, Sensitivity Analyses

	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021
Percentile			**($1,000)**			
5	-2,378	-1,065	2,897	1,050	3,971	1,403
50	-2,063	-448	3,683	1,949	5,209	2,532
95	-1,748	228	4,565	2,944	6,605	3,836

Source: Northern Economics

These results suggest AAC has a 50 percent chance to generate a loss of $0.4 million (rounded) of net operating income for FY2017. At the 95 percent level (19 of 20 chances), estimated net income will be a maximum loss of $1.1 million (rounded) while at the 5 percent level (1 in 20 chances), the amount of revenue will be positive at $0.2 million (rounded)

Under the assumptions stated, AAC is expected to reach at least break even during FY2018, on an operating basis.

Further details of the sensitivity analysis are available in an Excel file from AAC.

Conclusions

Northern Economics believes AAC has a strong chance of breakeven results in each of the fiscal years from FY2018 to FY2021 under the assumptions stated. We believe the officers and staff are fully aware of their current situation and are working towards greater sales, controlled costs, and active marketing of the firm's operations.

1 Introduction

The Alaska Aerospace Corporation (AAC) is headquartered in Anchorage, Alaska, with launch services at Narrow Cape, Kodiak Island. Figure 1 is a general location map that shows Kodiak (on the north) and Narrow Cape (to the south).

Figure 1. Kodiak, Narrow Cape, General Location Map

Source: Google Earth Pro, 2015

Figure 2 is a more detailed image, showing the road system and launch pads at Narrow Cape. The site is known as the Pacific Spaceport Complex – Alaska (PSCA).

Figure 2. Pacific Spaceport Complex, Narrow Cape, Alaska Aerospace Corporation

Source: Google Earth Pro, 2015

1.1 Objectives

Declining oil prices have meant that state funding has been removed and, as a result, AAC wants to develop a business plan to meet the expanding market for small satellite launches, as well as diversification of revenues through commercial launch services at ranges other than PSCA and by providing services to the emerging commercial satellite imaging market.

1.2 Approach

The project began with a kick-off meeting in Anchorage at AAC headquarters. The meeting introduced team members, confirmed objectives and project schedule, and outlined data needs, from both external and AAC sources.

Other tasks focused on data collection, especially aimed at the recent expansion of small satellite launches. Following a web-based search, team members met with AAC's Vice President for Business Development and received a copy of a marketing report prepared for AAC by Avascent (2014).

Northern Economics' project manager conducted a site visit of the Kodiak launch facility, talking with staff and viewing AAC assets. Figure 3 illustrates the launch pad area at PSCA, currently under repair from a rocket explosion on August 25, 2014 (ADN 2014).

Figure 3. Pacific Spaceport Complex, Kodiak

Source: Northern Economics, 2015

Final project tasks included market estimates, pro forma financial preparation, a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis, and a draft report (and presentation), followed by a final report.

1.3 Schedule

Northern Economics' team members met with AAC officers and staff, and attended Board Meetings in October and November.

1.4 Report Layout

The remainder of this report is organized in the following sections:

Section 2: AAC's mission, background, and capabilities

Section 3: Discussion of the aerospace markets

Section 4: Assessment of AAC's strengths, weaknesses, opportunities, and threats

Section 5: Historical and pro forma financial analysis

Section 6: Conclusions

2 AAC: Mission, Background, and Capabilities

This section provides more information about AAC's mission, background, and operations, along with a summary of capabilities, including current launch capabilities, and its on-going efforts to diversify revenues by providing services such as imaging, downlink storage and relay, and range safety and telemetry.

Recent changes to AAC's direction have included initial steps to form a Public-Private Partnership (P3) that could serve markets outside Alaska, along with joint ventures.

2.1 Mission

AAC's mission is listed below, as drawn from the corporation's Strategic Plan 2011 – 2016:

> AAC remains committed to excellence in space launch operations, focusing on the unique capabilities of polar orbits from KLC [now PSCA]. AAC is also expanding into other high technology aerospace related business opportunities for the purpose of establishing a strong aerospace technology industrial base in Alaska and providing job opportunities for Alaskans. AAC will develop the aerospace industry in Alaska through public and private sector cooperation in education, training, research, workforce development, investment, and aerospace centric incentive programs which create a viable, sustaining, in-state aerospace business sector.

The following mission, assigned to PSCA, is drawn from the "Pacific Spaceport Complex – Alaska Range User's Manual" prepared by AAC (2015):

> PSCA's primary mission is to serve as a west coast launch facility to commercial, government and military customers. PSCA's location at Narrow Cape on Kodiak Island is ideal for space access into polar, sun synchronous[1] and highly elliptical orbits.

AAC and the PSCA facility are now increasingly independent from State of Alaska funding, and will depend on launches and services beyond federal government contracts, though federal launches appear likely to remain a part of AAC's operations.

2.2 Background

AAC was organized in 1991 as a state-owned public corporation. It is affiliated with the University of Alaska, but has a separate and independent legal existence (AAC, 2015). For administrative purposes, it is located within the State of Alaska, Department of Military and Veterans Affairs.

The first launch was conducted in 1998, with 17 successful launches through August, 2014, approximately one per year; winter launches were approximately 40 percent of these missions. PSCA is one of the northernmost launch sites in North America, which has unique advantages, as discussed in Section 2.4.

[1] Sun synchronous orbits are polar orbits that cross over the equator at approximately the same local time each day, keeping the angle of sunlight on the earth's surface as consistent as possible. This consistency means scientists can compare images over time for climate change impacts, as an example (NASA Earth Observatory, 2015).

2.2.1 Launch History

PSCA has supported government and commercial launches for agencies such as:

- National Aeronautics and Space Administration (NASA)
- U.S. Army Space and Missile Defense Command
- U.S. Air Force Space and Missile Systems Center (SMC)
- Missile Defense Agency (MDA)
- Orbital Sciences
- Lockheed Martin
- Space Vector Corporation
- Sandia National Labs

Launch vehicles supported at PSCA have included Athena, Strategic Target System (STARS), and Minotaur systems for both suborbital and orbiting systems (AAC 2015), as shown in Table 1 by company, payload and Federal Aviation Administration (FAA) payload class; PSCA is permitted by the FAA for up to nine launches per year.

Table 1. PSCA Orbital Launch Vehicles

Rocket Attribute	Minotaur 1	Athena I	Minotaur IV	Athena II
Company	Orbital	Lockheed Martin	Orbital	Lockheed Martin
Payload, lbs.	1,250	1,500	3,800	4,000
Payload, kg	567	680	1,724	1,814
Payload Class (FAA)	Small	Small	Medium	Medium
Vehicle Length, feet	65	70	82	100
Rocket Diameter, inches.	66	100	92	100

Source: AAC, Northern Economics

Orbital launches lift payloads to an altitude where they achieve full (global) orbit; suborbital flights require less lift capacity and may be used, for example, to send target missiles downrange for interception. As the table illustrates, to date all launches from PSCA have fallen into the small or medium payload class, though PSCA has looked at the potential to launch intermediate payloads in the 2,200 kg to 8,000 kg categories (4,850 to 17,640 pounds).

2.3 Payload Categories, FAA

Satellites range in size from very large units, such as the Hubble Telescope and other modules for the International Space Station (ISS), to very small satellites used for specific research and imagery purposes, with shorter physical and economic lives.

In 2015, AAC contracted with the space marketing firm Avascent, based in Washington, D.C., to develop an estimate of potential launches that could be sited at PSCA. Avascent provided their information for the years 2016 to 2021 in launch categories used by the FAA:

Small	101–1,000 kg	(223 pounds to 2,205 pounds)
Medium	1,000–2,200 kg	(2,205 pounds to 4,850 pounds)

Intermediate 2,201–8,000 kg (4,850 pounds to 17,637 pounds)

Overall, Avascent projected just under 900 launches from all spaceports for the years 2016 to 2021. Approximately five to ten percent of those launches could be suited for PSCA operations. However, after discussion with AAC staff, Northern Economics compiled a more basic market estimate, discussed in section 3, with one or two potential launches per year. Team members agreed these numbers were more realistic and in line with both historical operations and future activity, once PSCA is fully operational in mid-2016.

2.4 Capabilities

AAC's capabilities extend beyond rocket launch services and include test services and mobile safety services. AAC staff and equipment can be deployed to other sites for supplemental (or primary) support.

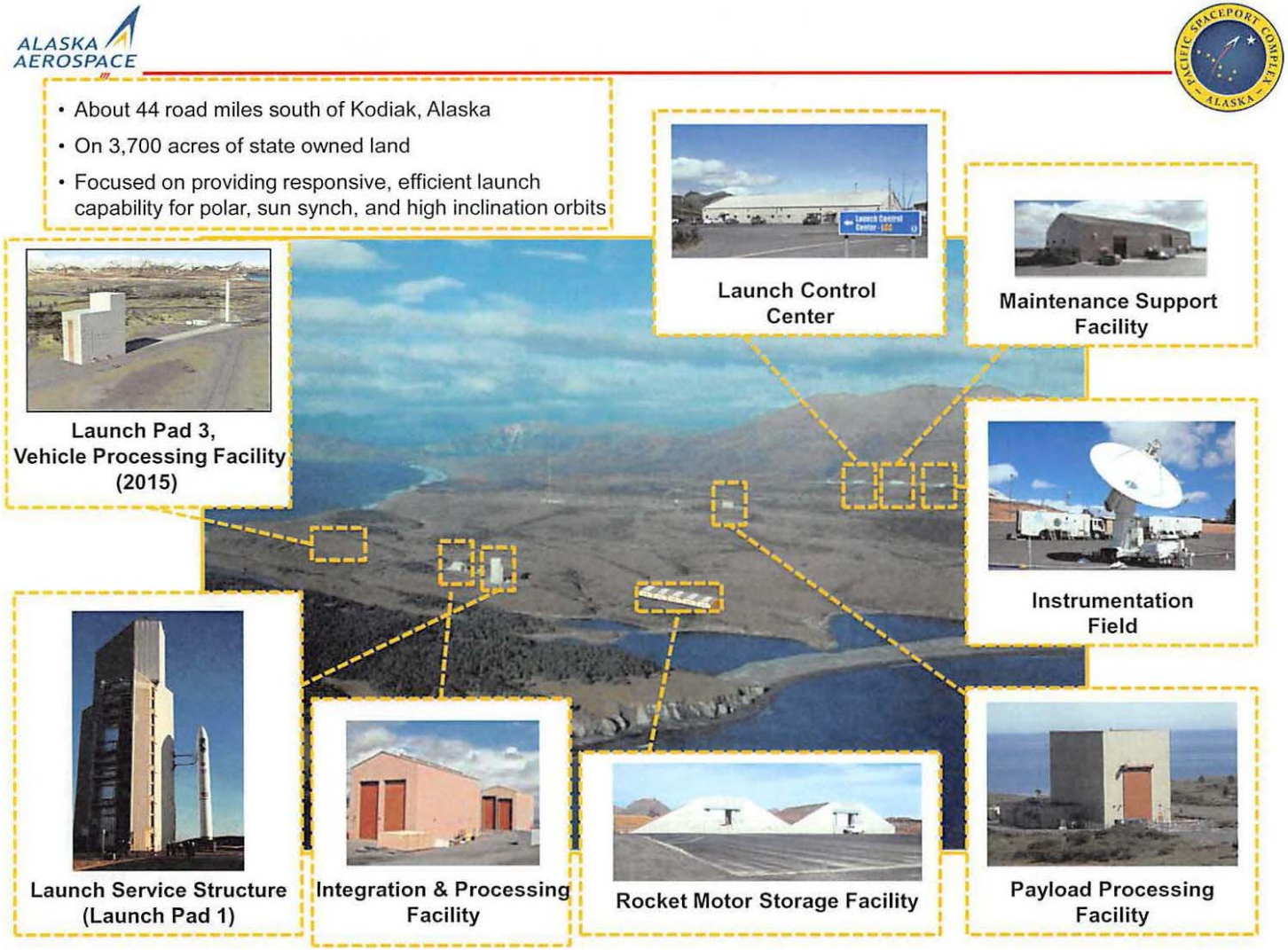
PSCA itself consists of ten primary facilities and a number of support facilities (AAC 2015):

1. Range Control Center;
2. Launch Operations Control Center;
3. Payload Processing Facility;
4. Integration and Processing Facility;
5. Spacecraft Assemblies and Transfer Building;
6. Launch Service Structure and Launch Pad – 1;
7. Launch Pad – 2;
8. Instrumentation Field;
9. Rocket Motor Storage Facility;
10. Maintenance and Support Facility.

In addition to these on-site facilities, PSCA also offers test and mobile safety services to potential clients in other parts of the U.S. or the world.

Figure 4 is a further facility overview of the Kodiak Launch Center (PSCA).

Figure 4. Kodiak Launch Complex, Overview



2.4.1 Launch to Polar Orbit

There are two general types of satellite orbits. First, equatorial orbits follow the earth's equator and if they match the speed of the earth's rotation, they appear to be stationary. Equatorial orbits are commonly used for communication, radio and TV uses. Their distance from the earth is approximately 22,237 miles (35,786 km) above the surface of the earth; at this distance, satellites appear stationary and are called geosynchronous (Wayana 2015).

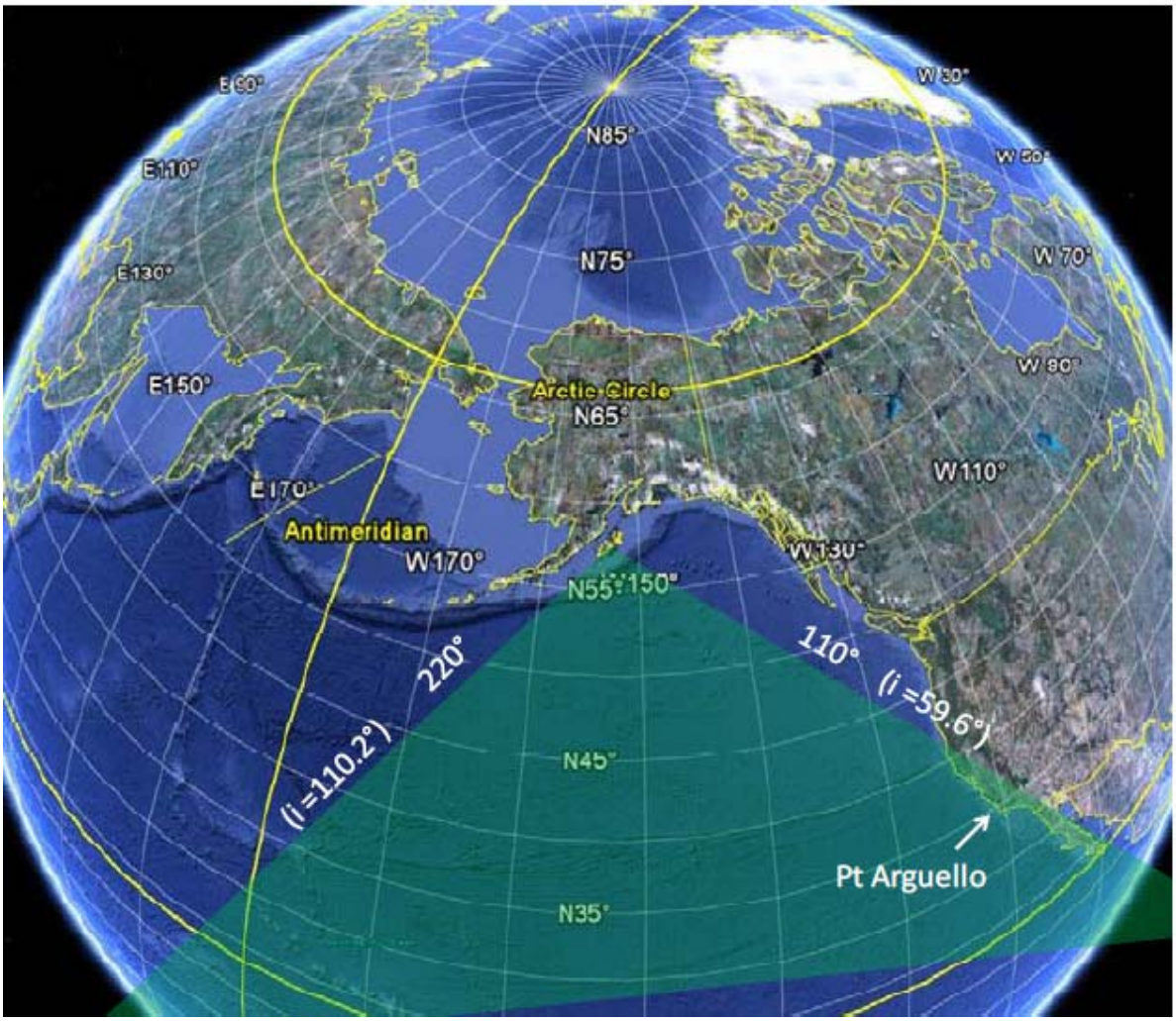
Geosynchronous satellites can see most of the earth's surface, but while they have a theoretical limit of 81 degrees (latitude, north and south), their practical limit is 75 degrees (Planetary Society 2015). This means polar (arctic and Antarctic) regions, approximately 20 percent of the earth, may not be seen by these satellites. However, the second type of orbit, a polar orbit, circles the earth and can see virtually all of the earth's surface.

Polar orbits have orbital planes that parallel the polar axis, from North to South (or the reverse). A satellite placed into a polar orbit will see the entire globe as the earth rotates beneath it, making these the preferred orbits for imaging satellites. PSCA is ideally suited for launches into polar orbits, as well as capturing down-link remotely sensed data and images, with the latter tied to sun synchronous orbits.

2.4.2 Unobstructed Down Range Flight Path

Figure 5 displays the wide launch azimuth and unobstructed downrange flight path that can be used for launching targets, satellites, and space science payloads into low-earth orbits, as well as polar, sun synchronous, and highly elliptical orbits (AAC 2015).

Figure 5. PSCA Launch Azimuths and Inclinations



Source: AAC, 2015

These attributes may enhance PSCA's appeal, especially in light of emerging market changes.

2.5 Emerging Markets

AAC is moving away from strict launch and launch-related services within the State of Alaska. The corporation's Board of Directors approved changes that would recast AAC as a Public Private Partnership organization, able to expand beyond the State of Alaska and with the ability to enter into Joint Ventures, sign contracts with qualifying governments or agencies, among other emerging services.

Aerospace markets are changing rapidly and AAC believes the P3 type of organization will allow it to meet market needs. There are further details in the next section.

3 Aerospace Markets

In the past ten years, rapid changes within the aerospace market have shown strong and determined moves away from launch services to other services that support pre-launch, launch, and post-launch requirements. Pre-launch and launch services include testing and tracking; post launch markets include support services such as data downloads, data servicing, and image or map sales.

The rate of change within aerospace markets is exemplified by the shift to smaller satellites, a shift driven by CubeSat definition, development, and deployment. Both are discussed briefly below.

Shift to Smaller Satellites

For many years, conventional and traditional satellite launches (or lifts) were characterized by heavy payloads, years of planning and scheduling, and high costs per launch. However, payloads began to shrink as more and more electronics could be fitted onto smaller computer chips and circuit boards.

This shift to smaller (and less expensive) satellites is in process and not fully developed as a potential revenue source for AAC. It appears clear that these trends will continue, however, according to Avascent (2015) and SpaceWorks (2015), with the latter noting 107 commercial nano/microsatellites (1–50 kg) were launched in 2014, with over 1,000 launches scheduled for commercial small satellites (101–500 kg) by 2030 (SpaceWorks 2015).

CubeSat Project

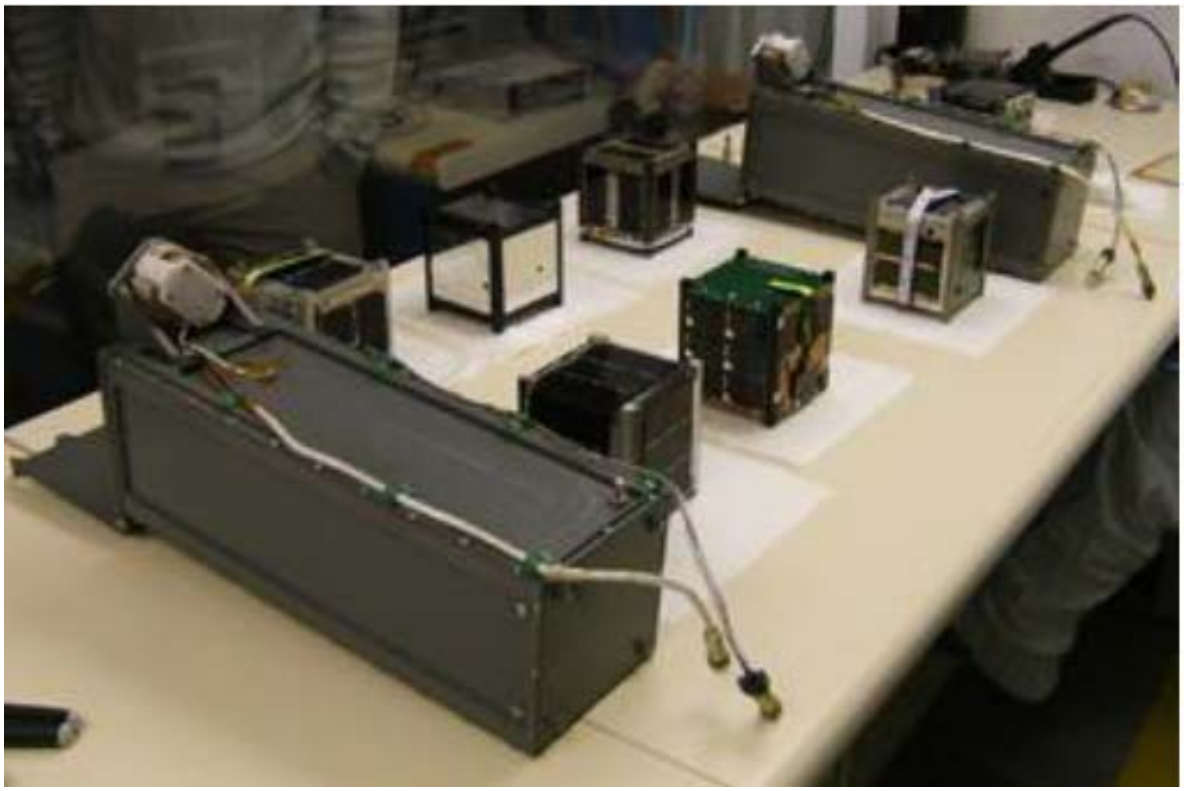
A major factor in the shift to smaller satellites is the CubeSat phenomenon as described in a recent article in The Economist (2014):

> Although widely used, satellites are expensive to build and to launch. That began to change last year [2013]. On November 19th Orbital Sciences, an American company, launched a rocket from the Wallops Flight Facility in Virginia. It carried 29 satellites aloft and released them into low-Earth orbit, a record for a single mission….
>
> Many of these [smaller] satellites were built in a standard format known as a CubeSat, a 10cm (4 inch) cube weighing 1.3 kg (2.9lb) or less. Some comprised units of two or three cubes. After a decade of fits and starts, during which some 75 CubeSats were launched, satellites of this scale and other small satellites are moving from being experimental kit to delivering useful scientific data and commercial services.

The CubeSat program began in 1999 as a collaborative effort between staff at California Polytechnic State University (Cal Poly) and Stanford University's Space Systems Development Laboratory (CubeSat Design, 2014). The program provided a standard for design of very small satellites (picosatellites) to reduce cost and development time, as well as to sustain frequent launches. The CubeSat satellite is a cube that measures 10cm per side, and has a mass up to 1.33 kg.

Figure 6 is a photograph of six CubeSats and two deployment systems, using a door and spring mechanism to push the CubeSats into orbit. The CubeSats and launch devices are designed to serve as small loads carried into space as supplemental cargo on launches of larger systems.

Figure 6. Six CubeSats and Deployment Systems.



Source: CubeSat, 2014, CalPoly.

The basic CubeSat is known as a 1U (1 unit) size, with larger combinations permitted, up to a 3U size, with a mass of less than 4.0 kg. Recent European design (ISIS, 2016) has expanded CubeSats into 6U, 8U, 12U and 16U standard sizes.

CubeSats are an example of how engineers and designers use smaller components, launched more frequently, to meet market needs. Image and communication satellites normally use polar orbits to provide more coverage of the earth; launching small payloads into polar orbit is something well-suited for AAC and its Kodiak facilities.

3.1 Small Imaging Satellites

Further examples of these recent market shifts are listed and discussed below.

3.1.1 Skybox Imaging

The firm Skybox Imaging was formed in 2009 to provide high-resolution earth imagery, with high-definition imagery, video, and analytics services (Huet, 2014). Google purchased Skybox Imaging in June of 2014, for a reported purchase price of $500 million (TechCrunch, 2014). The parent company noted Skybox would help keep Google Maps current, with up-to-date imagery, as well as potentially develop improved Internet access.

3.1.2 Planet Labs

Planet Labs, based in San Francisco, also represents the shift to smaller satellites, at lower costs, with frequent replacement. Former NASA scientists founded the company in 2010; their mission is to image the entire earth at least once each day (Planet Labs 2015).

Figure 6 shows imaging satellites, termed Doves, ready for shipment to a launch site. Planet Labs has launched over 100 satellites and, with the recent launch of a flock of Doves (Planet Labs' term for multiple, similar, satellites) to the ISS aboard an Atlas V rocket on December 7, 2015, the firm has 113 Dove satellites that reached orbit on six different launch vehicles over twelve operations.

Planet Labs also purchased BlackBridge and its RapidEye imagery library developed from several years of observations from its existing five satellites (TechCrunch 2015). Reporters noted BlackBridge sold imagery mostly to customers in Europe and South America, while Planet Labs' customers are concentrated in North America and Asia. Planet Labs reportedly raised over $183 million in funding, through mid-year 2015, while BlackBridge raised $22 million.

According to Planet Labs, their low earth orbit satellites will last from one to three years. This rapid replacement schedule also permits the company to improve each batch of satellites with the most current electronics.

A further example of this market shift occurred when Planet Labs lost 26 satellites in October of 2014 when an Antares rocket exploded. Off-the-shelf hardware permitted construction of 14 new Doves in nine days; they were launched in January of 2015 aboard a SpaceX mission.

As noted, AAC has an existing contract with BlackBridge and acts as a sales point for RapidEye imagery within Alaska.

Figure 7. Small Imaging Satellites

Source: NASA, Planet Labs

3.1.3 OneWeb

OneWeb is a startup company that proposes a launch of 648 active satellites (over time) that will form a constellation covering the entire earth (OneWeb, 2016). The company will use mass production facilities to manufacture payloads with fewer components, lighter weight and lower launch costs. Proposed services include communication of LTE wireless, 3G cellular and other Wi-Fi bands.

On January 26, 2016, OneWeb announced a joint venture with Airbus Defence and Space to design and build the 900 (total) satellites that will offer high-speed internet with global coverage. First round investors include Virgin and Qualcomm, major firms with interests in space.

3.1.4 World View

The Satellite Imaging Corporation is a value-added reseller (VAR) of imaging and geospatial data products for BlackBridge and Airbus Defence and Space (Satellite Imaging, 2016). As a VAR, Black bridge packages images and data from several systems, owned and operated by other companies and agencies.

The WorldView-3 Satellite Sensor is a larger satellite, at 2,800 kg (6,200 pounds) and with a size of 5.7 meters (18.7 feet) by 2.5 meters (8 feet) by 7.1 meters (23 feet) with solar arrays extended. It is sun-synchronous and has 0.31meter resolution. It was launched by ULA in August of 2014, marking the first commercial Atlas mission from Vandenberg (California).

This payload is within the intermediate class and is larger than any currently launched from Kodiak. However, the imagery services provided by WorldView, through the Satellite Imaging Corporation, represent a strong potential market for AAC and its download data and tracking services.

3.1.5 Surrey

Surrey Satellite Technology Ltd. (SSTL) is another small satellite firm, based in the UK as an independent British company within the Airbus Defence and Space group (SSTL, 2016). With 30 years of experience, including 43 satellites built and launched since 1981, SSTL offers design, manufacture, launch and operation of small satellites. It has two divisions, including earth observation and science and telecommunications and navigation. SSTL recently installed a ground station near Svalbard (Norway) to take advantage of high-latitude, increased satellite contact time. SSTL's station is co-located with others operated by Kongsberg Satellite Services (Figure 8).

Figure 8. Svalbard Ground Station

Source: Kongsberg Satellite Services, 2016

3.2 Launch Vehicles

Launch vehicles are those rockets (or airplanes) used to lift payloads into space. Three firms (and their launch vehicles) are discussed below.

3.2.1 Rocket Lab Electron

Rocket Lab is a firm founded in 2007 to provide dedicated small launch vehicles and flexibility not found with traditional rocket systems (Rocket Lab 2015). Company investors include several venture capital firms as well as Lockheed Martin. The company is U.S.-based with a New Zealand subsidiary.

Rocket Lab manufactures the Electron Rocket, which is a two-stage rocket that is priced at $4.9 million per launch of small satellites to low earth orbit (Rocket Lab, 2016). With an office in the U.S. as well, the company notes its rocket is designed to lift a 150 kg payload to a 500 km sun synchronous orbit (Rocket Lab 2015b). The company also developed an online booking system for CubeSats, with launch costs that range from $50,000 for a 1U CubeSat, up to $180,000 for a 3U system.

In November (2015), Rocket Lab announced selection of the Alaska Aerospace Corporation for Electron launches in 2016 or 2017. AAC will provide safety support, including a Range Safety Data Package and coordination between Rocket Lab and the FAA Office of Commercial Space Transportation to secure an operator's license. Rocket Lab's CEO, Peter Beck, noted this arrangement would help the company control costs and focus on an Autonomous Flight Termination System (Satnews, 2015).

3.2.2 Firefly Alpha

Firefly Space Systems, Inc. is based in Cedar Park, Texas and has focused its business model on small satellite launch vehicles such as the Firefly Alpha, its first dedicated small satellite rocket. Rocket engines were tested in late 2015 and the first (demonstration) launch is scheduled for March of 2018 (Firefly, 2015).

The Alpha will fly missions specifically for CubeSats and other sub-1 metric ton payloads in 400 to 500 km orbits. Firefly's proposed shift to launching CubeSats as primary payloads seems to further signal the growing market trend towards smaller, cheaper, and more frequently launched satellites.

Similar to the Electron system, FireFly could schedule launches from both PSCA and other launch sites, along with range services and potential downlink data support.

3.2.3 Super Strypi XBow.

The first Super Strypi rocket was launched in Hawaii from a rail system on November 4, 2015. The U.S. Air Force said the rocket carried 13 experimental small satellites and, after one minute into the flight, it appeared to spin wildly before breaking apart. The XBow was launched from the U.S. Navy's Pacific Missile Range Facility in Kauai, the first orbital launch attempt from that site.

The Super Strypi rocket was developed by a partnership of Sandia National Laboratories, Aerojet Rocketdyne, and the University of Hawaii. The rocket is also known as the Spaceborne Payloads Assist Rocket Kauai (SPARK) and is part of the Low Earth Orbiting Nanosatellite Integrated Defense Autonomous System (LEONIDAS), designed to provide low-cost systems that can place small payloads into orbit for the U.S. Department of Defense at relatively short notice (NASA Spaceflight 2015).

Like the Firefly Alpha, the XBow was designed to put payloads up to 300 kg in low earth orbit (SpaceNews, 2015), at a projected cost per mission of approximately $15 million.

AAC has supported this program by providing an on-site staff member, who assisted in the launch. As this rocket evolves, launches are possible from both PSCA and other launch sites.

3.3 Shift to Low Costs, More Frequent Launches

Along with market shifts to smaller (and more frequent) launches, there has been a similar market shift to emphasis on cost. Since 2002, beginning with the establishment of SpaceX by Elon Musk, the aerospace market has shifted from a focus on large, heavy payloads to smaller and less complex satellites and launch vehicles.

A recent webinar, International Commercial Satellite Markets, presented by the Aerospace Industries Association (AIA 2015) noted the major influence held by SpaceX and its business model. SpaceX has had major impacts on the aerospace industry, from the first orbital flight of its Falcon 1 rocket in 2007 to its current Falcon 9 and Falcon Heavy rockets.

SpaceX successfully pioneered many changes, including the following (Vance 2015):

- **Standardization.** SpaceX developed a basic engine (Merlin) and used multiple engines (such as five for the Falcon 5), rather than redesigning each rocket model.
- **Off-the-shelf parts.** SpaceX was formed during the time when many computer and other control devices were steadily improving and no longer required long production cycles.
- **Simplification.** SpaceX manufactures approximately 80 to 90 percent of its rockets in the U.S. at its own factories (Vance 2015), giving it the ability to design, test, and produce its own components, using simpler specifications and shortened component design cycles.
- **Focus on cost.** The Falcon 1 per-launch cost ranged from $6 to $12 million, at a time when most launches were considerably higher. The Falcon 5 replaced the Falcon 1, with a larger 9,200-pound payload capability and a per launch cost from $60 to $90 million, at a time when United Launch Alliance (ULA, a combination of Lockheed Martin and Boeing) quoted $380 million for approximately the same services from a Vulcan rocket.

A growing portion of the satellite market continues to evolve, from larger, heavier satellites to smaller satellites with shorter economic lives and more agile response launch frequency. Representative firms who are entering the small rocket market include Rocket Lab, FireFly, and Surrey and others. Two firms that are emphasizing more frequent launch schedules are Planet Labs and Blue Origin.

Planet Labs states its mission is to image the entire earth once per day. As its older satellites are drawn down by orbital decay, Planet Labs will replenish its constellation with launches of new replacement satellites, generally on a one to three-year basis.

Another example of increased launch frequency is Blue Origin. Although it has recently announced operations at Cape Canaveral in Florida (Space Florida 2015), it started its launch program in West Texas where the FAA published a Supplemental Environmental Assessment (FAA 2014).

In that report, Blue Origin stated their Recoverable Launch Vehicles (RLV) program included experimental, prototypes, and commercial launches. Starting with 16 maximum (assumed) RLV launches in 2014, Blue Origin projected 54 launches in 2019.

3.4 Spaceflight Market Prices, November (2015)

Table 2 illustrates public pricing for satellite payloads by orbit and mass, from 5 kilograms (11 pounds) to 300 kilograms (661 pounds), in thousands of U.S. dollars.

Table 2. Public Pricing by Orbit and Payload Mass, November 2015

	5 kg	10 kg	20 kg	50 kg	100 kg	150 kg	200 kg	300 kg
Orbit					**($1,000s)**			
Low Earth Orbit	295	545	995	1,750	3,950	4,950	5,950	7,950
Geostationary Transfer Orbit	650	995	1,950	3,250	5,950	6,950	7,950	9,950
Geosynchronous Sun Orbit	995	1,990	3,250	6,500	9,950	12,950	15,950	19,900

Source: Spaceflight, 2015

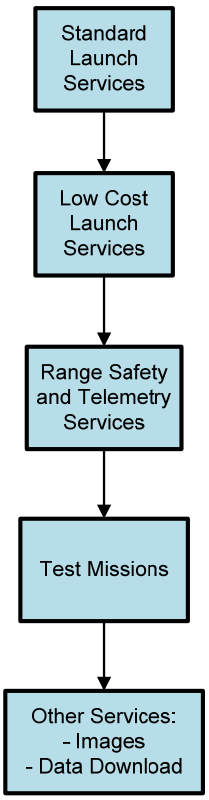
These are figures for "rideshare" prices, representing costs for payloads that will be matched with other (primary) payloads on launches scheduled from space ports throughout the world.

Although a direct comparison is difficult, comparing these prices with those forecast by AAC (see Table 4) suggests AAC's prices may be conservative. For example, AAC estimates $500,000 of potential revenue for a low-cost launch to low earth orbit irrespective of payload mass. Spaceflight quotes $545,000 for a 10-kilogram load to low earth orbit on a rideshare basis. In any case, AAC revenue estimates are used throughout this business plan. The figures in Table 2 are provided for reference.

3.5 PSCA Capabilities

Figure 9 summarizes PSCA capabilities, following interviews with AAC staff, the on-site inspection, and web-based research.

Figure 9. PSCA Capabilities, Grouped



Source: Northern Economics

AAC's historical rocket launches are considered as standard launches. As noted in the following section, however, standard rocket markets are also changing. Heavy lifts, for large satellites such as TV and radio communications satellites, were once the most common launch, yet recent activity has shifted to more frequent launches of smaller satellites, as discussed earlier.

3.6 Standard Launch Services

Launch services, at Kodiak and elsewhere in North America, are moving towards smaller payloads and more frequent launch cycles. This is illustrated in part by SpaceX's vision of increasingly automated small rocket launches with on-demand potential for event-specific requirements (crop ripeness imagery, forest fire mapping, armed conflicts, etc.).

Historically, PSCA has provided launch services for large government contractors, such as those noted below.

3.6.1 Orbital ATK

Orbital ATK is headquartered in Dulles, Virginia and employs more than 12,000 people across the U.S. and several international locations (Orbital ATK 2015). Orbital builds and supports satellites, including the GEOStar geostationary communications satellites. Orbital also provides cargo delivery services to the ISS.

Orbital has traditionally been one of AAC's best customers with their Minotaur IV, Minotaur I and potentially larger rockets in the future.

3.6.2 Lockheed Martin

Lockheed Martin, headquartered in Bethesda, Maryland, is a global security and aerospace company that employs approximately 126,000 staff worldwide. As stated on its web site (Lockheed 2015), the company is "…engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems, products, and services."

Lockheed's space system unit had sales of approximately $8.1 billion in 2014, including space launch, commercial satellites, government satellites, and strategic missiles.

Lockheed Martin has successfully launched the Athena I, Athena IIc, and the Athena IIS-6 from PSCA.

3.6.3 Missile Defense Agency

The MDA is a research, development, and acquisition agency operated within the U.S. Department of Defense (Department of Defense 2015).

MDA develops, tests, and operates the integrated Ballistic Missile Defense System. Potential future launches (and tests) include: Terminal High Altitude Area Defense (THAAD), Patriot missiles, and targets for other missile systems.

3.6.4 Potential: Blue Origin

Blue Origin is owned by Jeff Bezos, who also started Amazon, and it recently made news for returning a rocket from space, for potential reuse (The Economist 2015). The company notes its New Shepard system is "designed with researchers in mind" (Blue Origin 2015) with the ability to accommodate experiments up to 50 pounds in one of two payload lockers.

Blue Origin expects a larger rocket engine (the B-4), designed in its Kent, Washington, offices will lead to orbital capacity, rather than the sub-orbital capacity it now has (Blue Origin 2015b). In this sense, Blue Origin trails SpaceX, which has launched orbital payloads.

3.6.5 Potential: SpaceX

AAC has completed tracking services on all SpaceX flights to the ISS and it actively discusses potential launch capacity at Kodiak. If small to medium markets develop sufficient demand, SpaceX could launch larger payloads in Florida and move more specialized lifts to PSCA.

3.7 Test Missions

Programs and firms with higher potential demand for AAC test mission include the THAAD program and Raytheon's systems.

3.7.1 Terminal High Altitude Area Defense

THAAD is a system prepared for the MDA by Lockheed Martin. It is a land based system capable of shooting down a ballistic missile both inside and just outside the atmosphere (MDA 2015). THAAD works with the Ballistic Missile Defense System, using hit-to-kill technology to destroy incoming warheads. MDA has received a budget increase for THAAC in FY2017 for due to recent world security issues.

AAC could support THAAD with test range services for standard and new developments.

3.7.2 Raytheon

Raytheon builds interceptors, radars, and space sensors for protection against ballistic missiles, cruise missiles, aircraft and other threats (Raytheon 2015).

AAC could support Raytheon with test range services for standard and new developments, including Patriot missiles. Several Kodiak launches have sent targets into space, with interceptors launched from other locations, such as Vandenberg, attacking the targets.

3.8 Mobile Range Safety and Telemetry System Services

Two organizations that could contract for mobile safety services from AAC Space Florida and, with a contract signed in November 2015, Rocket Lab.

3.8.1 Space Florida

Space Florida is an independent Special District of the State of Florida, established for the purposes of "…fostering the growth and development of a sustainable and world-leading space industry in Florida." (Space Florida 2015).

In particular, a September 15, 2015 announcement by Blue Origin and Governor Rick Scott, stated that Blue Origin would be investing approximately $200 million in launch, manufacturing, and support facilities for its Orbital Launch Vehicle program (Space Florida 2015). The site is known as Complex 36 at Cape Canaveral and has served as the launch site for 43 years of service and 145 launches.

AAC could provide tracking services for CCAFS launches sponsored by Space Florida as well as data downlink (and analysis) services for post-launch requirements.

3.8.2 Rocket Lab

See section 3.2.1 for more complete information on Rocket Lab and its selection of AAC for Range Safety and Telemetry System (RSTS) services.

3.9 Other, Emerging Markets

AAC has recently seen other emerging markets for joint venture services as well as a renewed interest in Unmanned Aircraft Services (UAS), briefly discussed below.

3.9.1 Joint Venture Services

During the February 2016 AAC Board of Director meeting, Resolution #16-02 passed, authorizing AAC to create a joint venture for world-wide marketing and operations of the RSTS. AAC has been pursuing initiatives that could lower the annual costs of maintaining the RSTS while potentially providing new revenues from launch sites other than PSCA. AAC has been in in discussion with an aerospace company concerning potential business structures that could provide financial benefits to both companies from world-wide utilization of AAC's RSTS.

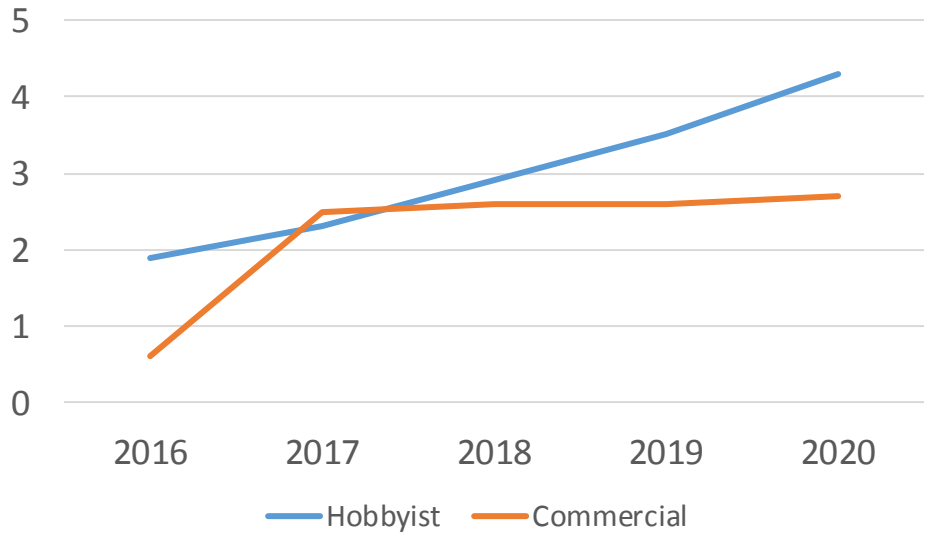
The new Joint Venture (JV) could provide benefits to AAC by increasing the used of the RSTS, while employing Alaskan in operation of the RSTS wherever it is located, and allowing for lower launch costs at PSCA, which would increase PSCA's competitiveness for commercial launches. This opportunity can help generate sustaining revenues through world-wide use of the AAC's RSTS, provide AAC retains ownership of the assets and has an equitable voice on the JV's management team or Board of Directors.

3.9.2 Unmanned Aircraft Systems

Unmanned Aircraft Systems (UAS) include both the unmanned aircraft (UA) and associated elements, especially communication and control links (FAA, 2016). The number of model aircraft and hobbyist UAS (also called drones) has grown exponentially in recent years with concurrent safety concerns about safe and efficient operations in the national airspace. Unmanned Aircraft System (UAS) operations are authorized by the FAA and are classified UAS, as of December 14, 2015, as those aircraft that weigh more than 250 grams (0.55 pounds) and less than 55 pounds. The rule required registration and as of mid-March 2016, there were over 408,000 registrations.

FAA forecasts, shown in Figure 10, project a strong increase in hobbyist aircraft with a projected plateau of commercial aircraft in 2017.

Figure 10. Forecast of Unmanned Aircraft, 2016 to 2020, in Millions, by Type



Source: FAA, 2016

Commercial UAS may be granted exemptions from requirements for an airworthiness certificate. They are granted on a case-by-case review of safety, conditions and limitations. The Certificate of Authorization of Waiver (COA) describes the specific operating areas and associated safety mitigations.

In Alaska, AAC has access to FAA databases and, once a mission is identified, both the UA and its mission are entered into the database, with a request to the FAA for permission. If granted, approval is based on a mission-by-mission approach.

The FAA expects to publish a final rule on UAS in the late spring of 2016. Part of that rule will define two categories of small systems: first, higher end units will have an average sales price of $40,000 per unit while lower end units will have an average price of $2,500 each. The FAA and its contractor project the top five markets as:

1. Industrial Inspection (42 percent).
2. Real Estate, Aerial Photography (22 percent)
3. Agriculture (19 percent)
4. Insurance (15 percent)
5. Government (2 percent)

As the most dynamic growth sector within aviation, the FAA expects overall demand to soar once operations are permitted beyond a visual line of sight, along with operation of multiple UA by a single pilot.

In Alaska, current and potential operations include use of UA to check for ice conditions, inspection of pipeline corridors, and mapping wildfires.

3.9.3 Other Markets

Other potential revenues sources include operating down-links and data centers for commercial and government entities, as well as imagery such as that marketed with BlackBridge.

AAC is aware of Alaska's longer contact times with satellites launched into polar orbits; the longer contact times provide greater download potential for servicing satellite data caches.

Surrey reports a ground station near Svalbard, Norway at 78 degrees North latitude; for comparison, Prudhoe Bay is approximately 70 degrees North latitude.

There is a ground station at Prudhoe, according to Surrey, with the potential for others. AAC could tie-in to ground stations at Deadhorse and use its high-speed fiber connections to provide data services to Lower 48 (or international) customers.

4 AAC Strategic Analysis

This section summarizes an analysis of AAC's strategic position, based on an assessment of its strengths, weaknesses, opportunities, and threats (SWOT). Northern Economics collected information from interviews with AAC staff members (Kodiak, Anchorage), AAC reports and documents, and other sources, including the State of Alaska and various web-based sites.

The information discussed in this section is grouped into the traditional four categories of a SWOT listing; it should be noted that strengths and weaknesses are mostly internal to an organization, while threats and opportunities are generally external to the organization. AAC, like other groups, will have more control over internal factors; government and market forces will have major influence on external variables.

Figure 8 summarizes the SWOT analysis, with further discussion in the sections that follow. This graphic is the same as Figure ES-1 (in the Executive Summary).

Figure 11. SWOT Analysis Summary

Strengths	Weaknesses
• Location—Launch site • Location—Launch corridor • Secure, Off-road • Sole U.S.-licensed, high latitude full service commercial spaceport • Cost-competitive operations • Launch availability • FAA licensed	• Location—PSCA limited to polar orbits • Remote • Logistics expense • Ownership by state • Funding support removed • Rebuilding from August 2014 anomaly • Staffing reduced • Lack of current customers • Lack of diversification
Threats	**Opportunities**
• Competition—Vandenberg • Competition—for suborbital • Competition—Non-U.S. sites • Competing horizontal launch vehicles • Minimum support staff • Limited local support • No Alaska government support • Political interference • Foreign launch site development	• P3 reorganization • High demand for small, low cost, satellite operations • Lower cost small-medium launch vehicles • Provide test range services • Provide mobile range services • Provide other support services (image, data downlink) • Logistics support with FedEx • Public process—education • Provide runway for direct air support • Unmanned aircraft system (UAS) growth • Demand for high latitude earth station • New spaceport development in U.S.

4.1 Strengths

Based on the research noted above, AAC's strengths include the following factors.

Geographic Location

Northern location. PSCA is the northernmost U.S. launch facility, and is an ideal location for high latitude launches and polar, sun-synchronous, and highly elliptical orbits.

Launch corridor. PSCA has a large launch corridor, over the Pacific Ocean, offering it a safety advantage over other facilities.

Off the United States road system. The PSCA benefits from enhanced security due to its being off the road system.

U.S. Facility

Nationality, government restrictions. As a U.S. organization, AAC is able to provide launches at PSCA and also other services for federal entities. It is also attractive to agencies and companies from other countries that want or need a U.S. facility for their launches. PSCA is FAA-licensed and meets federal government launch requirements.

Operations

Cost competitiveness. PSCA offers cost-competitive and safe polar launches due to its location and ability to price services to market rates.

Experience. PSCA has experience and a good launch record. This enhances its ability to secure future federal launches and to provide other services to both commercial and government agencies.

4.2 Weaknesses

AAC has weaknesses, as well, with several related to strengths noted above.

Geographic Location

Only able to offer polar launch capabilities. PSCA's location makes it infeasible for equatorial or geosynchronous orbits. Currently, if a customer needs both polar and equatorial launch capabilities, it would have to use two providers. AAC has recognized this and is working with other space ports in Virginia, Florida, and other launch sites to offer enhanced services.

Remoteness. PSCA's location may be too distant and costly to access for potential customers. In many cases, this may be more of a perception than reality, once potential customers visit PSCA and inspect the ten major facilities and services related to them.

State Ownership

Limitations. As a state-owned corporation, AAC had limitations on funding sources, expansion opportunities outside the state, and decision authority. However, privatization and creation of a P3 circumvents this limitation.

Lack of funding. The State of Alaska has eliminated funding of AAC, placing it in a position of having to fund operations with cash savings until the launch facility is rebuilt and it can attract new customers. AAC has sought funding from the federal government for certain security-related services and will continue to do so. The latest move toward privatization and creation of a P3 is intended to lead to more revenue and greater flexibility to pursue opportunities, which will alleviate this weakness.

Operational Status

Rebuilding. Since the anomaly in August 2014, the launch facility is not usable. Repairs need to be completed before it can resume operations and offer full services. AAC expects PSCA to be fully operational in 2016.

Staffing. Staffing levels have been sharply reduced. AAC will need to ramp up its staffing to meet demand once additional customers have been identified and placed under contract.

Positioning for New Markets

Outreach costs. The small launch vehicle market appears to require a high level of effort to solicit business. AAC will face a higher cost of attracting new customers from this market than it has from traditional markets, such as the federal government.

Capital investment. AAC will be required to make substantial capital investments to expand into new markets. Funding sources for these investments will need to be identified, though AAC is already checking with both public and private organizations and lenders.

4.3 Opportunities

AAC sees a great deal of opportunity ahead, as it builds on its strengths and reorganizes. The study team believes these opportunities include the following.

Launch Services

Small Launch Vehicles. The emerging markets for smaller launch vehicles are very suitable for PSCA. Smaller payloads also have a shorter lifespan than traditional payloads, requiring more frequent launches and providing a steadier potential revenue stream.

Medium Launch Vehicles. With capital improvements, PSCA could expand into providing launch services for medium payload launches. One opportunity relates to a possible airstrip near PSCA, allowing for both inbound cargo and passengers, as well as the opportunity for air launched payloads.

Entry to New Markets

Support Services. AAC has opportunities to expand its offerings of test range, mobile range, and other support services, especially due to its location and longer data windows for polar satellites and their unique orbits.

Unmanned Aerial Systems. AAC has the ability to access the FAA's UAS database and secure permission of UAS operations on a mission by mission basis. This service could be an entry into data processing, or even aerial photography for commercial and government use.

Data Downlinks. AAC also has opportunities to expand into data downlink services. New fiber optic cable being laid in the Arctic could provide the bandwidth needed for downlink stations on the North Slope, with potential connection to higher-speed fiber along the Dalton Highway, from Prudhoe Bay to Fairbanks.

Outside Alaska. With privatization and a public private partnership structure, AAC has opportunities to expand outside of Alaska. For example, it could expand to equatorial launch sites, which would allow it to provide both polar and equatorial launches while offering lower costs due to a single team potentially serving both areas.

Overcome Remote Location

Runway. Construction of an on-site runway at the PSCA would allow direct air access to the facility, bypassing the City of Kodiak and the approximately 45 miles of road to the site. However, this runway is estimated to cost $60 million.

Logistics. AAC has made major progress in logistics planning with FedEx Space, opening up opportunities for enhanced logistics support both to PSCA and globally.

Federal Climate

Budget pressures. Federal budget pressures could reduce the subsidy to Vandenberg AFB, which would improve AAC's relative position from a cost perspective.

Call for space port capabilities. The federal government has issued a call to develop commercial space port capabilities. PSCA could provide part of the market solution with its ability to quickly launch small to intermediate sized payloads.

Ownership Structure

Privatization and P3. AAC has discussed privatization and adoption of a P3 structure. This new structure allows AAC to take on private investment and expand outside Alaska, while maintaining its operations at the state-owned PSCA. This will not necessarily lower costs, but it could allow AAC opportunities for expansion.

Educational Opportunities

Educate residents about benefits. Many Kodiak Island residents lack understanding of AAC's operations and the benefits they bring to the local community and the state. Additional public outreach about the PSCA facility could help increase awareness and support AAC's mission.

4.4 Threats

AAC faces threats from competitors and its own current status. Addressing these threats, outlined below, will require timely action to stay ahead of competitors.

Competitors' Capabilities

Polar orbits from U.S. facilities. Vandenberg AFB, the California Spaceport, and Wallops Flight Facility offshore of Virginia each offer polar orbit capability.

Polar orbits from non-U.S. facilities. For companies not requiring a U.S. facility, the European Space Agency's facility in Kourou, French Guiana offers both polar and equatorial orbits. Other Arctic nations could bring polar launch capabilities online.

Data downlink service. Competitors have expressed interest in developing data downlink facilities on the North Slope and elsewhere in the world.

Competitors' Cost Structures

Federal Spaceports' Cost Structures. Due to federal subsidies at Vandenberg AFB and other federal spaceports, federal facilities are able to offer low-cost launches for commercial customers.

State Ownership

Elimination of state financial support. The State of Alaska has accelerated its reduction of state funding to AAC from a multi-year plan to the point where AAC no longer receives any state financial support. This will accelerate the need to decide on a course of action and quickly implement it.

Perception

Locals' negative perception about PSCA. The PSCA has been the target of uninformed negative perceptions, especially from a small number of local residents. For example, in 2015, opinions were published in the Kodiak Daily Mirror calling the PSCA facility a boondoggle and later claiming that AAC executives were receiving large increases in their cost of living allowances despite being profitless and in a challenging state fiscal environment. These assertions are incorrect.

5 Financial Operations

This section outlines AAC results for two fiscal years (FY2014, FY2015) and a budget prepared for the State of Alaska for FY2016.

5.1 Operations, Budget, FY2014 to FY2016

Table 3 illustrates operating results for Fiscal Year 2014 and 2015, with a budget for FY2016.

Table 3. AAC, Operating Results for Two Years, FY2016 Budget

Category	Funding Sources	FY2014	FY2015	FY2016
Revenues			*(in $1,000s)*	
	Federal Receipts	0	0	3,005
	General Fund	3,914	2,461	0
	Capital IP	9	234	234
	AAC Receipts	454	1,368	1,374
	Summary	4,377	4,063	4,613
Expenses				
	Personal Services	2,546	2,750	2,806
	Travel	210	169	169
	Services	1,467	1,109	4,114
	Commodities	154	27	27
	Capital Outlay	0	7	7
	Grants, Benefits	0	0	0
	Misc.	0	0	-2,510
	Total	4,377	4,063	4,613
Operating Income	Revenue less expenses	0	0	0

Source: AAC FY2014 Annual Report; State of Alaska Governor's FY2016 Budget, February 2015.

The figures reflect decreased state funding, at essentially zero in FY2016, along with federal funding (also in FY2016) in support of non-federal launch and support sites.

5.2 Potential Operations

AAC is actively seeking renewed contracts with prior clients as well as new clients. Services may be contracted at the PSCA itself or at the client's site, for test and safety services. Rebuilding should be completed in the second quarter of 2016, possibly the third quarter; until then, AAC is continuing its operations and maintenance program to be ready for operations once the facility is back to full operational status.

5.3 Pro Forma Revenue Estimates

Table 4 summarizes potential revenue per launch type (standard or low-cost) and missions related to test services and mobile safety services. Numbers shown under Low, Most Likely, and High column headings represent an estimated amount of price variation.

Table 4. Potential AAC Revenue by Launch or Mission

	Low	Most Likely	High
Estimated Revenue by Launch Type		**($1,000)**	
Standard Launch, each mission	2,000	2,500	3,500
Low Cost Launches, each mission	400	500	600
Range Safety, Telemetry System, contract	200	250	350
Test Missions	400	750	1,250

Source: AAC, 2016.

Revenue estimates shown under the column titled "Most Likely" are used in the pro forma statements with other estimates used in the sensitivity analysis (see Section 5.5)

5.3.1 Projected Launches, Contracts, Missions

Table 5 illustrates the estimated number of launches, contracts, and test missions, from FY2016 to FY2021. AAC staff and officers note these estimates may overlap fiscal years; also, these estimates will be updated periodically as the business plan is updated.

Table 5. Base Launches, Contracts, Missions, Forecast, AAC, FY2016 to FY2021

Launch Type	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021
Standard Launches	0	0	1	0	1	0
Low Cost Launches	0	1	1	1	1	1
Range Safety, Telemetry Contracts	0	1	2	4	4	4
Test Missions	0	2	2	3	4	4

Source: AAC, 2016

5.3.2 Revenue Pro Forma

Table 6 summarizes base revenue and expenses for the years 2016 to 2021, for the most likely case.

Table 6. Base Revenue Forecast, AAC, FY2016 to FY2021

	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021
Type			($1,000)			
Federal	2,550	2,000	2,500	2,500	2,500	2,500
General Fund	0	0	0	0	0	0
Capital	0	0	0	0	0	0
Subtotal	**2,550**	**2,000**	**2,500**	**2,500**	**2,500**	**2,500**
Standard Launches	0	0	2,500	0	2,500	0
Low Cost Launches	0	0	500	500	500	500
Subtotal	**0**	**0**	**3,000**	**500**	**3,000**	**500**
Range Safety, Telemetry	0	250	500	1,000	1,000	1,000
Test Missions	0	1,500	1,500	2,250	3,000	3,000
Subtotal	**0**	**1,750**	**2,000**	**3,250**	**4,000**	**4,000**
Imaging Sales	0.1	0.5	0.5	0.7	0.7	0.8
Downlink Sales	0.0	0.1	0.2	0.3	0.4	0.5
UAS Sales	0.0	0.1	0.3	0.5	0.5	1.0
Services & Studies	0.1	0.2	0.2	0.2	0.2	0.2
Subtotal	**0.2**	**0.9**	**1.2**	**1.7**	**1.8**	**2.5**
Total	**2,550.2**	**3,750.9**	**7,501.2**	**6,251.7**	**9,501.8**	**7,002.5**

Source: Northern Economics, AAC, 2016

5.3.3 Cumlative Revenue Forecast

Table 7 summarizes cumulative revenue for the fiscal years 2016 to 2021.

Table 7. Cumulative Revenue Forecast, AAC, FY2016 to FY2021

	FY2016	**FY2017**	**FY2018**	**FY2019**	**FY2020**	**FY2021**
Estimated Revenue			**($1,000)**			
Current	2,550	2,000	2,500	2,500	2,500	2,500
Launch	0	0	3,000	500	3,000	500
Range Safety, Telemetry	0	250	500	1,000	1,000	1,000
Test Range	0	1,500	1,500	2,250	3,000	3,000
Other	0.2	0.9	1.2	1.7	1.8	2.5
Total (rounded)	**2,550**	**3,751**	**7,501**	**6,252**	**9,502**	**7,003**
Expenses	4,613	4,300	4,100	4,500	4,700	4,700
Operating Income (Loss)	-2,063	-549	3,401	1,752	4,802	2,303
Cumulative Income (Loss)	**-2,063**	**-2,612**	**789**	**2,541**	**7,343**	**9,645**

Source: Northern Economics, AAC

AAC's cost base is relatively fixed, with discussion of major costs in the following section.

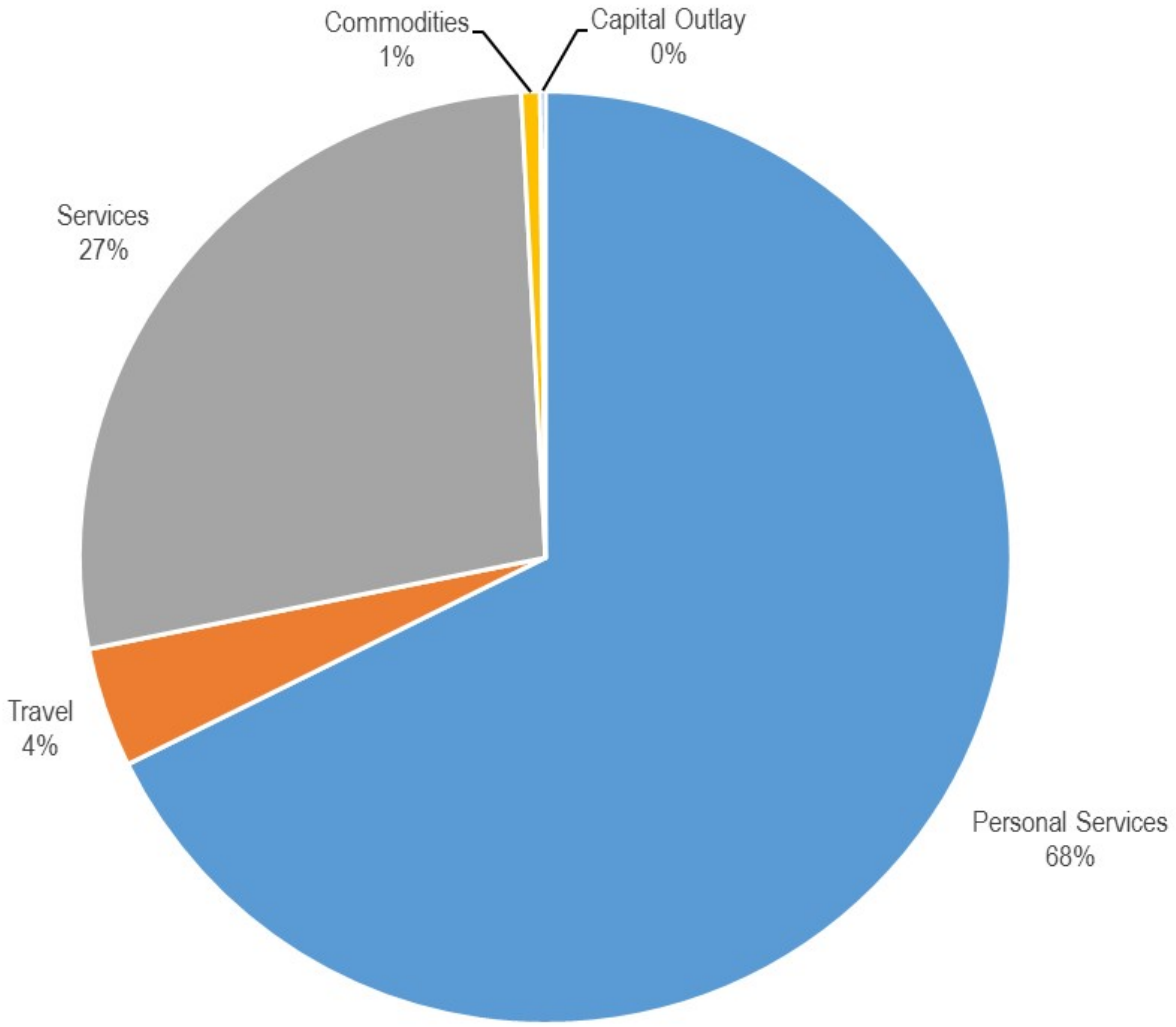
5.4 Pro Forma Costs

Pro forma operating costs are relatively flat at approximately $4.6 million per year; they are forecasted through FY2021 from $4.1 to $4.7 million per year. These amounts reflect, among other things, a decrease in full time positions from 18 in FY2015 to 12 in FY2016, based on the State of Alaska's FY2016 Governor Amended Operating Budget, February 5, 2015.

5.4.1 FY2015 Costs

Figure 9 illustrates expenses for FY2015, by type and percentage of the budget (rounded).

Figure 12. FY2015 Expenses, by Type and Amount, in Percent



Source: AAC, 2015

Personal services, along with other services, including contractors, comprise the majority of AAC's expenses at 95 percent of all those reported.

5.4.2 Fixed Cost Base

Discussion with AAC staff indicate approximately 42 percent of the projected (average) $4.6 million expense base is fixed, an amount (rounded) of $1.94 million. The rest of the reported expenses are variable ($2.7 million), with some degree of AAC control, such as further staff or direct cost reductions.

5.4.3 Break-even Analysis

Break-even amounts are those dollar figures where revenues equal expenses, highlighting which revenue or cost factors are most important at the time.

One method used to calculate break-even revenue is based on contribution margin. Contribution margins are the difference (in dollars or percentage) between average (sales) revenue and direct costs; gross margins are calculated in somewhat the same fashion and the projected FY2018 gross margin is approximately 40 percent, under stated assumptions. This suggests a break-even revenue of approximately $4.9 million is required.

5.5 Sensitivity Analysis

As part of the AAC business plan analysis, team members conducted a sensitivity analysis based on variables discussed in the following sub-sections.

5.5.1 Direct Funding

No state funds were used for the analysis; a $3.0 million federal appropriation was projected for FY2016, followed by $2.0 million in FY2017 and $2.5 million thereafter. These funds are part of a national program to support National Space Policy at both federal ranges (Vandenberg, Cape Canaveral) and, for the first time, non-federal spaceports at Kodiak and Virginia (MARS, the mid-Atlantic Region Spaceport, Wallops Island).

5.5.2 Missions, Revenues, and Costs, FY2016–FY2021

The forecasted numbers of launches and missions used for sensitivity analysis are drawn from Table 5. These base forecasts were developed from research, discussions, and additional input from AAC marketing staff. These are considered realistic and achievable, though they are much fewer in number than prior potential market figures prepared by others. AAC requested reduction to more conservative estimates to make this business plan as realistic as possible.

The three estimated levels of revenue per launch (and mission) are taken from Table 4. In addition to estimated launch revenue, AAC provided annual sales estimates for possible imagery sales, data downlink services, UAS (Unmanned Aircraft Services) and other services. These sales are held constant in Table 6. They do reflect potential revenue growth for AAC, but the most likely amounts are not considered material to AAC's overall operations, at least at this time.

Since 2012, AAC has reduced costs through elimination of staffing positions, allowing no increases in salaries, and careful attention to contract costs. It has refocused funding to marketing tasks, seeking partnerships in Florida, Hawaii, New Zealand, and Virginia to name several.

5.5.3 Sensitivity Results

Analysts used a software program to make 10,000 randomized calculations of revenues, costs, and funding, based on input figures discussed earlier. Table 8 summarizes results, by percentile, for the years FY2016 to FY2021.

Table 8. Pro Forma Operating Income, AAC, FY2016 – FY2021, Sensitivity Analyses

	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021
Percentile	($1,000)					
5	-2,378	-1,065	2,897	1,050	3,971	1,403
50	-2,063	-448	3,683	1,949	5,209	2,532
95	-1,748	228	4,565	2,944	6,605	3,836

Source: Northern Economics

These results suggest AAC has a 50 percent chance to generate a loss of $0.4 million (rounded) of net operating income for FY2017. At the 95 percent level (19 of 20 chances), estimated net income will be a maximum loss of $1.1 million (rounded) while at the 5 percent level (1 in 20 chances), the amount of revenue will be positive at $0.2 million (rounded)

Under the assumptions stated, AAC is expected to reach at least break even during FY2018, on an operating basis.

Further details of the sensitivity analysis are available in an Excel file from AAC.

6 Conclusions

Northern Economics was essentially asked two questions: Is there sufficient market for AAC to operate? And, if yes, how could AAC compete, from a financial (and organizational) perspective? Conclusions about these questions are discussed below.

6.1 Market Changes

As noted, there have been major market shifts in the aerospace industry since 2013. Specifically, there are changes in reduced payload size (and mass), shifts to lower costs, and plans by major industry participants to launch satellites more frequently.

Northern Economics believes AAC is well positioned to meet the demand for smaller satellites with more frequent launches on a low cost-controlled basis, especially for those orbits needed for full global coverage: images, sun synchronous orbits, and post-launch data tracking of high latitude satellites.

6.2 AAC Organizational Changes

Privatization and a P3 structure will help AAC retain control of PSCA and yet potentially expand beyond the boundaries of Alaska, currently not allowed by statute. The path for these changes was set at an AAC Board of Directors meeting in November and were forwarded to the Governor for his review and decision. This type of organization, as proposed by AAC's legal team, appears to meld state, federal, and private concerns.

6.3 Financial Feasibility

The pro forma operating statement, from FY2016 to FY2021, has several key assumptions. Market demand and revenues are conservatively estimated and reasonably in line with historical activity; expenses are held relatively constant throughout the period.

Northern Economics notes AAC staff have actively pursued contacts with other spaceports, a vast array of current and potential clients, and are widely promoting PSCA's return to full operations in mid-2016.

A key factor in the pro forma is the line item identified as federal funding, in the $2.0 to $3.0 million range per year. A loss of this support could generate negative net operating results, unless strong market demand provides sufficient offset revenue.

6.4 Probability of Success

Northern Economics believes AAC is in a position to achieve breakeven results in each of the fiscal years from FY2018 to FY2021 under the assumptions stated. We believe the officers and staff are aware of their current situation and working towards greater sales, controlled costs, and active management of the firm.

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