2010-11 Capstone Project Descriptions

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<th>Organization/Institution</th>
<th>Funding Type</th>
<th>Frequency</th>
<th>Sponsor(s)</th>
<th>Anticipate EOR</th>
<th>Anticipate FOP</th>
<th>EOR Anticipate</th>
<th>FOP Anticipate</th>
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<tr>
<td>2010-01</td>
<td>Helping LEAP Seal the Deal... and the House</td>
<td>Reid Bailey</td>
<td>Local Energy Alliance Program</td>
<td>Industry/Private</td>
<td>Twice per month</td>
<td>No</td>
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<td>2010-02</td>
<td>Improving the Handoff of Care from UVA Children’s Hospital</td>
<td>Ellen J. Bass</td>
<td>UVA Children’s Hospital Department of Pediatrics</td>
<td>Internal to UVA</td>
<td>Twice per month</td>
<td>No</td>
<td>No</td>
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<td>2010-03</td>
<td>Reducing celebratory drinking</td>
<td>Ellen J. Bass</td>
<td>Center for Alcohol and Substance Education</td>
<td>Grant</td>
<td>Twice per month</td>
<td>No</td>
<td>No</td>
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<td>2010-04</td>
<td>Automated Analysis of Classroom Video and Audio</td>
<td>Peter Beling, Jinping Wang</td>
<td>Curry School of Education</td>
<td>Grant</td>
<td>Twice per month</td>
<td>No</td>
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<td>2010-05</td>
<td>Development of a Simulation Environment for Multi-sensor Overhead Surveillance</td>
<td>Peter Beling, Jinping Wang (in collaboration with)</td>
<td>PMWI, LLC</td>
<td>Industry/Private</td>
<td>Once per month</td>
<td>No</td>
<td>No</td>
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<td>2010-06</td>
<td>Prioritizing Infrastructure Projects in Afghanistan</td>
<td>Donald E. Brown</td>
<td>U.S. Army Corps of Engineers</td>
<td>Grant</td>
<td>Once per month</td>
<td>No</td>
<td>Yes</td>
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<td>2010-07</td>
<td>Development of a Simulation Environment for Multi-sensor Overhead Surveillance (Cogif)</td>
<td>Randy Cogill (in collaboration with)</td>
<td>MAUI, LLC</td>
<td>Industry/Private</td>
<td>Once per month</td>
<td>No</td>
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<td>2010-08</td>
<td>Analyzing Anonymous Financial Transactions Online</td>
<td>Jamie Conklin</td>
<td>Booz Allen Hamilton</td>
<td>Industry/Private</td>
<td>Once per month</td>
<td>No</td>
<td>No</td>
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<td>2010-09</td>
<td>Interdisciplinary Capstone: An Immersive Virtual Training Capability, Combining Sensors, Actuators and a Virtual Reality System</td>
<td>Gregory Gerling</td>
<td>Systems Engineering Research Center (SEERC) at Stevens</td>
<td>Grant</td>
<td>Once per month</td>
<td>No</td>
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<td>2010-10</td>
<td>CFC Gettix</td>
<td>Stephanie Guerlain, Jinping Wang</td>
<td>UVA Children’s Fitness Clinic</td>
<td>Grant</td>
<td>Once per month</td>
<td>No</td>
<td>No</td>
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<td>2010-11</td>
<td>Risk-based Strategy Adapting Commercial Land Development and Critical Infrastructure Systems</td>
<td>James H. Lambert</td>
<td>US Federal Highway Administration, Virginia</td>
<td>Grant</td>
<td>Once per month</td>
<td>No</td>
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<td>2010-12</td>
<td>Rapid Adaptive Needs Assessment (RANA) Tool</td>
<td>Garrick Louis</td>
<td>Systems Engineering Research Center (SEERC) at Stevens</td>
<td>Grant</td>
<td>Twice per month</td>
<td>Yes</td>
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<td>2010-13</td>
<td>Water and Health in Limpopo (WHL)</td>
<td>Garrick Louis</td>
<td>LWA Small Infrastructure Development Center (SBD)</td>
<td>Grant</td>
<td>Twice per month</td>
<td>Yes</td>
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<td>2010-14</td>
<td>Behavioral Aspects of Automatic Control of Diabetes</td>
<td>S. D. Patel</td>
<td>NSF</td>
<td>Grant</td>
<td>Once per month</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<tr>
<td>2010-15</td>
<td>Bidding on Exchange-based (spot market) online video improvisions</td>
<td>WT Schneider</td>
<td>TidalTV</td>
<td>Industry/Private</td>
<td>Once per week or more</td>
<td>No</td>
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<td>2010-16</td>
<td>Albemarle-Charlottesville Regional Jail Length of Stay Systems Analysis</td>
<td>Michael Smith, Pres White</td>
<td>Thomas Jefferson Area Community Criminal Justice</td>
<td>Local Government</td>
<td>Once per month</td>
<td>Yes</td>
<td>No</td>
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<td>2010-17</td>
<td>WORKFLOW ANALYSIS AT THE UNIVERSITY OF VIRGINIA HEALTH SYSTEM PEDIATRICS AMBULATORY CARE CLINIC</td>
<td>Michael Smith</td>
<td>thrive Healthcare, Chief, UVA Hospital Ambulatory Services</td>
<td>Internal to UVA</td>
<td>Once per month</td>
<td>No</td>
<td>No</td>
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<td>2010-18</td>
<td>US-Brazil Exchange</td>
<td>Stephanie Guerlain</td>
<td>University of Virginia and Universidade Federal do Rio de Janeiro</td>
<td>US Brazil/Education</td>
<td>Once per month</td>
<td>Yes</td>
<td>No</td>
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2010-01 -- Helping LEAP Seal the Deal... and the House

Faculty Advisor: Reid Bailey

Sponsor: Local Energy Alliance Program
Type of Sponsor: Industry/Private
Expected Frequency of Direct External Client Interaction: Twice per month

Is this project a continuation of a prior capstone project? No
Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
• Will students be expected to sign a non-disclosure agreement with the sponsor? I don't anticipate so, but am not totally sure
• Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? I don't anticipate so, but am not totally sure

Project Description:
The primary mission of LEAP, the Local Energy Alliance Program (http://www.leap-va.org/), is to "facilitate unprecedented utility (energy and water) savings by retrofitting buildings and installing renewable technologies in residential and commercial buildings.

LEAP's start-up capital comes from a $500,000 grant from the Southeast Energy Efficiency Alliance (SEEA), which the city and the county won in June 2009 by detailing their strategies for achieving energy savings. Over the next five to seven years, LEAP hopes to retrofit 30 to 50 percent of the homes and businesses in the Charlottesville-Albemarle area, cutting those buildings' energy costs by 20 to 40 percent."

1 You read that right: LEAP must convince at least 30 percent of homes and businesses to spend money to improve their energy efficiency. According to their documentation, that would be over 17,000 homes! A fundamental question driving this capstone project is:
How can LEAP get homeowners in the Charlottesville area to "pull the trigger" and spend money on the most effective energy efficiency projects for their home?

As many homeowners will use the dollar savings from the energy efficiency improvements to pay for the project (via a loan from the bank paid back over several years), increasing consumer confidence in the impact of a project on reducing energy use and saving money is critical. Not only will increasing confidence in predicted savings increase the number of consumers who want to "pull the trigger," but it will increase the willingness of banks to lend money to these consumers. One way to increase such confidence is through contractors offering the consumer a performance warranty – which essentially guarantees that the projects will result in a specified reduction in energy usage. Models for predicting energy savings, however, do not make the very accurate predictions. Hence, contractors are wary of offering performance warranties. Organizations such as LEAP are considering offering contractors incentives if they make such warranties.

The capstone team will study this system (which, at a minimum, includes consumers, contractors, banks, and LEAP) with a focus on increasing the accuracy of predictions for energy savings in the central Virginia region. Making such predictions accurately is a complicated problem -- the impact of a certain energy efficiency retrofit project is dependent on a wide array of factors (e.g., number of floors, age of house, how well sealed a house is, type of heating/cooling system, etc.) – and data is available but necessarily plentiful.

Other dimensions of this problem that may come into play for this team include how to best structure a performance warranty to increase consumer and bank confidence, how to measure and verify the impact of upgrades, and evaluating the impact of LEAP offering incentives to contractors who offer warranties. This problem -- an inability to predict the impact of retrofits on energy use -- is not unique to LEAP. Other organizations across the country need accurate predictive capabilities as well. So one can find many other government, commercial, and academic research organizations working on this problem. The capstone team would not duplicate these other research efforts, but instead would find ways to compliment these other established research projects in the context of LEAP's goals for the Charlottesville area.

This is a project aimed at helping the local community make big strides to reduce environmental impact and your work can make a big difference. Students on this team need to be excited about working on a project that requires them to take initiative, learn new things, and apply their systems skills to address a real world need.
Faculty Advisor: Ellen J. Bass

Sponsor: UVA Children's Hospital Department of Pediatrics
Type of Sponsor: Internal to UVa
Expected Frequency of Direct External Client Interaction: Twice per month

Is this project a continuation of a prior capstone project? No

Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
• Will students be expected to sign a non-disclosure agreement with the sponsor? No
• Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? No

Project Description:
Handoff of care at the time of hospital discharge is a critical element in the future health of the patient involved. Pediatric patients are particularly vulnerable at the time of hospital discharge because of their reliance on others for ongoing health care. Key players involved in the care of children outside of the hospital are their families, primary care providers, and sometimes schools or other community resources (health departments, visiting nurses, etc.). These players make up what is currently referred to as the "Medical Home". Any gap in understanding among these caregivers may result in a poor clinical outcome for the patient. Our hypothesis is that with better handoff of care related written, electronic, and verbal communications, clinical outcomes including decreased medical errors, shorter patient lengths of stay/readmissions/emergency department usage, and fewer medical laboratory tests will also improve. In addition communication process measures including the frequency of accurate essential data elements provided in electronic and verbal communications will improve. As surrogates for safe and effective care delivery, subjective measures including patient understanding/satisfaction and primary care provider understanding and confidence will improve.

To make such improvements, this capstone project therefore involves discharge process characterization and evaluation. The team will characterize the current practice related to discharge from the Children's Hospital and will identify areas for improvement. Current practice includes the process of hospital discharge as well as the materials provided to families and health care providers at discharge. The recommended improvements need to fit into the current process as well as with the new electronic medical record (EMR) system scheduled to be implemented in the in-patient setting in March 2011. To accomplish these goals, the team will using ethnographic methods (survey, interview and observation techniques) to follow patients and families from admission to the Children's Hospital through discharge and follow up.

The team will develop instruments and methods for data collection and analysis. With the help of medical subject matter experts, the team will examine discharge materials (both from the current and new electronic medical record systems). The team will evaluate patient understanding, discharge documentation and primary care provider confidence in the final handoff from the hospital to the medical home. The team will identify recommendations for process improvement as well as identify areas for additional investigation.
Faculty Advisor: Ellen J. Bass

Sponsor: Center for Alcohol and Substance Education
Type of Sponsor: Grant
Expected Frequency of Direct External Client Interaction: Twice per month

Is this project a continuation of a prior capstone project? No

Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
- Will students be expected to sign a non-disclosure agreement with the sponsor? No
- Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? No

Project Description:
This is an interdisciplinary team working with students from outside of sie. While the entire team will have 5-6 team members, **TWO SIE STUDENTS WILL BE MATCHED TO THIS PROJECT from the voting**.

Students’ health and well-being are central to their ability to learn and colleges have been called to action to find effective approaches to address health promotion concerns, especially the abuse of alcohol. The Center for Alcohol and Substance Education (CASE) is responsible for developing prevention programs at UVa. It has recently been integrated with the Office of Health Promotion within Student Health. CASE is also taking on the operations of the Gordie Foundation. A website needs to be created to help with CASE’s enhanced mission.

In addition, the promotion of healthy social norms through mass media is known as social norms marketing, a merging of the social norms approach with the field of social marketing. Social norms marketing involves correcting misperceptions about the prevalence and acceptability of hazardous behaviors such as alcohol abuse. The social norms approach states that most students overestimate the actual prevalence of substance use, thus leading them to consider hazardous drinking to be the norm. College students consistently overestimate the amount of alcohol that their peers consume and the misperception of peer norms is associated with higher rates of alcohol use.

Successful social norms marketing campaigns follow the five step process: 1) Collect baseline data (usually via surveys); 2) Based on an analysis of the baseline data, develop simple, truthful, and consistent messages that highlight lower-risk drinking norms and protective behaviors; 3) Ensure credibility of the message source (generally by gathering sample data from the target population in Step 1); 4) Deliver the message to the target population where best practices dictate, incorporating student feedback into the media before delivery, and 5) Support message retention within the population, generally achieved by using multiple media avenues in Step 4 and providing incentives for students who can recite key campaign messages.

Additional prevention and enforcement efforts are needed at the University of Virginia (U.Va.) during four particularly high-risk times of the year. Student-driven social norms marketing campaigns, will result in a more coordinated and collaborative approach to addressing celebratory drinking associated with Halloween, the last home football game, spring break, the spring Foxfield Races, and 21st birthday celebrations. As a result of these public advertising campaigns, more students will engage in healthier drinking behaviors, including abstaining from use, and avoid the adverse consequences associated with drinking. Enhanced enforcement efforts during two of the most hazardous drinking occasions will also promote student safety and reduce underage drinking.
Faculty Advisor: Peter Beling, Jianping Wang

Sponsor: Curry School of Education
Type of Sponsor: Grant
Expected Frequency of Direct External Client Interaction: Twice per month

Is this project a continuation of a prior capstone project? No

Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
- Will students be expected to sign a non-disclosure agreement with the sponsor? No
- Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? No

Project Description:
Researchers in the Curry School of Education at UVA have established a program known as the Classroom Assessment Scoring System (CLASS) for improvement of teacher performance in the classroom. CLASS has as its basis an analysis of classroom environment and dynamics to identify key markers of teaching and learning effectiveness. To date, the process of identifying and documenting markers has been dependent on the efforts of trained evaluators. This Capstone project will focus on using technology to aid and supplement the manual CLASS evaluation system. Specifically, the project goal is to use automated (computer) analysis of classroom video and audio to identify activities and events of interest, such as:
  - Question and answer exchanges between the instructor and students
  - Periods during which particular modes of instruction, such as blackboard-based lecturing or small group work are in use.
  - Periods during which student attention and engagement is unusually high or low.

If we are successful in achieving these or similar capabilities, then in the future it should be possible to automatically filter collections of video and audio down to those portions most pertinent to CLASS evaluation, which would in turn greatly reduce the time and cost of manual scoring evaluations. A big part of this project will be the adaptation and integration of a variety of algorithms and software for audio and video analysis. The capstone group will make use of open source and UVa custom software for a variety of low-level measurements from video and audio recordings, including: location, orientation, and body articulation of humans; dynamics of human movement derived from location measurements; speech recognition and transcription; audio indexing and retrieval; speaker identification; and acoustic and prosodic analysis.
Faculty Advisor: Peter Beling, Jianping Wang (in collaboration with Randy Cogill's project)

Sponsor: MAV6, LLC.
Type of Sponsor: Industry/Private
Expected Frequency of Direct External Client Interaction: Once per month

Is this project a continuation of a prior capstone project? No

Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
- Will students be expected to sign a non-disclosure agreement with the sponsor? I don't anticipate so, but am not totally sure
- Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? I don't anticipate so, but am not totally sure

Project Description:
Two capstone teams, one advised by Prof. Beling and one by Prof. Cogill, will work together to design and implement a simulation environment for an overhead surveillance system. The client for this project, MAV6, LLC., is engaged in designing, constructing, and fielding a fleet of airships that will be used for overhead surveillance in military and emergency response scenarios. Each of these airships will be greater than a football field in length, will be capable of remaining airborne for weeks at a time, and will carry a suite of sensors including radar, ladar, and wide-area and narrow-area electro-optical and infrared cameras. The data stream from the sensors will be partially processed by an array of computers on the airship and then will be transmitted over a dedicated wireless link to the ground, where it will feed displays used by operators and analysts. Before the hardware design for the airships is made final, MAV6 needs to consider a number of design and operation questions, including:

- What logic should control the operations of the various sensors? Should they operate independently or in coordination? What role should operators and analysts on the ground play in controlling the sensors?
- What is the best way to manage the wireless link between the air and the ground, given that it has quite limited capacity compared with the volume of data that the sensors can generate? To what degree should sensor data be processed and filtered in the air before it is sent to the ground?
- How should sensor information be displayed to analysts and operators on the ground? How should one deal with tradeoffs between low resolution but wide-area views and high resolution but narrow-area views?

Two capstone teams will together take on the job of designing and implementing a simulation environment that the sponsor can use to explore the above issues. There will be four primary areas of simulation:

1. Ground activity and environmental conditions, including vehicle movements and changes in weather and light conditions.
2. Data generated by the sensors on the airship.
3. Transmission of sensor and control data between air and ground on a wireless link.
4. The display for operators and analysts on the ground. Prof. Cogill’s group will have sole responsibility for the area #2, while Prof. Beling’s group will have sole responsibility for area #4. The two groups will collaborate on areas #1 and #3.
Intellectual Property:
- Will students be expected to sign a non-disclosure agreement with the sponsor? I don't anticipate so, but am not totally sure
- Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? I don't anticipate so, but am not totally sure

Project Description:
Successful counterinsurgency (COIN) and reconstruction operations require an extraordinarily complex integration of military, political, and psychological actions. Current understanding of these operations now includes maintenance and improvements of indigenous infrastructures as an essential factor to the success of all the counterinsurgency and reconstruction operations. In many cases the infrastructure was structurally deficient before the counterinsurgency campaigns. In some cases, the infrastructure has been damaged by campaigns and in many cases the insurgents have taken direct actions to damage or destroy key elements of the local infrastructure.

To address this problem the U.S. Army has developed a new vision of COIN that incorporates actions to directly improve the infrastructure in the area of operations. This vision seeks to minimize infrastructural deficiencies that aid the enemy while simultaneously improving those elements of the infrastructure needed to directly support the counterinsurgency operations, economic development, and the well-being of the populace. In the most advanced approaches commanders and their staffs develop roadmaps for infrastructure improvement for optimum resource allocation. These roadmaps identify opportunities to selectively target infrastructure improvements over time to maximize the success of COIN operations. Modeling, simulation, and data analysis methods and techniques can support the development of these infrastructure roadmaps. This capstone will specifically look at the choice and application of these modeling, analysis, and simulation tools. The goal will be to find a subset of tools that can aid in identifying, prioritizing, and optimizing infrastructure projects in Afghanistan.
Faculty Advisor: Randy Cogill  (in collaboration with Peter Beling's project)

Sponsor: MAV6, LLC
Type of Sponsor: Industry/Private
Expected Frequency of Direct External Client Interaction: Once per month

Is this project a continuation of a prior capstone project? No

Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
• Will students be expected to sign a non-disclosure agreement with the sponsor? I don't anticipate so, but am not totally sure
• Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? I don't anticipate so, but am not totally sure

Project Description:
Two capstone teams, one advised by Prof. Beling and one by Prof. Cogill, will work together to design and implement a simulation environment for an overhead surveillance system. The client for this project, MAV6, LLC., is engaged in designing, constructing, and fielding a fleet of airships that will be used for overhead surveillance in military and emergency response scenarios. Each of these airships will be greater than a football field in length, will be capable of remaining airborne for weeks at a time, and will carry a suite of sensors including radar, ladar, and wide-area and narrow-area electro-optical and infrared cameras. The data stream from the sensors will be partially processed by an array of computers on the airship and then will be transmitted over a dedicated wireless link to the ground, where it will feed displays used by operators and analysts. Before the hardware design for the airships is made final, MAV6 needs to consider a number of design and operation questions, including:
• What logic should control the operations of the various sensors? Should they operate independently or in coordination? What role should operators and analysts on the ground play in controlling the sensors?
• What is the best way to manage the wireless link between the air and the ground, given that it has quite limited capacity compared with the volume of data that the sensors can generate? To what degree should sensor data be processed and filtered in the air before it is sent to the ground?
• How should sensor information be displayed to analysts and operators on the ground? How should one deal with tradeoffs between low resolution but wide-area views and high resolution but narrow-area views?

Two capstone teams will together take on the job of designing and implementing a simulation environment that the sponsor can use to explore the above issues. There will be four primary areas of simulation:
1. Ground activity and environmental conditions, including vehicle movements and changes in weather and light conditions.
2. Data generated by the sensors on the airship.
3. Transmission of sensor and control data between air and ground on a wireless link.
4. The display for operators and analysts on the ground. Prof. Cogill’s group will have sole responsibility for the area #2, while Prof. Beling’s group will have sole responsibility for area #4. The two groups will collaborate on areas #1 and #3.
2010-08 -- Analyzing Anonymous Financial Transactions Online

Faculty Advisor: Jamie Conklin

Sponsor: Booz Allen Hamilton  
Type of Sponsor: Industry/Private  
Expected Frequency of Direct External Client Interaction: Once per month

Is this project a continuation of a prior capstone project? Yes

Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
• Will students be expected to sign a non-disclosure agreement with the sponsor?  
  I don't anticipate so, but am not totally sure
• Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)?  
  I don't anticipate so, but am not totally sure

Project Description:
We are now in the age of transnational terrorism and crime, enabled and empowered through the fiber optic backbones submerged across the world's oceans in the 1990s. The Internet is one of the most powerful manifestations of this explosion of international connectedness. The Internet in its base form is a seemingly anonymous medium for communications, shopping, entertainment and other purposes. This is deceiving, as IP addresses can be tracked, cookies and malware can identify and locate you, and unencrypted emails can be read. The intelligence and law enforcement community relies upon these vulnerabilities to monitor targets of interest. This defensive bulwark against online anarchy is beginning to crumble. Covert and anonymous communications and non-traditional banking mechanisms are beginning to proliferate and are being used by those criminal and terrorist groups who were previously held in check through these various counter-measures. Networked virtual environments (NVEs) such as Second Life now give individuals the ability to cloak themselves in anonymous personae and communicate, coordinate and even recruit through these virtual worlds. Additional systems are being created specifically to accommodate anonymous communications and money transfers. These systems are proliferating and becoming layered, linking and assisting the functionality of the each other, and facilitating the effectiveness of transnational criminals and terrorists.

Objective: Building on last year's capstone team's work to database and visualize the network of online financial transactions, this year's capstone team will implement tools to aid in the analysis of networks of financial transactions. These tools will be used by Booz Allen Hamilton as they provide consulting services to a range of customers including government analysts and financial institutions. This project will expose students to cutting edge internet security research and some of the leading research efforts in this area. Students interested in communication systems, cybercrime, and internet security will find this an exciting project. Internet security and cybercrime are becoming a driving force in the design of virtually all networked systems. This experience will provide a good background for any student planning to work in the design of networked systems.
Faculty Advisor: Gregory Gerling

**Sponsor:** Systems Engineering Research Center (SERC) at Stevens Institute of Technology and National Capital Area Medical Simulation Center

**Type of Sponsor:** Grant

**Expected Frequency of Direct External Client Interaction:** Once per month

**Is this project a continuation of a prior capstone project? No**

**Do team members need to be U.S. citizens (e.g., Due to ITAR)? No**

**Intellectual Property:**
- Will students be expected to sign a non-disclosure agreement with the sponsor? No
- Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? No

**Project Description:**

An Immersive Virtual Training Capability, Combining Sensors, Actuators and a Virtual Environment, to Track Hand and Finger Position and Deliver Forces to Fingers

Three to five students from Systems Engineering, and five to seven students from Computer Science (3), Electrical Engineering (2), and Mechanical and/or Biomedical Engineering (2) will be selected for a year-long project to develop an immersive training capability. This project will be directed by Professor Gregory Gerling and his research/teaching assistant.

The capstone team will define, develop, and evaluate “mixed-reality” immersive training tools, which draw upon approaches involving virtual reality graphics, force feedback haptics, computerized mannequins, and custom-built mechantronics. The team will work with a DoD client, the National Capital Area Medical Simulation Center (SimCen), which supports the Uniformed Services University of the Health Sciences (USUHS). The SimCen conducts more than 15,000 training encounters per year with the Army Reserve, the Department of Human Health and Human Services and the three branches of the military. Dr. Alan Liu's group at the SimCen is a model client who holds particular domain knowledge, in terms of medicine and engineering disciplinary training and of military and civilian work backgrounds.

The goal of this capstone project is to develop physical (sensors and actuators) and software interfaces to facilitate the interaction with and perception of physical stimuli at a user's fingers. The sensors and actuators will be tied to a software virtual environment. The unique interaction tools to be developed fit into the area of “mixed-reality” simulation which bridges the gap between inanimate mannequins with computerized virtual reality (e.g., 3D vision and haptic force feedback). The “mixed-reality” paradigm seeks to better facilitate a user’s sense of presence in the simulation. At present, an issue with pure virtual reality is that it is difficult for a user to seamlessly connect his or her senses into a coherent sense of being immersed in the experience (e.g., contacting an object with a pen-based device is disconnected from cues involved in real interactions and with those observed – visually and kinesthetically – in the virtual world). Therefore, we propose to focus the development of sensors and actuators on tracking hand movements and actively delivering sensations in both physical and virtual worlds. Delivering information to the user’s bare fingers and palm is important for training a wide variety of medical procedures and in combat situations.
Activities: In specific, we propose the following activities: 1) Develop a mobile mechanical-electrical device to deliver forces and vibration to the circumference of the digits of the index and ring fingers, and thumb on one hand, 2) Devise a means of tracking absolute and relative positions of all fingers and the palm on both hands, and 3) Integrate both concepts (active force delivery and passive position sensing) with the display of a virtual hand and forces in a complex 3D software environment that is joined with a haptic force feedback device.

Although it will be the task of the team to define and create specific technologies that best fit the client’s problem and domain, potential strategies in Activities 1 and 2 include the use of servo motors, force sensors, pager motors; position tracking in the form of programmable data gloves (AcceleGlove by AnthroTronix); computer programming of microprocessors and circuit design. To join these with Activity 3, we will utilize, as a base platform, an existing graphical virtual reality environment (X3D software API) with a 3D monitor (Miracube) and a haptic environment (SenseGraphics H3D software API to control Sensable OMNI robotic devices). The programming utilizes C++, Python, and OpenGL. In its present setup, operators interact with various tools, and proceed through defined stages of a medical procedure where their hands-on skills are evaluated via defined metrics. In addition, Dr. Gerling’s group has built preliminary versions of add-on physical tools, which relate to virtual interactions in the virtual environment, such as a scissor handles in the physical world that tie to cutting motions in the virtual world. The project will flow through five main stages: definition of the problem, drafting requirements, prototyping an implementation of the solution, integrating disparate parts of the solution together, and validating its authenticity in a human-subjects experiment. In their role as client, Dr. Liu’s group would meet with the group of students on 2-3 site visits (two at the SimCen) and one at the University of Virginia in Charlottesville. Their group would provide domain knowledge given the complex medical and military environments within which we will be working. In specific, Dr. Liu’s group can provide grounding on the needs, capabilities, and limitations placed on warfighters, doctors, and other users of the system they would be developing.

More broadly, this interdisciplinary capstone project will allow the Department of Systems and Information Engineering to extend the capstone experience to other engineering majors. In particular, the students will be able to learn through two components of the experience. First, both the non-systems and systems engineering majors will learn through directly working on the interdisciplinary team. Several studies have indicated the direct positive impact of an interdisciplinary capstone experience compared to a single disciplinary capstone, where students on interdisciplinary projects are also more confident in their ability “to design a system to meet a set of needs.” Second, all work will be reviewed once per month by a DoD expert who will come to grounds to help the teams.

Students successfully completing the capstone shall be able to demonstrate that they can: • apply a systems methodology to a realistic, open-ended design problem, • work effectively on teams with engineers from multiple disciplines, • develop professional skills relating to working with project stakeholders, • use project management tools effectively, • communicate to a broad audience via both written and oral reports, and • apply approaches for developing innovative solutions. Finally, at various points through the semester, external experts will be brought onsite to engage the students in mentoring/apprentice activities, including faculty for all engineering disciplines and systems engineering experts from industry and government, such as Northrop Grumman, Lockheed Martin, Boeing, SAIC, and various DoD organizations.
Faculty Advisor: Stephanie Guerlain, Jianping Wang

Sponsor: UVa Children's Fitness Clinic
Type of Sponsor: Grant
Expected Frequency of Direct External Client Interaction: Once per month

Is this project a continuation of a prior capstone project? Yes

Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:

• Will students be expected to sign a non-disclosure agreement with the sponsor? No
• Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? No

Project Description:

Over the past four decades, the percentage of children and adolescents who are overweight has almost quadrupled. The effects of being overweight go beyond appearance; more than 25% of overweight children and adolescents have two or more additional risk factors for cardiovascular disease and nearly 60% have at least one additional risk factor. Being overweight or obese also increases a child’s chance of Type II diabetes, depression, and a shorter life span. In the Charlottesville, VA area, the prevalence of overweight and obese children is above the national average at 45%; almost one in every two children is overweight or obese. Without weight loss efforts, data show that overweight children typically become more overweight, suffering from a BMI increase of 0.1 standard deviation per year. With the increase in popularity of cellular phones and text messaging among children, this technology has potential to provide solutions to the issues with the current paper logs used to track activities, mood, and diet. Electronic patient journals would allow fitness counselors to track their patients’ health habits more consistently. SMS text messaging, due to its time stamp component and “cool” factor, may also be more reliable than paper diaries.

As such, a 2009-2010 capstone team designed an initial prototype technical solution called CFC GetFit, an interactive website that includes health education, health progress, and the capability for patients to send the system text messages. The motivation for this automation is three-fold and leads to the following hypotheses: Such a system will: 1) increase the patients’ interest and drive to consistently and more accurately report their daily food intake, mood and activity, 2) increase the amount of information exchange between the patients and their counselors between CFC visits 3) reduce “data gathering” activities and increase “counseling” activities during counseling sessions, 4) be seen as a feasible and useful alternative to paper logs for at least 50% of patients in the target age group (13-18 years old) and 5) cause patients to remain in the CFC counseling program longer.

Tasks for this year’s capstone are to:

1. Evaluate and iterate on the design of the prototype based on feedback from patients and counselors and add functionality to the system (e.g., progress reporting features, automatic replies to patient queries, etc.).
2. Enroll patients and their parents to participate as subjects in a field trial of the system.
3. Collect and analyze data.
4. Continue to iterate on the design and functionality of the counselor side of the system.
5. Write proposals for future funding to continue the development and evaluation of the system. This capstone would likely be of interest to those interested in working with children, who like technology development, who enjoy conducting literature reviews and writing, and/or who enjoyed SYS 2202, 3021 and 3023. Jianping Wang, a research scientist with a computer science background, is available to assist students with fleshing out their programming skills and learning how to develop secure, client-server systems. Clients at the CFC (located next to the UVa Police Station at the Kluge Children’s Rehabilitation Center) include a medical counselor, a dietician, and a physical fitness counselor. They are motivated and interested in the development of this system so that it may be put into use as part of their practice within the next year.
2010-11 -- Risk-Based Strategy Adapting Commercial Land Development and Critical Infrastructure Systems

Faculty Advisor: James H. Lambert

Sponsor: US Federal Highway Administration, Virginia Department of Transportation, Virginia Transportation Research Council
Type of Sponsor: Grant
Expected Frequency of Direct External Client Interaction: Once per month

Is this project a continuation of a prior capstone project? No

Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
- Will students be expected to sign a non-disclosure agreement with the sponsor? No
- Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? No

Project Description:
Annually across the US more than $500 billion is invested in non-residential construction with commercial land development accounting for over $40 billion. Non-adapted development contributes to future degraded performance of the adjacent critical infrastructure systems, requiring corrective actions and retrofitting. Strategies and methods are needed to reduce the burgeoning costs associated with surprise, regret, and belated action. For example, a substantial cost of the ongoing $5 billion Dulles Metrorail corridor extension might have been avoided from forecasting and adaptation through decades of land development. The protection of our critical infrastructures, including transportation, energy, water, and communications, will benefit from a risk-based approach that addresses the likelihoods and severities of adverse effects. Investments, benefits, and risks must be balanced in order to adapt investment portfolios to geographically extensive infrastructure networks. Capstone students will have the discretion to research and explore approaches to assemble unique data and several complementary layers of methodology focusing on the time horizon and extent of potential commercial development. The modeling and analysis will utilize information of commercial property locations and valuation, commercial space rental, socio-economic behaviors, employment, population, physical geography, and related activity levels and forecasts. The anticipated outcomes of the capstone effort will be immediately significant and applicable for the Commonwealth of Virginia protecting and growing a 6,000-mile passenger and goods mobility system. Stakeholders and parties to this effort include commercial developers, regional organizations, localities, and infrastructure agencies and utilities. This project invites students with interests and careers in risk assessment and management, commercial real estate, financial engineering, economic development, and critical infrastructure systems. Some travel will be needed.
Faculty Advisor: Garrick Louis

Sponsor: Systems Engineering Research Center (SERC) at Stevens Institute of Technology – with funding from the Department of Defense
Type of Sponsor: Grant
Expected Frequency of Direct External Client Interaction: Twice per month

Is this project a continuation of a prior capstone project? Yes
Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
• Will students be expected to sign a non-disclosure agreement with the sponsor? No
• Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? No

Project Description:
The goal of the Rapid Adaptive Needs Assessment (RANA) tool is to characterize the local water and sanitation resources available in the region surrounding the base of operations for humanitarian assistance and disaster response (HA/DR) teams in the wake of a disaster. The objectives are to determine the location and quality of significant water sources and sites for human waste and solid waste disposal. Search and rescue teams could deploy the water quality assessment kits in water sources discovered during reconnaissance activities, recording the GPS coordinates of these sites at the time of their deployment.

Data from the kits would be recovered on a portable computer. This would be used at the base camp to generate a map of regional water sources with sampled water quality, and relative location of waste disposal sites. An associated decision algorithm would use the water quality data to generate a list of requirements for treating the water from each source to drinking water standards. This information could then be matched with detailed procurement information and cost for delivery from external supply sources (such as US military) to the site. The algorithm would compute the cost of onsite services using local water sources against the cost of providing water and sanitation using imported supplies, such as bottled water and port-a-potties. In this way the feasibility of using local water sources could be established in a matter of hours or days.

• The water quality assessment kit consists of a submersible multi-parameter sensor that connects to a Pocket PC via a serial adaptor cable. The sensor records pH, dissolved oxygen, turbidity, total dissolved solids, and depth. Latitude, longitude and altitude coordinates are recorded on a bluetooth GPS receiver and transmitted via Bluetooth to the pocket PC. Data from the pocket PC are downloaded to a laptop computer loaded with mapping software. The data from the water quality kit are uploaded to a Google Earth map of the area. When combined with similar data collected from multiple water sources, the kit can quickly generate a map of water quality within a specified region.

A prototype of this system was developed by a Capstone team in 2006. The goal of the new Capstone is to extend the capability of that prototype to sense for multiple contaminants simultaneously, and to broadcast from its remote location to the base station. This will facilitate the related mapping and decision support analysis to be performed at that station. This will be a multidisciplinary project with students from Systems Engineering, Environmental Engineering, Electrical Engineering, Computer Science, and
Environmental Science. The Capstone group will meet once per each week with the project advisors at the University of Virginia, and submit a weekly project report to the project advisors and the client from the Department of Defense.
There are 0.87 billion people worldwide that lack access to safe drinking water and 2.2 billion that lack access to basic sanitation. This situation contributes to elevated rates of mortality and morbidity among the affected populations, including the deaths of 1.8 million people annually (WHO, 2004) most of whom are children under 5 years of age. The situation is worst in Africa, Asia, and Latin America and the Caribbean. Asia has the largest number of people without access to water and sanitation services (WASAN), and Africa has the highest percentage of population lacking access. The Center for Water, Health, Environment, and Development (WHEAD) at the University of Virginia (UVA) and University of Venda (UNIVEN) is building a model in Limpopo province, South Africa, to sustain access to adequate levels of safe water and sanitation services, and improved human health outcomes in developing communities. The goals of the water and health in Limpopo (WHIL) project are; (i) to characterize any causal relationship that exists between access to wasan services and the level of community health, and (ii) to use this information to craft appropriate interventions to sustain access to adequate wasan services and associated improvements in community health in Limpopo. The WHIL project is being conducted in the villages of Tchibvumo and Tshapasha. The 2009 WHIL Capstone evaluated, designed and built a water supply system in the village of Tshapasha. The goals of the 2010 WHIL Capstone are:

i. to evaluate options for a water supply system in the village of Tchibvumo and
ii. to design, specify, and develop the implementation plan for the Tchibvumo water supply system.
iii. to work with their peers from the University of Venda to build the water supply system in Tchibvumo during the period of May – August 2011.
iv. To use available project data and maps to test if causal links between access to wasan services and the incidence of childhood diarrhea in Tchibvumo and Tshapasha (T&T).

These goals will be achieved by the following objectives:

1. Review previous work (including the performance of the system in Tshapasha) to determine the criteria and technical options for the water supply system in Tchibvumo
2. To evaluate and select a short list of candidate systems for the Tchibvumo water supply that are consistent with prevailing water policy.
3. To draft a build-out plan with budget for the water supply system for Tchibvumo
4. To communicate at least once per week on project developments with the students at the University of Venda working in parallel on the WHIL project
5. To analyze the literature and all existing data for statistical evidence of a causal relationship between access to safe water and sanitation and childhood diarrhea incidence in T&T.
6. Use the results of the analysis to recommend changes to the project's information management and mapping systems.

The Capstone group will meet once each week with the project advisors at the University of Virginia, and submit a weekly project report to the project advisors. The UVA Capstone team will collaborate with an Univen Capstone team conducting related data collection, analysis, and mapping work, as well as research into relevant water policy. Students considering this project will be required to know GIS, basic statistics and databases. They should also be willing to work in Limpopo for 6 to 10 weeks in Summer 2011 on the WHIL project.
Recent national data show that nearly 21 million Americans have diabetes - a lifelong condition that affects people of every age, race, and nationality, and is the leading cause of kidney failure, blindness, and amputations not related to injury. Approximately 1.5 million of these people have Type 1 Diabetes Mellitus (T1DM), in which the immune system destroys the pancreatic beta cells, permanently suppressing insulin secretion. A typical T1DM patient will need 50,000 insulin shots over his/her lifetime, accompanied by testing of blood glucose levels several times a day. The primary purpose of diabetes treatment is to minimize post meal hyperglycemia (high blood sugar) while avoiding hypoglycemia (low blood sugar) through accidental overcompensation with insulin.

Encouraged by the recent introduction of reliable continuous glucose monitoring devices and insulin pumps, the diabetes technology community has embraced the challenge of designing algorithms that can provide real-time insulin dosing recommendations for tight control of blood sugar throughout the day. The challenge in designing such algorithms is delay: the time it takes for a meal to be detected as rise in blood sugar is approximately 30 minutes, and insulin treatment at this time is simply too late to prevent a large hyperglycemic excursion. Prior knowledge of meals could be extremely useful, but this is unrealistic in practice. Fortunately, even though eating behavior is random, it is possible to detect patterns in behaviors that can be used to inform and evaluate insulin-dosing strategies.

This capstone project, continuing a project from 2009/10, aims to develop models and algorithms for characterizing behavioral influences on the control of diabetes, focusing especially on random meal behavior. The goal is to inform the development of control algorithms that adapt gracefully to uncertainty about upcoming meals, being most aggressive when future disturbances are known with certainty and being correspondingly more circumspect when the disturbance process is highly variable. The project will involve studying prior work on behavioral characterization, seeking and/or developing sources of data for developing models, prototyping algorithms for parameter estimation, and possibly integrating with on-going control design efforts taking place at UVA.
Faculty Advisor: WT Scherer

Sponsor: TidalTV
Type of Sponsor: Industry/Private
Expected Frequency of Direct External Client Interaction: Once per week or more

Is this project a continuation of a prior capstone project? No

Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
- Will students be expected to sign a non-disclosure agreement with the sponsor? Yes
- Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? Yes

Project Description:
TidalTV is a video advertising, optimization, and yield management solutions provider. Our technology leverages the power of data and mathematics to guarantee delivery of a brand’s message against a very targeted demographic, and enables content creators and publishers to completely monetize audiences across varied demographic segments. Currently, TidalTV has deployed its technology for online video and is working to expand its reach to all video delivery platforms, including television and mobile devices. http://www.tidaltv.com/

1) Project Description
   a. Client’s Problem: What are the best bidding strategies to use and when do you use them for bidding on Exchange-based (spot market) online video impressions? How does one trade-off earning vs. learning in the bidding process? How does one incorporate a futures market into the pricing strategies for the spot market?
   b. Work Statement: Need to determine real problem definition, develop criteria for evaluation, brainstorm alternatives, rank alternatives, develop execution plan for top alternative(s).
   c. Background: Online Video (OLV) is a marketplace just like corn, commodities, and the NYSE. The OLV marketplace has unique characteristics related to the supply and demand participants and the industry’s historical practices. OLV has 2 ways to purchase: up front, and via real-time bidding exchanges. The key question is how to best manage OLV media buying across both up front and RTB exchanges in such a way that maximizes marketplace profit subject to meeting stakeholder constraints.

2) Milestones
   a. Semester One
      i. Learn the rules / marketplace necessities
      ii. Develop alternative strategies
      iii. Create test plan
   b. Semester Two
      i. Test strategies
      ii. Present recommendation
2010-16 -- Albemarle-Charlottesville Regional Jail Length of Stay Systems Analysis

Faculty Advisor: Michael Smith, Pres White (teleconferencing-in while on sabbatical)

Sponsor: Thomas Jefferson Area Community Criminal Justice Board
Type of Sponsor: Local Government
Expected Frequency of Direct External Client Interaction: Once per month

Is this project a continuation of a prior capstone project? Yes

Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
- Will students be expected to sign a non-disclosure agreement with the sponsor? No
- Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? No

Project Description:
I. Background

The Albemarle-Charlottesville Regional Jail (ACRJ) currently houses over 500 inmates, well above its rated capacity of 329. Forecasts indicate that if current trends continue, the jail population will continue to grow. Nationally, jail overcrowding is not a new phenomenon. Despite declining crime rates since 1991, U.S. incarceration rates have risen continuously over the past thirty years. As of February 2008, the U.S. led the world in incarceration, with more than 1 out of 100 adults in jail or prison.2

Overcrowding imposes significant costs on the community. The average annual cost of incarcerating one federal prisoner is more than $20,000, far exceeding the $13,000 average annual tuition of a public university. Furthermore, between 1977 and 1999, national corrections spending increased by 946 percent, whereas education spending rose only 370 percent. This increase in corrections spending was largely a result of the costly construction of new

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2 Emily Hesaltine, Erin McElroy, Katie P Justice Study - Final Report*, prepared University of Virginia, Charlottesville, VA, for the Thomas Jefferson Area Community Criminal Justice Board, April 30, 2008.
Overcrowding threatens public safety by limiting resources available to rehabilitate high-risk offenders. Offenders often leave jail and return to society in the same or worse state than when they arrived. In summary, overcrowding hinders a jail’s ability to fulfill its role in the criminal justice system and the community effectively.4

Recently, the Thomas Jefferson Area Community Criminal Justice Board (CCJB) evaluated the length of stay for inmates at the ACRJ and, as expected, confirmed that, in 2008, inmates with length of stay exceeding 90 days represent 11% of the jail population but occupy 76% of the beds (see figure at right). Appropriate reductions in length of stay could reduce overcrowding in the jail. Moreover, for inmates who are incarcerated at the ACRJ for more than 90 days, over 1/3 are transferred to the Virginia Department of Corrections to serve the remainder of their sentence (see figure next page). Another 27 percent are released after serving their sentence. The remainder are released under various conditions or are transferred to other facilities to serve the remainder of their sentence.

The CCJB would like to gain a more in-depth understanding of the dynamics that lead to longer lengths of stay and the resulting demand for more jail beds with the intent of discovering ways to reduce unnecessarily long lengths of stay by either more timely release or transfer of inmates. By focusing on inmates with lengths of stay in excess of 90 days, the CCJB seeks ways to avoid unnecessary capital investments in jail expansions since these are the inmates that occupy about three-fourths of the jail capacity.

II. Project Objective

The primary objective of this project is to examine jail operations and procedures in the context of the overall criminal justice system in the Region 10 counties to identify opportunities for safely reducing the length of stay at the ACRJ and the CVRJ to avoid overcrowding and the need for new capacity at the regional jails.

3 Ibid.
4 Ibid.
While the specific study activities may evolve over the course of the study, this objective will likely be achieved through the following tasks and these tasks will be performed in an iterative manner, with successive refinement as needed to support decision making:

1. Develop a deep understanding of the challenges and opportunities associated with Albemarle-Charlottesville Regional Jail and the Orange County Regional Jail by reviewing annual reports, analyzing historical data, observing jail operations, and interviewing jail personnel.
2. In concert with the Jail Superintendent and senior leadership, develop measurable objectives and related performance measures to be used in assessing jail performance and alternatives for dealing with jail overcrowding in terms of both reasons for incarceration and unnecessary delays in releasing inmates.
3. Document current “as is” inmate flows, information flows and methods, and personnel roles and responsibilities using widely accepted methods for documenting and communicating such information.
4. Identify possible deficiencies and/or improvement opportunities in current information and related workflows where resources are used inefficiently or inappropriately.
5. Investigate current “best practices” in other local and regional jails through literature review and other sources available to the project team.
6. Develop models (static or dynamic) that can be used illustrate alternatives and the potential improvements in throughput and volume that can be achieved within the available capacity.
7. Identify feasible alternatives for improving jail performance and characterize these alternatives in terms of their potential contribution to achieving jail objectives with respect to inmate population.
8. Evaluate alternatives including their sensitivity to changes in priorities or accuracy of data or predictions about the alternatives; include potential “bundles” of alternatives that, together, provide a cohesive set of improvements which, taken together, result in benefits that might not be realized without the set of improvements (e.g., some improvements may depend on implementing other improvements).
9. Prepare a draft and final report and presentation including recommendations and an executive summary for jail senior leadership to use in determining next steps to take with respect to improvements in the jail operations.
Faculty Advisor: Michael Smith

Sponsor: Yvonne McHorney, Chief, Uva Hospital Ambulatory Services
Type of Sponsor: Internal to UVa
Expected Frequency of Direct External Client Interaction: Once per month

Is this project a continuation of a prior capstone project? No

Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
- Will students be expected to sign a non-disclosure agreement with the sponsor? No
- Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? No

Project Description:
I. Background

The University of Virginia Health System’s Ambulatory Care Services offers comprehensive health care for all ages in the outpatient clinic setting. Services are provided in multiple locations around Charlottesville as well as in surrounding areas including Orange, North Garden and Nellysford (Wintergreen). The Ambulatory Care Clinics provide primary care services, women's health, pediatrics, medical and surgical specialties and psychiatry and mental health.5

In November 2009, the Medical Center Operating Board endorsed construction of a new approximately 200,000 gross square foot facility at the corner of Jefferson Park Avenue and West Main Street on the site of the existing open parking lot. The project will allow the University to 1) relocate most of the Medical Center’s outpatient pediatric clinics to a site convenient to parking and the main hospital; 2) enhance the layout, appearance, and amenities of the clinics; 3) support the installation of new therapeutic equipment; and 4) create a “free learning” Children’s Hospital at the University of Virginia. In addition, the Medical Center will be able to relocate and expand the Outpatient Surgery Center, currently located in a facility that is nearing the end of its useful life. The program goal is to improve patient care, consolidate the outpatient pediatric program, and develop an expanded Outpatient Surgery Center.6

As part of a recent Medical Center reorganization, Ambulatory Services adopted a joint leadership structure that consists of two newly created roles, a Medical Director of Ambulatory Services and a Chief of Ambulatory Services. Dan McCarter, M.D., assumed the role of Medical Director, and

6 Item summary from the November 16, 2009 meeting of the Medical Center Operating Board prepared for the UVa Board of Visitors. Website http://www.virginia.edu/bov/meetings/09nov/’09%20NOV%20MCOB%20BOOK.pdf accessed on July 28, 2010.
Yvonne McHorney, MHA, assumed the role of Chief of Ambulatory Services. Their first charge was the development of a strategic business plan to guide the direction of ambulatory care and enhance the synergy between the Medical Center and Medical Directors. To achieve this, an Ambulatory Oversight Committee was established as a collaborative among the management of the School of Medicine, the Medical Center, and the Health Services Foundation.\textsuperscript{7}

The Ambulatory Oversight Committee will serve as the advisory body for Ambulatory Services and is charged to bring leadership focus to the clinics and to growth opportunities associated with Ambulatory Services. The Committee will develop and implement strategies to increase market share, facilitate growth, and ensure high-quality care by focusing on enhancing patient access to services and consistently delivering a positive patient experience.\textsuperscript{8}

On September 22, 2009, Ambulatory Services held the first meeting of all Medical Directors, Medical Center Managers, and Medical Center Administrators under the new structure. Attendance and participation in the meeting were exceptional, with over 60 Medical Directors, Managers, and Administrators working collaboratively to develop strategies and suggestions on improving patient access to the clinics. Every attendee had the opportunity to offer feedback regarding existing qualities that must be preserved in clinics, the top areas for and barriers to improvement, and the drivers of patient access (including Medical Center employees) to our clinics.\textsuperscript{9}

II. Scope

As part of this initiative to focus on growth opportunities and to improve Ambulatory Care services, the administrative and medical leadership of the Pediatric Clinics are committed to improving the workflow in their current facilities located on the 4th floor of the current Primary Care Center in preparation for the move to new facilities in the 2012 timeframe. The idea is to identify bottlenecks in information flows and patient flow and to examine current roles and responsibilities to determine how best to allocate tasks and manage information so that patients receive the best care possible with the most appropriate and efficient use of available resources, including facilities", equipment, and personnel. The desired outcome is to improve the efficiency of the Pediatric Clinic so that it can continue to increase throughput and, therefore, grow the volume and related revenue streams while delivering exceptional patient care.

III. Project Objective

The objective of this project is to assist the administrative and medical leadership of the UVa Health System Pediatric Clinics to identify feasible alternatives for increasing throughput and growing volume with the available resources while continuing to provide exceptional patient care and related services.

While the specific study activities may evolve over the course of the study, this objective will likely be achieve through the following tasks and these tasks will be performed in an iterative manner, with successive refinement as needed to support decision making:

1. Develop a clear understanding of the challenges and opportunities associated with Pediatric Clinic operations by reviewing annual reports, analyzing historical data, observing clinic operations, and interviewing Clinic personnel.
2. In concert with Pediatric Clinic leadership, develop measurable objectives and related performance measures to be used in assessing Clinic performance and alternatives for

\textsuperscript{7} Ibid.
\textsuperscript{8} Ibid.
\textsuperscript{9} Ibid.
improving performance with respect to both patient services and overall Clinic throughput and growth.

3. Document current “as is” patient flows, information flows and methods, and personnel roles and responsibilities using widely accepted methods for documenting and communicating such information.

4. Identify possible deficiencies and/or improvement opportunities in current information and related workflows where resources are used inefficiently or inappropriately.

5. Investigate current “best practices” in primary care centers through literature review and other sources available to the project team.

6. Develop models (static or dynamic) that can be used illustrate alternatives and the potential improvements in throughput and volume that can be achieved.

7. Identify feasible alternatives for improving Clinic performance and characterize these alternatives in terms of their potential contribution to achieving Clinic objectives.

8. Evaluate alternatives including their sensitivity to changes in priorities or accuracy of data or predictions about the alternatives; include potential “bundles” of alternatives that, together, provide a cohesive set of improvements which, taken together, result in benefits that might not be realized without the set of improvements (e.g., some improvements may depend on implementing other improvements).

9. Prepare a draft and final report and presentation including recommendations and an executive summary for Pediatric Clinic leadership to use in determining next steps to take with respect to improvements in the Pediatric Clinics.

IV. Other Considerations

Because of the desire by Pediatric Clinic leadership to identify and implement workflow improvements as quickly as possible, the study team will provide frequent updates and interim progress reports to Clinic leadership including provisional analysis and recommendations that are likely to emerge over the course of the study.
2010-18 -- US-Brazil Exchange

Faculty Advisor: Stephanie Guerlain

Sponsor: University of Virginia and Universidade Federal do Rio de Janeiro
Type of Sponsor: US Brazil/Education
Expected Frequency of Direct External Client Interaction: Once per month

Is this project a continuation of a prior capstone project? Yes

Do team members need to be U.S. citizens (e.g., Due to ITAR)? No

Intellectual Property:
• Will students be expected to sign a non-disclosure agreement with the sponsor? No
• Will students on this project be expected to transfer their IP generated on this project to the sponsor (or otherwise not own it themselves)? No

Project Description:
This project is no longer taking additional students. You CANNOT vote for this project.
The UVa SIE US-Brazil Exchange program has been going on for 7 years (www.sys.virginia.edu/brazil). Students spend the first semester of their senior year as students at the Universidade Federal do Rio de Janeiro and join Brazilian students on a capstone team that is started in Brazil and then finished in the spring semester back at UVa. Because of the special nature of the program, students apply in their 3rd year. Thus, this capstone is already started and closed to new students.