

December 13, 2022

The Honorable Caren Merrick  
Secretary of Commerce and Trade  
Commonwealth of Virginia  
Patrick Henry Building  
1111 East Broad Street  
Richmond, Virginia 23219

The Honorable Barry D. Knight  
Chair, House Appropriations Committee  
Virginia House of Delegates  
Pocahontas Building  
900 E. Main Street  
Richmond, Virginia 23219

The Honorable Janet D. Howell  
Co-Chair, Finance and Appropriations  
Committee  
Senate of Virginia  
Pocahontas Building  
900 E. Main Street  
Richmond, Virginia 23219

Michael Maul  
Director, Virginia Department of Planning  
and Budget  
1111 East Broad Street  
Room 5040  
Richmond, Virginia 23219-1922

The Honorable George L. Barker  
Co-Chair, Finance and Appropriations  
Committee  
Senate of Virginia  
Pocahontas Building  
900 E. Main Street  
Richmond, Virginia 23219

Robert Stolle  
President and CEO  
Virginia Innovation Partnership Authority  
Center for Innovative Technology  
Gather  
313 East Broad Street  
Richmond, Virginia 23219

**Commonwealth Center for  
Advanced Logistics Systems (“CCALS”)**

Ladies and Gentlemen:

Respectfully submitted is the full and complete report with audited figures of CCALS required by Section N.2. of Item 135#1c of the 2020 Session Budget Amendment HB30 (Conference Report). This replaces the partial report with unaudited figures filed September 27. The CCALS 2021 audit as of the October 1 reporting deadline was not complete.

Sincerely,

Dr. Dawit Haile  
Chairman

cc w/enclosure: Dr. James Haug  
Secretary, CCALS

**Commonwealth Center for Advanced Logistics Systems (CCALS)**  
**Report of Unaudited Revenues, Funding Sources, Research Activities**  
**and Relevant Economic Outcomes**  
**For Calendar Year 2021**

**I. VIPA HB30 Legislative Background**

*CCALS shall submit a report by October 1st of each year to the Secretary of Commerce and Trade, the Chairs of the House Appropriations and Senate Finance and Appropriations Committees, the Director of the Department of Planning and Budget, and VIPA to include (i) all planned and actual revenue and expenditures along with funding sources, including state, federal, and other revenue sources for CCALS, (ii) the research activities of CCALS, and (iii) relevant economic outcomes as a result of the CCALS' work in each fiscal year.*

**II. Revenue and Funding Sources as of December 31, 2021**

Commonwealth Center for Advanced Logistics Systems  
 Revenue and Functional Expenses  
 December 31, 2021

Revenue and Support

Federal

State

Other

Port of Virginia (NIT)

\$50,000.00

CIT

\$350,000.00

Total Revenue and Support

\$400,000.00

Operating Expenses

Program Services

\$139,749.00

Management and General

\$179,403.00

Total Operating Expenses

\$319,152.00

Increase in Net assets without donor restrictions

\$60,730.00

### **III. CCALS 2021 Research Activities and Relevant Economic Outcomes**

#### **1) Seventh Year of CCALS and Port of Virginia Research Partnership**

- a. CCALS is in the seventh year of an ongoing research relationship with the Port of Virginia. The Port of Virginia delivers opportunity by driving business to, and through, the Commonwealth. The underlying mission of the port is to foster economic development and job creation. The POV is indirectly responsible for 1 in 10 jobs in the Commonwealth. That means making Virginia the location of choice for those individuals and companies that utilize maritime facilities as a part of their ongoing businesses, regardless of whether they are cargo owners, supply chain and logistics firms, transport companies, or storage and distribution facilities. Therefore, part of the job is to make it in others economic interest to locate in the Commonwealth. The CCALS/UVA project underscores risk and resilience, advanced logistics trends, security and trust, asset management, prioritization, and capital infrastructure improvements as defined in the POV 2065 Strategic Master Plan so the Port can better understand the new marketplace and develop plans and procedures that will succeed in that marketplace by bringing new business to the Port and jobs to Virginia.
- b. This project supports research for an intermodal port community ecosystem with the POV, including collaboration with the office of the VDOT/VTRC Director of Research and Innovation and the Virginia Freight Advisory Committee for advanced technology solutions and opportunities for data sharing synergy for logistics mobility of service and modal convergence. This project improves operations and management of the POV through modeling and simulation by analyzing the port truck reservation system, terminal turn times, vessel berthing assignments, pro-forma, and resilience to disruption at the main POV terminals to meet key performance metrics.
- c. Based on the COVID-19 impact on the logistics infrastructure, the research team studied the supply-chain disruptions at the POV including the Richmond Marine Terminal (RMT) business activity.
- d. A key performance indicator of POV is the turn time or how quickly they can unload and then reload a container for transportation outside the terminal gates. The industry standard is 60 minutes. CCALS first contribution was data analytics and options for improving turn times. POV now operates at 35 minutes for traditional turn time and 39 minutes for expanded turn time significantly below the industry standard of 60 minutes in 2021 making it one of the most efficiently run ports on the east coast.

#### **2) Virginia Transportation Research Council (VTRC)**

- a. CCALS is consulting on a VDOT project with UVA for Data Analytics and Resilience of Transportation Plans with Emergent and Future Conditions. This is Phase 4 of a 5-year technical assistance effort ending in 2025. This effort continues to develop and enhance various methods

of data analytics that support transportation planning, performance measurement, trends analysis, project prioritization, travel demand modeling, corridor studies, investment evaluation, corridor management, and data sharing platform.

- b. The results will support resilience of transportation plans in terms of policy, business processes, practices, methods, and tools. Primary tasks accomplished in 2021 are focusing on Truck Travel Time Reliability Forecasting (Project Task 2.1) and development of Volume Delay Function Parameters (Project Task 2.2) with ongoing support for VDOT Pathways for Planning data hosting and development of training modules (Project Task 1).

### **3) Transition to Sustainable Aviation fuel (SAF) in Virginia**

- a. CCALS is supporting a feasibility analysis for “Supporting the Transition to Sustainable Aviation Systems in the Commonwealth of Virginia.” There is growing urgency for technology and supply-chain innovations that will contribute to decarbonizing the aviation sector. Many flights, including long haul routes, will continue to rely on liquid fuels, but will transition to those derived from renewable resources rather than petroleum.
- b. In Washington, the recently introduced *Sustainable Aviation Fuel Act* seeks to incentivize sustainable aviation fuel (SAF) production via establishment of an aviation-only *Low Carbon Fuel Standard*. The first FAA certification of a drop-in aviation biofuel was achieved recently. The major commercial airports of Virginia will require ready access to SAF to remain competitive. US military installations of the Commonwealth will also contribute to SAF demand.
- c. It is therefore of interest to explore: (1) What are the leading pathways for supplying SAF at scale and what infrastructure does Virginia need to put in place to ensure a supply of SAF to both commercial and military facilities? (2) What is the economic potential for Virginia to capture some of this production market for SAF? (3) What tradeoffs could a Virginia-based SAF sector introduce to food, water, land, and other <sup>[SEP]</sup>environmental systems?

### **4) Collaborative Research with National Science Foundation (NSF) - Center for Hardware & Embedded Systems Security & Trust (CHEST)**

- a. CCALS transforms advanced logistics systems for market-ready solutions. Its robust network provides value through metrics-based problem solving for today’s real-world challenges. One of the challenges for advanced logistics systems is security and trust for cyber security and IoT. That is why CCALS is one of the original industry members of the NSF sponsored Center for Hardware and Embedded Systems Security and Trust (CHEST) through the University of Virginia (UVA) site.
- b. CHEST is the largest NSF IUCRC and our go-to center for researching and developing security, assurance, and trust strategies to meet Virginia’s commercial economic needs for supply chains. CHEST coordinates university-based research with needs of industry and government partners to advance knowledge of security, assurance, and trust for electronic hardware and embedded systems. We will achieve natural growth by continuously providing high quality security,

assurance, and trust strategies for cyber-physical systems and the IoT. CHEST research has informed discussions with COVID-19 Virginia Department of Emergency Management on vaccine supply as well as work with the Port of Virginia.

- c. The CHEST Industry Advisory Board (IAB) approved 2021 funding (year 2) for four CCALS supported projects. NSF CHEST Year 2 Industry Project 6\_21: Reverse Engineering Methodology for Field Programmable Gate Array (FPGA) semiconductor bit-streams, NSF CHEST Year 2 Industry Project 8\_21: NDIA Model for Security Countermeasures, Trust and Assurance of Microelectronics Manufacturing, NSF CHEST Year 2 Industry Project 9\_21: Risk Mapping for Mission and Business Assurance and Critical-Device Protection, NSF CHEST Year 2 Industry Project 23\_21: Managing Security through the Hardware Lifecycle with Risk-Based Standards.

#### **5) U.S. Army Corps of Engineers (USACE) Engineering Research and Development Center (ERDC)**

- a. CCALS is consulting on a 5-year UVA project with the USACE for modeling and data analysis to improve resilience of complex systems that are in the purview of the US Army Corps of Engineers. This fundamental research (National Security Defense Directive 189) will be performed by the University of Virginia with recognition of the needs of current missions of the ERDC-USACE.
- b. The key deliverables are reports, software, databases, demonstrations, and technology transfer in the form of peer-reviewed publications. The expected results will extend the capabilities of the USACE-ERDC in network science, resilience and scenario analysis, cyber-physical systems resilience, supply-chain resilience, resilience metrics and quantification, social and psychological factors, and automation of tools for resilience analysis. The proposed effort will develop and demonstrate methods, metrics, and databases.
- c. A proposal for the next five-year decision support effort was submitted in support of 2021 BAA: W912HZ-21-BAA-01 Amendment 002. Decision Analysis (EL-41) This decision support can be provided in the form of a deliberate method for making a decision, for considering how best to incorporate different types of evidence into an existing decision framework, or for creating a mathematical tool to help clients to effectively manage complex dynamic systems. Specific applications include Multi-Criteria Decision Analysis (MCDA), Weight of Evidence, Portfolio Analysis, Value of Information Analysis

#### **6) Development of Secure Compartmentalized Automated Refrigerated Storage (SeCARS) for Controlled Medicines -CRCF Project MF18-011\_LS**

- a. The secure storage and control of access to medicines is an important component of modern hospital pharmacy practice. Examples of medicines which must have controlled access include opiates (e.g. Vicodin, Fentanyl) as well as other common treatments such as insulin. The existing marketed technology has several deficiencies, the most important of which is that the commercial room-temperature storage systems lack the analogous capability for secure and controlled storage of refrigerated medicines in individual compartments. In order to address

these deficiencies and take advantage of a significant market opportunity the development of a Secure, Compartmentalized, Automated, Refrigerated Storage (Scars) system has been designed and a provisional patent has been filed.

- b. In addition to the qualitative value of appropriate storage of controlled medicines, it is possible to demonstrate the monetary value of the proposed SeCARS unit using a single specific example of cisatracurium. Last year, 50% of the cisatracurium expired unused due in part to lack of refrigerated secure storage with a conservative value of \$70,000. This is only one example out of hundreds of related refrigerated medicines at VCU with a total waste value of over \$3M.
- c. The CIT CRCF funding is intended to prepare the SeCARS for licensing and commercialization by i) the use of CCALS supply chain expertise to determine the value of SeCARS across the entire VCU system and extend that to valuation in other large hospital systems and ii) to develop a fully functional prototype to confirm operating parameters and demonstrate to potential customers.

## **7) Addressing the Logistical Challenge of Medication Reconciliation in Emergency Medicine Settings – CRCF project MF18-012-LS**

- a. Knowledge of a patient's current medication is of extreme importance for physicians and surgeons in emergency medicine setting. A majority of patients admitted to hospitals for trauma or emergency medicine are older adults on 3-7 prescription medications. Increasing frailty with age results in most of those patients being either unconscious, unable to think clearly or not knowing their current medications at the time of hospitalization. This forces the hospital to obtain this information using other sources (calling pharmacies, primary care providers, next of kin etc.) that are not reliable, time consuming and prevents timely interventions to affect clinical outcome. All attempts using electronic records to track medication have failed so far. Considering the 130 million annual ER visits in the US and the greater than 1500 FDA approved drugs on the market, identifying a patient's current medication using existing methods in a timely manner is a major logistical challenge.
- b. The research proposes the use of a mass spectrometry-based approach to directly identify medications in a patient's blood stream as a novel approach towards addressing this logistical challenge. We have now demonstrated feasibility by accurately detecting novel oral anticoagulants in the blood of 350 elderly trauma patients. Currently we are expanding the list of medications to a total of 50 and are in very early stages of forming a company to take the product to market. However, considering the large number of FDA approved medications, we need to expand the list of medications covered to at least the top 100 most common medications for this method to be broadly applied. The CIT CRCF funding achieves the goal of transitioning the work into a commercial entity and to increase the product value for better marketability.
- c. Product 1: Ai driven retention time prediction: The initial work demonstrated a primary barrier to large scale adoption of our proposed technology is the variability in retention times of the

analytes being investigated. Furthermore, new method development for new therapeutic and illegal recreational agents coming to market is also significantly delayed due to this. Over the past two years, our lab has gained a significant amount of expertise in AI driven predictive analytics. We harnessed this expertise and are currently developing an AI driven retention time prediction algorithm for development in a Software as Service (SaaS) format. We have already created an LLC in the state of Virginia (Lights Out AI) and have submitted an SBIR grant for this endeavor.

- d. Product 2: We are continuing the development of the simplified extraction system that will be in the form of an all in one cartridge that has all the required standards. Movement on this product is much slower as the interest in the clinical diagnostics industry for such a product is low at the moment. However, we believe when coupled together with product 1 there will be a big advantage for using the product 2 as it will provide a compatible starting point for implementation across all device manufacturers.

#### **8) VSU and UVA MS/PhD Cohort 2021.**

- a. As part of the continuing CCALS Diversity, Equity, and Inclusion (DEI) effort, four VSU undergraduate students are pursuing a fully funded (tuition, medical insurance and stipend) graduate degree at UVA School of Engineering and Applied Science (SEAS). In 2021, three students received the prestigious U.S. Department of Education's Graduate Assistance in Areas of National Need (GAANN) fellowships. This program assists graduate students with excellent academic records who demonstrate financial need and plan to pursue the highest degree in a field designated as an area of national need.
- b. Three students are pursuing a graduate degree in systems engineering and one student is in the civil engineering degree program.

#### **9) Crater Planning District Commission (CPDC) EDA CARES Act Recovery Assistance Grant**

- a. CCALS is conducting an economic recovery and resilience analysis on supply chain disruptions in the region's logistic sectors in response to the coronavirus pandemic. Analysis of the long term and short-term forces affecting regional supply chains with emphasis on the logistics-based businesses including the Distribution, Warehousing and Transportation sectors. It will include analysis of year over year business activity at the Port of Virginia as well as the Port of Richmond because of the COVID -19 environment. The analysis will identify and quantify the potential risk of supply chain disruption, higher risk of uncertainty about supply disruption owing to fragmentation of global supply, outsourcing, off shoring, materials management, and Covid-19 environment.
- b. The report extends the resilience register methodology to perform supply chain disruption analysis. Specifically this report addresses the long and short-term disruptions, which have occurred due to COVID-19 with an emphasis on business logistics for distribution, warehousing,

and transportation sectors. This report addresses the impact of other disruptive scenarios on the Crater region, addressing projects, employers, and logistics assets.

- c. The methodology is implemented in four steps. Step one begins by collecting a set of initiatives – these could be projects, assets, policies, technologies, or other investments. Additionally, the resilience register outlines performance criteria, which reflect organizational goals. Each initiative is then scored based on how well it addresses performance criteria. In step two, the register identifies disruptive events and groups these events into scenarios. The register measures the influence of each scenario on each initiative and performance criteria. In step three the resilience register outlines how the priorities of initiatives change when exposed to disruptive scenarios. The initiatives are ranked by their values under a baseline scenario, but the register displays how rankings change due to disruption. In step four, these disruptions are aggregated to determine which scenarios are the most disruptive to the system as a whole. This process is iterative – stakeholders update criteria, initiatives, emergent conditions, and scenarios after viewing the results of the initial analysis.
- d. This report presents four case studies. Case one analyzes projects from the 2021-2022 Crater Planning District Commission project priority list using the resilience register. Case two uses the resilience register to assess the impacts of disruptions to several of the largest employers in the Crater region. Case three employs the resilience register to analyze industry supply chain disruptions. Case four utilizes the modality diversion model to identify origin regions, destination regions, and commodities that are at risk of moving through another region of the country for import or export. This combined with scenario analysis enables identification of stable priorities.
- e. Across all analyses, the natural disaster and pandemic scenarios were the most disruptive to the region. The cyber security attack scenario ranked third. Other scenarios such as a funding decrease, increased environmental regulation, climate shift, and the green technology movement are not as disruptive.
- f. This analysis indicates that abrupt, unpredictable scenarios are more disruptive to the Crater region and associated industry supply chains than foreseeable events. Such knowledge indicates that Crater could benefit from investigating in initiatives that are resilient to the physical destruction of infrastructure and are not limited by reduced movement of the population.