Status Update

October 1, 2022

CONTENTS

CCAM STATUS UPDATE

This update is being submitted as required by HB30 (Chapter 2), Item 127, K.5.:

> K.5. "CCAM shall submit a report on October 1 of each year to the Secretary of Finance, Chairs of the House Appropriations and Senate Finance and Appropriations Committees, and VIPA containing a status update of all new incentive programs, including but not limited to the following: (i) MOUs it has entered into with each university partner; (ii) funds disbursed to both university and private sector partners of CCAM, as well as any other recipients; (iii) any other agreements CCAM has entered into with representatives of the public and private sectors that may impact current and future incentive fund disbursements; (iv) all efforts and costs associated with obtaining federal research grants; and (v) any additional information requested by the Secretary of Finance, or the Chairs of the House Appropriations and Senate Finance and Appropriations Committees."

Elements requested in K.5. are outlined on page 16. In addition to those items requested, a brief overview is provided below to communicate CCAM's progress over the past year.

Executive Summary

Financial Update

- With the support from the Commonwealth, CCAM is making strong progress on improving its balance sheet while steadily executing its growth plan for long term sustainability.
- CCAM is in the process of completing its annual audit for FY2022. Final audit results are expected later this year with an expected designation of an unqualified opinion. Audited financial statements can be provided once received by CCAM.
- [redacted].
- CCAM trade debt is current [redacted]
- While legislative actions were put in place for the DGS to acquire the CCAM property (HB1800 Chapter 552, approved April 7, 2021), the transaction has not yet been finalized. DGS is working with CCAM, CCALS, UVA Foundation, and the U.S. Economic Development Association (EDA) to facilitate use of bond proceeds of the Virginia Public Building Authority for the acquisition. [redacted].
- In preparation for co-location of the Commonwealth Center for Advanced Logistics Systems (CCALS) at the CCAM building, CCAM has been directed by DGS to cover an estimated [redacted] in Tenant Improvement "TI" expenses to benefit CCALS.
- [redacted].
- CCAM has contracted with Chmura Economics & Analytics Group to develop an objective assessment of CCAM's impact on the economy of the Commonwealth. Preliminary data indicate that from 2011 through 2022, CCAM operations are estimated to have generated a cumulative impact of $106.1 million (direct, indirect, and induced) in Virginia, generating $8.8 million impact annually and supporting 54 state jobs per year.

CCAM Industry Membership: Two new "Strategic" and two new "Affilliate" members

- **RACER Machinery International, a Canadian machine tool manufacturer, has joined CCAM at the Tier I (Strategic) level**, and will direct their $250K annual membership dues for CCAM Research Engineers to support [redacted].
- Air Turbine Tools and Creaform signed as new Affiliate Members, and have contributed a combined $350,000 in equipment and software capabilities.
- **Northrop Grumman upgraded their membership to Tier I (Strategic) level**, significantly expanding the pipeline of Directed Research work that they conduct at CCAM with an additional $150K in annual member fees.
- On August 30th and 31st, CCAM held a Research Day event, "Applying the Digital Thread in Advanced Manufacturing industries". **More than 140 people and 58 companies attended the in-person event** – the first since prior to the pandemic.

Federal Funding: Federal funding momentum continues with significant future impact

- Commonwealth support has accelerated CCAM's engagement in attracting federally funded programs.
- CCAM's federal awards results already show early progress: awards increased YOY by 31% in FY21 and then by 166% in FY22 to $1.34M. Over 3 years these new awards equate to $450k in revenue per year.
- The pipeline of CCAM campaigns and proposals grew >500% ($4.1M to $24.8M). The $24.8M award when probability weighted translate to **expected awards to CCAM of $6.5M**, a >600% increase in value YOY. With an initial ramp up phase in FY23 of approximately $0.5M, this $6.5M award value translates to a **potential $2M in annual revenue in FY24-FY26**.
- CCAM was able to contribute to the large federal program and award applications pending below. While these wins could bring significant economic activity to Virginia entities, it is expected that they would result in $6M+ of CCAM revenue, or $2M annually for three years.
    - Build Back Better Region Challenge with the Alliance for Building Better Medicine (~$53M)
    - Mobile Technology Insertion Program with Genedge ($10M extendable to $40M)
    - [redacted]
- Note that in terms of CCAM operations, **each dollar in federal funding revenue does not equate to a dollar in industry revenue**, as hourly rates from federal funding are significantly lower. However, federal revenue is valuable as an effective approach of offsetting a portion of CCAM overhead. Put another way, it takes more effort and expense to earn a dollar of federal funding than it does for a dollar of industry funding.
- **CCAM was recognized nationally**, as CCAM was selected by the National Institute of Standards and Technology (NIST) to lead a US Roadmap development effort: "***Developing a Roadmap to Strengthen the US Manufacturing Supply Chain via the Digital Thread***"

Workforce Development: CCAM recognized as a leader in developing a talent pipeline

- Through investment of CCAM's leadership, the Central Virginia Chapter of the **Federation of Advanced Manufacturing Education (FAME) successfully launched with nine Core Member manufacturing companies from the surrounding area**. With the roster now at twelve, and continuing to grow, FAME is recognized as favorably impacting young people and Central Virginia's economy.
- The continued success of CCAM's Internship Program has led to recognition by Virginia's Talent +Opportunity Partnership as a **"Top Employer for Interns"**.
- CCAM is now **collaborating with five area school divisions and the Institute of Advanced Learning and Research (IALR) to extend the reach of the GO TEC** (short of Great Opportunities in Technology and Engineering Careers). Pending grant funding support approval from GO Virginia, GO TEC, the plan is to establish Career Connections labs in middle schools to spark their interest to pursue STEM careers.

Operational Risks

- **Staffing** – CCAM is still navigating a very competitive labor market which has made it challenging to secure top talent in a reasonable timeframe. With current market conditions, there is also a measure of risk with staff attrition. Current gaps in key positions of need present a couple risks: a) delayed execution (decreased revenue, increased research liability) for certain projects, b) potential resource constraints with anticipated ramp up in Federal program activity. While we would like to prepare staffing levels for anticipated federal award wins, we are careful not to hire too early. CCAM has engaged with four recruiting firms in the past 18 months and actively posts on LinkedIn and within internal networks.
- **Recessionary** – The threat of a potential recession is likely to have a ripple effect in corporate spend on research and development. For CCAM, this could put pressure on existing membership status, slow new industry memberships, and reduce additional spend by existing members above their annual member fees. CCAM's efforts to diversify its revenue sources via Federal program growth is paramount to offsetting a decline in the industrial sector. CCAM is also assessing its tiered membership levels among other best-in-class research organizations to better understand the needs of the changing market.
- **Federal Program Growth** – Submission of a single federal award proposal is a probability weighted activity which could result in zero dollars awarded. To mitigate this risk, CCAM has been diligently growing its pipeline (>500% increase over prior year) of business and proposal development activities which should provide greater odds of overall return. While we have tried to remain conservative on our probability projections, there are a few large awards in our pipeline which are binary in terms of win/loss. This could result in a large fluctuation in what CCAM actually receives in terms of awarded contract value.

Overview

CCAM continues to make solid progress in executing the 5-year strategy laid out in January 2021. Operational performance has improved despite significant market challenges. In FY2022, CCAM has added new members at the "Affiliate" (Air Turbine Tools) and "Strategic" levels (RACER). CCAM upgraded an existing member, Northrop Grumman, to the "Strategic" membership level as well. State funds provided to CCAM to develop a program for pursuing Federal funds has gained momentum, increasing CCAM's awards 2.6X YOY (from $505K to $1.34M) with significant increases expected in FY23. Commonwealth support and partnerships with several Commonwealth agencies, the higher educational system and industry have positioned CCAM for additional growth as it is able to team on much larger collaborations. CCAM is a core team member of the Alliance for Building Better Medicine - winner of the national Build Back Better Regional Challenge – bringing $53M to the Richmond-Petersburg area. CCAM is also a key team member in GENEDGE's Manufacturing Technology Insertion Program (MTIP) – a $10M congressional add program that could expand to $40M – which aims to roll out advanced manufacturing technology to Small and Medium sized Manufacturers (SMMs) across the Commonwealth. CCAM is also in pursuit of a NSF Regional Engines award and a significant Navy award, which, if successful, will be the largest program CCAM will have participated in to date, [redacted]. With continued Commonwealth support and execution of CCAM's defined strategy, CCAM remains on track toward significant impact on the advanced manufacturing ecosystem in Virginia.

Articulating the Economic Impact of CCAM

CCAM is an integral ingredient in many activities that drive success for regional, national, and global businesses (especially manufacturers). This work generates value for the Commonwealth's economy in several ways, and it is important for CCAM and its stakeholders to understand the value of this work to capitalize on strengths and address improvement opportunities. Toward that end, CCAM has engaged Chmura Economics & Analytics (Chmura) to survey a broad spectrum of CCAM's customers and provide an objective analysis of the economic value of the following four activities:

1. Research and Development (R&D): Measurement of CCAM's R&D impact includes the value of new products and manufacturing processes (including quality and cost improvements) that result from the R&D conducted at CCAM – both Core and Directed.
2. Workforce Development: Measurement of the value of CCAM's workforce programs and services by the total economic impact in Virginia that results from the incremental labor income as CCAM helps advanced manufacturing companies secure the skilled individuals they need to support their current operations and their growth plans.
3. Business Attraction: Even before its inception, the Commonwealth's commitment to CCAM has helped to bring advanced manufacturing businesses to Virginia. The economic impact of these new businesses' operations, as measured by the new jobs created in Virginia and associated economic output, is an important factor to be calculated.
4. Federal Funding: CCAM helps business and other organizations obtain federal funds to propel their growth. This federal funding is used both for R&D and Workforce Development programs, and the value is analogous to that of the other categories.

Chmura initiated their analysis in May 2022 and constructed a survey to obtain relevant data from a wide variety of stakeholders to perform their assessment. This is a complex process for an entity such as CCAM, as much of the data is intertwined with companies' confidential information about product strategies, manufacturing processes, and supply chain performance. Further, some of the data are difficult to assess, are not tracked in the direct context requested, or are part of product strategies that take many years to develop and implement.

These data only consider the effects of CCAM's operational spend in the Commonwealth in terms of economic impact and job creation. As of this writing, the analysis is still in-progress, and results are only available for approximately half of the outlined activities. It is expected that as additional information is obtained, results will improve. Despite the limited information, it is clear that CCAM has had a positive effect on Virginia's economy, contributing >$100 million of economic impact and ~650 Jobs in the Commonwealth.

CCAM Operational Revenue

CCAM's operations generate significant economic impact in and for Virginia. In FY22, total CCAM revenue was ~ $7.5 million (see Figure 1). Revenue sources include state funding along with industry sources plus federal and local grants. Values in this chart exclude pass-through funding that CCAM distributes from their sources to other organizations. CCAM revenue is used to conduct R&D, manage workforce programs, and cover overhead expenses. As of June 30, 2022, CCAM employs 34 full-time staff.

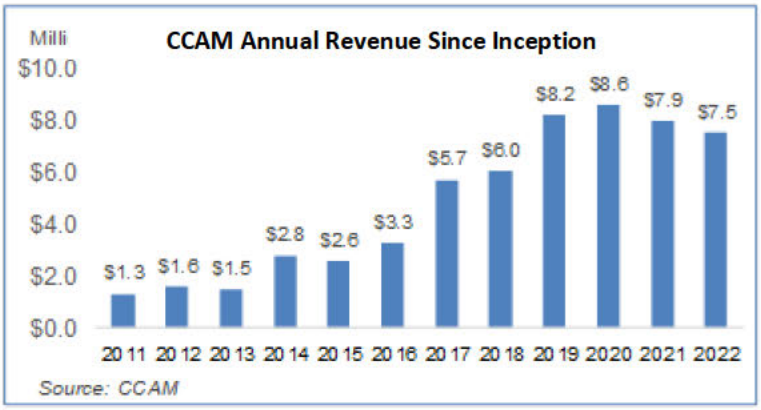


Figure 1: CCAM annual revenues.

The 2022 indirect impact was estimated to be $3.7 million and 20 jobs, benefiting other businesses in Virginia that support CCAM operations. Examples include utilities such as electricity and water service, suppliers of lab equipment and materials, and office supply companies, among others. The induced impact was estimated to be $2.8 million and 25 jobs in 2022 in, mostly benefiting consumer-related businesses such as retail shops and restaurants. From 2011 through 2022, CCAM operations are estimated to have generated a cumulative Virginia impact of $106.1 million (direct, indirect, and induced). On an annual average basis, it is estimated that CCAM operations generate $8.8 million Virginia impact (direct, indirect, and induced), supporting 54 jobs per year (Table 2).

Table 1: Preliminary Assessment by Chmura of CCAM Economic Impact and Job Creation

		Direct	Indirect	Induced	Total Impact
Cumulative (2011-22)	Spending (Million)	$56.8	$27.7	$21.5	$106.1
	Employment	282	162	205	648
Annual Average (2011-22)	Spending (Million)	$4.7	$2.3	$1.8	$8.8
	Employment	23	14	17	54
Annual (2022)	Spending (Million)	$7.5	$3.7	$2.8	$14.0
	Employment	34	20	25	78

Note: Numbers may not sum due to rounding *Source: IMPLAN 2020, CCAM, and Chmura*

Strategy and Execution

CCAM continues to execute the strategy outlined in the 2020 October 1 report and in more detail on the federal funding front in the 2021 January report to the Commonwealth. Excellent progress has been made in line with the key challenges the strategy was developed to address:

1) Diversify the industrial membership base from a heavy focus on aerospace. COVID-19 revealed the risk in relying solely on a single industry vertical membership base. Aerospace was hit particularly hard by the pandemic.
2) Overhaul the approach towards attracting federal funding. Though correctly identified as a key element to CCAM sustainability – the execution plan was sub-optimal, resulting in federal funding revenues that were an order of magnitude lower than projected.
3) Focus CCAM strategy on the digital factory concept that allows CCAM to execute (1) and (2), above, while remaining focused on the core technology stack.
4) Enhance CCAM's collaboration with Universities and Virginia government organizations.
5) Pursue a means to relieve the over weighted building costs, which is being addressed via a creative solution by the legislature to repurpose a bond for the purchase of the CCAM building.

In addition, in FY22 CCAM added an additional focal point to the strategy:

6) Increased focus on workforce development and education in conjunction with our academic partners.

Business Development

Strategy Execution

CCAM's digital factory and Industry 4.0 strategy are enabling expansion into new industry verticals including consumer goods, advanced pharmaceutical manufacturing, controlled environment agriculture, and even energy transmission & distribution. This intentional diversification of CCAM's member strategy is proving to be a key element for growth and resiliency. Execution of that strategy is paramount to achieving the articulated impact, and leadership at CCAM is fully focused on that execution. Our Business Development team continues to strengthen ties with government, education, and industry partners across Virginia. This has catalyzed greater interaction and collaboration among organizations, leading to a more robust pipeline of potential CCAM members that naturally support VA-based manufacturers. These partnerships rely less on legacy CCAM members and enable connections with new and diverse industries.

CCAM regularly collaborates with government and economic development entities including VIPA/VIPC, GENEDGE, VEDP, Virginia Gateway Region, GO Virginia, Virginia's Growth Alliance, Hopewell Prince George Chamber, Crater Planning District, nonmember colleges and universities, as well as Federal manufacturing institutes like America Makes, ARM, CESMII and our own Prince George County. Partnering with these organizations enables CCAM to identify local companies that could benefit from CCAM's capabilities as well as economic development prospects seeking to expand into Virginia. Economic development entities including Prince George County, the Greater Richmond Partnership, Virginia's Gateway Region, and the Virginia Economic Development Partnership now reference and feature CCAM in their promotional materials and websites.

New Members Recruited

During the past year, CCAM welcomed several new members, and has upgraded or sustained others. These new members are bringing energy and capabilities to our portfolio, proving the case for membership diversification.

RACER Machinery International, a Canadian machine tool manufacturer, joined CCAM at the Tier I (Strategic) level. RACER holds many contracts with the US Department of Defense, and is uniquely positioned as a North-American based builder of a broad range of high-end machine tools. State incentive funds were used to attract this company, which will be conducting engineering work at CCAM to support development of a [redacted]. RACER plans to locate one of their

prototype versions of this machine at CCAM so that our industry and university members can use it for advanced manufacturing process development. Additionally, they have expressed interest in potentially establishing a US headquarters in Virginia as a result of their membership in CCAM.

While not directly related to RACER's membership in CCAM, Organizing University Member Virginia State University (VSU) recently ordered two Computer Numerically Controlled (CNC) machine tools from RACER. These machines will be outfitted with the newest version of Siemens controls, thereby creating additional leverage, collaboration and development opportunities for all three CCAM members, along with educational program benefits for the VSU College of Engineering and Technology. The machines will become part of VSU's Intelligent Manufacturing Cell, being developed under a grant from the US Department of Defense. This cell will demonstrate distributed manufacturing capabilities with a similar cell installed at CCAM via use of the Digital Thread.

Air Turbine Tools signed as a new Tier III (Affiliate) Member. Air Turbine manufacturers spindle-speeder technology that enables manufacturers to significantly increase the range and flexibility of what they can produce on a standard machine tool. CCAM had previously incorporated Air Turbines products on Directed Research projects for its members. With Air Turbine now part of the CCAM team, we have a wide-range of their products at hand, along with ready-access to their engineering and application expertise. This relationship is already yielding new directed work for CCAM and opening up opportunities for current and potential members. Air Turbine Tools contributed in excess of $150,000 of products to support their membership.

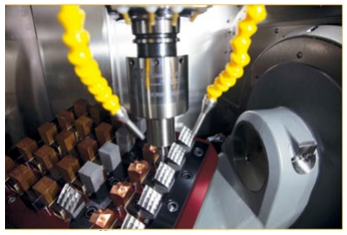


Figure 2: CNC milling machine 'Spindle Speeder' from Air Turbine Tools.

Creaform, a manufacturer of advanced non-contact metrology equipment also signed as a new Tier III (Affiliate) Member. Creaform is a Canadian based company that has also collaborated with CCAM on previous projects. Their equipment is able to scan extremely complex parts, delivering high-speed, high-accuracy results, and enabling huge leaps in manufacturing process intelligence. Creaform donated in excess of $200,000 of equipment and software to support both Directed and Generic Research projects at CCAM.

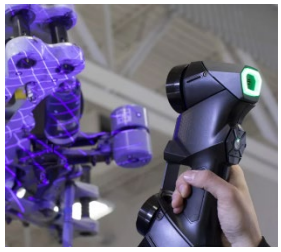


Figure 3: Creaform's 'Handi-Scan' precision measurement device.

Northrop Grumman upgraded their membership level from a Tier II (Principal) level to Tier I (Strategic) level. State matching funds helped catalyze this to happen. The majority of the work CCAM conducts for Northrop Grumman supports their Charlottesville and Baltimore operations, and this upgrade represents their confidence in our results and an expansion / broadening of our work with this global company.

Growth Opportunities In-Progress

With emphasis on the rapidly expanding Advanced Pharmaceutical Manufacturing industry in Central Virginia, CCAM's list of prospective new members is now very robust. The through our partnership with GENEDGE, we are now speaking with more small and medium-sized VA-based companies than ever before. Recent economic development announcements from across the Commonwealth are also creating opportunities for CCAM.

Beyond the obvious, potential members include: a consumer, surgical, and industrial blade manufacturer for consumer goods and health care; a European pharmaceutical printing company; and a major utility provider. Two of these companies are headquartered in the Commonwealth and the European company is considering to base its US operations in Virginia. CCAM is utilizing the Commonwealth's incentive funds combined with digital factory / Industry 4.0 strategy to attract a new pipeline of CCAM members and increase the diversity of advanced manufacturing footprint in Virginia.

CCAM is also actively engaged in supporting the redevelopment of the former Rolls-Royce Crosspointe facility in Prince George. Since the site is obviously well-suited for Advanced Manufacturing, CCAM is pursuing the logical goal of membership for the new tenant. CCAM has already hosted the new site owner and a potential industrial occupant to demonstrate our value proposition for both R&D and workforce development.

CCAM Research Days – 30 & 31 August 2022

This summer, CCAM held its first in-person Research Days event since prior to the pandemic. CCAM brought together both suppliers and consumers of Digital Thread technologies to discuss and demonstrate application opportunities to use digital data to help make manufacturing processes and supply chains more efficient and effective. Our goal was to showcase the different industry sectors that digital thread is and can be applied in, and to brainstorm with both members and potential members about possibilities to extend applications to further support their businesses.

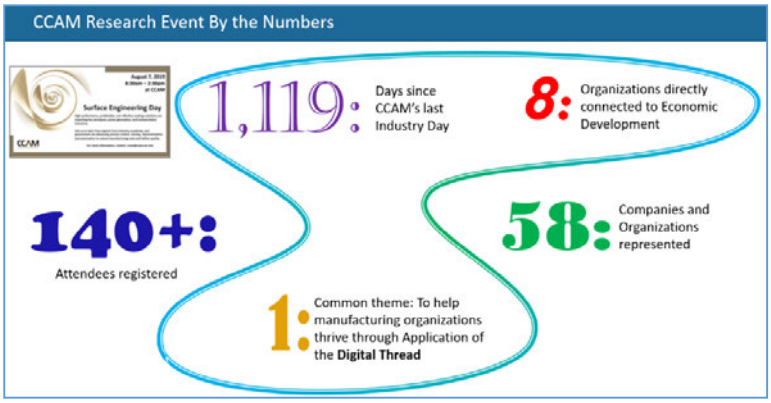


Figure 4: CCAM's Research Day event fun facts.

This event was achieved by overwhelming support from our members, Board of Directors, potential members, and community stakeholders, with >140 people in attendance over the two-day event.

Highlights from the event included a keynote presentation from Don Kinard, Ph.D., a Senior Fellow for Lockheed Martin Aeronautics Production Operations, and a variety of demonstrations from the CCAM team and some of our Tier III (Affiliate) Member partners. CCAM's collaborations with GENEDGE to support small and medium-sized manufacturers in Virginia, along with our work to establish the Central Virginia Chapter of the Federation for Advanced Manufacturing Education (FAME) were also showcased. These helped to provide context to the days by emphasizing the broad applicability and the skillsets needed to support these technologies.

Digital thread workshops (pictured) brought participants from industry, academia, and government together to brainstorm opportunities, challenges, and ways to solve them that could advance their business' objectives.

Figure 5: Digital thread workshop held during CCAM Research Days event.

All five of CCAM's Organizing University Members also participated in the event, with undergraduate and graduate students presenting at a poster session to showcase the on-campus and collaborative research work they're involved in to our members and the greater community.

Workforce Development

Central Virginia FAME

CCAM played a lead role in the development and launch of the Central VA Chapter of the Federation for Advanced Manufacturing Education (FAME). FAME-USA is part of The Manufacturing Institute, the workforce arm of the National Association of Manufacturers. FAME-USA has over thirty-six chapters in fourteen states in the U.S. and serves over four hundred manufacturers. It is a work/study cooperative education model which recruits students (mostly new high school graduates) to become global-best advanced manufacturing technicians. The startup of this program was largely supported by GO Virginia Region 4, Prince George County & The Cameron Foundation. FAME was vetted by local manufacturers and educational programs to fill a critical workforce development gap for skilled trades roles in Advanced Manufacturing industries.

FAME succeeds through integration of strong technical training, manufacturing core competencies, intensive professional practices, and intentional hands-on experience. Students recruited by FAME manufacturing employers are becoming a solid pillar of their companies' futures all the while receiving training and earning a great starting compensation. What also makes FAME successful is that the industry partners shape and lead the program, with CCAM and our partner Richard Bland College of William and Mary (RBC) providing structure and support. Current FAME industry partners (mostly attracted by CCAM) include Altria, Amsted Rail, AMPAC Fine Chemicals, BluePrint Automation, Concrete Pipe & Precast, CivicaRx, Coesia / GD-USA, EPT USA, Jewett Automation, Niagara Bottling, Phlow, and Sabra Dipping.

Graduates can expect to earn an above-median wage salary after completing the 2-year program, during which they will have earned an Associates of Science degree from RBC. Many of the educational credits earned by FAME participants are transferable toward Bachelor's degrees at local 4-year institutions. FAME technical courses are delivered at CCAM, where students are exposed to Fortune 100 companies (many with VA operations) and engineers, in a high-tech, state-of-the-art, innovative manufacturing environment. The first Central VA FAME cohort (Class of 2023) includes 6 students from the following School Divisions: Prince George, Chesterfield, Isle of Wight, Henrico, and Annapolis. The second Central VA FAME cohort (Class of 2024) launched in August 2022 and includes 10 students from Prince George, Dinwiddie, Loudoun, Chesterfield, Hopewell and Isle of Wight School Divisions. Because CCAM's educational partner Richard Bland College has on-campus housing, Central VA FAME is able to attract students from all across the Commonwealth of Virginia and beyond.

GO TEC

To further strengthen the overall workforce pipeline in Central Virginia, CCAM is currently working with the Institute for Advanced Learning and Research (IALR) in Danville to implement Great Opportunities in Technology and Engineering Careers (GO TEC) Career Connections Labs in middle schools across the Region. GO TEC was launched in 2017 at the IALR in Danville, and labs are now operational or in-progress in twenty-five Virginia middle schools, mostly in GO Virginia Region 3. Even though GO TEC's target audience is still several years away from directly contributing to the workforce, the program is being directly credited for helping Region 3 to attract STEM-focused companies to locate or expand their operations. CCAM has been named Region 4's "Coordinating Entity", with support from partners VSU College of Engineering & Technology and Brightpoint Community College. If approved, CCAM will establish a GO TEC lab and teacher training facility to support all participating middle schools in the area. Regional school divisions currently participating in this expansion effort include Colonial Heights, Dinwiddie County, Hopewell, Petersburg, and Prince George County.

CCAM Internship Program

CCAM's Internship Program for our Organizing University Members has continued to expand, and has accommodated 219 interns and 18 graduate research assistants since its inception in 2016. Of the interns, 28% come from Virginia State University, a Historically Black College and University. CCAM is proud to have been recognized in August 2022 by the Virginia Talent + Opportunity Partnership as a "Top Employer for Interns". This award acknowledges the value that our Internship Program delivers to employers, students, and Virginia's economy.

Figure 6: CCAM recognized as a 2022 TOP Employer for Interns.

Additional Workforce Development and Recognition

CCAM's successes in supporting manufacturers in workforce and economic development have been recognized around the Region. In April 2022, Chesterfield County Economic Development aired a special podcast episode of their "Chesterfield Behind the Mic" podcast, featuring CCAM's Lorin Sodell speaking about critical success factors for manufacturers and their importance to economic development.

Related to CCAM's foundational role in the launch of the Central Virginia FAME Chapter, Lorin Sodell was invited to speak as a panelist at the National FAME Conference in October. Just one year into its operation, Central Virginia FAME is recognized as a national model for how to launch a chapter with broad-based funding and commitment. The specific focus of his session will be on engaging partners and building community support across private and public sector stakeholders who came together to recognize and fulfill a common need / barrier to growth for the Region's manufacturers.

Pursuit of Federal Funding

Strategy

Federal funding is a key element in the strategy for CCAM's long-term sustainability. As described in detail in the January 2021 report, these tenants still apply:

1) **Multiyear funding of large federal programs provides a stabilizing effect on the year-to-year funding variation that is typical of industry funding.**
2) **Federal funding provides significant resources in developing state-of-the-art capabilities today that will retain and attract industry members in the future.**
3) **In addition to year-over-year funding stability, federal funding can significantly impact overall profitability on industry research.**

The report also outlines CCAM's "flywheel" concept for generating multiple, large federal funding campaigns, which CCAM has leveraged well over the last 1 ½ years. The funds provided by the state for CCAM's pursuit of federal dollars is showing results, as awards have increased significantly. Even more significant are the programs pursued and awards pending for which CCAM has been an integral core team member, including the BBB, MTIP, and [redacted], with a significant focus on innovative technology, SMMs, workforce development and education. All of these significant programs resulted from efforts with significant collaboration between multiple entities within the Commonwealth and beyond. The manufacturing ecosystem is working – and growing!

Outlook

Execution of CCAM's federal funding plan was initiated in the first half of FY21, but accelerated nicely in the 2nd half of the FY21 and through FY22 due in large part to the funding allocated by the Commonwealth to help kick-start the process. Despite the typical 24-month cycle time from federal campaign generation to initial award results, CCAM's federal awards results already show early progress, as awards increased YOY by 31% in FY21 and then by 166% in FY22 (Figure 7). Detail on the awards comprising the $1.34M total for FY2022 can be found in

Table 2. While good progress has been achieved, more work needs to be done. CCAM's goal is to generate $4M in federal funding *revenue* annually by 2026 (Figure), which requires booking higher levels of federal awards beforehand, as awards are typically 36-month efforts. Converting an award to revenue thus has a time delay: e.g., a $3M project awarded in one year results in $1M in revenue for the next 3 years. This effect means that FY22's awards still fall short of the CCAM internal target, where $1.9M was the FY22 target set back in 2020, thus we are tracking approximately 6+ months behind plan. Fortunately, CCAM has two large proposals in the pipeline for FY23 that should enable us to continue expanding our awards. Figure shows the YOY change in CCAM's awards and pipeline from FY21 through present: the pipeline of CCAM campaigns and proposals grew >500% ($4.1M to $24.8M), while the probability-weighted award projections increased >600%, from $0.9M to $6.5M YOY. Support from the commonwealth has made it possible for CCAM to engage in the federally funded community, build relationships, and pursue these larger programs. Without this support, the timeline for the planned growth would take several more years.

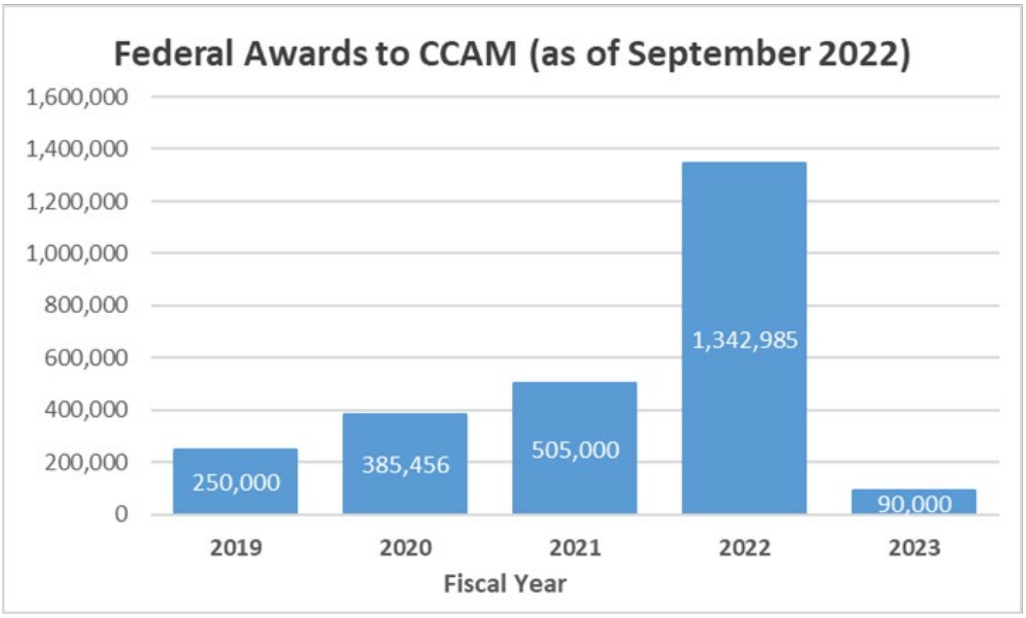


Figure 7: CCAM annual federal awards as of 1QFY23.

Table 2 - Federal Awards to CCAM (FY2022).

Agency/ Program	Project	Prime	CCAM Award
NIST	Digital technology and machine learning for spatial and temporal data alignment from disparate sources	CCAM	$ 149,540
ONR	Proof of Concept Intelligent AM Ecosystem	CCAM	$ 750,000
CESMII	Auto generation of SM Profiles using OPC UA - MTConnect companion Spec	CCAM	$ 108,445
NIST	Developing a Roadmap to Strengthen the US Manufacturing Supply Chain via the Digital Thread	CCAM	$ 300,000
US Navy	SBIR N221-009 - Metrology Research Topic	Luna Labs	$ 35,000
		Total	**$ 1,342,985**

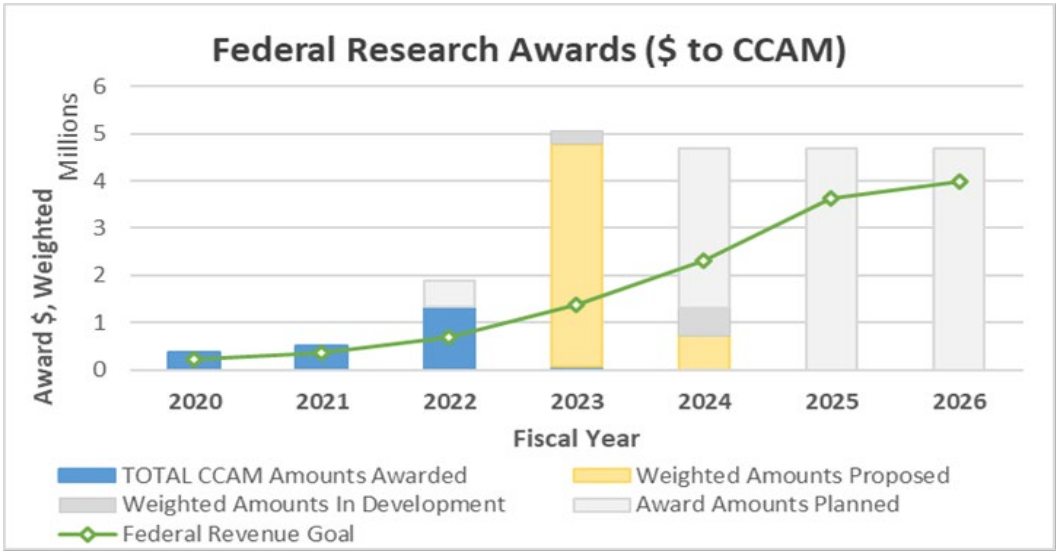


Figure 8: CCAM federal funding awards plan and actuals/latest estimate.

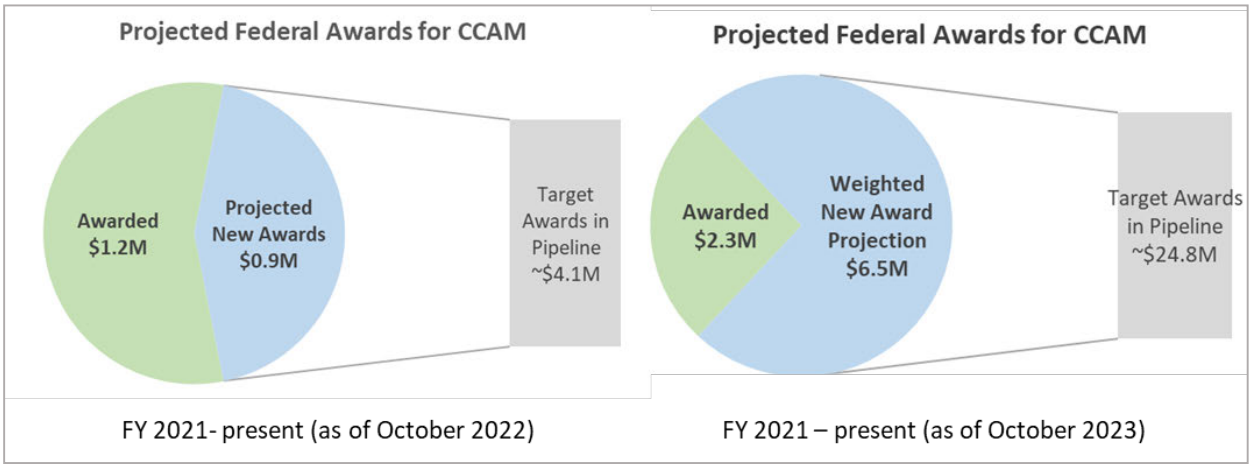


Figure 9: YOY comparison of CCAM federal awards, existing and projected with pipeline from FY 2021 through present.

It should be noted that in terms of CCAM operations, **each dollar in federal funding revenue does not equate to a dollar in industry revenue**, as hourly rates from federal funding are significantly lower. Put another way, it takes more effort and expense to earn a dollar of federal funding than it does for a dollar of industry funding. However, federal revenue is valuable as an effective approach of offsetting a portion of CCAM overhead. Most importantly, CCAM is able to develop foundational new capabilities that will be leveraged for attracting future programs across our membership base. Additionally, large collaborative federally funded projects inject significant funds within the manufacturing ecosystem in the Commonwealth.

Strategic Collaborations

CCAM has expanded its collaboration network within the Commonwealth and – as part of core collaboration teams – has targeted several federal programs that benefits entire regions in the Commonwealth. Increased interaction with our community, including University, government, and industry partners, as well as other NGOs in the Commonwealth has inserted CCAM at all levels of the manufacturing ecosystem in the state. CCAM is a core team member of the Alliance for Building Better Medicine - winner of the national Build Back Better Regional Challenge – bringing $53M to the Richmond-Petersburg area. CCAM is also a key team member in

GENEDGE's Manufacturing Technology Insertion Program (MTIP) – a $10M congressional add program that could expand to $40M – which aims to roll out advanced manufacturing technology to Small and Medium sized Manufacturers (SMMs) across the Commonwealth. Additionally, CCAM is in pursuit of a NSF Regional Engines award and a significant Navy award, each of which, if successful, will be the largest program CCAM will have participated in to date, [redacted]. While the latter programs are in development or waiting to be officially announced, the former program, the Build Back Better Regional Challenge, has been well publicized and is outlined below.

Build Back Better (BBB) Regional Challenge

CCAM is proud to be a core partner of the Alliance for Building Better Medicine. CCAM has partnered with Activation Capital on two important projects for the recently awarded Build Back Better Regional Challenge grant including the Scale-up Development Center Project and the Joint Engineering Degree Project. The Alliance for Building Better Medicine, a coalition of public and private sector stakeholders in the Richmond-Petersburg region, and Governor Glenn Youngkin recently announced $111 Million of new investment by federal, state, local, and private supporters to accelerate the development of the advanced pharmaceutical and manufacturing cluster emerging in Central Virginia.

Figure 8: CCAM and other core team members during the celebratory BBB Regional Challenge announcement by Governor Glenn Youngkin.

The Build Back Better Regional Challenge grant was almost $53 million and will be matched by $13.6 million of funding from local private and public organizations and an additional $44.6 million invested by the Commonwealth.

Funded by President Biden's American Rescue Plan and administered by the US Economic Development Administration (EDA), the Regional Challenge provides funding to rebuild regional economies, promote inclusive and equitable recovery, and create thousands of good-paying jobs in industries of the future such as clean energy, next-generation manufacturing, and biotechnology.

University Collaborations

CCAM continues to build on collaboration with our university partners through both federally funded programs and innovation funds provided by the Commonwealth. In the area of advanced pharmaceutical manufacturing, CCAM has engaged Virginia Commonwealth University (VCU) and Virginia State University (VSU) on a number of programs. We have jointly submitted a proposal with the Medicines4All institute at VCU to the FDA to develop [redacted]. We developed new technology in [redacted] with VCU's Professor Barbara Boyan, and teamed with Dr. Liu at VSU to identify [redacted]. A proposal to DARPA on using advanced machine learning techniques for improving supply chain resilience was submitted by CCAM and VCU Professor Milos Manic. CCAM won a prestigious award from NIST to ***Develop a Roadmap the Strengthen the US Manufacturing Supply Chain via the Digital Thread***. VSU and VCU both play critical roles on that NIST program. And, of course, VCU, VSU and CCAM teamed on an education workforce development project as part of the successful Build Back Better Regional Challenge proposal which was recently selected for a $53M award.

Old Dominion University (ODU) and CCAM submitted a National Science Foundation proposal on [redacted]. With VSU and Virginia Tech (VT), CCAM is developing concepts for proposals to DOD in the areas of [redacted]. CCAM had a VT Graduate Research Assistant (GRA) and a student intern on site this past summer working at our robotic DED cell. CCAM has recently submitted a NSF Regional Engines Type I proposal that, if selected, will define a program [redacted]. CCAM is also leveraging a NIST funded program in developing intelligent distributed manufacturing cells, by collaborating to install node hubs at both VSU and VT. The CCAM-VT-VSU teaming resurfaces as we explore opportunities to collaborate on Controlled Environment Agriculture programs.

CCAM is partnering with Professor Radhika Barua of VCU and her students working onsite with CCAM research engineers, [redacted], respectively, on these topics. CCAM continues to work with Doctor Shephard at VCU, developing and testing new methods of programming industrial robots, making it easier for companies to inject this technology – even if they do not have robotic programming skill on staff. CCAM is also engaged with Paul Rocheleau at VCU in the concept development of the new C4 computing cluster and related ecosystem.

CCAM continues collaboration efforts with the University of Virginia (UVA) in the areas of advanced materials modeling for additive manufacturing, including an innovation program with Oak Ridge National Labs (ORNL) on a DOE High Performance Computing for Manufacturing (HPC4Mfg) program. CCAM is collaborating on an innovation program [redacted].

The CCAM-University innovation programs have made significant strides, demonstrating better alignment for developing novel solutions that address real world challenges in applications-specific contexts, thus improving opportunities for jointly attracting additional federal and industry funding. Many of the collaborations listed here would not have been possible without the Commonwealth's Innovation Funds provided to CCAM for exactly this purpose.

Commonwealth Funding

The Commonwealth has provided critical support of CCAM's mission, enabling new leadership to execute a holistic strategy under the pressure of a pandemic. This, along with sound financial management has positioned CCAM for growth. Halfway through the typical 24-month cycle time for federal funding initiatives to bear fruit, improved performance is evidenced with early wins, and future projections are bullish. There is more work to do to ensure that becomes reality and continued funding is needed to achieve this goal. We reaffirm the position that, continued, level funding support is needed during the current biennial funding cycle. Assuming the building transitions to DGS as expected with minimal expense to CCAM, the organization will be in a strong enough position heading into the next biennial to begin to taper its request for financial assistance from the Commonwealth as state funds are gradually replaced by industrial and federal sources.

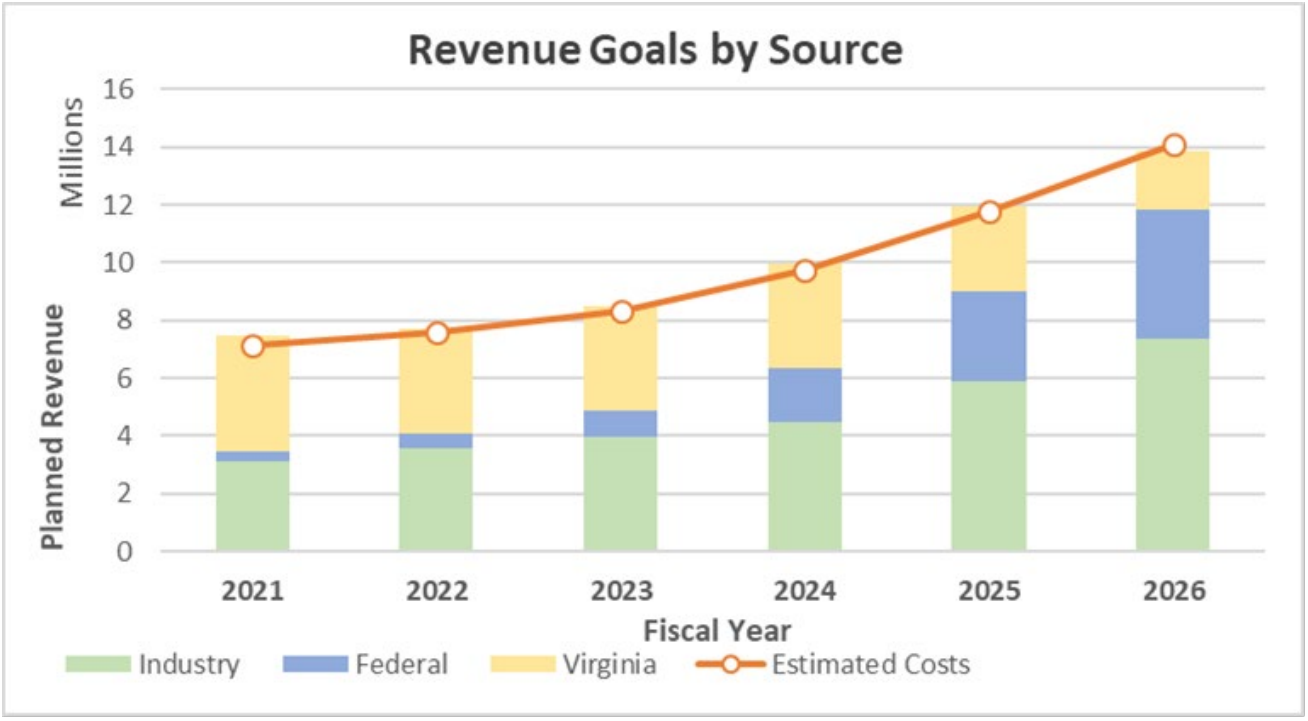


Figure 9: CCAM 5-year revenue plan targeting industrial and federal funding growth.

As noted above, executing the CCAM strategy requires maintaining flat funding already in place for the FY2023/4 biennial funding cycle, which includes the following:

- Continue CCAM's current operational budget allocation from the Commonwealth for $925k. While CCAM continues ramp up of federal and new member funding sources, this is critical in smoothing revenue inconsistency during periods of staffing shortage and potential member revenue fluctuation.
- Continuation of the $1.1M industry grant. These funds have proven to be a vital component in driving additional revenue through existing members while attracting new ones.
- Continuation of the $600K university grant for joint projects and follow-on efforts, including road mapping activities, marketing and proposal development, to continue momentum and leverage previous project activities for the pursuit of CCAM/University jointly funded federal programs.
- Continuation of the $1M appropriation to support federal award program development. CCAM continues to gain traction in the federal space. This funding is key to furthering that growth. Obtaining federal funding via pre-marketed campaigns typically takes 18 to 24 months to be fully engaged in the federal funding cycle, thus continued support is required while we incubate and grow federal funding.
- Provide building rent and operations support. Original legislation language outlined the building purchase by DGS and subsequent M&O support beginning July 1 of FY22. As the transaction is still an open item, this remains a critical need for CCAM's success and completing that transfer in FY23 is vital.

In FY23, the Commonwealth also provided one-time, long-term debt relief for CCAM, allocating $5.391M in funding to pay back the organization's early Bank and Tobacco Commission loans. These loan paybacks have already been executed and the loan vehicles have been closed. This debt relief is an important enabler for CCAM to focus resources on future growth, rather than committing them to previous obligations.

HB30 (Chapter 2), Item 127, K.5. Requirements

(i) MOUs with university partners

One MOU, signed January 2019, between CCAM and its Organizing University Members was included in CCAM's Operating Plan submitted to VEDP in July 2019. This referenced university placement of Research Professors and Graduate Research Assistants at CCAM, and university commitments for innovation funding. There UVA, VCU, VSU and VT each committed to placement of Research Professor at CCAM. An MOU was since established between CCAM and ODU in December 2019 to satisfy their "placement" of a Research Professor (provided in prior year reporting). An update on these university commitments is provided in the appendix.

(ii) Funds disbursed to university and private sector partners of CCAM

Item 127, K.2. – Private Sector Incentive Grants

The funds shown in the table below have been deployed as private sector incentives in FY2022 and FY2023 to date. These funds have been designated for research match funding and new CCAM membership.

Industry Member	Detail	Grant Funding
[redacted]	Project D-455	$ 56,479
	Project D-463	$ 39,892
	New Strategic Membership	$ 75,000
[redacted]	New Strategic Membership	$ 200,000
[redacted]	Project D-452	$ 100,000
	Project D-453	$ 80,000
[redacted]	Project D-447	$ 127,740
	Project D-460	$ 41,945
		$ 721,056

The funds in the table below have been invested in seed projects that are intended to support skill, technology, and capability development targeted towards growth in industry investment at CCAM. Each of these programs are targeted towards a specific manufacturing process, technology, partner, or industry, and are being marketed to existing and prospective members.

Area of Study	Grant Funding
[redacted]	$ 132,555
[redacted]	$ 112,587
[redacted]	$ 36,159
[redacted]	$ 2,768
	$ 284,069

Item 127, K.3. – University Research Grants

The funds shown in the table below have been deployed at CCAM for the execution of Innovation Projects in partnership with CCAM Organizing University Members. Funding in this category required a one-to-one match made by universities to fund their portion of research on their campuses.

University Member	Detail	Grant Funding
University of Virginia	Projects E-078, E-079, E-080, E-081	$ 250,000
VCU	Projects E-082	$ 100,000
Virginia Tech	Projects E-084, E-085, E-086, E-092	$ 133,000
Virginia State University	Project E-087, E-088	$ 100,000
Old Dominion University	FY22 project not yet scoped	$ -
		$ 583,000

(iii) Other agreements entered into with public and private sectors

CCAM has not entered into any agreements with representatives of the public or private sectors that would impact current and future incentive fund disbursements.

(iv) Federal Award Program Development

Since inception of this category of funding, $2,400,000 has been made available (FY2021-23). The table below summarizes the deployment of funds made available to date for the purpose of attracting federal funding. The total amount reflects expenditures to date as of the time of this report.

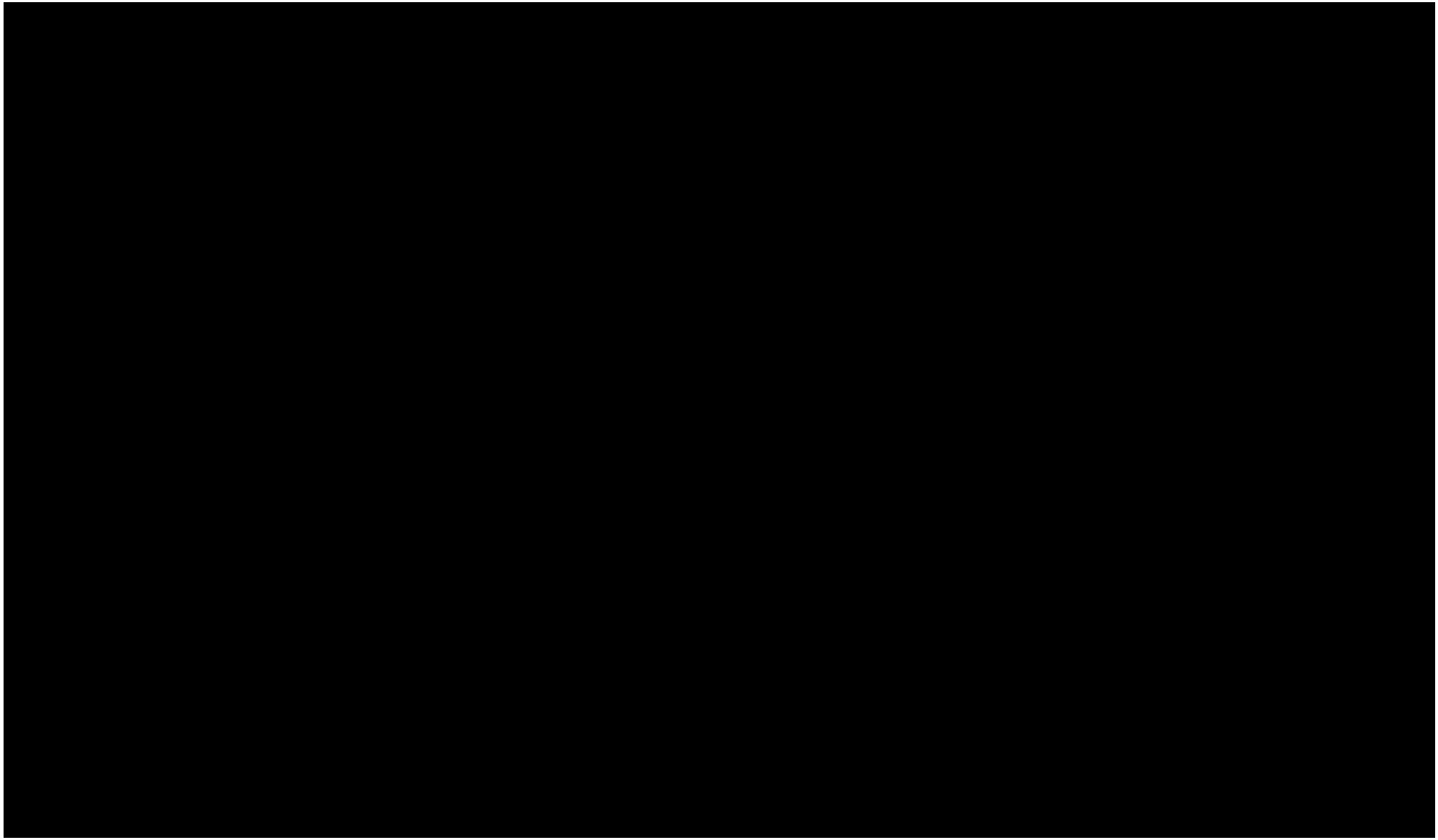
Category	Detail	Grant Funding
Business Development	Engagement with federal agencies, exploration of award solicitation, campaign material development, travel for award related business development, process infrastructure consulting and development (award admin, export control, CMMC compliance).	$ 730,127
Proposal Development	Concept paper & proposal ideation, development and submission.	$ 147,360
Non-reimbursable Federal Award Costs	Federal research program costs not reimbursable on federal research awards.	$ 734,034
		$ 1,611,521

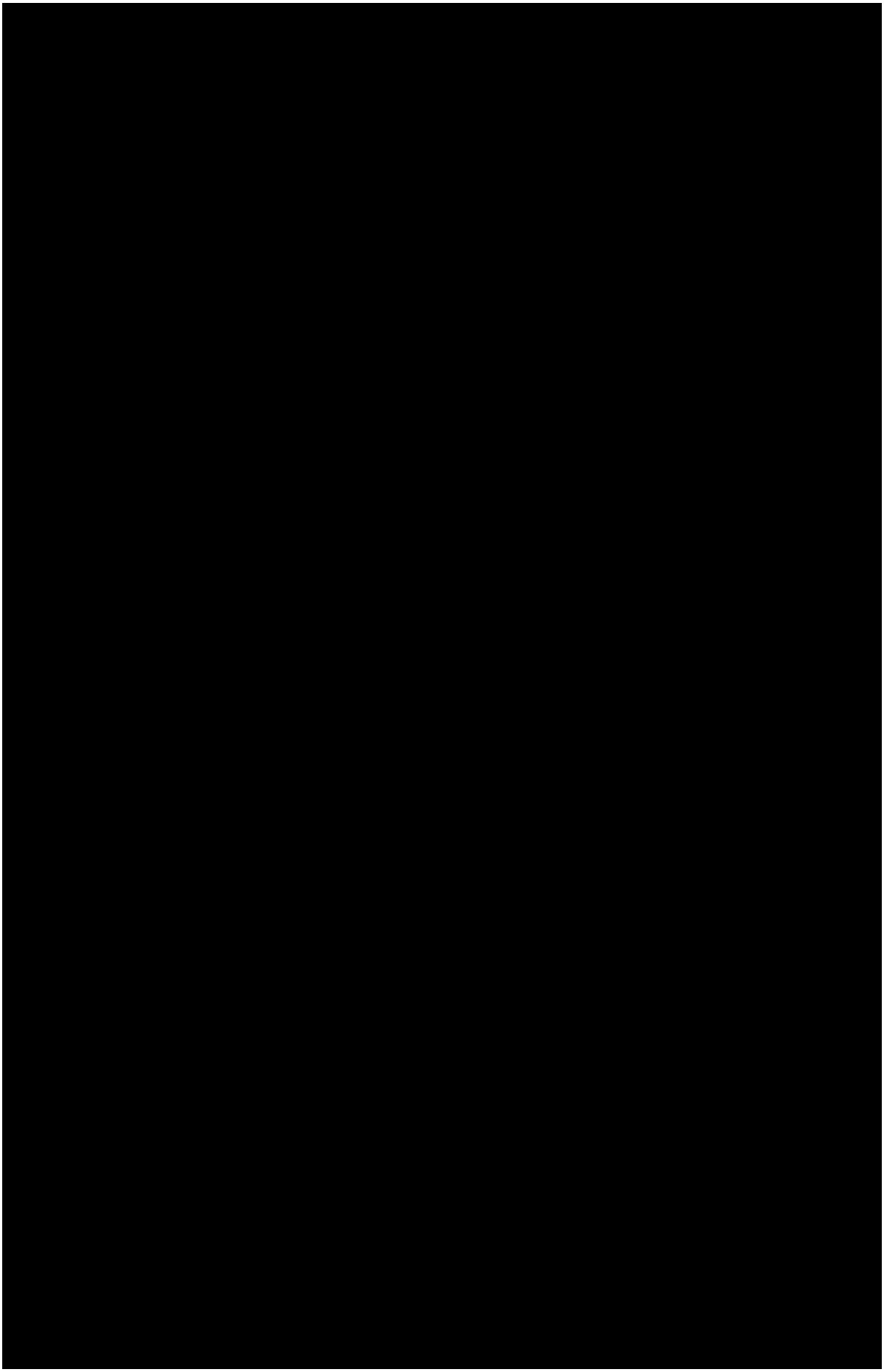
(v) Additional information requested

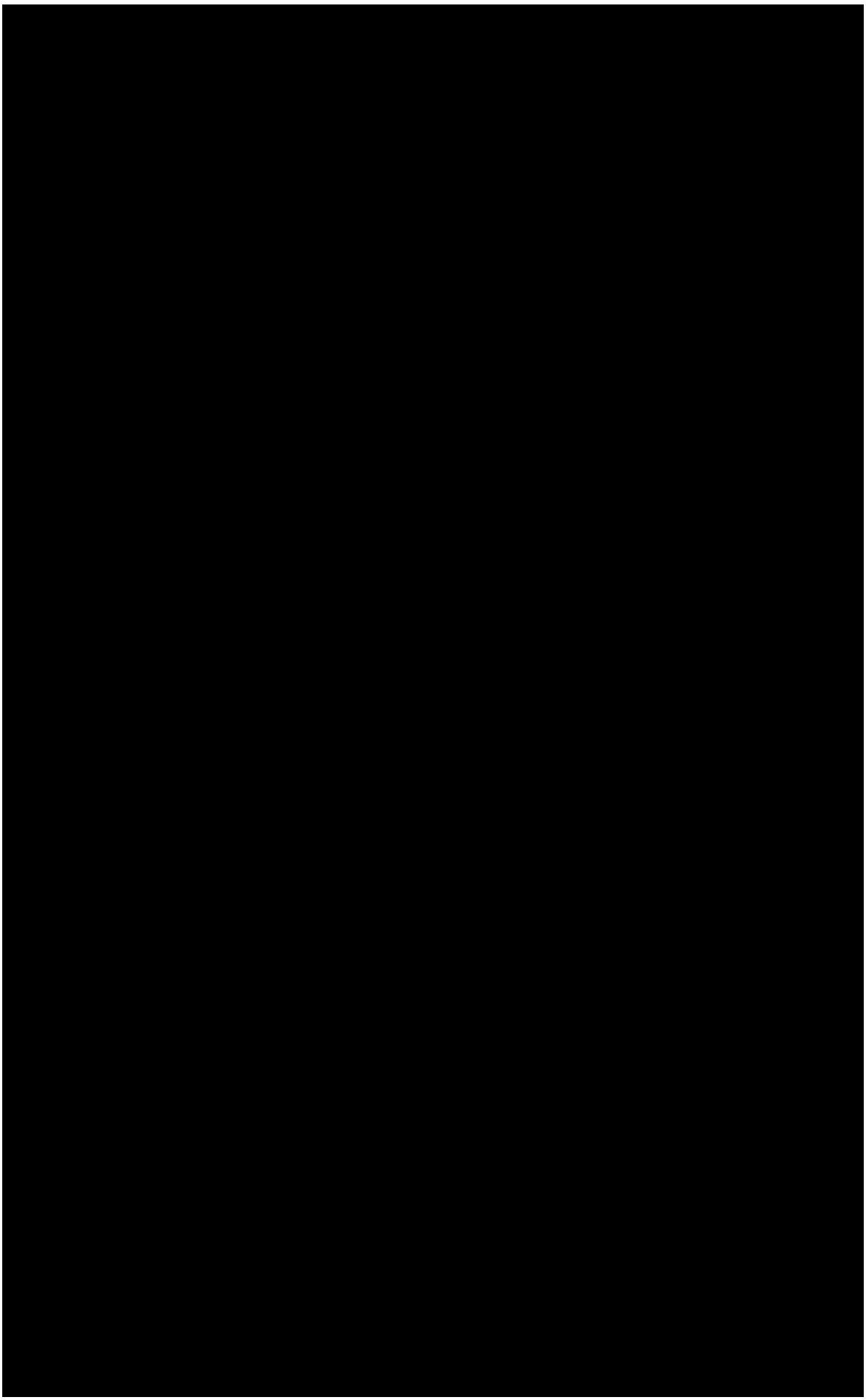
No additional information has been requested at this time.

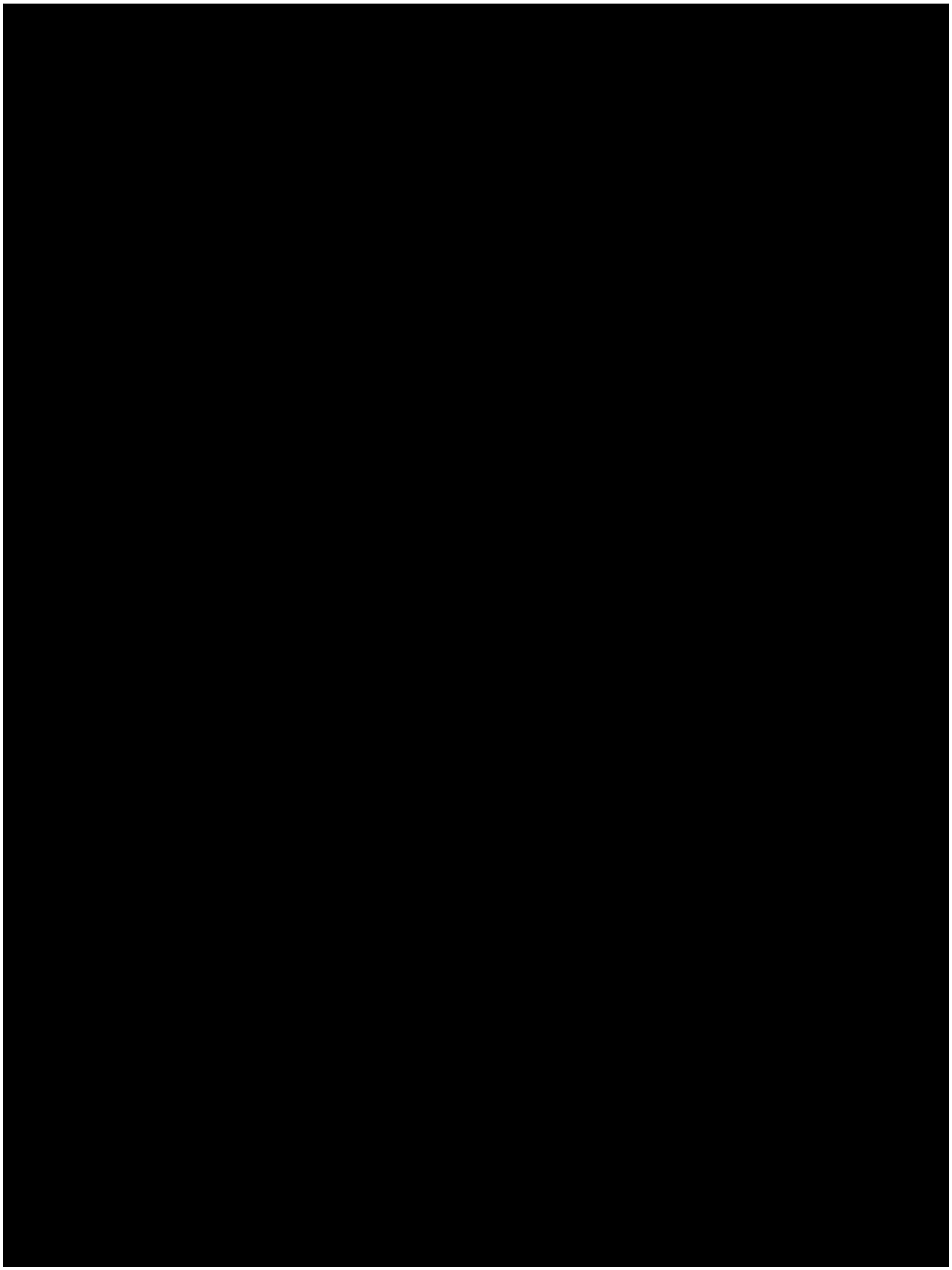
APPENDIX

Financial Schedules









Update on University Commitments

As outlined in the "Plan to Operationalize & Implement University Member Enhanced Engagement" the university members committed to activities designed to strengthen CCAM-University engagement in 3 primary areas: CCAM Research Professors, graduate research assistants (GRAs), and Innovation Projects. Specifically, the commitments are as outlined below:

- Identify & hire four (4) Research Professors associated with CCAM Strategic Focus Areas and aligned with research strengths of the university partners.
- Identify & hire nine (9) Graduate Research Assistants to be primarily working at CCAM.
- Create an Innovation Fund ($600K per year total from Universities, matched by state funding) to seed research activities at the Member Universities that are aligned with CCAM Industry Member needs and have potential for external funding.

The heat map below shows the status of each of these activities for fiscal year 2022.

University	Research Fellow Positions	GRA(s)	Innovation Funds
VCU	Dr. Radhika Barua succeeds Dr. Afroditi (Vennie) Filippas; 25% Research Fellow on staff since FY2020	Two GRAs on site at CCAM	One project ($100K)
University of Virginia	Dr. Rich Martukanitz on staff on Jan 2019; still active at 25%. Upcoming transition plan (retirement) needed.	Two GRAs on site at CCAM	Four projects ($250K)
VSU Virginia State	Budgeted and seeking candidates.	No GRAs, however there were 4 interns on site funded by VSU	Two projects ($100K)
Virginia Tech	Job description written and posted 2X in FY22 w/ no acceptable candidates. Reposting in FY 23.	One GRA on site	Four projects ($133K)
Old Dominion University IDEA Fusion	CCAM/ODU have agreed to flexible resourcing	Active in joint federal proposal development collaborations	Active in joint federal proposal development collaborations

Plan Not in Place	Beginning Stages	Final Stages	Complete