

### BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 136

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Presentation Time: 2:00-2:40pm

Presenters: Max Decker and Cecilia Hansen

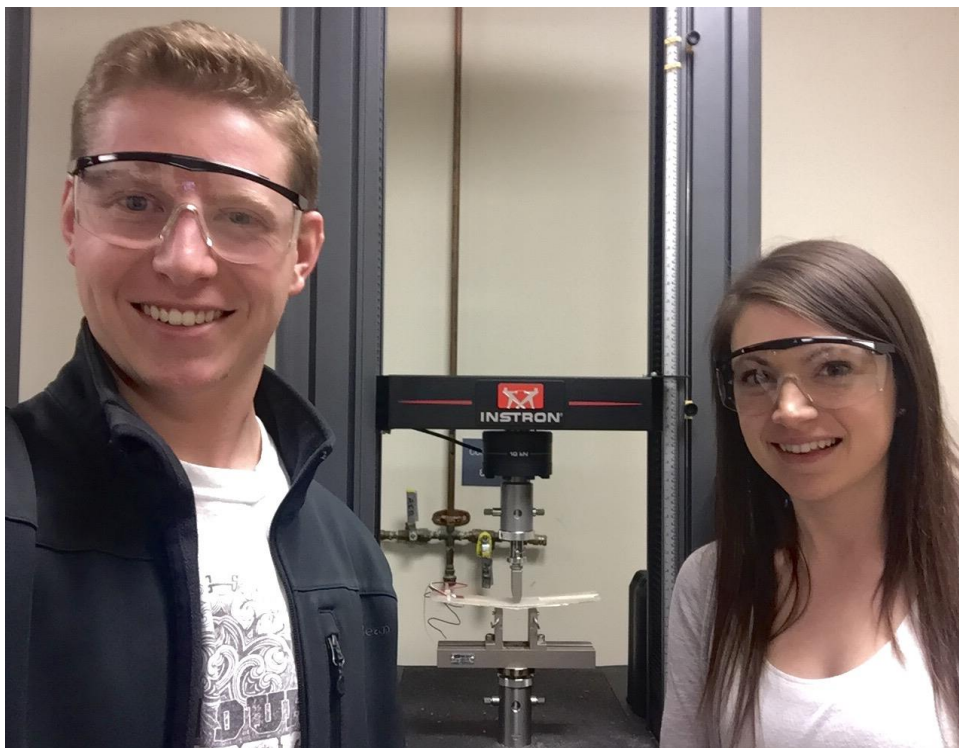
Concentration: Engineering & Manufacturing, and Environment

Capstone Advisor: Dr. Steven Frysinger

**Capstone Title:** *Sustainable Manufacturing Using Rapid Prototyping: A Snowboard Evaluation*

#### **Abstract:**

The purpose of this project is to present a new way to manufacture snowboards with potential environmental benefits. Our background research included completing a lifecycle analysis of a current snowboard including an evaluation of materials and manufacturing processes. Snowboards are composed of a wide variety of materials, some of which have harmful effects. Our project aims to simplify the snowboard design and create a new product built with environmentally responsible materials. Additional research throughout the project included discussions with JMU faculty and professionals in both the snowboarding and 3D printing industries. From this, we decided to utilize rapid prototyping to create several small test models. CES EduPack software was used for materials evaluation regarding mechanical properties and environmental impact while modeling was done in Autodesk software such as 123D Design. Deflection and vibration tests were performed on the models to select the



material combination closest to that of a true snowboard. Our project hopes to prove the benefits of rapid prototyping in manufacturing design and to influence the manufacturing decisions in other industries.

### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 136**

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Presentation Time: 2:45-3:10pm

Presenter: David Glenn

Concentration: Applied Biotechnology, Environment

Capstone Advisor: Dr. Steven Frysinger

**Capstone Title: *Surfer's Myelopathy: An Investigation into This Rare Injury***

#### **Abstract:**

Surfer's Myelopathy is a very rare injury that is caused by what scientists believe to be a "pinching" of the spinal cord, and leads to varying degrees of paralysis. To date, only 23 cases have been reported and studied, however the medical community is seeing more cases emerge at a faster pace. This project will focus on an in depth analysis of the cause of this injury, as well as highlight key differences in the 23 patients and their recovery status. This project is to include recommendations for potential alternatives to both the cause of the injury as well as treatments for it. The goal of this project is to make this rare injury better known among the scientific community, as well as the general public, in hopes that more research can be done to aid those with the injury.

### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 136**

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Presentation Time: 3:15-3:55pm

Presenters: Ashley Keane and Emery Siegrist

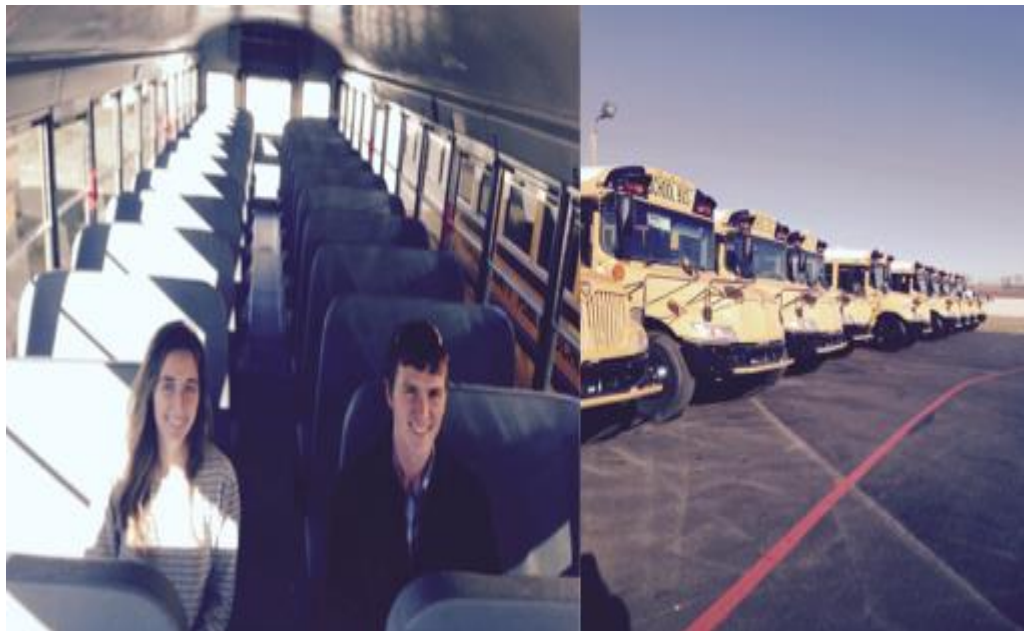
Concentration: Environment

Capstone Advisor: Dr. Steven Frysinger

**Capstone Title: *Mobility and Sustainability: The Tiny House Solution***

#### **Abstract:**

This project seeks to explain how a Tiny House is a viable solution for those seeking to counterbalance the tremendous impact the increase in average home size has had on the environment. The spatial size increase of the average home in America is directly related to the growth in waste, increases in emissions and energy consumption that our country must mitigate. We explored what constitutes a tiny house, the social aspects of living small and explored the option of converting a school bus into a tiny home. In terms of sizing a house, the psychology of space will be investigated to determine how much space is necessary for a human to lead a thriving life, the legalities in the construction of a tiny house and the social schema surrounding living in a tiny house. The technical exploration of our solution includes exploring the steps necessary to convert a school bus into a livable space complete with comforts which we would expect of any home. The design will take into consideration alternative utility sources such as electricity, water and waste. High resource consumption rates and heavy environmental impact can be tackled with a combination of modern technology and innovative design. Tiny living will leave a tiny footprint.



### BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 136

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Presentation Time: 4:00-4:25 pm

Presenter: Sara Miskowic

Concentration: Environment

Capstone Advisor: Dr. Steven Frysinger

**Capstone Title:** *Phase One Site Assessment: Area B, Fort Detrick*

#### **Abstract:**

Fort Detrick is approximately 47 miles west of Baltimore and 45 miles northwest of Washington D.C. Area B is a 399-acre, noncontinuous tract of land that in 2009 was added to the EPA's National Priority List. Currently Area B contains communication antennas, an indoor shooting range, paintball fields and a municipal landfall. Historically this plot of land was home to the US Army's biological Warfare center from 1955 until after World War Two. Fort Detrick is an active army installation operated under the



Installation Management Command. The purpose of this phase one site assessment is to identify 'recognized environmental conditions' in connection with the subject party using the American Society for Testing and Materials standard practices (ASTM). The primary contaminants of concern in the Area B disposal tanks are trichloroethene (TCE) and tetrachloroethene (PCE) which are considered to be the source of groundwater contamination found in 2009 that caused the site to be added to the NPL. TCE is a metal-cleaning solvent linked to liver and kidney damage, and tetrachloroethylene, or PCE, a degreasing compound believed to cause liver cancer. Area B-11 disposal pits received chemicals from 1955-1970. Although it is difficult to determine when chemicals started leaking into the soil, solvents were detected in the groundwater in 1992. This assessment has not identified any evidence of recognized environmental conditions in connection with the subject party with the limitation that have been set throughout the investigation. It's my recommendation that this investigation should be redone with allowance on the site without making internal observations may have led to a huge hole in the data. This this report should be reviewed and expanded on once the law suit against For Detrick is finished. This would allow for more interviews with the public as well as government officials.

**BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 136**

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Presentation Time: 4:30-5:10pm

Presenters: Annelise Libera, Celia Ross, and Alex Thompson

Concentrations: Applied Biotechnology, Environment

Capstone Advisors: Dr. Shannon Conley and Dr. Steven Frysinger

**Capstone Title:** *On Campus, Off the Grid: A Closer Look into Sustainable University Residence Halls*

**Abstract:**

College campuses are taking a strong interest in the fast growing issue of sustainability and environmental stewardship. The ways in which universities are implementing this way of thinking are diverse, but the majority surround redesigning or renovating campus buildings to function in an energy efficient and environmentally friendly way. The purpose of this project is to design a sustainable residence hall for James Madison



University (JMU) and evaluate different aspects of what it means to “live sustainably”. The areas of interest investigated for this project look at the Social, Architectural, and Technological approaches to building such a residence hall and how the combination of the three produces not only a green living space, but also encourages a sustainable way of thinking during and after college. Through investigation and research, appropriate architectural features, energy technologies, and social strategies have been selected to design the “Eco Village”, a residence community, to support environmental and social sustainability for the students of JMU.

**BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 148**

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Presentation Time: 2:00-2:40pm  
Presenters: Jinny Yang and Hannah Young  
Concentration: Environment  
Capstone Advisor: Dr. Wayne Teel  
Sponsor: Tom Benevento with New Community Project  
**Capstone Title: *Aquaponics Systems in Your Own Backyard***

**Abstract:**

A current issue in today’s society is the degradation of good farm land. This is due to poor farming practices and little knowledge about soil sustainability. One way to tackle this issue is through the use of sustainable aquaponics systems. The goal of our capstone project is to evaluate the suitability of an aquaponics system based on environmental parameters, economic costs, and embodied energy analyses. An aquaponics system is a combination of raising fish in a tank while utilizing the fish byproducts to supply nutrients and grow plants without the use of soil. After the physical construction, these systems typically produce little to no waste and require minimal energy input. While we already had a system, it was not operating properly. We had to obtain a new pump, rework wiring, and fix the water flow system. Our unheated greenhouse led to our first trial of plants to freeze due to the grow beds overflowing. With temperature considerations, we decided to test the system using goldfish instead of tilapia.



We plan to grow tilapia once the system is completely tested and successful. New Community Project graciously sponsored our capstone project which is located in one of their greenhouse gardens. This will be utilized as an educational tool and to support local food production in the downtown Harrisonburg community.

### BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 148

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Presentation Time: 2:45-3:25pm

Presenters: Parker Ballam and Asa Nienstadt

Concentrations: Applied Biotechnology, Environment

Capstone Advisor: Dr. Wayne Teel

Sponsor: Wood Edge Farm

**Capstone Title:** *Design and Construction of an Aquaponic System for Small-Scale Agricultural Production*

#### **Abstract:**

Every year, precious top soil, which is vital to maintaining healthy crops, is lost faster than natural processes are able to replenish it. Urbanization and poor farming practices lead to compaction, capping, and wash off of this ideal growing media. However, this is not the only impact



traditional farming has on the environment. Pollution loading through fertilizers is one of the top contributors involved in the impairment of waterbodies housing a variety of wildlife. Farm equipment is also notorious for loading the atmosphere with post-combustion pollutants. As a means of reducing the negative environmental impacts associated with agriculture, or as a means of growing food without soil availability, a less energy intensive and invasive technique must be adopted. Aquaponics is an example of such a technique. Using only water that is nutrient-rich with fish waste and a soil-less grow media as simple as gravel, an aquaponic system is a prime example of cyclical recycling that requires minimal input and has the potential to produce food in densities equal to or greater than traditional soil agriculture. Since the only material leaving the system involuntarily is evaporated water, harmful pollutant discharge is almost non-existent as well. Unlike growing off of the land, aquaponics also has the capability to expand vertically rather than horizontally, which mitigates problems associated with rapidly depleting soils suitable for agriculture. In order to demonstrate the practicality and feasibility of aquaponics in a small-scale setting, we have constructed a system at Woods Edge Farm in Harrisonburg. Research was conducted on the development of a relatively inexpensive, low-maintenance operation. Areas of concern for the design process included determining the ideal fish species, feed, growing media, and plants to be grown. Once operational, we studied system variables such as nutrient cycling and plant growth with respect to nutrient load.

### BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 148

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Presentation Time: 3:30-4:10pm

Presenters: Casey Lee and Thomas Vasilopoulos – Honors Capstone

Concentrations: Energy, Environment, and, Environmental Science & Marine Biology

Capstone Advisor: Dr. Wayne Teel

**Capstone Title:** *Assessing the Impact of a Constructed Wetlands Biome on the Ecosystem Health of Cedar Run*

#### **Abstract:**

A wetlands ecosystem is defined as “an area saturated by surface or groundwater at a frequency or duration sufficient to support...a prevalence of vegetation typically adapted for life in saturated soil conditions” (Batzer and Sharitz, 2007). Wetlands serve as biofilters and thus have been used to treat sewage and wastewater, as well as to restore the health of water systems that have been polluted. Solly Walker and Lorinda Palin, owners of a certified natural and biodynamic farm called Avalon Acres located in Broadway, Virginia, constructed a wetlands two years ago, using the stream, Cedar Run, that flows through their property. Pollution from agricultural activity in the watershed upstream of Avalon Acres has compromised the health of the ecosystem. The water from these polluted streams and tributaries runs into the North Fork of the Shenandoah River, connects with the Potomac River, and eventually flows into the Chesapeake Bay. Ultimately, Solly and Lorinda would like to restore the health of the stream ecosystem, provide a safe habitat for native plant and animal species, and help to mitigate ecological destruction taking place downstream. The purpose of this project is to assess the impact that the constructed wetlands has had on water and soil quality. Stream water quality data, such as nitrate, phosphate and coliform levels, dissolved oxygen concentration, pH and conductivity, were collected over the course of 11 months. Soil carbon data and results from plant and macro-invertebrate sampling were also used to analyze the influence of the wetlands on the ecosystem. Due to the limited time and scope of the project, and the relatively recent introduction of the wetlands, no definitive conclusions can be made regarding the impact of the wetlands. However, consistently high levels of nitrates and phosphates were found indicating impairment of the stream. This research project establishes a baseline for further investigation into the impact of the wetlands at Avalon Acres Farm over the coming years.





### BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 148

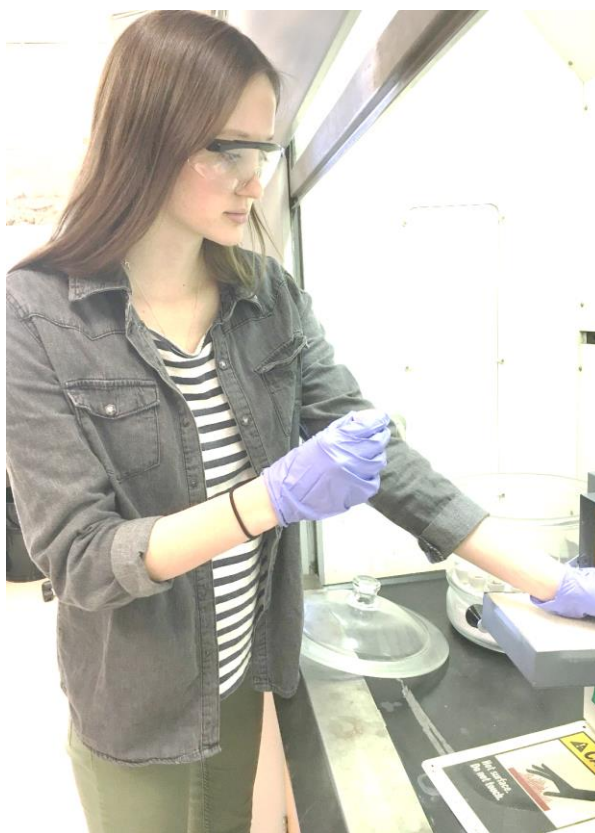
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Presentation Time: 4:15-4:40pm  
Presenter: Kylee Hohman – Honors Capstone  
Concentration: Applied Biotechnology  
Capstone Advisor: Dr. Wayne Teel

**Capstone Title:** *Compost Land Management and Soil Carbon Sequestration*

#### **Abstract:**

Extensive fossil fuel burning has released carbon dioxide into the atmosphere. Under proper ecological conditions plants convert atmospheric carbon dioxide into stable soil organic matter, a natural and efficient means of mitigating climate change. In the symbiotic relationship between mycorrhizae and plants, mycorrhizae provide plants with essential nutrients in exchange for carbon sugars leaked from the plants. Mycorrhizae convert carbon sugars to an exudate called glomalin, a protein that assists in developing soil aggregates composed of sand, silt, and clay. These aggregates, called humus, store carbon for hundreds of years under healthy ecological conditions. Compost prompts soil microbes to aerobically transform organic matter into nutrients readily available to plants. Compost fosters the relationship between plants, mycorrhizae, and soil organisms to enrich the humification process. The Marin Carbon Project is an effort to augment this soil carbon sequestration process through compost application onto California rangelands. This project is being modeled on the East Campus Hillside to determine if compost boosts carbon storage within soils. The Hillside area has 1.5 acres of tallgrass prairie meadow. Eight 10 x 10 meter meadow plots were treated with compost, another eight meadow area plots served as controls, and the remaining 6 plots were located in the lawn area for comparison. Soil samples were gathered from each plot by the ISAT 320 class and analyzed by the Waypoint Laboratory. Additional samples were collected and then burned in an on-campus muffle furnace to calculate the total carbon from each sample. The data assembled from the muffle furnace was analyzed spatially and statistically to investigate correlations between the soil treatment and percentage of stable soil carbon. Across the trials executed, soil treated with compost had the highest carbon percentage. Results from this experiment will be integrated into the ongoing study of the health of the East Campus Hillside.



### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 148**

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Presentation Time: 4:45-5:25pm

Presenters: Linda Bouzaher and Kevin Moore

Concentrations: Applied Biotechnology, Energy, Engineering & Manufacturing, and, Environment

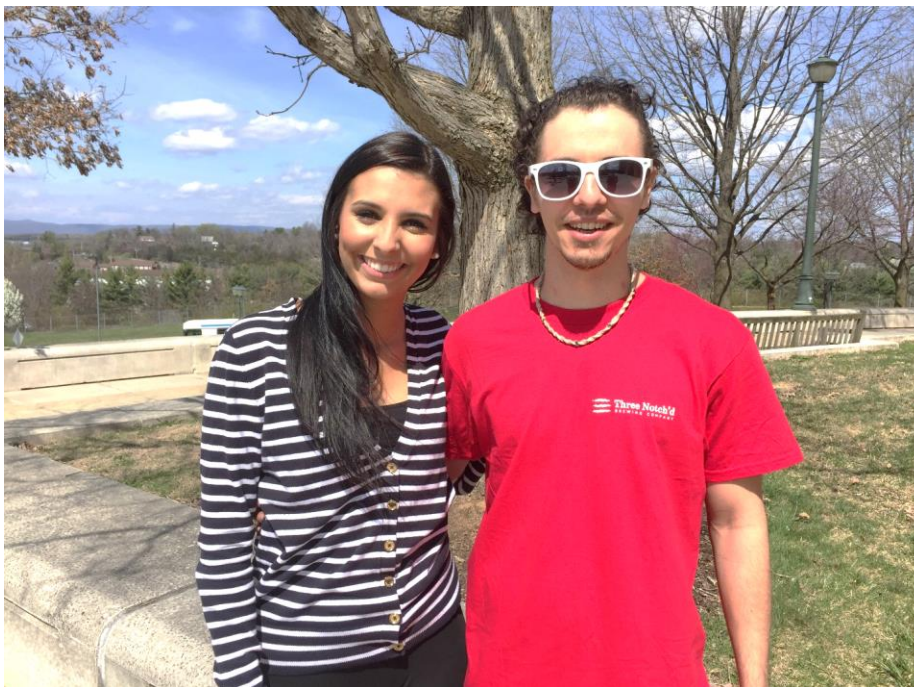
Capstone Advisor: Dr. Wayne Teel

Sponsor: Dennis Stoneburner, Glen Hill Farm, Inc.

**Capstone Title:** *Developing a Sustainable Management Plan for Glen Hill Farm, Inc.*

#### **Abstract:**

The purpose of this study is to develop a sustainable management plan for a local Harrisonburg mixed livestock and crop farmer. Sustainability is an important concept in today's growing society as it ensures that the livelihoods of future generations will not be compromised by those of current ones. The purpose of this sustainable management plan is to



identify pollution mitigation options, potential energy efficiency improvements, waste management options, and undertake an economic analysis of the costs and benefits of these options for the farm. The project was conducted in three phases. First, the types and quantities of waste, energy, water, animal feed, and labor were determined. Next, an assessment was performed in order to determine the feasibility of potential renewable energy systems, water collection systems, farming mitigation options, and other alternatives for reducing runoff and waste produced on the farm.

Finally, calculations were used to determine the costs and benefits of the improvement options presented for the farm. This project is of community significance because sustainable agriculture not only promotes environmental health, but it enhances economic profitability, while also increasing consumer health and safety. Creating a more sustainable farm preserves the environment, protects public health, upholds animal welfare, and most importantly sustains communities.

### BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 148

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Presentation Time: 5:30-5:55pm  
Presenter: Bria Bryant  
Concentration: Environment  
Capstone Advisor: Dr. Wayne Teel  
Sponsor: Friends of the North Fork of the Shenandoah River

**Capstone Title:** *Escherichia coli in the Shenandoah River*

#### **Abstract:**

The project examined the levels of *E. coli* in the Shenandoah River at 11 different points in order to determine the safety level of human recreation in the water source. This is significant because a majority of residences that live within the watershed value this body of water for recreational purposes as well as a source for food. While working in conjunction with Friends of the North Fork of the Shenandoah River, it was discovered that certain recreational areas have levels of bacteria that are over the state's standard of 235 *E. coli* colony forming units/ 100mL of water by a factor of 10.

The Shenandoah River and most of its tributaries have been listed as impaired for many years due to its high levels of nitrates and phosphates as well as poor macro invertebrate health. This data, which is provided by the Department of Environmental Quality, along with historical data from the Friends of the North Fork and literature, such as Sunny Long's thesis all contributed to the conclusions drawn from the data obtained during this research.

The data collected throughout the project was compiled into a professional research document, which FNFSR released and the results were put into a national database used by various agencies, such as the EPA. From this point it is up to the various environmental departments to take further action on creating mandates and guidelines on how to decrease the level of *E. coli*. They are also planning to put warning advisories at the locations where *E. coli* levels frequently were above safety guidelines.



**BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 259**

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Presentation Time: 9:00-9:40am

Presenters: Matthew Buckley and Wesley Bumgarner

Concentrations: Engineering and Manufacturing

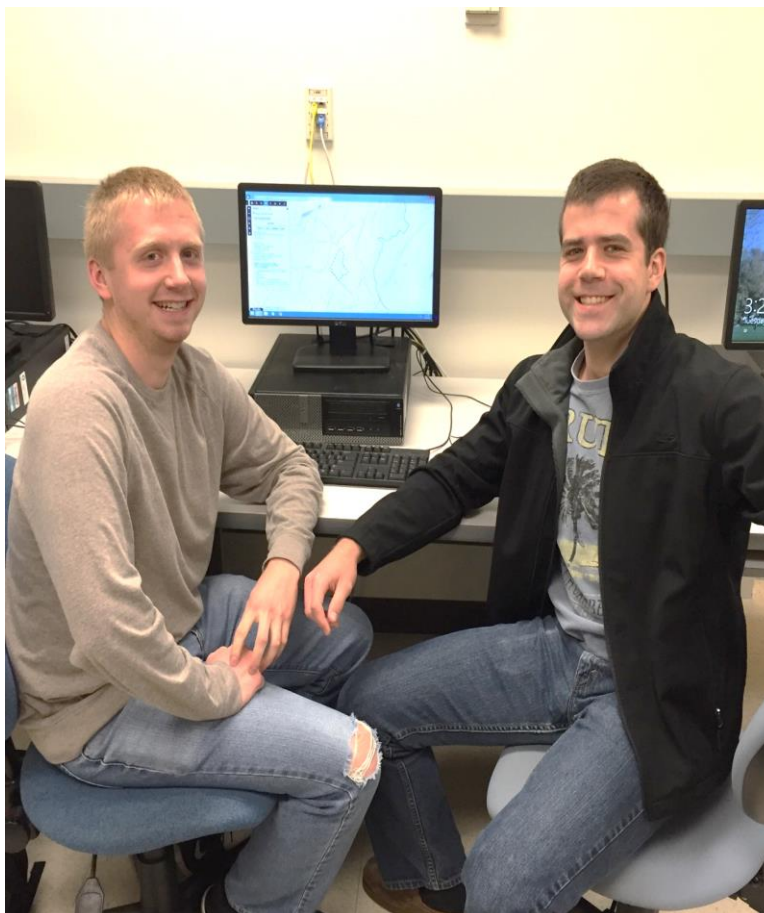
Capstone Advisor: Paul Goodall

Sponsor: Paul Goodall

**Capstone Title:** *The Design of an Off-Grid and Off-Stream Watering Trough System And the Tax and Environmental Health Implications of an Open-Spaced Easement*

**Abstract:**

The purpose of this project is to design engineer a mechanical watering trough system for use with heavy animals, in this case, beef cattle. Cattle grazing and management techniques are constantly evolving and improving as environmental awareness, environmental stewardship, regulations, incentives, and awareness of cattle health benefits push them into more and more farms and areas. One of the main goals of this project is to give a landowner the ability and knowledge to make his or her land into a conservation easement. A conservation easement is an agreement with an agency to conserve a parcel of land and to use environmentally conscious practices on it. This project also encompasses the research and understanding of many factors



that went into designing an off-stream and off-grid watering trough system for beef cattle specifically, although much of the same knowledge is applicable to most large animal watering trough systems.

### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 259**

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Presentation Time: 9:45-10:10am

Presenter: Zachary Browning

Concentration: Energy

Capstone Advisor: Paul Goodall

**Capstone Title: *DC Microgrids: An Option for Utilizing Distributed Generation***

#### **Abstract:**

Direct Current (DC) microgrids operate as autonomous entities capable of supplying end use power derived from distributed energy generation sources, backup battery banks and/or the main electrical grid. The push for distributed generation has been an effort to increase energy sustainability but it also reduces transmission distances to the final end load. In microgrid setups this reduces line losses and has the potential to increase overall system resiliency. As technology has progressed, the proportion of electrical devices that operate using DC current has increased and many of the renewable energy sources that are emerging produce DC current. The use of DC systems allow for increased efficiency during power transmission by minimizing the use of inverters and rectifiers, which consume power in the AC/DC and DC/AC conversion processes. DC microgrids can be designed to supply power for individual buildings, college campuses, or multiple systems can be integrated in to a macrogrid system in order to connect consumers over vast distances. The use of separate DC and AC busses and localized distributed generation allows these systems to efficiently deliver reliable energy with reduced power loss and offer a superior system for delivery of power to towns, cities, or villages that have not previously had access to electricity. Standards are under development which set indoor voltages at levels that are safe to the touch while minimizing power losses. This project describes the feasibility these systems and also describes a system that was designed and built to assess a small, functioning DC microgrid model.

### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 259**

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Presentation Time: 10:15-10:40am  
Presenter: Michael Johnson  
Concentration: Energy  
Capstone Advisor: Paul Goodall  
Sponsor: Chuck Heckman and Mary Jo Heckman

**Capstone Title:** *Full Home Energy Audit and Solar Panel Analysis for a Local Residence in Harrisonburg, VA*

#### **Abstract:**

The energy efficiency of a home is very important to assess since it provides the opportunity to save the homeowners a significant amount of money over time and improve the environment. The scope of this project was to analyze the efficiency of a residential home in Harrisonburg, Virginia to show how simple changes can reduce the energy cost and improve the quality of life of the homeowners. Typical energy auditing techniques were used and economic analyses were performed for these techniques. A simulation of the home's performance was modeled in Building Energy Optimization (BEopt). BEopt is a common software used in the residential energy audit sector to get a better picture of what aspects of the home are consuming the most energy depending on geography, orientation, and a variety of other internal factors of the home. An analysis was also performed to determine the size, cost, and payback of solar panels to power the homeowner's whole house versus their basement apartment.



### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 259**

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Presentation Time: 2:30-3:10pm

Presenters: Taner Durusu, Alissa Good, Ethan Pompeo, and Preston Rhodes

Concentrations: Energy, Environment, Business and Technology

Capstone Advisor: Dr. Maria Papadakis and Dr. Mike Deaton

**Capstone Title:** *Analysis of the Energy-Efficient Appliance Rebate Program*

#### **Abstract:**

In order to mitigate global greenhouse gas emissions and prevent further damage to the environment, more energy efficient technologies must be used. A major contributor of pollution comes from the residential sector. As the population invests in more energy efficient technologies for home use, global greenhouse gas emissions will decline. Currently there is no single factor known that motivates individuals to invest in these more energy efficient technologies. By cleaning, merging, and querying rebate data for Mid-Western states we analyzed a relationship between socioeconomic and capital forces on producing energy savings in the residential end use sector. Complex models were created to investigate these interactions between technology and socioeconomic choices being made in order to find the greatest environmental benefit by looking at greenhouse gas reduction for economic spending. Further analysis was made from the data to investigate correlations between incomes and ethnic diversity in order to find what amount of money to allocate for a rebate to get the greatest greenhouse gas mitigation.



### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 259**

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Presentation Time: 3:15-3:55pm

Presenters: Mary Harding and Kathryn O’Leary

Concentrations: Energy, Environment, Business and Technology

Capstone Advisor: Dr. Maria Papadakis and Dr. Mike Deaton

**Capstone Title:** *Energy Analysis of an IT Data Center and Equipment for a Fortune 300 Company Commercial Building*

#### **Abstract:**

Our project evaluated the energy usage of a Fortune 300 company and made recommendations for methods that the company can use to evaluate the energy efficiency of its internal data center. Most information technology energy auditing protocols are designed for buildings in which the entire facility is a dedicated data center, and aren’t useful for smaller centers that are embedded in a larger building. Our presentation will discuss key energy indicators for data centers such as Power Usage Effectiveness and systems such as the IT Equipment Power Chain. Using insights from case studies and energy assessment protocols for small and embedded data centers, we identify techniques for both energy assessment and energy conservation.



### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 259**

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Presentation Time: 4:00-4:40pm  
Presenters: Gregory Baker and A.J. Tanner  
Concentrations: Energy, Environment, Information Knowledge Management  
Capstone Advisor: Dr. Christie-Joy Broderick Hartman  
Sponsor: Sunnyside Retirement Community,  
Executive Director, Josh Lyons

**Capstone Title:** *Characterization of Sunnyside Retirement Community's Environmental Stewardship Efforts*

#### **Abstract:**

This senior project was conducted in response to Sunnyside Retirement Community's request for assistance with their environmental stewardship efforts. This project sought to characterize the environmental stewardship-related facilities management practices at a portion of Sunnyside Retirement Community in Harrisonburg, VA and compare the documented practices to those of similar entities. The first step was to conduct a literature search and contact associations to characterize current environmental stewardship practices at assisted living facilities in the United States. Next, an



original set of questions was developed for Sunnyside Retirement Community's facilities management staff. The questions were discussed in-person and follow-up discussions took place via e-mail and in person. Practices in the following areas were documented: energy usage, water consumption, transportation, waste management, indoor air quality, environmentally preferred products, renewable energy, and community awareness. The final deliverable compared Sunnyside Retirement Community's environmental stewardship-related facilities practices to those documented in the literature and identified some modified and additional practices that might be considered by Sunnyside Retirement Community. The product can inform the development of an environmental stewardship action plan by the community.

**BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 337**

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Presentation Time: 9:00-9:25am

Presenter: Nicholas Kamienski

Concentration: Information and Knowledge Management and Energy

Capstone Advisors: Dr. Nicole Radziwill and Dr. Morgan Benton

**Capstone Title:** *Design for STEAM: Creating Participatory Art with Purpose*

**Abstract:**

As technology advances, innovation is simultaneously reflected in the variety and diversity of art that is produced. Over the past century, art forms have progressed along a continuum from static to dynamic, and then to interactive and participatory forms. The therapeutic value of creating and engaging in art has also been identified. Over the past few years, educators have recognized the profound value of art and design within the context of scientific and technical learning, and STEAM (science, technology, engineering, art, and math) has emerged as an educational philosophy with a strong following. Motivated by a prototype student-developed art piece (the “zome”), this capstone project articulates the participatory philosophy of an educational STEAM project, and provides guidance for how to develop full-scale art installations that are completely participatory. We 1) present emerging social and organizational models that align with STEAM, 2) develop a design framework for creating new participatory art that meets the goals of STEAM learning, and 3) capture design ideas for expanding the zome from prototype to full scale in the future using this framework.



### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 337**

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Presentation Time: 9:30-9:55am

Presenter: Christopher Miller

Concentration: Information and Knowledge Management

Capstone Advisor: Dr. Nicole Radziwill

**Capstone Title:** *EasyDTF: An R Package to Simplify Transformations and Distribution Fitting for Simulation*

#### **Abstract:**

When simulating a complex system, oftentimes one of the first steps is to identify the data generating process (DGP) that produced a collection of random variables. Distribution fitting is the analytical process used to identify how a given data set may have been generated. R packages such as fitdistRplus have significant distribution fitting capabilities, however, they can be overwhelming for practitioners and students. This project introduces EasyDTF (“Easy Data Transformations and Fitting”), a new package for the R Statistical Software that streamlines the distribution fitting process. EasyDTF provides a family of functions that include best-guess distribution fitting with confidence ratings, simple summaries of distribution attributes such as skewness and kurtosis, and basic data transformation capabilities. With EasyDTF, functionality becomes more accessible for the beginning user while preserving much of the functionality typically only available to power users.

### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 337**

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Presentation Time: 10:00-10:40am

Presenters: Josh Cobb and Noah Lamma

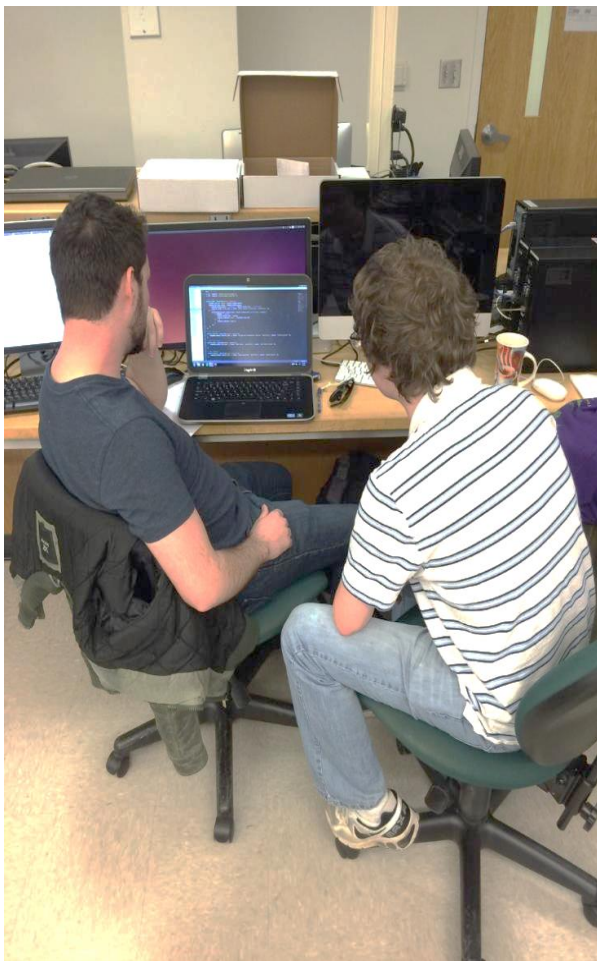
Concentration: Information and Knowledge Management and Telecommunications

Capstone Advisor: Dr. Morgan Benton

**Capstone Title:** *SmartClickr 2.0: In-Depth Statistical Analysis of Audience Response*

#### **Abstract:**

SmartClickr v1.0, developed in 2013, was a browser based audience response system meant to facilitate interaction between presenters and their audiences. The system aims to improve audience enjoyment, enhance attention, and improve learning when used in a classroom environment. A market analysis of audience response systems in 2015 revealed that the majority of competing products had eclipsed SmartClickr v1.0, and had even started to implement collaborative features like PowerPoint integration. Also noted was the fact that no product currently in the market had improved on how the data itself was presented, and was limited to only minimal descriptive statistics. Using these findings, SmartClickr 2.0 was created; preserving the existing user interface, but implementing several changes under the hood. Among these changes were the conversion from Node Express to Node Loopback and AngularJS framework, switching from MySQL to PostgreSQL for the database, and finally implementing a new data visualization system. These tools have given SmartClickr a new and unique market identity. With the ability to have not only multiple visualizations per question, but multiple questions per visualization, SmartClickr promises to be one of the most statistically in-depth audience response systems coming out in 2016.



### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 337**

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Presentation Time: 10:45-11:10am

Presenter: Michael Davis

Concentration: Information and Knowledge Management

Capstone Advisor: Dr. Morgan Benton

**Capstone Title:** *CourseDuke Course Advisement Application*

#### **Abstract:**

At colleges all across the country, choosing courses, setting your schedule, and planning for your academic future can be some of the most stressful times for students, and that's all before a single book is picked up, any lectures are attended, or any exams have begun. With all of the stress that comes with being a college student, deciding which classes need to be taken and in what order should not be one of them. The purpose of this project is to create a web-based application that will allow students to input their academic information (such as intended major, minor, previous coursework, etc.) and then receive a detailed, interactive schedule and academic plan to help the student plan for their future and stay on task throughout their collegiate career.



### BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 337

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Presentation Time: 2:00-2:40pm

Presenters: Michael Garcia, Chris Johns, and Raymond Oram

Concentration: Information and Knowledge Management, Telecommunication, Networking and Security

Capstone Advisor: Dr. Samy El-Tawab

Sponsor: 4VA

**Capstone Title:** *Improving Transit Bus Operations using Low Cost Bluetooth/Wi-Fi Technology*

**Abstract:**

At James Madison University, the transit bus system is an integral part of urban transportation. There is a high demand of people to serve around campus. Often times, the JMU community finds themselves waiting a significant amount of time for a bus. Not only is this an inconvenience but it results in students being late to their classes, meetings, and important events. JMU has various bus stops as well as routes in which students travel. Several projects have been done in developing apps for the time schedule of the bus system at JMU. The transit bus system was chosen as it is a key component in achieving a more sustainable urban transportation system. Using low cost technology with Bluetooth and/or Wi-Fi capabilities, we are able to collect, analyze and send this data (e.g. waiting times) to cloud storage at each bus station. The goal of this project is to improve the passenger's experience by refining the current infrastructure in place, focusing on better planning and route distribution, and to increase bus ridership through better scheduling and route management. Our project uses a self-contained package that consists of a Raspberry Pi equipped with Wi-Fi/Bluetooth technology and a battery to scan and collect data. In addition, we use smart phone applications on both iOS and Android platforms to collect the same data for comparison reasons. Assuming the user's Bluetooth and Wi-Fi are enabled on their mobile device, upon connection; their waiting times are recorded and sent to a database stored in the Cloud. By collecting data (ex. waiting times), the performance of the bus system can be further analyzed and we are able to suggest or make changes in a route in order to improve the transit bus system at JMU.



### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 337**

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Presentation Time: 2:45-3:25pm

Presenters: Peter Christie, Melvin Gonzalez, and Briana Wolters

Concentration: Information and Knowledge Management

Capstone Advisor: Dr. Samy El-Tawab

**Capstone Title:** *Mobile and Web Application (Hey Taxi!): Centralized Hub for Lease of Communication between clients and customers*

#### **Abstract:**

Living in an era of mobile development, transportation from point A to point B should not be a nuisance; cue Hey Taxi!, a mobile and web application that can be integrated with the taxi services of any location to provide users with a more streamlined approach to requesting rides. Transportation in Harrisonburg, VA is becoming increasingly difficult for college students and the general city population due to clogged roadways. Students who choose to adventure out on the weekend often have a difficult time finding a safe ride home. Through the creation of the user-friendly Hey Taxi!, anyone can easily call a taxi to their immediate location with the click of a button. Hey Taxi! will help reduce traffic congestion by reducing the number of student drivers on the road. Not only will this application help stabilize the taxi branch of the Harrisonburg transportation industry but it will create healthy competition between Harrisonburg taxi companies and the drivers within. The driver side of the mobile application comes in the form of a bounty system; meaning that once a driver selects a user request to pursue, no other driver can complete that interaction with the user/customer. Several different platforms were tested and a few were actually used in order to create this user-friendly mobile application and website including Heroku's server using HTML, CSS, Javascript, and PHP to host the website and Parse to host the database and mobile application, made in Xcode 7--Swift's Software Development Kit (SDK), for Apple products. The website and mobile application have been/are being tested on different devices such as desktop and laptop computers, and iPhones generations 4+. For the future of Hey Taxi! the creators aspire to have Apple approval for sale in the App Store.



### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 337**

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Presentation Time: 3:30-3:55pm  
Presenter: Riley Sung  
Concentration: Information and Knowledge Management  
Capstone Advisor: Dr. Samy El-Tawab  
Sponsor: Madison Trust

**Capstone Title:** *An iOS App Development for Smart Parking at JMU*

#### **Abstract:**

Students aimlessly search for parking all across James Madison University (JMU) campus. As a cheap alternative to constructing more parking lots, Smart Parking using the Cloud Environment (SPACE) will aim to solve this problem. Using Radio Frequency Identification Devices (RFID) to count cars entering and exiting parking lots, we are



able to accurately, at near real-time, provide parking lot specific information to drivers. These cars will be equipped with smart tags replacing current parking passes which can provide our system with detailed information of the car to better evaluate which spots will likely be filled, such as handicap or teacher/student spots. Users will simply open the SPACE iOS mobile application to check the current parking lot or structure availability of their choosing to best determine where to park. Beyond the average consumer use, the iOS mobile app also has the functionality for JMU Parking Services to manage parking lots, being able to create, update, or delete parking lots. A full administrative component allows system administrators to login and edit lot information as well as add or delete a lot from the database. New administrators can be easily created via the same interface. Our database is stored in the Cloud in a secure storage.



### BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 346

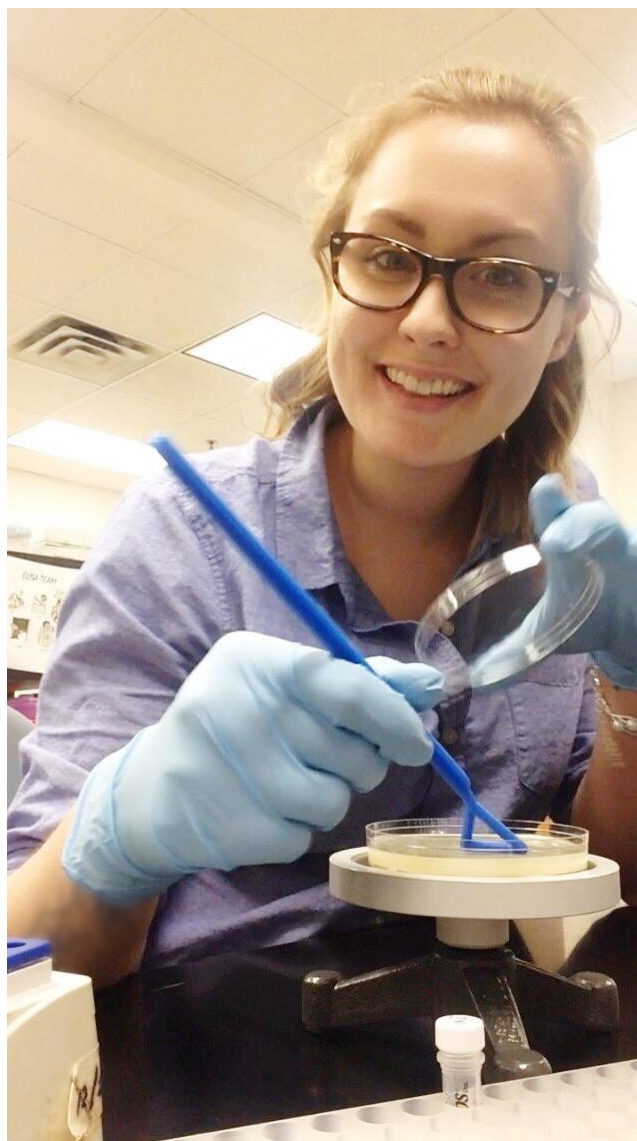
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Presentation Time: 9:00-9:25am  
Presenter: Jessica A. Denham  
Concentration: Applied Biotechnology  
Capstone Advisor: Dr. Ronald Raab  
Sponsor: Lacritin Consortium, JMU.UVA

**Capstone Title:** *Cloning, Expression and Purification of Canine Lacritin Variants as a Study of Antimicrobial Properties*

#### **Abstract:**

Lacritin is a secretory protein that is found in the human lacrimal gland located behind the eye. Lacritin and some Lacritin deletion variants have been found to have antimicrobial properties, and may be a potential treatment for chronic dry eye syndrome. A potential market for a Lacritin treatment could be for the treatment of dry eye syndrome in humans and dogs. Recently a canine analog to Human Lacritin has been cloned, expressed and purified here at JMU. In this study the N-45 and N-65 variant of Canine Lacritin proteins were designed to evaluate if they had similar antimicrobial properties to that of the N-65 Human Lacritin protein. To accomplish this, each Canine variant was cloned into the expression vector pTBX1, and then purified. This was done utilizing standard recombinant DNA engineering techniques which included: a polymerase chain reaction, gel electrophoresis, endonuclease restriction enzymes, plasmid purification, and confirmed by DNA sequence analysis. Each variant was then successfully expressed and purified using an intein/chitin binding system. Protein purity was shown using 16.5% Tris-Tricine gel. Through biofilm assay analysis, both N-45 and N-65 Canine Lacritin variants were found to have antimicrobial properties.



### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 346**

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Presentation Time: 9:30-10:10am

Presenters: Evan Bowles, Tiffany Hamilton, and Wilton Mallory

Concentrations: Energy and Environment

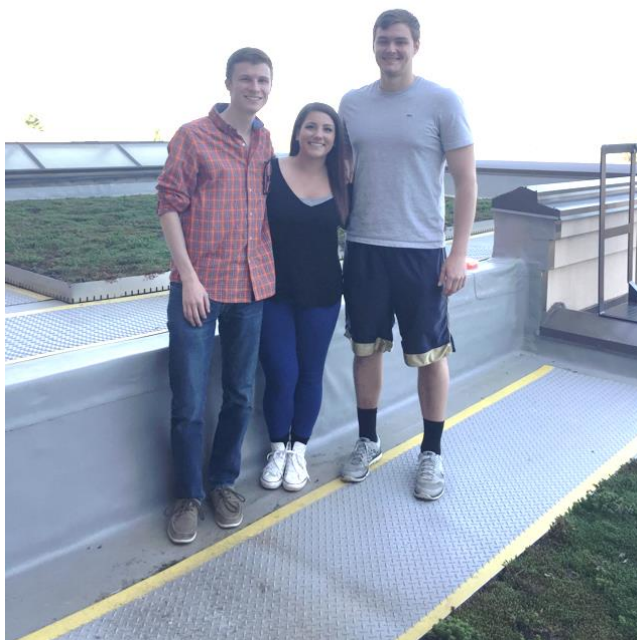
Capstone Advisor: Dr. Tony Chen

Sponsor: Mr. Dan Beachy Virginia Mennonite Retirement Community (WMRC)

**Capstone Title:** *Analyzing the Energy and Environmental Impacts of the VMRC Green Roof System*

#### **Abstract:**

Green roof systems are a widely growing technology that have a wide variety of energy saving and environmental benefits. Some of these include, but are not limited to: HVAC use/cost reductions, capturing of unwanted chemicals and nutrients from storm water, reducing the load on sewer systems by delaying the time of runoff, and increasing biodiversity. The purpose of this Capstone is to observe a green roof system both through energy and environmental testing in order to improve effectiveness for future models. We are conducting a study on a newly installed green roof at a local retirement community called Virginia Mennonite Retirement Community (VMRC) through the aid of Mr. Dan Beachy, the designated facilities manager. The steps that will be taken to achieve this include analyzing the green roof system, monitoring soil temperatures, followed by testing pH levels of runoff. We will be monitoring the



system using heat flux sensors, LogTag®, DAQPRO® data loggers, and infrared cameras. The data we collect will be used to conduct an analysis of the green roof system and its benefits on the VMRC building and its surrounding environment. Through such analysis, we will be promoting the universal goal of educating communities on the benefits of the implementation and use of green roofs on a larger scale. This research will benefit our local community and the Virginia Mennonite Retirement Community by providing analysis of numerical data suggesting the advantages of the installation of this green roof.

**BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 346**

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Presentation Time: 10:15-10:40am

Presenter: Jordan Cornell

Concentrations: Energy Management

Capstone Advisor: Dr. Tony Chen

Sponsor: Mr. Josh West, Devils Backbone Brewing Company

**Capstone Title:** *Green Brewery – Energy Audit of Devils Backbone Brewery, Outpost Branch*

**Abstract:**

The purpose of this project was to inform Devils Backbone Brewing of potential projects that, if implemented, would yield the greatest savings with the least cost and disruption to the firm. There were three distinct phases to this project: first identify areas of the plant having the greatest potential for energy savings; second, analyze data collected; and third, present conclusions to management. Window treatments, lighting and steam pipe insulation were the three areas identified as having the greatest potential for energy savings with relatively small capital investments. In the lighting phase, a photocell was considered for its ability to reduce employee error while yielding significant energy savings. The ultimate goal of the project was to inform the facility manager of potential projects that, if conducted, would result in energy savings. This project explored the viability of installing solar radiation reflective



window film as a means to reduce the heating and cooling load on the facility's HVAC system. Also of interest was the feasibility of relamping portions of the facility's fluorescent lights with more energy efficient LEDs. This segment of the project also included looking into the feasibility of installing a photocell sensor in the fermentation cellar to reduce the energy bill, while meeting the manager's requirement that the fermentation tanks be visible at night. The third and final area of the project examined the energy savings and the economic soundness of reinsulating a degraded section of insulation surrounding a steam pipe.

### BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 346

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Presentation Time: 2:00-2:30pm

Presenters: Joshua Feshari and Sergio Mateo

Concentrations: Energy, Environment

Capstone Advisor: Dr. Tony Chen

**Capstone Title:** *Efficiency and Applicability of Piezoelectric Energy Harvesting*

#### **Abstract:**

The goal of this project was to visualize and understand the potential impacts of a piezoelectric energy harvesting system. There are a lot of potential impacts this system could have that haven't been tapped into fully by society. Effect on the environment, energy efficiency, and economic impact to



society were the main areas of focus when conducting this project. Environmentally the system could reduce pollution because of its clean way of producing energy and offer many alternatives to fossil fuel consumption thus reducing the carbon footprint. The system produces voltage and thus electricity in a circuit from deforming piezoelectric materials; this is a system not needing any external hydrocarbon energy resource but produces high grade energy as electricity. Understanding that it is beneficial for the environment and has untapped potential energy uses this system would have a very positive impact on a society's economy. Implementing the piezoelectric energy harvesting system could reduce bills for power and those savings can be put towards investing in more sustainable technologies.

The study began with simple testing of functionality of the piezoelectric generators and then circuits were built to produce the most power output. Circuits created were connected to a battery and from different amounts of pressure/ force being applied to the connected generators they would charge the battery to full capacity. This battery once charged would be able to charge other devices such as a cell phone or other electronics at a bus stop or be utilized in a car. Although the study was small scale the data collected would then allow for assumptions and estimations to model out the impact on a bigger scale such as the James Madison Campus or a small city.

### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 346**

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Presentation Time: 2:35-3:10pm

Presenters: Kyle Hatterick and Jennifer Schwarz

Concentrations: Energy, Environment

Capstone Advisor: Dr. Tony Chen

**Capstone Title:** *Feasibility Study of a Pico-Hydroelectric Power Station and Its Environmental Impact*

#### **Abstract:**

Hydroelectric power is the most widely used renewable energy source. It provides a constant supply of electricity with low emissions to millions in the residential, commercial, and industrial sectors. Traditionally, the infrastructure and construction of today's hydroelectric power plants disrupt their surrounding environment, but the electricity generated by these dams or rivers greatly reduce the burning of fossil fuels. Hydroelectricity can



be applied to a smaller body of water that allows power generation with less invasive environmental and economic impacts.

This project is a preliminary study to hypothetically implement a run-of-stream pico-hydroelectric system (about 500 W) in a stream at a cattle farm in Keezletown, VA on Cub Run. Since we chose a working cattle farm for our hydroelectric system, we not only had to create an environmentally friendly, cost-efficient solution to reduce the household's dependency on fossil fuel energy but we also had to create a system that could withstand the day-to-day wear and tear of the cattle. Therefore, we designed our system using polybutylene pipes and polyvinylchloride (PVC) pipes, a turbine/generator, and an intake screen. In order to determine the optimal placement for our hydroelectric system, we conducted stream flow and head height measurements and calculations. These efforts in addition to other environmental assessments, helped to provide future implementation options.

### BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 346

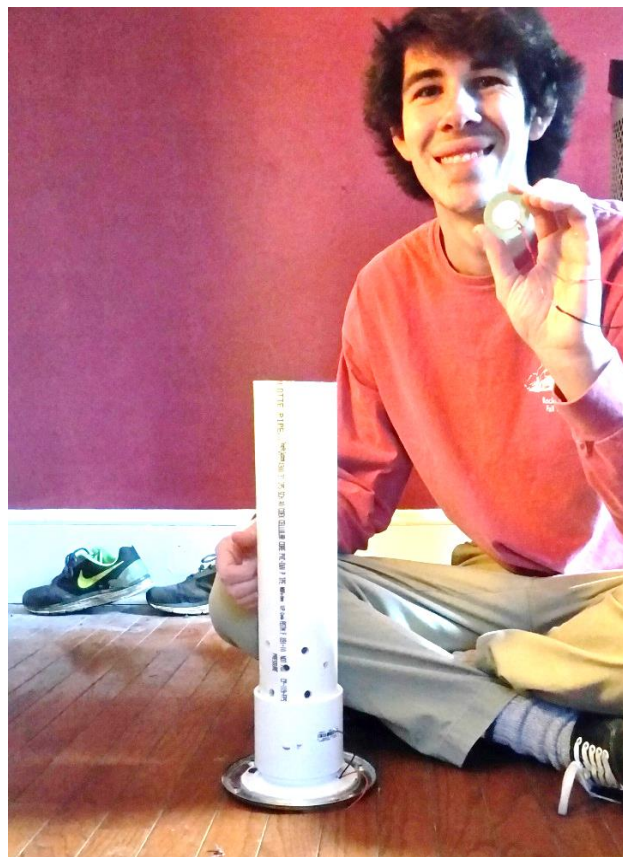
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Presentation Time: 3:15-3:40pm  
Presenter: Andy Miles  
Concentrations: Energy and Environment  
Capstone Advisor: Dr. Eric Maslen

**Capstone Title:** *Piezoelectric Energy Harvesting*

#### **Abstract:**

The majority of electricity generated in the United States today comes from coal-fired power plants. These power plants are part of a centralized system, where a single generator provides electricity for a vast array of consumers. This centralized system has inherent flaws, such as when too much or too little power is generated for the plant's respective region. Another concern with coal-fired power plants is their notoriously dirty generation process. The EPA ranks power plants that use fossil fuels as the largest source of CO<sub>2</sub> emissions. Therefore, many envision the future of energy generation as decentralized and clean. This project focuses on harvesting energy by converting heel strike energy to electricity through the piezoelectric effect. The piezoelectric effect is the ability of certain materials to generate an electric charge when mechanical stress is put on them. The objective is to determine whether or not a piezoelectric shoe generator could make enough electricity for the practical application of charging a cell phone, as well as compare the environmental impact of piezoelectric generation to that of coal-fired power plants. In order to determine how much electricity can be harvested from a piezoelectric transducer a heel-strike simulator was made. The simulator consists simply of a mass dropping from a certain height and landing on the equivalent of the inside of a shoe with an embedded transducer. The input force from the dropped mass was designed to be equal to that of an average footstep. Resistive loads ranging from approximately 15.5 to 333 ohms were connected to the transducer to determine the maximum power output. The results indicate a very low conversion efficiency and power output. It was concluded that piezoelectric transducers are more suited for low-power sensing applications and may not be practical for larger scale uses like charging cell phones.



**BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 346**

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Presentation Time: 3:45-4:10pm  
Presenter: Olivia Ceppi  
Concentrations: Energy and Environment  
Capstone Advisors: Dr. Joy Ferenbaugh and Dr. Paul Rittenhouse  
Sponsors: Dr. Jeffrey Seminoff, NOAA  
Ms. Robin Leroux, NOAA  
Dr. Tomo Eguchi, NOAA

**Capstone Title:** *Assessing Human Impact on Loggerhead Sea Turtle Research: Analyzing the Effectiveness of the Hotline*

**Abstract:**

In the past year, there is a paradigm shift in the number of Loggerhead Sea Turtle sightings off of the coast of California, which has led to a new research program by the National Oceanic and Atmospheric Administration (NOAA). Dr. Jeffrey Seminoff and a group of scientists from NOAA are surveying and collecting data in this area, largely based on sightings that have been recorded by a NOAA hotline. This “hotline” is in the form of an email address to which anyone can report sightings. I am working with Dr. Seminoff and NOAA to investigate how robust this data is and how much it influences the overall research. I will be investigating the validity of the hotline data and patterns in the demographics of the hotline participants. I have also been working with Geographic Science students, Mark Kluck and Collin Riley, to develop a streamlined app that will eventually replace the hotline for a more user-friendly product that provides researchers more precise and structured answers.



### BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 346

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Presentation Time: 4:15-4:40pm

Presenter: Oliver Allen

Concentration: Applied Biotechnology

Capstone Advisor: Dr. Louise Temple

**Capstone Title:** *Designing a Multiplex PCR Primer to Detect Coliphages in the Waterways of the Shenandoah Valley*

#### **Abstract:**

The presence and abundance of fecal matter in the waterways of the Shenandoah Valley is producing noticeable negative effects. The Chesapeake Bay is the sink into which all of the water from the Shenandoah Valley will flow. The most noticeable effect that fecal matter has on waterways would be the persistent algal blooms that block available sunlight to the plants that dwell under water; leading to the death of these plants. The removal of these primary producers disrupts the ecosystem as a whole. Algal blooms in the Chesapeake Bay disrupt not only the ecosystem, but the economy of the areas that depend on the Bay as well. The large presence of the microorganism, *Escherichia coli*, in water samples can be used as an indicator for the presence of fecal matter. Current detection techniques focus on finding specific strains of *E. coli*. It would be more economically viable to be able to test for the presence of the organism rather than determining specific strains of the bacteria in a given sample. The purpose of this project was to develop a multiplex Polymerase Chain Reaction (PCR) primer to detect a broad group of bacteriophages (viruses) that infect *E. coli* (coliphages) from water samples collected from the Shenandoah Valley. Such a detection method should be economical and more accurately reflect the coliform bacterial number.

To create this detection system; two bacteriophage genes, DNA polymerase and DNA packaging enzyme, were found to be conserved amongst a number of coliphages. The sequences of these genes were obtained from the National Center for Biotechnology Information (NCBI) database. Sequences from 10 of these were then aligned via Clustal Omega to find highly conserved regions that could be detected by PCR. Preliminary work required construction of control DNA to measure the efficacy of the detection method. Thus, plasmids containing the conserved genes were purchased and primers to detect the synthesized genes were designed. The primers proved to amplify the desired regions as designed. To estimate the lowest amount of DNA needed for detection, we made a series of dilutions of our plasmids and used these for the same PCR reaction. The results showed that as little as 0.014 nanograms were adequate for detection. Currently, we are constructing a derivative of coliphage Lambda to serve as a more relevant positive control. The PCR detection method will then be tested on stream water from our region.



### **BSISAT PROGRAM PRESENTATIONS -ISAT/CS ROOM 346**

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Presentation Time: 4:45-5:10pm

Presenter: Hunter Hart

Concentration: Environment and Biotechnology

Capstone Advisor: Dr. Jennifer Coffman

**Capstone Title:** *Demographic Realities and Sociocultural Change in Northern Tanzania*

#### **Abstract:**

Pastoralism is a subsistence-oriented lifestyle centered on livestock. In the semi-arid rangelands of Northern Tanzania and Southern Kenya, Maasai pastoralists are currently experiencing significant challenges to and changes in their lifestyles due to increases in human populations in and around rangelands, climatic variation that places significant restraints on their livestock-based livelihood, and various other socio-cultural factors. This study contributes to an ongoing project to learn and educate about sociocultural



and ecological changes happening among Maasai pastoralists. Project goals included examining how self-identifying Maasai influence, are influenced by, and understand conservation efforts, national and local policy, land-use changes, and economic diversification. Data were collected through literature reviews; semi-structured, open-ended interviews; direct observation; and the use of the Culturally Anchored Eco-Game™ ERAMAT in Northern Tanzania and at James Madison University (JMU). In Tanzania, research sites were identified in conjunction with the JMU East Africa Field School, founded and directed by Dr. Jennifer Coffman, the advisor of this research project. Research was conducted throughout Maasai homestays in Longido District, Tanzania, and during an internship period that was facilitated through the East Africa Field School. Additionally, ERAMAT game sessions were facilitated at JMU and data from student gameplay were collected and compared to data collected in Tanzania. Oral interviews revealed that a number of drivers, including land access, climatic variation, and cultural preferences, are actively influencing economic diversification and changes in Maasai lifestyles. Data from ERAMAT game sessions showed that life experiences often affected the ways Maasai players strategized and interacted with ERAMAT. Comparisons of ERAMAT game sessions showed initially different management strategies between JMU student and Maasai players, yet an overall convergence of values emerged as gameplay progressed. Drawing from the guiding framework of political ecology, data analyses reinforced that Maasai livelihoods endure environmental conflicts and exclusions, and that these conflicts are exacerbated and often defined by gendered, political, and class struggles.

### BSISAT PROGRAM PRESENTATIONS –HHS Room 1202

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Presentation Time: 9:00-9:40am

Presenters: Brice Bader, James Franzo, Jason Levy, Chris Lu, and James Smith

Concentration: Engineering and Manufacturing, Information Systems Analysis,  
And Biotechnology

Capstone Advisor: Dr. Geoffrey Egekwu

**Capstone Title:** *The 3D Scanning Process and its applications*

#### **Abstract:**

Three-dimensional (3D) scanning is a new and extremely useful technology. This project focuses on improving technological scanning applications, as well as streamlining the process of editing rendered 3D images. Working in conjunction with Hatch 3D, a local 3D printing company, the initial goal was to improve the quality of their 3D scans, so that the editing time could be cut down to increase productivity. The experimental process led to a refocus on improving the lighting environment at Hatch 3D while using their Occipital Structure Sensor linked to their Apple iPad. Several other improvements were considered and tested, but did not lead to quicker or easier processing. The solution of shadow boxes and backdrops help improve the overall scan quality as well as reduce the amount of time spent on editing. The application of 3D scanning technology in manufacturing – particularly in reverse engineering - is also discussed.



### **BSISAT PROGRAM PRESENTATIONS –HHS Room 1202**

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Presentation Time: 9:45-10:10am

Presenter: Matthew Carl

Concentration: Engineering and Manufacturing

Capstone Advisor: Dr. Geoffrey Egekwu

**Capstone Title: *Windsors and Woodwork Business Plan***

#### **Abstract:**

Windsors and Woodwork is a small business based out of a one man shop in Chester Connecticut, where the owner and craftsman Joe Carl creates true works of art out of nothing but wood. The name of the company derives from the fact that Joe specializes in making colonial style Windsor chairs with only hand tools - the same exact way they were made back in the 18<sup>th</sup> century. The craftsmanship goes from the painstaking process of shaping the seat from a solid block of wood, down to the fine detail of finishing it with milk based paint, again, like they did in the old days.

Although Windsor chairs are the owner's passion, it is a very small niche market with low demand. In recent years the main projects undertaken have been custom kitchen cabinets and furniture with smaller household products on the side. In the current economic state, there is not a large consumer population investing in handcrafted pieces and many consumers are turning more towards mass-produced products despite lower quality due to the lower costs.

Currently, the business is marketed solely through word of mouth. In today's society, a lot of marketing is done on the Internet allowing for a larger target population. Windsors and Woodwork would like to determine the best way to market the company in a technology driven world that is both cost and time effective and would allow for a steady flow of orders throughout the year. This project will create a business plan that the company can use to evaluate available opportunities.

### BSISAT PROGRAM PRESENTATIONS –HHS Room 1202

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Presentation Time: 10:15-10:40am  
Presenter: Ivan Ango  
Concentration: Engineering and Manufacturing  
Capstone Advisor: Dr. David Lawrence

**Capstone Title:** *Solar Hydrogen Generation: Development of photoanodes for photoelectrochemical (PEC) water splitting*

#### **Abstract:**

Hydrogen is the simplest element, consisting of one proton and one electron. It is high in energy and when burned it produces pure water and no pollution. This makes hydrogen a clean renewable fuel that could be valuable in the future if we can find a way to inexpensively mass produce it. Since hydrogen is always combined with other elements, hydrogen separation is required. The process called electrolysis is when electrical current is used to separate water into its components of oxygen and hydrogen. It is relatively easy to perform water splitting because all that is needed is a photovoltaic cell connected to an electrolyzer. This process is expensive given the low amount of hydrogen that can be harvested due to the inefficiencies of photovoltaic cells. Consequently, there has been a strong interest in producing hydrogen from the sunlight powered photoelectrolysis of water in a photoelectrochemical (PEC) cell. Research has been conducted worldwide to find more efficient photocatalysts and methodologies to incorporate them into working devices. Such devices need to have a solar-to-hydrogen efficiency of at least 10%, and in order for them to be adopted in today's market, they need to have a low manufacturing cost. This project focused on the investigation of manganese oxide as a photocatalyst. An inexpensive, scalable spray process was used to prepare coatings of this material. So far only limited light sensitivity has been achieved. However, the material shows promise as an inexpensive electrocatalyst that could potentially replace more expensive materials used in electrolyzers.



**BSISAT PROGRAM PRESENTATIONS –HHS Room 1203**

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Presentation Time: 9:00-9:40am

Presenters: Erika Murray, Cameron Stalker, and Greg Von Wald

Concentration: Energy, Environment, Business and Technology

Capstone Advisor: Dr. Christopher Bachmann

**Capstone Title:** *Increasing Market Penetration of Residential Solar in Virginia*

**Abstract:**

Continued reliance on the current fossil-fuel based, thermoelectric power production paradigm creates devastating impacts on the global environment and local air quality. Solar photovoltaics have been a viable electricity generation option for decades, yet have not gained the market penetration needed to make significant impacts on an entrenched energy system. The aim of this study is to provide and present a cartographic representation of current photovoltaic penetration into residential electricity markets for use by small solar companies looking for geographic market trends. Utilizing a time-lapsed version of the Arc-GIS data visualization tool, a spatial and temporal analysis was conducted to identify the events which catalyzed consumer decisions to install solar systems, including but not limited to community co-op initiatives and government incentives. Additionally, all of Virginia's residential solar owners were surveyed to ascertain their motives for adoption and acquire consolidated feedback on the effectiveness of initiatives and incentives. With concerns of global climate change, national energy security, and local air quality at the forefront of the public's mind, understanding solar photovoltaic market penetration provides a pathway towards a more sustainable Virginia.



### BSISAT PROGRAM PRESENTATIONS –HHS Room 1203

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Presentation Time: 9:45-10:25am

Presenters: Hannah Aloumouati, Victoria Foster, McKinnon Langston, and Alexander Macfarlane

Concentrations: Applied Biotechnology, Energy, Engineering and Manufacturing, Environment

Capstone Advisor: Dr. Christopher Bachmann

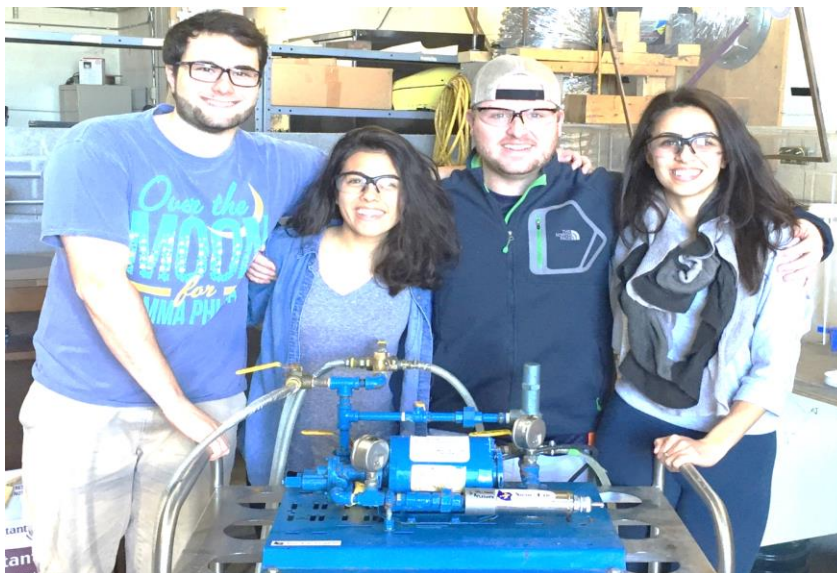
Sponsors: Mr. Wes Pence, Wholesome Energy  
NONOX Ltd.

**Capstone Title:** *Optimization of Novel Algae Oil Harvesting Strategy for Renewable Biofuels*

**Abstract:**

The United States Environmental Protection Agency has determined that the U.S. transportation sector was responsible for producing approximately 1,802 million metric tons of CO<sub>2</sub> in 2013. The use of algae as a biofuel has attracted considerable attention because of its potential to provide abundant, clean, renewable fuel that could be carbon neutral and does not interfere with the global food supply. The DOE's National Algal Biofuels Technology Roadmap identifies two main problem areas that need to be overcome for algae biofuels to become economically viable: large-scale algae production and algae harvesting. This project focuses on the optimization of a novel, energy efficient and cost effective algae harvesting method. This method was

developed through a public-private partnership between James Madison University and Wholesome Energy of Edinburgh, VA. The process uses an extreme high shear mixing process in the presence of a powerful non-polar solvent to breakdown algae cell membranes and facilitate migration of oil into the solvent phase. The algae oil is then purified from the solvent and the solvent is recycled back into the extraction process. Production is costly and this investigation examined ways to improve the overall energy efficiency and cost effectiveness by reducing cycle



time and optimizing solvent levels. Despite the higher cost of algae biofuels compared to conventional petroleum, this algae-oil harvesting strategy could potentially be used to facilitate the cleanup of harmful algae blooms by providing an economic incentive for algae collection. When combined with offshore algae cultivation, this system has the potential to provide abundant, clean, renewable fuel not only to Virginia, but also to other parts of the United States. This would result in significant reductions in harmful greenhouse gas emissions from the transportation sector, helping to create a cleaner environment for future generations.

### BSISAT PROGRAM PRESENTATIONS –HHS Room 1203

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Presentation Time: 2:00-2:40pm

Presenters: Jonathon Gellings, Sean McArdle, and Preston White

Concentrations: Energy, Environment

Capstone Advisors: Dr. Jonathan Miles and Dr. Mace Bentley

**Capstone Title:** *Offshore Wind Resource Characterization using Cross-Calibrated, Multi-Platform Ocean Surface Wind Data off the East Coast of the United States*

**Abstract:**

There is a major initiative to increase the amount of electricity generated by renewable energy technologies both globally and in the United States. Wind energy is at the forefront of this development, and there are already many land-based wind power plants in the United States and other in development. However, at present, there are no operating wind power plants off any coast of the U.S. One of the main reasons for this is the lack of reliable data available that describes the offshore wind resource. The National Aeronautics and Space Administration (NASA) provides cross-calibrated, multi-platform (CCMP) ocean surface wind data that were used to assess the wind resource for an offshore region along the East Coast of the United States. The analysis produced maps with colorized contours proportional to wind speeds. A statistical comparison of the CCMP data to corresponding buoy data was completed in order to determine the validity of the method.



### BSISAT PROGRAM PRESENTATIONS –HHS Room 1203

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Presentation Time: 2:45-3:25pm

Presenters: Kayla Cook and Sydney Sumner – Honors Capstone

Concentrations: Energy, Environment

Capstone Advisors: Dr. Jonathan Miles

**Capstone Title:** *Pilot Project to Advancing Distributed Wind in Virginia*

#### **Abstract:**

The Virginia Energy Plan of 2014 created a demand for alternative energy sources to meet the goal of producing 25% of Virginia's energy from alternative sources by 2025. One of the most promising sources of alternative energy in Virginia is wind. As a result, the Virginia Department of Mines, Minerals, and Energy (DMME) took action to incentivize distributed wind (DW) energy by enabling loan assistance with highly favorable terms toward the purchase and installation of distributed wind systems. Our team identified the nine sectors considered most likely to present the strongest potential for development of DW, and landowners within these sectors were invited to apply for assistance and loan consideration through the Distributed Wind Assistance Program (DWAP) that we developed. The program received 12 applications; these were evaluated through a desktop analysis in order to select the four most competitive candidates as determined through a comprehensive scoring evaluation. These strongest applications



were considered for state-based loans and were guided to consider additional support from the U.S. Department of Agriculture if eligible. One applicant, Bradford Bay Farm, was able to progress at a rapid rate and a full site evaluation was performed, including an on-site visit. The final outcomes of this effort and lessons learned are described.



**BSISAT PROGRAM PRESENTATIONS –HHS Room 1204**

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Presentation Time: 2:00-2:25pm  
Presenter: Andrew Funkhouser  
Concentration: Telecommunications  
Capstone Advisors: Dr. Emil Salib  
Sponsor: Shentel RF Engineering Department

**Capstone Title:** *Heat-map of Cellular Long Term Evolution (LTE) Signal Strength in the City of Harrisonburg Using Software Defined Radio (SDR)*

**Abstract:**

Long Term Evolution (LTE) is the fastest method of data transfer in the current cellular industry, as every wireless service provider/carrier claims they have the fastest speeds and the best coverage in most geographical areas anywhere in the country. Unfortunately, there is no way for consumers to be able to tell just how high the quality of an LTE signal at a local level. There are two goals for this project: (a) to produce a series of heat-maps displaying the signal strength of several LTE service providers throughout the City of Harrisonburg through Radio Frequency drive testing of their transmitted signals and (b) to create a low-cost RF testing system capable of producing these heat-maps through the use of Software Defined Radio (SDR) technology. These heat-maps have been created using an Anritsu Linkmaster ML87110A (a high performance multi-band receiver borrowed from Shentel), and two low cost SDR based receivers: RTL2832U SDR, and the HackRF One (acquired through the ISAT department). The following LTE frequency bands were tested for this project: 751 MHz, 866.3 MHz, 1941.8 MHz, 1962.5 MHz, 1992.5 MHz, and 2130 MHz. The preliminary results of the drive tests indicate that the two best frequencies in the city are located at 751 MHz and 866.3 MHz.



### BSISAT PROGRAM PRESENTATIONS –HHS Room 1204

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Presentation Time: 2:30-3:10pm

Presenters: Micah Corcoran and Eric Mason

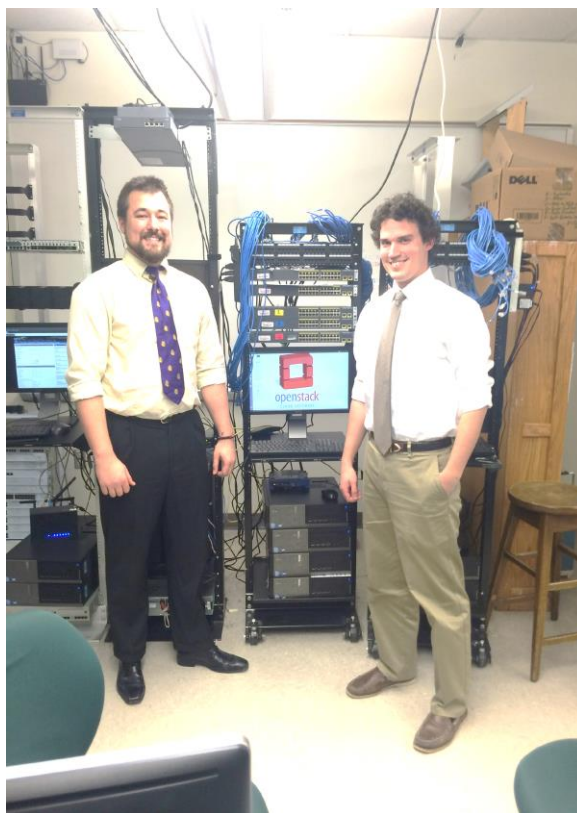
Concentrations: Telecommunications and Information Knowledge Management

Capstone Advisors: Dr. Emil Salib

**Capstone Title:** *Private Cloud Computing Using OpenStack Open Source Operating System*

#### **Abstract:**

Current desktop virtualization solutions have been implemented using VMware vSphere and Horizon View software suites. The license fees of these are high, with little room for the flexibility to meet the hands-on Networking and Security curriculum needs and requirements. For example, it does not support seamless integration of client hardware with the virtual machines running on the VMware ESXi hosts. To realize this functionality, along with many others, requires significant re-purposing and financial investment that are beyond our reach. The goal of this project is to create our own private Cloud Computing System using an open source operating system known as OpenStack. "OpenStack is a cloud operating system that controls large pools of compute, storage, and networking resources throughout a datacenter, all managed through a dashboard that gives administrators control while empowering their users to provision resources through a web interface." Many organizations and software developers are turning to OpenStack for its open APIs, flexible architecture, and easy management interface. One of the greatest strength of OpenStack is the large and influential community support. Through that support, we expect numerous creative features but as importantly faster delivery of many of them. Due to the modular and flexible architecture of OpenStack, we have been able to install and run its components on a stack of to-be-surplused desktops resulting in additional saving in the upfront cost of starting our first pilot effort. We have implemented a proof of concept using 5-node OpenStack server with 40GB of RAM, 1 TB of storage, and 12 processors. We have also performed our pilot study offering ISAT 361 students access to Windows 8 virtual machines from anywhere on James Madison University's network, with an individual VM having been created and assigned to each ISAT 361 group. The work done on OpenStack also provides a strong foundation for future capstone projects.



### BSISAT PROGRAM PRESENTATIONS –HHS Room 1204

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Presentation Time: 3:15-3:55pm

Presenters: Kyle Chipman and Matt Feimer

Concentrations: Telecommunications and Information Knowledge Management

Capstone Advisors: Dr. Emil Salib

**Capstone Title:** *Biometrics2S (B2S) – Web-based Two-step Identity Authentication via Biometrics Facial Recognition (Open Source OpenCV)*

#### **Abstract:**

Security and privacy is a growing issue in our technologically evolving society today and continues to become a concern for most if not all organizations. The type of security most businesses face today deals with access to sensitive and competitive information in the form of files and applications on their computing and networking devices. When signing onto a computer you are normally asked for username and password but this one-step identity authentication process is vulnerable to many readily available security attacks and "hacks". These organizations could greatly benefit from a cost effective and efficient solution based on a two-step identity authentication process. This project provides the design and implementation of a biometric-based security system that can be



implemented into organization of different sizes and needs. This system promises to elevate security access control where user identification and authentication is supplemented with biometric facial recognition. Biometrics-based security is a prevalent and well-proven technology and has become increasingly more affordable. We have implemented our "Biometrics2S (B2S)", with facial recognition capabilities, using OpenCV open source software. The end user interface incorporates web based digital image acquisition from a source, such as, a digital camera, user account permission and security levels assignment management. The B2S software can be run on a desktop, laptop or small devices such as Raspberry Pi 2 & 3.

### BSISAT PROGRAM PRESENTATIONS –HHS Room 1207

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Presentation Time: 9:00-9:25am

Presenter: Katie Kelly – Honors Capstone

Concentrations: Applied Biotechnology and Environment

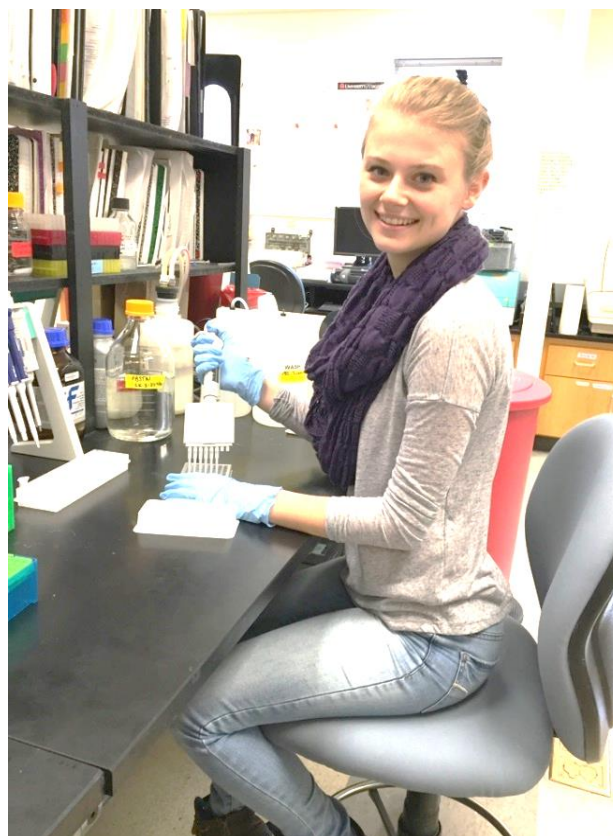
Capstone Advisor: Dr. Robert McKown

Sponsors: This work was supported by the 4-VA Collaborative at James Madison University

**Capstone Title:** *Clinical Study of Canine Tear Lacritin as a Treatment for Dry Eye*

#### **Abstract:**

Keratoconjunctivitis sicca (KCS), the deficiency of tears also known as dry eye, is a prevalent disease that affects both humans and canines. The current treatment for dry eye, cyclosporine (Restasis®), only provides temporary relief, is often associated with discomfort and some people have little or no effective reaction to the medication. Lacritin is a naturally occurring human tear glycoprotein secreted from the human and canine lacrimal glands. It has been shown that lacritin stimulates basal tearing in rabbits when applied topically. This study characterized lacritin as a potential new canine and human therapeutic for the treatment of dry eye. In collaboration with the Virginia-Maryland College of Veterinarian Medicine, tear samples were collected from dogs being treated at the veterinary clinic and transported to JMU for analysis. At JMU, the tears were eluted from the wicks and assayed to determine total protein concentrations. An indirect Enzyme-Linked Immunosorbent Assay (ELISA) was developed and optimized to quantitate total tear lacritin. SDS Polyacrylamide Gel Electrophoresis (PAGE) was used to visualize the tear total protein profile. Western blot analysis was used to visually determine monomeric and higher order complexes of canine lacritin in tear samples. A total of 64 tear samples were analyzed with 32 samples from healthy dogs and 32 samples from dogs clinically diagnosed with dry eye. It was found that canines with KCS had a significant decrease in tear film lacritin as determined by ELISA analysis. Western blot analysis detected prominent bands in healthy tears at approximately 18kDa corresponding to monomeric canine lacritin that were absent or faintly observed in tears from dry eye dogs. This study provides clinical data that supports the application of lacritin as a topical therapeutic for the treatment of dry eye disease.



### **BSISAT PROGRAM PRESENTATIONS –HHS Room 1207**

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Presentation Time: 9:30-9:55am

Presenter: Joseph Straub

Concentrations: Applied Biotechnology

Capstone Advisor: Dr. Robert McKown

**Capstone Title:** *Lacritin Market Analysis: Feasibility and Profitability of Entering the Veterinary Dry Eye Disease Market*

#### **Abstract:**

Dry eye disease affects many animals including dogs, horses, and cats. Currently there are no effective treatments on the veterinary market. Dr. Gordon Laurie and his team of researchers at the University of Virginia have found a protein that is lacking in a significant amount of human dry eye disease cases. The team is currently working to develop a topical solution that will introduce a synthetic version of the protein to the surface of the eye to treat and cure dry eye disease for humans. The team believes that this protein may also be beneficial to animals, after several pre-clinical animal tests. This project evaluates the current veterinary dry eye disease market to see if it is feasible and profitable for Dr. Laurie and his team to pursue the creation of a product that would treat and cure dry eye disease in animals.

In the United States, there are approximately 70-80 million dogs. On average, about 1% of dogs are affected by dry eye syndrome, however some specific breeds can experience increased prevalence like the King Charles Cavalier Spaniel with 11.5% of the breed affected. Dry eye disease is relatively uncommon in both cats and horses. This project analyzes at both external and internal environmental factors as well as targeted market segments. Externally, it evaluates market trends, competition, demand from veterinarians, and uncontrollable factors. Internally, it evaluates growth drivers, threats, key success factors, and constraints.

**BSISAT PROGRAM PRESENTATIONS –HHS Room 1207**

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Presentation Time: 10:00-10:25am

Presenter: Austin Payne and Zachary Yorio

Concentrations: Applied Biotechnology and Information Knowledge Management

Capstone Advisor: Dr. Stephanie Stockwell

**Capstone Title:** *Translational Field-to-lab Work Involving the Analysis of Native B. japonicum Strains from Local Soils, in Partnership with Local Schools*

**Abstract:**

A problem of modern agriculture is the overuse of N-rich fertilizers that run-off and negatively impact local ecosystems. Application of Bradyrhizobium japonicum, a symbiotic soil bacterium that fixes nitrogen for host soybean plants, is a potential biotechnological solution to this issue. To uncover how B. japonicum initiates the symbiotic relationship, a library of native strains is being constructed for genetic characterization. Unfortunately previous collection methods have not allowed for significant progress towards our goals. Thus, the objective of this project was to develop a more efficient and streamlined collection protocol. This involved expanding our Citizen Science-based collaboration with the Harrisonburg High School (HHS) STEM Academy. High school students isolated 18 potential B. japonicum strains from local farms. To enhance the partnership with HHS, a web-based research database was created. The database is a physical home for the project—hosting protocols, images, and general information—for the communication with current collaborators and the recruitment of potential new partners. With the database in place, we hope to significantly expand our B. japonicum collection and analysis efforts while supporting K-12 science education.



**BSISAT PROGRAM PRESENTATIONS –HHS Room 1207**

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Presentation Time: 10:30-10:55am  
Presenter: Gabriel Liu  
Concentrations: Applied Biotechnology  
Capstone Advisor: Dr. Stephanie Stockwell  
Sponsor: Integrated Global Services, Inc.

**Capstone Title:** *The Effects of Microbiologically Induced Corrosion by Desulfovibrio desulfuricans on Thermal Spray Coatings*

**Abstract:**

Microbiologically induced (or influenced) corrosion (MIC), corrosion caused and/or encouraged by microorganisms such as bacteria, plays a significant role in the degradation of metals in industry and infrastructure. It is estimated that MIC accounts for 20% of combined corrosion costs worldwide, equating to hundreds-of-billion of dollars per year.

Desulfovibrio is a genus of Gram-negative sulfate-reducing bacteria and is obligately anaerobic. Specifically, Desulfovibrio desulfuricans has been reported to cause MIC in nearly all environments including soil and water (both fresh and salt) and in industries such as oil, power generation, marine industries, buried pipelines, and cooling water systems. In order to assess the damage MIC can cause to thermal spray coatings, Desulfovibrio desulfuricans was cultured onto thermal sprayed steel and allowed to develop biofilms and proliferate over a period of three months. The resulting damage, or lack thereof, will be evaluated using various metallurgical techniques including optical microscopy, scanning electron microscopy with energy-dispersive x-ray spectroscopy and x-ray photoelectron spectroscopy, atomic force microscopy, and electrochemical techniques. In order to perform this experiment, a functional biology lab was established at the global headquarters of Integrated Global Services, Inc. in Chesterfield, Virginia.



### BSISAT PROGRAM PRESENTATIONS –HHS Room 1207

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Presentation Time: 2:30-3:10pm

Presenters: Jamie Figler and Joseph Hoang

Concentrations: Engineering and Manufacturing, Environment

Capstone Advisor: Dr. Robert Brent

Sponsor: Eastern Bioplastic

**Capstone Title:** *Removal of Cr, Ni, Zn, Cu, and Cd in Wastewater Using Chicken Feather Intermediate*

#### **Abstract:**

Many harmful metal compounds end up in the wastewater of industrial facilities. These facilities are monitored and required by law to manage the metal concentrations discharged into the environment. A common method of removing metals in wastewater is adsorption onto granular activated carbon (GAC). Chicken feathers, a waste product of chicken farming, contain keratin, which, due to its high surface area, is predicted to have similar adsorption qualities. This study investigated the economic and technical feasibility of using chicken feathers to remove metal contaminants from wastewater. The performance of the chicken feathers was evaluated through scanning electron microscopy, batch kinetic experiments, and adsorption isotherm experiments using simulated wastewater containing Ni, Zn, Cu, and Cd. Based on the isotherm experiments, feathers were 82.4% as effective as GAC for Ni, 86.9% for Zn, 88.0% for Cu, and 178.2% for Cd. The batch kinetic tests showed that the feathers had a relatively high rate of adsorption for each metal. While the adsorption properties of chicken feathers were slightly inferior to the industry standard of GAC, the chicken feathers represent a waste product, and can be produced at one third the cost of GAC. The analysis showed that the performance to cost value for the chicken feather make them a feasible technology for the removal of metals from industrial wastewater.



### BSISAT PROGRAM PRESENTATIONS –HHS Room 1207

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Presentation Time: 3:15-3:55pm

Presenters: Carli Kohler and Matthew McCarter

Concentrations: Environment

Capstone Advisor: Dr. Robert Brent

Sponsor: National Fish and Wildlife Foundation

**Capstone Title:** *Edith J. Carrier Arboretum Stream Restoration and Storm Water Monitoring*

#### **Abstract:**

With over 75% of the United States population living in urban areas, large population centers have large areas of impermeable surfaces, which decrease infiltration, increase runoff, and alter the hydrology of the surrounding streams. This issue is termed urbanization and is happening to streams globally. Urban streams are usually highly modified from their natural, pre-urbanized state, with significant differences in stream and riparian habitat, stream flow, and water quality. Typically, streams in urban areas serve a variety of functions: habitat, urban drainage and flood management, and public and community amenity (including linkages to open space), and can include special cultural and community significance. These functions are often impaired in urban areas by altered hydrology and decreased water quality. Stream restoration projects that return the stream to more natural conditions can be effective in improving water quality and restoring the intended functions of these urban streams.

At James Madison University specifically, the Edith J Carrier Arboretum has been chosen for restoration and been granted the funds to do testing and assessments to restore the stream back to a more natural state. Construction occurred from August-December 2015, to restore and stabilize the stream banks, reconnect the stream to the floodplain, and reestablish wetland areas. To assess whether this restoration improved water quality, a monitoring program was instituted. This program includes data collection at two sites, the inlet and the outlet of the arboretum, during the pre construction, during the construction, and post construction. In five pre-construction storm events where samples were collected, all storm events had estimated mean concentrations that exceeded the EPA recommended water quality criteria for total nitrogen, total phosphorus, total suspended solids, and turbidity. These results will provide a pre- construction baseline for water quality sampling that will continue post construction. These comparisons will assess the ultimate success of the arboretum restoration project.



### **BSISAT PROGRAM PRESENTATIONS –HHS Room 1207**

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Presentation Time: 4:00-4:40pm

Presenters: Alex Barnes, Alex Pineda, and Richard Rizzo

Concentrations: Environment

Capstone Advisor: Dr. Carole Nash

**Capstone Title:** *The Impact of River Flow on Micro-Hydroelectric Operations*

#### **Abstract:**

In this project, the group addressed the feasibility of operating a micro-hydroelectric dam in various low head conditions, using the case study of Burnshire Hydroelectric, LLC, Woodstock Virginia on the North Fork of the Shenandoah River. Micro-hydroelectric power operations are expensive to run and maintain, but with an increasing demand for clean renewable energy, micro-hydroelectric power has become an appealing option on a local scale. As a run-of-the-river operation, Burnshire is fed by a pondage associated with river flow alteration from the construction of the dam in the 1800s. General guidelines for its operation limit power generation during conditions of low flow (i.e., when water is not flowing over the dam), but the lack of specific regulations and concerns of downstream stakeholders for municipal water supply availability have introduced several social and environmental issues that must be analyzed to determine effects. This case study will include a statistical analysis of the flow of water on the North Fork both upstream and downstream of the dam to determine annual and monthly trends. The water flow data, coupled with comparative studies, an analysis of the Burnshire operation, and an evaluation of the regulations regarding the usage of the dam are organized to present the Burnshire owner with recommendations concerning operation during low-flow conditions.



**GEOGRAPHIC SCIENCE PROGRAM PRESENTATIONS –HHS Room 1201**

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Presentation Time: 9:00-9:40am

Presenters: Meaghan Fitzgerald, Melanie Freshwater, Rachel House, and Olivia Meyer

Concentrations: Environmental, Conservation, Sustainability and Development (ECSD)

Capstone Advisor: Dr. Amy Goodall

Sponsors: Keister Elementary School

**Capstone Title:** *Elementary School Gardens as Environmental Education Spaces*

**Abstract:**

Elementary school gardens can provide opportunities for students to interact with natural systems and to gain knowledge and skills related to physical and human sciences. The W.H. Keister Elementary school (KES) garden in Harrisonburg, VA was developed by Geographic Science (GS) students during spring



2012. Since that time, a relationship between the elementary school and the GS program has developed so that the garden provides study sites for undergraduate research as well as a learning laboratory for elementary students, especially during summer school. The infrastructure for a garden at Waterman Elementary School (WES) has existed for a longer time period but few gardening activities have taken place during recent years, limiting the potential use of the garden as a learning environment. Our senior capstone project was designed to increase use of the gardens for student learning, especially for the time period from September through May. From fall 2015 – spring 2016, we directed the maintenance of the garden at KES, established an after-school garden program at KES, worked to revitalize the garden at Waterman Elementary, and involved elementary students to make requests for *Garden 2016*. Our presentation summarizes the after-school activities we created, our assessment of the value of those activities, and our involvement with the faculty and staff at KES and WES to further develop their garden program. We also make recommendations for continuing the after-school program from the perspective of elementary student benefits, the potential for undergraduate research, and the potential impact that these activities may have for increasing student interests in nature.

**GEOGRAPHIC SCIENCE PROGRAM PRESENTATIONS –HHS Room 1201**

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Presentation Time: 9:45-10:25am

Presenters: Matthew Jacobsen, David Ramsden, Jessica Stanford, and Anna Warner

Concentrations: Environmental, Conservation, Sustainability and Development (ECSD)  
Applied Geographic Information Science (AGIS)

Capstone Advisor: Dr. Amy Goodall

Sponsors: ANICIRA Veterinary Center

**Capstone Title:** *Temporal analysis of free ranging cats in our local environment*

**Abstract:**

We conducted a spatial analysis of free ranging cats that were taken into veterinarian clinics within the cities of Harrisonburg and Staunton, VA. We also investigated literature about the impact of free ranging cats on biodiversity. Our work is a follow-up of previous analyses conducted by JMU Geographic Science (GS) students in association with the Anicira Veterinarian Clinic in Harrisonburg, VA. Our objectives were to 1) understand if there were any changes over the past 3 years in the abundance of free ranging cats in the region, 2) determine if previous work between JMU GS projects and the Anicira Clinic has influenced the abundance of free ranging cats, and 3) assess the impact on biodiversity by free ranging cats in this region. We summarize spatial patterns of cat abundances and discuss the need to educate the public about the biodiversity issues associated with free ranging cats.



**GEOGRAPHIC SCIENCE PROGRAM PRESENTATIONS –HHS Room 1201**

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Presentation Time: 10:30-10:55am

Presenter: Kara Krantz

Concentrations: Environmental, Conservation, Sustainability and Development (ECSD)  
Applied Geographic Information Science (AGIS)

Capstone Advisor: Dr. Mary Kimsey

**Capstone Title:** *Analysis of the Responses to Poverty in Harrisonburg, Virginia*

**Abstract:**

Lyndon B. Johnson’s War on Poverty was established in 1964 to eradicate poverty in the United States. There have been great strides towards accomplishing this goal; however, poverty continues to persist. The purpose of this study is to analyze poverty in Harrisonburg, Virginia and how it compares to poverty at the state and national levels. In addition, this study evaluates the services provided by nonprofits and government agencies to the poor in Harrisonburg. Finally, it investigates the interactions among the nonprofits and government agencies. Poverty statistics come from the U.S. Census Bureau. Analysis of the data reflects that the presence of poverty in Harrisonburg exceeds the state and national average. Interviews were conducted with a dozen local nonprofit directors and government workers to discuss how each entity addresses poverty in the city and how each interacts with other organizations. The interviews reveal that Harrisonburg nonprofits have taken great strides to assist those in poverty in the city and are constantly communicating with other nonprofits to best address those in need. While the state and federal government agencies have programs implemented to assist those in poverty, there is more that could be done at the local government level. A greater knowledge and understanding of poverty, combined with a goal of assisting the poor and working together with other nonprofits, allows the nonprofits in Harrisonburg to address more accurately the needs of the community.



**GEOGRAPHIC SCIENCE PROGRAM PRESENTATIONS –HHS Room 1201**

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**POSTER PRESENTATION**

Presentation Time: 11:00-11:25am

Presenter: Lindy Westenhoff

Concentrations: Environmental, Conservation, Sustainability and Development (ECSD)  
Applied Geographic Information Science (AGIS)

Capstone Advisor: Dr. Henry Way

**Capstone Title:** *Perceptions of Safety in Urban Spaces: The Fan District, Richmond, VA*

**Abstract:**

This poster identifies and spatially analyzes factors that influence the perception of safety in populations of women within Richmond's LGBT community. The project was conceived due to increasing calls for awareness about street harassment. Its purpose is to examine what factors at the street level increase or decrease feelings of safety or discomfort. In the first phase of the project, survey data was collected from volunteer participants in a partnership with Diversity Richmond, the area's local LGBT resource center. Using blank maps provided, participants highlighted areas of the city that they valued as "safe" with green, "less safe" with yellow, "neutral" with blue, or "unknown" with orange. The second phase of the project aggregated the map data using GIS technology, producing areas multiple participants considered to be the most safe or unsafe areas of the city. Interestingly, more women felt safe in park areas, while less safe around museums. The third and final phase of the project identified street-level factors in areas that had been determined to be more "unsafe." These include line of sight, lighting, vegetation alongside the walkway, and the width of the sidewalk. Further research would incorporate applying the results found in this study to other city models - for instance, taking the results found in the third phase and determining if those same factors hold true in Charlottesville as they do in Richmond.

### GEOGRAPHIC SCIENCE PROGRAM PRESENTATIONS –HHS Room 1201

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#### POSTER PRESENTATION

Presentation Time: 11:30-11:55am

Presenter: Emma Martin

Concentrations: Environmental, Conservation, Sustainability and Development (ECSD)

Capstone Advisor: Dr. Carole Nash

**Capstone Title:** *Using Residential Location to Assess the Environmental Value-Action Gap in Students at James Madison University*

#### **Abstract:**

This study focuses on the environmental Value-Action Gap of students at James Madison University (JMU) in Harrisonburg, Virginia. This gap occurs when a person has pro-environmental beliefs but does not have congruent actions. Often, there are other factors apart from a person's values that influence his/her willingness to participate in eco-friendly behavior (Howell 2013). For this study, the factor of influence being addressed is location. When students live on-campus at JMU they are surrounded by 'green' initiatives. Understanding the diffusion of environmental behavior from



on-campus living to off-campus living is important because the majority of a JMU student's residency is often off-campus. It is hypothesized that the Value-Action gap is wider in students who reside in off-campus housing compared to students who reside in on-campus housing as a result of reduced proximity to these initiatives. 1,004 JMU students were sampled using an IRB-approved Qualtrics survey that included questions about age, gender, academic year, environmental values, and environmental actions. Additionally, each participant indicated his/her location of residence using an ArcGIS Online map of Harrisonburg divided into eight generalized on-and off-campus zones. A 2-Dimensional Model of Ecological Values (2-MEV) was used to assess students' preservation and utilization values, and a series of Likert-scaled statements assessed the frequency of students' environmental actions. An ANOVA test was used to determine variation in the responses of on-campus and off-campus participants. Contrary to the hypothesis, it is understood that off-campus students have a higher mean value and action score than that of on-campus students, although a Value-Action Gap does exist in both populations. Additionally, there is a moderate correlation between the values and actions within both groups, indicating that stronger values lead to more frequent actions. The results of this study can be applied to help enhance 'green' behavior in JMU students.

**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 348**

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Presentation Time: 8:00-8:20am

Presenter: Jake Smith

Capstone Advisor: Dr. Jeffrey Tang

**Capstone Title:** *The effects of Big Data on Marketing Intelligence over the next 10 years*

**Abstract:**

Business Intelligence, especially the subset Marketing Intelligence, is important to the operations of a Business. It helps keep a business competitive within the markets it targets, and can help give a business an advantage. Big Data techniques have helped to process more data than traditional methods can process, and has become part of many businesses' Marketing Intelligence strategies. This examines how effective Big Data will be through the next decade.

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Presentation Time: 8:25-8:45am

Presenter: Karl A. Beckett

Capstone Advisor: Dr. Jeffrey Tang

**Capstone Title:** *China beyond the Horizon: A Look at China as a Military Power by the Year 2035*

**Abstract:**

China's announced budget for military spending in 2015 was the equivalent of \$144.2 billion US dollars. This research project provides three potential outcomes related to China's military posture by 2035: a supreme world leader with a large military and strong economy, a fractured nation fighting the Islamic State supporters within China, or economic stagnation that leads to a reduction of military assets and spending. The implications for these alternative futures will provide my customer with an expanded range of options, allowing him or her to consider the impact of current and future decisions or strategies in each of the scenarios. Because of the ambiguity and complexity of this project, an Alternative Futures Analysis methodology was selected, allowing the analyst to consider a wide range of various factors while constructing each scenario.



**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 348**

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Presentation Time: 8:50-9:15am

Presenters: Janickal Hanson and Dara Sao

Capstone Advisor: Dr. Jeffrey Tang

**Capstone Title: *The Future Economic Future of the U.S. Oil Energy Market***

**Abstract:**

Oil is the leading and most dominant fuel in the world, with a global energy consumption of 33%. Oil exploration, production, and consumption are all important to the U.S.' economy, and failure to acknowledge its importance and future can be detrimental to the U.S., as it may affect how we do business, job growth, investments, climate change, energy security, and even our relations abroad. We have assessed the future of the U.S. oil energy market and some plausible implications that follow. Through this, we have identified trends that are likely to affect oil demand, prospects of other fuels, consumers, our government, transportation, and our oil supply.

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Presentation Time: 9:20-9:40am

Presenter: John-Eric F. Bell

Capstone Advisor: Dr. Jeffrey Tang

**Capstone Title: *US Foreign Policy Implications of Russia's Increased Presence in Syria: A Systems Based Analysis***

**Abstract:**

Russia's increased regional dominance and the introduction of ISIS as a regional player in the Middle East have dominated US foreign policy over the past 5 years and severely impacted US interests in both the Middle East and Europe. Russia's long standing ties with the struggling Assad regime in Syria and ISIS's regional transgressions into Syria have caused these two players to clash in what has become one of the most complex and dangerous international conflicts since WWII. This analysis seeks to both capture the sophisticated nature of the Russo-Syrian relationship as well as gain insight into how Russia's recent direct military involvement in Syria impacts US foreign policy in the struggle against ISIS. By utilizing a systems based approach as well as a red team analysis, this analysis seeks to identify key leverage points by examining the issue from the view of Vladimir Putin and the Russian government. These key leverage points include the shared US-Russian terror threat, the decline of the Russian economy and the stability of the Putin regime. These key leverage points ultimately capture insights into how the US Department of State may effectively engage Russia in effective diplomatic relations.

**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 348**

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Presentation Time: 9:45-10:10am  
Presenters: Mitchell Connolly and David Saunders  
Capstone Advisor: Dr. Jeffrey Tang  
Sponsors: NGA National Geospatial Intelligence Agency

**Capstone Title:** *Development of Geospatial Indicators for the Analysis of Food Security In West Africa*

**Abstract:**

The ability to see food security indicators through maps is of vital importance to the Intelligence Community as it provides an easy to understand visualization that communicates an issue with little cost and time. The goal of our analysis is to create a meaningful set of indicators that others can use to effectively analyze food security and stability in West Africa. We selected the Inner Niger Delta in Mali as it provides an ideal study area to analyze the links between climate vulnerability and change, food resources, human security, conflict, and adaptation. The Inner Niger Delta provides water for agriculture, fishing, livestock, and trade; in Mali, where 80% it's labor force is engaged in farming and fishing practices, food production is key. However, recent environmental changes and human activities have deteriorated the area causing a drastic rise in food insecurity. We have studied this situation and developed seven indicators we believe will allow for the projection of future food security crises in West Africa.

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Presentation Time: 10:15-10:35am  
Presenter: Jeremy Wilson  
Capstone Advisor: Dr. Jeffrey Tang

**Capstone Title:** *Future of Water Services in the United States: Provided Publicly or Privately?*

**Abstract:**

Water privatization in the United States has been a growing trend since the mid-1980s. However, for the first century of America's existence water services and wastewater management were largely private services. But as cities became larger these services became a core part of government function because of raised concerns that private providers would not be able to keep quality service and efficient distribution. Now, cutting costs within local government has become a major concern and many municipalities in the US are looking towards water service as a way to cut costs or even make money. This project is meant to give a better understanding of the future of water services providing in the United States. Water services in the US are nearing a critical point where a decision is going to have to be made to both invest in the infrastructure and keep water a public service or contract it out to privately owned firms. In conclusion this project attempts to give a clearer picture of water services in the US and whether those services will continue to be publicly distributed or if privatization will be the preferred method of water service within the next ten years. The methods used to achieve the final conclusion include an in-depth SWOT Analysis, Trend Analysis, and Scenario Generation/Alternative Futures Analysis. This project will include and analyze general trends in the United States currently and in the future and leave out specifics on individual municipalities.

### **INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 348**

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Presentation Time: 10:40-11:00am

Presenter: Joshua Dunn

Capstone Advisor: Dr. Jeffrey Tang

Sponsors: Toffler Associates: Masseh Tahiry and Jason Fieger

**Capstone Title:** *The MENA Region: The Impacts on Youth Population and Employment on US National Security*

#### **Abstract:**

The Middle East and North Africa (MENA) region has become extremely significant in terms of youth and the impacts they can have on their societies. Events such as the Arab Spring highlight some of the impacts youth can have. The purpose of this project is to examine the current variables that are affecting the youth populations in the MENA region and its potential impacts on United States national security by using creative and insightful methodologies to provide better understandings into the problems currently plaguing the youth populations. The MENA region has one of the largest youth bulges of any region in the world. This has created a growing demand for food, water, energy usage, and employment. This coupled with the increase in political instability, the capability of this region to adequately support such a youth bulge, let alone the general population, will cause problems for US strategy in the Middle East and North Africa in the future. This project will analyze a wide array of themes such as: economy, infrastructure, technology, cultural and societal influences, as well as governance and the potential effects they might have on the youth. Some of the methodologies that will be used to examine these themes will be trend identification, identifying trends that will help to understand the causal forces influencing the course of events in the region, and scenario generation, which will provide reasonable outcomes based on the current variables highlighted by trend identification. Brought together, these methodologies and analysis will help to improve current and future US strategy in the Middle East and North Africa.

**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 348**

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Presentation Time: 12:00-12:30pm  
Presenters: Caroline Leary, Sean Donovan, and Tommy Dunne  
Capstone Advisor: Dr. Jeffrey Tang  
Sponsors: Dr. Edna Reid (JMU) & Dr. Dhiraj Murthy (Goldsmiths, University of London)

**Capstone Title:** *The Islamic States recruitment through social media*

**Abstract:**

The terrorist organization, Islamic State, is mainly comprised of Sunni jihadists who seek to establish a caliphate based on Sharia law. The Islamic State has gained an impressive following in a short period through their use of a social media campaign on platforms, such as Facebook and Twitter. Overall, it has been noted that with the increasing presence of the Islamic State online, there will need to be an external force that comes in to combat their efforts. This project explores how effective the Islamic State’s recruitment methods on social media outlets are in recruiting young individuals from Westernized countries over the next 5 years. For this analysis, the strategic assessment analyzed how the Islamic State runs its social media campaign with the influence of outsider factors and their strengths and weaknesses. Lastly, we completed a scenario generation to examine the future state of the social media campaign as the Islamic State continues their attacks.

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Presentation Time: 12:35-1:05pm  
Presenters: Allison Beich, Aimee Cunningham, and Joseph McNamara  
Capstone Advisors: Dr. Jeffrey Tang and Dr. Noel Hendrickson  
Sponsors: Toffler Associates

**Capstone Title:** *A Futures Assessment of the Islamic State in Syria by 2020*

**Abstract:**

This capstone project explores the possibility of Syria being overrun by The Islamic State (IS) if President Bashar al-Assad’s government is overthrown. We also assess if Syria is likely to become a breeding ground for IS extremism. Syria is in danger of becoming a failed state, which threatens stability in Syria and the Middle East region. With the crisis in Syria escalating, many questions remain about who will govern the state assuming Assad is no longer in power. We identify the internal and external causal forces affecting the environment in Syria, forecast different scenarios describing both how Assad will be removed from power as well as the result of his removal, and list indicators and implications of each of these scenarios.

**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 348**

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Presentation Time: 1:10-1:45pm  
Presenters: David Abretski, Eric Brown, Sarah Knarzer, and, Gavin To  
Capstone Advisor: Dr. Jeffrey Tang  
**Capstone Title: *Market Intelligence for JMU's IA Program***

**Abstract:**

The purpose of this study is to analyze the undergraduate intelligence education landscape in the United States. The need for strong undergraduate intelligence education programs is of great interest to employers, faculty, and prospective students. By utilizing 4C and SWOT analysis, we assess the overall value of James Madison’s intelligence analysis program as well as other reputable programs in the U.S. To complement the market research, we collaborated with the Alumni Association by actively collecting qualitative and quantitative data from IA alumni.

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Presentation Time: 1:50-2:15pm  
Presenters: Travis Floyd and Matthew Grieco  
Capstone Advisors: Dr. Jeffrey Tang and Dr. Edna Reid  
**Capstone Title: *The Emerging Cyber Threat to U.S. Hospitals***

**Abstract:**

Community Health Systems, one of the United States’ largest hospital systems, experienced a data breach in which over 4.5 million individuals had personal information compromised. There has been a shift of cyber-attacks from other industries such as industrial, retail, and financial to the healthcare industry, specifically targeted at hospitals. This project examines the cyber vulnerabilities in U.S. hospitals and future threats they are likely to face. Using data and trend analysis, we identify emerging threats such as network intrusions, advanced malware, insider threats, and lack of cyber education. We also identify what data is being targeted and stolen in various data breaches, giving insight into motivations behind attacks.

**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 348**

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Presentation Time: 2:20-2:55pm

Presenters: Liam Barrett, Jake Cottrill, Chris Horton, and Ryan Kunde

Capstone Advisor: Dr. Jeffrey Tang

**Capstone Title:** *The Competitive Future of Virginia Craft Brewing*

**Abstract:**

Craft brewing has shifted the paradigm for American beer, creating tens of thousands of jobs and over \$25 billion in annual revenue. In Virginia alone, the number of breweries has jumped from 40 to 142 in the last five years. This project examines the current craft beer competitive environment and its interactions with the biggest players in the industry. We examined the craft beer industry to map causal relationships between relevant variables, analyzed national trends to apply to Virginia's landscape, and generated plausible future scenarios given the directions of the variables and trends for the next five years.

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Presentation Time: 3:00-3:30pm

Presenters: Alex Pate, Lauren Shires, and Morgan Volpe

Capstone Advisors: Dr. Jeffrey Tang and Dr. Noel Hendrickson

**Capstone Title:** *Re-evaluating al-Qaeda: The Role of US Foreign Policy in Yemen*

**Abstract:**

Al-Qaeda in the Arabian Peninsula (AQAP) has been declared the strongest al-Qaeda threat to the United States as a result of its strong record of violence, terrorist attacks, and narrative against western values. As a result of the culminating instability within the Middle East, this most active and dangerous affiliate of al-Qaeda has continued to grow in strength and size. This thesis aims to answer the question, "What US policy approach will most likely reduce AQAP recruitment and reduce threats to US security interests?". Through systems dynamics and scenario generation, the greater systemic implications of US foreign policies on AQAP are better understood and provide valuable direction on two fronts: what factors motivate citizens to join AQAP and how US policy might enable potential AQAP recruits to join extremist movements.

**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 348**

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Presentation Time: 3:35-4:00pm

Presenters: Robert Banez and Hope Williams

Capstone Advisor: Dr. Jeffrey Tang

**Capstone Title:** *Assessment of the Impact and Role of Climate Change in the Destabilization of Syria*

**Abstract:**

In the last decade, climate change has caused severe environmental changes impacting many regions throughout the world. Climate change has been specifically linked to the current conflict in Syria as it has played a direct role in the current humanitarian and environmental crisis. However, despite the apparent connection to the conflict in Syria there are still many disagreements over the issue. The purpose of this project is to determine climate change's overall role in the conflict and to assess if climate change was the root cause of conflict in Syria.

Methodologies that were used to obtain the end results were Analysis of Competing Hypotheses, Causal Analysis, and Trend Analysis. It was determined that climate change was primarily a contributing factor to the conflict. It was determined that the government's mismanagement and neglect to implement policies to prepare for a potential water crisis was the root cause of the conflict. As a reaction to the humanitarian crisis the citizens of Syria began political protests to try and bring about reform. Instead of responding with change, the Syrian government countered with violent and indiscriminant military actions toward the population. Overall, it is assessed that climate change contributes to the conflict acting as a threat multiplier as it increased the possibility of conflict emerging.

**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 348**

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Presentation Time: 4:05-4:25pm  
Presenter: Celia Turner  
Capstone Advisor: Dr. Jeffrey Tang  
Sponsor: Harrisonburg Police Department

**Capstone Title:** *Creating an Intelligence Division at Harrisonburg Police Department*

**Abstract:**

With recent increasing tensions between police and citizens, many citizens do not support or understand the use of intelligence in policing. Intelligence-led policing is a relatively new and controversial strategy used by police departments across the nation. This capstone project seeks to determine the factors that may contribute to or hinder a successful intelligence program at Harrisonburg Police Department, including demographics of Harrisonburg and surrounding areas, crime rates, community support, and the organizational structure of the department.

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Presentation Time: 4:30-4:50pm  
Presenter: Benjamin Nuger  
Capstone Advisors: Dr. Jeffrey Tang and Dr. Michael Deaton  
Sponsor: Michael Mayo and Eric Chase from Toffler Associates

**Capstone Title:** *Causal Analysis and Strategy Assessment of Company Brand Scandals*

**Abstract:**

Crises to company brands can lower market share, stock price, sales, or even cause the company to go out of business. With the growth of online and traditional media over the last half century, brand ambassadors have been used as a marketing tool, which presents risk for companies for those ambassadors implicated in scandals. This project examines different case studies of both brand ambassador and non-brand ambassador related crises using causal analysis to visualize and explain the dynamics of these crises with a strategy assessment of how the crises were handled. Parallels and differences are drawn from both types of crises to provide implications for companies for how to mitigate and even prevent the effects of brand crisis.



**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 348**

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Presentation Time: 4:55-5:15pm  
Presenter: Marielle Monne  
Capstone Advisor: Dr. Jeffrey Tang  
**Capstone Title: *Syrian Refugees***

**Abstract:**

Since 2011, 4.5 million people have fled Syria. Most of those 4.5 million are in neighboring countries while others have fled to Europe to seek refuge. Another 6.5 million people are internally displaced within Syria. This capstone examines possible responses by the United States. It will take into account the United States' responses to previous refugee crises and what other nations are doing to help.

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Presentation Time: 5:20-5:40pm  
Presenter: Timothy M. Miller  
Capstone Advisor: Dr. Jeffrey Tang  
**Capstone Title: *Implications of the U.S.-Cuban Detente in the Next Ten Years***

**Abstract:**

This capstone seeks to analyze the current trends, policies and leadership associated with warming relations between the United States and Cuba in order to better understand the future social, political, and economical environment in the next decade and to inform policymakers. This project will develop plausible future scenarios and their implications by using various analytical methodologies such as causal analysis, futures analysis, leadership analysis and GIS.

### **INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 350**

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Presentation Time: 8:40-9:15am

Presenters: Connor Healey, John Cundiff, Mike Lehman, and Neil Roberts

Capstone Advisor: Dr. Stephen Marrin

**Capstone Title:** *An Analysis of Equitable Participation for Division I Student Athletes*

**Abstract:**

Currently, one of the National Collegiate Athletic Association (NCAA) Core Values states that the NCAA must provide “an inclusive culture that fosters equitable participation for student-athletes”. Despite this promise, student athletes are not equitable participants in the college sports systems under the authority of the NCAA. In order to understand why student athletes, at the Division I level, are not being properly valued by the NCAA, this analysis will examine the amateur status of all college athletes, examine athletic department deficit spending, and examine the lack of revenue sharing opportunities for student athletes.

Even though student athletes are awarded with the opportunity to receive a college education and even money to pursue higher education, does that in fact equate to how much each student athlete is actually worth? Are student athletes being treated fairly and is the NCAA providing “an inclusive culture that fosters equitable participation”? This analysis will answer these questions and see what the future implications are not only for student athletes but for the NCAA and college sports as a whole. Our group will use scenario generation and system dynamics to conduct this analysis.

**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 350**

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Presentation Time: 9:20-9:45am

Presenters: Danielle Ash and John Levy

Capstone Advisor: Dr. Stephen Marrin

**Capstone Title:** *An Analysis of Cloud Computing’s Implementation into Critical Infrastructures*

**Abstract:**

Cloud computing, or the technique of using remote servers to process a computer’s resources, has emerged as the preeminent model for managing multiple computers and networks, and is likely to soon be brought into critical infrastructure, which is where the United States’ (U.S.) most important assets are located. This project is designed to employ futures analysis and similar techniques to creatively assess what kinds of risks cloud-computing would bring to critical infrastructures. Since critical infrastructure is already home to important processing functions and sensitive data storage servers for the U.S.’ most critical sectors, such as electric, financial and healthcare ones, cloud-computing is likely to have a huge impact on American security. Thus, developing different potential future scenarios offers insight into the potential security risks and helps project what could happen to any one of the 16 critical infrastructure sectors without the development of proper cyber-security safeguards.

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Presentation Time: 9:50-10:10am

Presenter: Evan Haskel

Capstone Advisor: Dr. Stephen Marrin

Sponsors: Mr. Dean Checknita, and Mr. Joe Palmieri-Department of Homeland Security

**Capstone Title:** *Critical Infrastructure: Assessing the Threat Posed by Homegrown Extremists*

**Abstract:**

This Capstone project evaluates the significance of the threat posed to critical infrastructure sectors of interest by Homegrown Violent Extremists (HVEs). Critical infrastructure sectors represent the social and economic backbone of the US; if terrorists exploit vulnerabilities in these sectors, then economic damage may result from an HVE attack in addition to the lives lost. Not only can terrorist attacks result in high repair costs, attacking certain targets may frighten away consumers, causing a potentially dangerous loss of profit. Furthermore, this project will assess which sectors represent the most tempting targets to terrorist organizations based on vulnerabilities and the physical or economic damage that could result from an attack. It will also factor the usage of social media by terrorist organizations to covertly recruit new members and select targets in assessing the HVE threat.

### **INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 350**

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Presentation Time: 10:15-10:50am

Presenters: Kyle Jenkins, Deirdre Kane, Kaitlyn Monahan, and Angela Rush

Capstone Advisor: Dr. Stephen Marrin

External Sponsor: Ken Knight, Analytic Director at CENTRA Technology

**Capstone Title:** *Extended U.S. Military Intervention: Could the Rise of ISIS Realistically Have Been Prevented?*

#### **Abstract:**

Extending military intervention in cases of increasing sectarian violence, political corruption, and lack of border integrity is likely to inhibit the growth of Islamic terrorist groups that would pose a threat to U.S. interests. Evaluating whether the rise of ISIS could realistically have been prevented by using a retrospective counterfactual approach exposed warning signs that existed as this problem unfolded. Given these indicators, the United States could have assisted in preventing the rise of ISIS had they maintained a military presence in Iraq in 2011. The absence of U.S. military personnel in Iraq exacerbated an already unstable environment conducive to recruitment by Islamic extremists. Under the rule of Iraqi Prime Minister Nouri al-Maliki, sectarian and ethnic violence increased as a result of power struggles and corruption within the government. Without a military presence in Iraq, the United States was unable to help shape political outcomes that leveraged both Sunni and Shi'a interests. No longer under the advisement of the U.S., Iraqi Security Forces lacked the training and instruction to effectively combat the violence spilling over from the Syrian Civil War, which started in early 2011 following the Arab Spring. All of these factors facilitated an environment for al-Qaeda in Iraq, self-proclaimed at the time to be Islamic State in Iraq (ISI), to merge with al-Nusra, forming the Islamic State in Iraq and Syria (ISIS). With a strong foundation in Iraq and an increasingly unstable Syria, ISIS was able to eventually take hold of strategic cities such as Raqqa, Ramadi, and Mosul from which they launched their terror campaign. The lessons learned from this case study on ISIS will aid decision makers when evaluating the rise of non-state actors in the future and help determine whether extending U.S. military intervention is an appropriate response.

### **INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 350**

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Presentation Time: 12:10-12:35pm

Presenters: Trevor Knickerbocker and Eric Lehman

Capstone Advisor: Dr. Stephen Marrin

Sponsor: Pherson Associates, LLC

**Capstone Title:** *The Arctic to 2035: An Examination of Futures Analytical Methods*

#### **Abstract:**

The purpose of this analysis is to examine and evaluate various future-oriented structured analytic techniques. Each of the techniques will be conducted using the growing accessibility of the Arctic and its potential effects on the global maritime transportation industry as a case study. The analysis begins with a current assessment of the region's accessibility and use, then projects multiple different future scenarios using three distinct future-oriented techniques, all using key variables extracted from the current assessment using a STEEPM framework, and finally compares and contrasts each method's outcome to discover their respective strengths and weaknesses. The Arctic offers an inherently complex and constantly evolving environment with an uncertain future that is well suited for testing differences between methods. We developed criteria to evaluate the three methods used and will determine which could be most useful for a shipping company under certain real world circumstances.

### **INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 350**

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Presentation Time: 12:40-1:15pm

Presenters: Andy Dove, Nick Johnson, Jonathan Rodriguez, and Eric Shifflett

Capstone Advisor: Dr. Stephen Marrin

Sponsors: Department of Homeland Security, Office of the Chief Security Officer

**Capstone Title:** *Threat to U.S. Technological Development: How Secure are Department of Defense Research Programs at Universities?*

#### **Abstract:**

The purpose of this project, in coordination with the Department of Homeland Security, is to identify vulnerabilities to the security of defense technology development at universities in the United States, and to assess how these vulnerabilities will shape the future landscape of DoD-contracted research with universities. In order to gain the perspective necessary to understand this relationship, the scope and interpretation of the factors must be clearly identified. For the scope of this analysis, universities have been defined as 4-year universities and research institutes with current research contracts, including those universities predominantly utilized by the Department of Defense. This framework is based on past conceptualization efforts by the Government Accountability Office and Federal Bureau of Investigation, in order to most accurately capture the essence of universities that are actively involved in DoD sponsored research. Criteria used to select sample data has been based on numbers of foreign students at the university, size of defense research contracts, past and current efforts by the university to maintain research relations with the Department of Defense, and the types of contracts awarded by the DoD. There are various parts of the university security infrastructure for research and technology development that should be of concern to the Department of Defense (DoD) agencies that are partnered with universities. The assessed vulnerabilities are identified as weaknesses in university research methods and information security policies, as well as a lack of awareness of foreign espionage threats that is being exploited by the efforts of foreign entities to gain access to restricted information. In addition, this issue will be analyzed by conducting Structured Analytic Techniques, Systems Dynamics and Modeling, and Futures Analysis.

**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 350**

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Presentation Time: 1:20-1:40pm  
Presenter: Katie Keplinger  
Capstone Advisor: Dr. Stephen Marrin  
Sponsors: Matthew Downey, Department of Defense  
Dr. Paul Boisen, Department of Defense

**Capstone Title: *European Refugee Crisis: An Opportunity for Criminal and Terrorist Exploitation***

**Abstract:**

This project analyzes the current extent and possible future implications of the European Security threat posed by criminal and terrorist exploitation of the methods refugees use to travel to Europe from Syria and various Northeast African countries. Evaluating the availability of clandestine infiltration opportunities into Europe entails understanding the factors that influence how refugees are able to travel between their countries of origin and destination. This is done via a Causal Analysis to determine the relevant variables and their relationships, and an Alternative Futures Analysis in order to examine future outcomes of the situation. Determining the availability of clandestine infiltration is essential to ascertaining the national security implications for various U.S. allies in Europe, particularly Greece and Germany, at the behest of the U.S. Department of Defense.

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Presentation Time: 1:45-2:10pm  
Presenters: Alexandra Bernabeu and Tiffany Nguyen  
Capstone Advisors: Dr. Stephen Marrin and Dr. Noel Hendrickson  
Sponsor: Mark Toler at Raytheon Blackbird Technologies

**Capstone Title: *Analyzing the Future Cyber Environment & Its Implications for Public and Private Industry***

**Abstract:**

This capstone project will determine the most significant trends present in the current cyber environment and to what extent those trends can positively and negatively impact the dynamic between government and private industry. This will be done through an examination of the present factors affecting the current cyber environment. Using Trend Identification, we will create a picture of the existing cyber environment and its underlying drivers. We will then conduct Scenario Generation in order to determine how these emerging trends will generate potential change in the cyber landscape. Our question is facilitated by Mark Toler at Raytheon Blackbird Technologies, and the answer to it may be used to inform U.S. Government cyber entities of possibilities they may have not considered concerning the cyber environment. This will then enable our client to see what challenges or opportunities are present as they work towards their cyber defensive missions.

### **INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 350**

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Presentation Time: 2:15-2:45pm

Presenters: Sean Monks, Matthew Royer, and David Wickizer

Capstone Advisor: Dr. Stephen Marrin

External Sponsors: Robert Wagner (Toffler)  
William Desrosiers (Toffler)

**Capstone Title:** *Vulnerabilities and Threats Stemming from the Future of the Automobile Industry*

#### **Abstract:**

It is probable that the vulnerabilities within the computerized networks of automobiles, the rise of self-driving vehicular technology, and the lack of a true cyber intelligence tradecraft will enable malicious actors to create both small and large scale threats within the United States. Modern vehicles now incorporate a system of software protocols known as the Controller Area Network, but only a small portion of the major car manufacturers have developed any capability to detect and respond to a hacking attacks in real time. “White-hat” hackers are now used to show how easily they can remotely take over a vehicles computer network via their connection to the internet and implemented Bluetooth technology. Despite the lack in vehicular cyber security, the automobile industry is continuing its development of self-driving cars, which will require a constant internet connection in order to create a “safer” driving experience. Automobile manufacturers have recalled millions of cars to patch security flaws, however patching current issues will not be enough, there will need to be a push to integrate the intelligence tradecraft into cyber security in order to identify threats ahead of time. Terrorist’s organizations are now taking steps into cyber warfare by hiring and training hackers, revealing the necessity of intelligence driven cyber security. The notion of hacking vehicles has implications for the automobile industry, such as lawsuits and brand impact, but also for U.S. Cyber Command as it will take a combined effort to not only protect vehicles on the road, but to identify those who will want to cause harm. Through causal analysis, scenario generation, and guidance from our sponsor Toffler Associates, this project will examine the vulnerabilities within the computerized networks of automobiles, what threats could take advantage of them, and what threats can be created in the coming years.



### INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 350

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Presentation Time: 2:50-3:10pm

Presenter: Pavan Girish Gudimetta

Capstone Advisor: Dr. Stephen Marrin

**Capstone Title:** *Knowledge is Power: Using Artificial Intelligence to Prevent Spear-Phishing Attacks*

#### **Abstract:**

Artificial Intelligence (A.I.) paired with threat-intelligence-based spear-phishing detection schemes are vital to prevent large-scale spear-phishing campaigns on enterprise-level networks in the near future. Spear-Phishing is a targeted network-based attack that uses a victim's preconceived notions to gain unauthorized access to secure networks. Spear-phishing Current spear-phishing detection schemes are unable to prevent hidden or obfuscated spear-phishing attacks leading to successful campaigns penetrating large networks. Given how large-scale enterprises have begun to prioritize network security and prevention of spear-phishing attacks, the need for a potential solution to protect against spear-phishing is evident. Due to the lack of current effective detection schemes, the advantages presented by an AI threat-intelligence-based technical solution can solve current issues related to spear-phishing attacks as well as provide solutions for other network-based attacks.

Using a hybrid of causal analysis and counterfactual reasoning, current spear-phishing detection schemes were evaluated and compared with the proposed implementation of a threat-intelligence-based A.I. The potential advantages for a "smart" technical solution can range from live network feeds for inbound network traffic, unstructured data readily available for network defenders as well as constant monitoring and adaptation to inbound network attacks based on a collective knowledge base taken from previous foreign encounters. While this project can be seen as best suited for large corporations or businesses, a threat-intelligence based AI can prove to be useful even in small to medium-scale home-networks giving end-users the ability to view live threat-intelligence within their own networks. A "smart" technical solution has the potential to provide long-term support as well as additional knowledge and value to large-scale enterprises looking to expand their networks and provide security for their businesses.

**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 350**

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Presentation Time: 3:15-3:40pm

Presenters: Stephanie Bender and Heather Funkhouser

Capstone Advisors: Dr. Stephen Marrin and Dr. Ronald Raab

**Capstone Title:** *Intentional Anthrax Release: Analyzing a University's Response to a Weapon of Mass Destruction Scenario*

**Abstract:**

This project will assess whether existing safety procedures at a university are able to effectively prevent, detect, respond, mitigate and recover from a small-scale anthrax attack. While the likelihood of a biological event taking place at a university remains low, the widespread implications should a single event of this nature occur require consideration. Upper-level management at a university would play a crucial role in each of the above-mentioned steps, from prevention to recovery, with the existing policies guiding their actions and determining the ultimate outcome. Along with red team, high-impact/low-probability, and cost-benefit methodology, local, state and federal policies were examined in a specific scenario in order to analyze the effectiveness of each and determine areas where improvement is needed.

**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 350**

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Presentation Time: 3:45-4:05pm

Presenter: Britta Rollins

Capstone Advisor: Dr. Stephen Marrin

Sponsor: Mary Nayak

**Capstone Title: *Human Trafficking in Today's Greatest Conflicts***

**Abstract:**

Major violent criminal organizations no longer play a miniscule role in the human trafficking trade and instead are now using human trafficking as a key military strategy in their fight for dominance in today's most violent armed conflicts occurring in Mexico, Nigeria, Syria, and Iraq.

Many insurgent groups, drug cartels, and terrorist organizations have had ties to human trafficking for years if not decades yet these ties have always been so minute and covert that they have been ignored almost entirely by scholars. Yet today scholars, analysts, and government officials can no longer ignore these ties, not now when human trafficking is being employed by arguably the most violent criminal groups in the world: the Islamic State in Iraq and Syria, Boko Haram, the Sinaloa and Los Zetas cartels. Not only should it come as a shock that the most lethal groups in the world, even though they have different agendas (for the most part), different backgrounds, and are fighting in different conflicts on different continents, they are ALL active in human trafficking and decisively more active than they (or their predecessors) were in the past decade.

It is not clear as to why this trend is so new (no more than five years old) especially when both human trafficking these other types of criminal organizations have been around for nearly a century. Past explanations given to explain this phenomenon are not enough to explain the drastic and sudden occurrence of this new trend. It is also not clear what this means for the future. Will this be a new, long-lasting trend that survives until the end of these conflicts or will it die out almost as swiftly as it appeared.

This paper strives to pinpoint the differences between these conflicts and the role human trafficking plays as well as to discuss the future of human trafficking in major armed conflicts and what the future holds.

**INTELLIGENCE ANALYSIS PROGRAM PRESENTATIONS –ISAT/CS Room 350**

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Presentation Time: 4:10-4:30pm

Presenter: Justin Humphries

External Sponsor: Toffler Associates

Capstone Advisor: Dr. Stephen Marrin

**Capstone Title:** *Autonomous Vehicle Technology: A Vulnerability Analysis*

**Abstract:**

The purpose of this analysis is to assess how security vulnerabilities of autonomous vehicle technology can be exploited to carry out malicious acts. Autonomous vehicles can be broken down into a few categories based on the level to which they can operate without driver interference and this project will mainly focus on the level of vehicles that can operate fully without the need for a driver. Two different methodologies will be used to conduct the beginning stages of the analysis to get a better understanding of the motives of the malicious actors. Understanding the motives allows the project to be narrowed to only the vulnerabilities that would be exploited by bad actors. The methodologies include Brainstorming and Red-team Analysis. With current forecasts predicting autonomous vehicle production to the public to begin within the next 10-15 years, it is important to shine a light on the vulnerabilities now before production begins. The overall goal of this project will be to point out the most significant weaknesses that autonomous vehicles have so that steps can be put in place to mitigate them.