Track Descriptions

Decision Analysis. This track deals with evaluating complex non-repetitive decision opportunities by examining values, uncertain variables, preferences, and alternatives.

Project and Engineering Management. This track features applications of engineering principles to operations, project management and business practice. Presentations include engineering surrounding product development, manufacturing, construction design engineering, industrial engineering, technology, production, or any other field that employs personnel who perform an engineering function.

Modeling and Simulation. This track deals with modeling methods and applications for representing static or dynamic characteristics of systems in order to support effective systems design or improvement.

Modeling and Simulation for Defense Applications. This track deals with modeling methods and applications for representing static or dynamic characteristics of systems in order to support effective systems design or improvement, specifically for military applications.

Problem Solving. This track features projects that apply systems engineering principles and processes to solving problems. Emphasis is on correctly defining the problem, generating possible solutions, then choosing and implementing the best one.

Process Modeling and Analysis. This track deals with methods and applications addressing the modeling of partially ordered activities to achieve a goal for systems existing in the real-world (process analysis) or not (processing engineering), to support effective design or systems improvement.

Systems Design. This track showcases projects from engineering and problem solving that feature significant levels of systems design. This includes notable examples of requirements specification, functional analysis, systems architecture, model-based systems engineering, or the use of modeling and simulation in the design process.

Systems Design for Defense Applications. This track showcases projects from defense-related projects that feature significant levels of systems design. This includes notable examples of requirements specification, functional analysis, systems architecture, model-based systems engineering, or the use of modeling and simulation in the design process.

Honors Track. This track features research performed in the pursuit of an honors degree from the Department of Systems Engineering at the United States Military Academy. This includes a presentation by a single cadet as well as the review of an honors thesis.

Hollis Award. The Walter W. Hollis Award's annual competition is co-sponsored by the Department of Systems Engineering and the Department of Mathematical Sciences. It recognizes excellence in military operations research and systems analysis.

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TRACK 1 – SYSTEMS DESIGN

Track Chair: Mr. Gene Lesinski
Jefferson Hall, Room 401

CAA Capstone: The ADAPT Project

United States Military Academy
Track: Systems Design
Students: Cadets Joseph Tustin, Theodore Glesener, Dillon Schaaf & Ethan Cook
Advisor: Dr. Roger Burk

The Application for Data Analysis, Processing, and Transformation (ADAPT) process is a program used by the Center for Army Analysis (CAA). The CAA primarily uses this program to transfer files from the Joint Country Force Assessment (JCOFA) output to the Joint Integrated Contingency Model (JICM) format. The ADAPT process creates an input file for the JICM to use in campaign level war games and simulations. The ADAPT process is currently written in LISP, an uncommonly used programming language, and has extremely large computation times. The CAA has tasked this capstone group with developing a new way to complete the ADAPT process in a more common and versatile programming language.

UHS ED Redesign

Binghamton University
Track: Systems Design
Students: Carlos Arciniegas, Joseph Burns, Reginald Carrion, Xiaoman Guo, Lauren Kelemen & Gregory Schilling

The UHS Wilson Emergency Department has low patient satisfaction due to lack of privacy and long waiting times. The goal of the team is to develop a layout that will include more efficient processes and communication between staff members, private rooms, modern technology, and equipment that will fit the needs of the geriatric population in Binghamton. To accomplish this, the team utilized lean tools such as QFD and 5s. The team also used benchmarking to see what features are working in the nation's top emergency departments, as well as simulation to acquire validated results on designs. The final design resulted in much more efficient processes from admission to discharge for each patient, as well as more accommodating material and equipment and increased privacy. This new emergency department will efficiently service and accommodate the aging Binghamton population for years to come.

The Science of Soldiering

United States Military Academy
Track: Systems Design
Students: Cadets Aaron Gilliam, Matthew Park, Peter Jaros & Timothy Young
Advisor: LTC Paul Evangelista

Today's American Soldier carries too much weight. Soldier load is a classic tradeoff problem, and the present research seeks to build a framework to measure and understand this tradeoff. Through the development of constructed scales and newly developed direct measures, it is possible to gain improved understanding of the effect of load on Soldier performance. When considering the effect of Soldier's load, it is critical to consider the Soldier as a system, with critical functions and requirements. The measurement of these functions, and the impact of Soldier load on the efficacy of these functions, is not well understood. A methodology to understand Soldier functions, and several techniques to measure these functions is proposed. Results include the presentation of novel constructed scales of an existing obstacle course, insights from a weapon employment experiment that explored Soldier load impact, and an alternative measurement technique for load effects during movement. The application of this work extends into a variety of human performance domains.

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NetSciDraw

SUNY Binghamton
Track: Systems Design
Students: Matthew Dabrowski, Bradley Dreher, Chukwudi Kanu, Jake Lewis & Eli Shirk
Advisor: Dr. Hiroki Sayama

Abstract: The NetSciDraw application is a part of the NetSciApps project that focuses on students learning through systems thinking. The problem facing many young academic communities is that children are not learning how to think in terms of networks. Therefore, the goal of this project is to build an application that helps students think in more creative ways rather than in linear paths. The primary grades of focus are ranged from K-12 so that the children can begin to think about solving problems with networks early on in their academic careers. At the current state of the application, the users are able to draw nodes (of varying sizes) and edges to connect the nodes. The users can also put their thoughts and ideas into these nodes while additionally being allowed to change the color of each node. The application has received some feedback from users, which include suggestions on how features can be either added or improved. The team will continue to ask for feedback from users and truly thinks that the NetSciDraw application can be a revolutionary learning tool that can change the way students approach the world today and in the future.

Redesigning the PharmAssist RDSx

SUNY Binghamton
Track: Systems Design
Students: Ralph Diaz, Sean Finnegan, Sean Kiernan, Kevin Paredes & Jarrod Parower

Our team has been tasked with redesigning the PharmASSIST RDSx pharmaceutics dispensing and filling device for Innovation Associates. Our objective is to increase the throughput of the device. Currently, the central FANUC robotic arm is the bottleneck of the system. The team's redesign will focus on the removal or modification of the arm. In order to choose between multiple proposed designs, comparison tests like analytical hierarchy processes were performed. The team is looking into creating a mixed conveyor belt system that will introduce multiple vials into the system. The team is working hard to ensure that the throughput increases as well as staying within health regulations. The team is using simulation and CAD software to model and draw the new design. Upon delivering the proposed design to Innovation Associates, the team will work to continue to optimize the process.

Testing and Evaluation Phase for the CH-47F Block II

United States Military Academy
Track: Systems Design
Students: Cadets Marcus Bernardino, Tyler Davis, Shawn Quillen & Scott Washle
Advisor: LTC Hise Gibson

The Chinook (CH-47) helicopter has been the primary heavy lift helicopter for the United States (US) Army since the Vietnam War. The current model is the CH-47F Block II. Boeing and PM Cargo are responsible for ensuring that this aircraft reaches it next critical milestone by fiscal year 2021. Through further analysis, PM Cargo has identified a need for a detailed understanding of how weather conditions during the test and evaluation phase impacts the overall program lifecycle. At West Point, we have been put through an extensive curriculum centered on Systems Engineering. We have spent time looking at supply chain management, systems simulation, engineering economics, and many other fields. This paper presents analysis to the development of a model that can provide insights on how weather impacts the program life cycle. This model can analyze weather parameters, allowing us to consider the feasibility of accomplishing different tests on a day to day basis. Due to the time constraints during the testing and evaluation phase of the program, being able to analyze the most volatile aspect, weather, allows us to offer a reliable mitigation technique when minimizing inefficiencies.

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TRACK 2 – SYSTEMS DESIGN FOR DEFENSE APPLICATIONS

Track Chair: LTC Hise Gibson
Jefferson Hall, Room 414

Application of the Systems Decision Process to Swarm Drone Nuclear Detection

United States Military Academy
Track: Systems Design for Defense Applications
Cadets William Ratliff, Alfred Girardot & Michael Volpe
Advisor: COL Ricardo Morales

The purpose of this study is to serve as a practical application of the Systems Decision Process to the application of Unmanned Aerial Systems (UAS) Swarm Drone technology to solving the problem of post-blast nuclear forensic analysis. This study analyzes how the Systems Decision Process (SDP) was utilized in identifying problems and providing solutions to this complex, real-world problem. Additionally, this study applies many Systems Engineering tools like functional and requirement analysis to our given problem. The interdisciplinary nature of our capstone project (12 members across 5 different academic disciplines) aided the focus of this paper to be on general application of Systems thinking and problem solving rather than a focused look into one technical aspect of our problem. This project serves as an example of the interdisciplinary nature of Systems Engineering.

Determining Uncertainty Within Life Cycle Cost of Engineered Resilient Systems

United States Military Academy
Track: Systems Design for Defense Applications
Students: Cadets Ikenna Ejekam, Andrew McLean, Andrew Mendel & Blake Newton
Advisor: LTC John Richards

This article discusses how the Life Cycle Costing (LCC) component of Engineered Resilient Systems (ERS) can be utilized in order to create a more accurate and reliable process for predicting the costs of Department of Defense projects. While researching this project the Capstone team looked at multiple ways of predicting ERS project costs such as Bayes Theorem and Regression Analysis. Jupyter notebooks provides the capability of a Python script that isolates cost element structures and their respective cost estimating relationships in order to understand the propagation of uncertainty. In the end the team found that when given the mean and standard deviation of constants in cost estimating relationships that have been completed, there are commonalities between them that can be extracted and used to identify uncertainty. This will help predict future costs for similar systems.

Maintaining an Inland Petroleum Distribution System

United States Military Academy
Track: Systems Design for Defense Applications
Students: Cadets Steven Bushold, Matthew McCarthy, Lauren Muckey & Egbezien Obiomon
Advisor: LTC David Hughes

The Inland Petroleum Distribution System (IPDS) is a dynamic metasystem whose purpose is to transport bulk fuel to the front lines through pipelines fed from an offshore petroleum distribution system (OPDS). The IPDS is broken into three key components: the pipeline, pump station, and special assemblies. Each hose in the system is broken into five-mile sets with pump stations every fifteen miles depending on terrain. Currently, the United States Army lacks a viable solution for maintaining the IPDS. The purpose of the research is to conduct an analysis of alternatives to recommend methods for maintaining an IPDS in support of various operations. The solution recommended varies dependent on the environment in which the IPDS is operating. Maintaining the IPDS is critical; the disruptive shockwave of not having the

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system reduces the United States forces' capability to rapidly deploy, operate, and win conflicts around the world.

Army Mission Planning Using Drone Imagery and Virtual Reality

United States Military Academy
Track: Systems Design for Defense Analysis
Students: Cadets Alec Riggins, Exter Gilmore, Dexter Penick & Tyler Pham
Advisor: LTC Brent Morrow

In order to improve the efficiency of mission planning for US Army, we developed a method using virtual reality that will better prepare soldiers before entering their mission. This method is being referred to as Leader's Enhanced Mission Planning (LEMP). The intended audience for LEMP is primarily soldiers in leadership positions, as they will be the ones to pass down any necessary information to their subordinates. Introducing virtual reality will help prepare soldiers by putting them into a virtual replication of the world that they will encounter once out on their respective mission. While this technology has endless possibilities, this project focuses on an enhanced planning checklist a leader can use to appropriately plan an operation while getting the most out of technology currently available today, as well as in the future.

A New Cyber Enemy and How to Beat It

United States Military Academy
Track: Systems Design for Defense Applications
Students: Cadets Robert Fenton, Richard Hernandez, Jordan Nettles & Chris Wagner
Advisor: COL Robert Kewley

A growing problem that the United States Army faces is with the use of Unmanned Aerial Systems (UAS) flown by enemy units. These UAS's can tactically hover and drop airborne improvised explosive devices over a standard infantry platoon conducting a mission as well as having the potential to be used to call for indirect fire. In an effort to combat this new problem the United States Army needs to adopt a counter UAS jamming system will allow a standard infantry platoon to continue on mission even if spotted. The capstone team was then told to transition from creating potential counter UAS solutions to creating a baseline experiment that could better assist companies in creating an optimal counter UAS system. This paper outlines the research and experiment conducted by the capstone team in an effort to create a series of requirements and testing capabilities for the United States Army to better inform their decision on purchasing a dismounted counter-UAS system.

Social Media Image Labeling and Extraction:
Using Convolutional Neural Networks to Identify Threats to National Security

United States Air Force Academy
Track: Systems Design for Defense Applications
Students: Cadets Sheamus Larkin, Nick Forrest, Andrew Tien & Josh Radjenovich

Modern advancements in technology and connectivity have caused reconnaissance and intelligence gathering capabilities to evolve from traditional means, such as aerial and satellite photography, to cyber-based gathering. As social media becomes more prevalent in society, it creates a new platform to gather data and information, providing aid in intelligence acquisition. This project aims to answer the question, "How can convolutional neural networks and image recognition be used to further identify national security threats revealed through social media?" The main approach used in this project uses Naïve Bayesian statistics to predict whether an image pertains to national security based on the objects detected from a convolutional neural network. The final model is able to scan through a set of images, identify key features within those images, and label images that pose potential threats to national security. The model currently performs at 85.5% test accuracy with a 1.5% false positive rate correctly identifying

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the threat classification of 170 out of 200 images. These results prove that conditioning the probability of an image being a threat on the objects detected in the convolutional neural networks improves overall model accuracy when searching for images of national security interest. Once applied to social media platforms, this model will be able to classify images of national security interest and further label social media data to simplify the amount of information that warfighters, first responders and policy makers need to sort through.

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TRACK 3 – PROCESS MODELING AND ANALYSIS

Track Chair: LTC Matt Dabkowski
Jefferson Hall, Room 423

DoD Aircraft Maintenance Rating Analysis

United States Military Academy
Track: Process Modeling and Analysis
Students: Cadets Daniel Voecks, David Jeong, Jonathan Grinsell & Aliyah Murray
Advisor: MAJ Matthew Beigh

The Department of Defense recognizes the importance of corrosion prevention in the military and its impact on the military equipment, infrastructure, and the associated high annual cost. The Corrosion Policy and Oversight office seeks to determine whether corrosion related maintenance is addressed effectively frugally on DoD assets in order to meet the availability targets. West Point administration provided a capstone group the opportunity to analyze “big data” with the final goal of establishing a method of scoring the relationship between CPO's two superordinate goals: achieved availability compared to target and cost per day of availability. The group created a model that provided a score of how well certain units and locations controlled maintenance. The group then used this information to identify parts that play significant roles in cost and maintenance performance.

USTRANSCOM Closewatch Process Improvements: Identification of Closewatch Population and Improvement of Shipment Delivery Date Prediction

United States Military Academy
Track: Process Modeling and Analysis
Students: Cadets Jermaine Adams, Michael Gabrielsen, Clare Shea & Adam Stepan
Advisor: LTC John Hiltz

For the past several years United States Transportation Command Logistics Sustainment Division (USTRANSCOM TCJ4-L) has struggled with identifying and predicting high priority containers that will be late to their final destination. USTRANSCOM needs to develop a solution to this problem in order to alert clients when their shipments are going to be late. In addition, USTRANSCOM needs a method of identifying and categorizing a container that has been labeled as “crucially important” from its customer. These crucially important items are added to what is known as a Close Watch list. Any container or Port Call File Number (PCFN) that is added to this list is monitored throughout its shipment process to determine its estimated delivery relative to the initial contractual delivery date, known as the Required Delivery Date (RDD). Currently, a Close Watch dashboard has been created at USTRANSCOM for clients to access and view the status of their shipments. However, the algorithm behind this predictive model can be improved. This report examines the current TRANSCOM predictive process and evaluates its success. An enhanced predictive algorithm will be created to forecast when containers are going to be late with greater accuracy. This report will examine the different methods that can be used to improve the USTRANSCOM processes in predicting and improving the shipping methods of containers. The methods that will be explored include prediction techniques in the shipping industry, Electronic Data Interchange (EDI) events, and supply-chain reactions so we are able to establish a better understanding of what performance measures are necessary to improve the Close Watch process at USTRANSCOM.

Remediating Nuclear Contamination through Phytoremediation

United States Military Academy
Track: Process Modeling and Analysis
Students: Cadets Sean Badua, Eli Eichenberger, Rhyan England & Kai Kizzie,
Advisor: Dr. Timothy Elkins

With the increasing threat of nuclear weapons and use of nuclear energy, the need for effective means

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of decontaminating any nuclear disaster is also increasing. More specifically, an efficient means of decontaminating farmland is needed because this could negatively affect food supply if the soil is not decontaminated in a timely manner. Phytoremediation, the process of using plants to absorb contaminates from soil, has been experimented with in different nuclear scenarios, namely Fukushima, but there is no verified way of modeling this process to know how well it can work given different parameters. Our research looks into modeling this process using systems dynamics modeling. In system dynamics modeling, all factors that can affect phytoremediation are accounted for, which can help responders to nuclear events make informed decisions on decontamination without wasting precious time.

Developing Accuracy Measurement and Anomaly Detection Processes for Categorical Data in Defense Maintenance Records

United States Military Academy
Track: Process Modeling and Analysis
Students: Cadets Kameron Grubaugh, Nicholas McAfee, Emily McGowan & Zachary Zimmerman,
Advisor: LTC Paul Evangelista

The Department of Defense (DoD) recently initiated an effort to compile all inter-service maintenance data for equipment and infrastructure, requiring the consolidation of maintenance records from over 40 different data sources. This research evaluates and improves the accuracy of this maintenance data warehouse by means of value modeling and statistical methods for anomaly detection. The first step in this work included the categorization of error-identifying metadata, which was then consolidated into a weighted scoring model. The most novel aspect of the work involved error identification processes using conditional probability combinations and likelihood measures. This analysis showed promising results, successfully identifying numerous invalid maintenance description labels through the use of conditional probability tests. This process holds potential to reduce the amount of manual labor currently necessary to search and clean the DoD maintenance data records and provide better fidelity on DoD maintenance activities.

Towards the Development of an Early Lifecycle Cost Estimation Model

United States Military Academy
Track: Process Modeling and Analysis
Students: Cadets Kyle Werner, Christopher Raymond, Sai Kumar & Alex Aukerman
Advisors: MAJ Thomas Ryan & Dr. Ricardo Valerdi

The Department of Defense's (DoD) Engineered Resilient Systems (ERS) is developing a suite of tools that could radically change how engineers conduct analysis of alternatives, impacting all major DoD acquisitions. To expand upon this ability, the Early Lifecycle Cost Estimation (ELCE) Parametric Model was created as a potential costing complement to ERS' TradeBuilder suite of high-powered computing tools. The model leverages Pre Milestone-A Engineering products that are readily available at the early stages of a system's development. Currently ELCE is conceptual with only two proofs of concept applied; however, the necessity of process mapping for use and coding of the ELCE tool into TradeBuilder inspired this research. This paper discusses the development of a use case for each cost parameter of the ELCE tool, a systematic approach for the prospective ERS user to create a cost estimate for a system, and the potential impacts of a coded ELCE model.

Scheduling Tissue Bank Technicians To Clean Rooms While Considering Dynamic Demand

United States Air Force Academy
Track: Process Modeling and Analysis
Students: Cadets Thomas Riganti, Christopher Graham & Hunter Morrow
Advisors: Lt Col Gregory Steeger, Capt Paul Weisgarber & Maj Kenneth Horton

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Tissue banks' innovative products change the lives of people; burn victims or even professional athletes benefit from this live-saving work. We study one such tissue bank that produces over 200 different products for hospitals that in turn use the products with their patients. We study the scheduling process of assigning clean rooms and processes to technicians and posed the question: What is the optimal way to both schedule technicians and map them to clean rooms while considering the dynamic demand of tissue products? We use two integer programming models: one which assigns technicians to a weekly shift and the other assigns technicians to both a room and specific processes, daily. We find that by changing variables we have control over, we could improve the daily output by as much as 11.8%. These results show that AlloSource has an excess of employees and should focus on increasing their technician qualifications in order to increase utilization further.

Binghamton Hyperloop

SUNY Binghamton
Track: Process Modeling and Analysis
Students: Kasey Hill, Darren Silvanic, Anthony Dorsa, Boxu Zhu & Connor Wickham

The future of civilization is the future of transportation. In 2013, Elon Musk released a white paper on Hyperloop, a high- speed bullet train inspired by vacuum tube technology. The past few years, SpaceX has challenged universities from across the globe to build a small scale Hyperloop Pod. This year, Binghamton Hyperloop is designing a pod that optimizes efficiency and maximizes speed. In accordance with competition requirements, the pod is self-propelled with successful means of deceleration. A unique feature of the design includes the actuation of magnetic levitation skis after reaching a target velocity of 200mph, which decreases magnetic drag. An Emrax 228 motor is powered by two packs of 220 lithium-ion cells wired in series and neodymium magnets (arranged in halbach arrays) are used to deploy the levitation skis. Our design reduces mechanical complexity and prioritizes safety with a hard-kill switch for emergency use. The Binghamton Hyperloop team is comprised of 17 students from various engineering backgrounds and has qualified as a top 50 semifinalist in the 2018 SpaceX Competition. Together, we are looking to creating the future of transportation.

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TRACK 4 – MODELING AND SIMULATION FOR DEFENSE APPLICATIONS

Track Chair: Dr. Pat Driscoll
Jefferson Hall, Room 501

Discrete Event Simulation and Analysis of the Plating Facility at the Corpus Christi Army Depot

United States Military Academy
Track: Modeling and Simulation for Defense Applications
Students: Cadets Paulo Almeida, Andre Bergstein, Billingsley Pogue IV & Marisa Reyes
Advisor: Mr. Gene Lesinski

The Corpus Christi Army Depot (CCAD) is one of the largest rotary wing repair facilities worldwide, performing essential maintenance for the U.S. military. The objective of our project is to model the capacity of the Plating Shop at CCAD to maximize productivity and efficiency. The Plating Shop is a vital entity in CCAD's repair process, with multiple implications for successful aircraft maintenance. We developed a discrete event simulation in ProModel™ that allows a user unfamiliar with the software to generate and analyze production scenarios that measure throughput and utilization rates of the Plating Shop. These scenarios and their metrics allow CCAD to understand the capacity of the Plating Shop, identify bottlenecks, and make informed decisions to increase quality and decrease cost. The model enables a crucial component in the U.S. defense industry to increase speed and efficiency in its continuing efforts to support the American military.

Modeling Insults to Food Security: A System Dynamics Approach

United States Military Academy
Track: Modeling and Simulation for Defense Analysis
Students: Cadets Clara Pitts, Nicholas Santorelli & Trevor Woods
Advisor: Dr. Kenneth McDonald

Food security is a complex issue which impacts all populations in all regions of the world. Without food security, a nation will collapse. The Food Security System Dynamics Model (FSSDM) is a quantitative representation which provides insight on the relationships between the many factors which affect food security and the total food insecure population fraction within a region. However, this model does not include the impacts following major disturbances, or “insults,” such as natural disasters or nuclear attacks. This research analyzes threats to food security and evaluates their impacts on a country. The research conducted utilized the Systems Decision Process (SDP) to create a value hierarchy and redefined problem statement that provide a framework for the design of a system dynamics model which captures the impact of insults on food security. Additionally, refinement of the model will provide a thorough assessment of impacts to aid decision makers in developing policies to respond to and potentially prevent insults. Limitations to the FSSDM include inflexibility which restricts the number of insults possible to model at one time, discrete coding which oversimplifies the system’s processes, and finally the model only illustrates the food security system in Afghanistan. Despite these limitations, the research determined that immediately following an insult, the food insecure population fraction sharply increases but over time with the increase of mitigating factors such as non-governmental organization (NGO) aid, the fraction gradually decreases and stabilizes. However, if the insult impact is extremely severe, the system may not completely recover to the status quo level. The FSSDM now includes the insults of hurricanes, earthquakes, CBRNE events, and civil unrest. The model’s output illustrates the maximum food insecure population fraction, the total recovery time, and the final state of the system following these insults. Future work should improve the flexibility of the model to extend to countries beyond Afghanistan.

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Developing a Solution to the TRADOC Analysis Center's Big Data Problem: A Big Data Opportunity

United States Military Academy
Track: Modeling and Simulation for Defense Applications
Students: Cadets Kenneth Rau, Lee Bares, Daniel Min & Daniel Davis
Advisor: LTC Matthew Dabkowski

As data production, collection, and analytic techniques grow, emerging issues surrounding data management and storage challenge businesses and organizations around the globe. The U.S. Army Training and Doctrine Command's Analysis Center (TRAC) is no exception. For example, among TRAC's many tasks is the evaluation of new materiel solutions for the Army, which typically necessitates the use of computer simulation models such as COMBAT XXI. These models are computationally expensive, and they generate copious amounts of data, straining TRAC's current resources and forcing difficult, suboptimal decisions regarding data retention and analysis. In this paper, we address this issue directly by developing "big data" solutions for TRAC, and we evaluate them using its organizational values. Framed in the context of a use case that prescribes system requirements, we leverage Monte Carlo simulation to account for inherent uncertainty and, ultimately, focus TRAC on several high potential alternatives.

Autonomy in Counter-IED UGVs

United States Military Academy
Track: Modeling and Simulation for Defense Analysis
Students: Cadets John O'Brien, CDT Galen Robison, CDT Nicholas Chatel & Carrie Wasdyke,
Advisor: Dr. Carlee Bishop

This project analyzes the use of C-IED UGVs in urban EOD operations and recommends technological solutions to certain inefficiencies. The two areas of focus for the project are in extending communication with a UGV beyond line of sight (LoS) and increasing autonomy/automated functions of the UGV. With regards to extending LoS, the team has identified and compared two potential solutions: Wi-Fi puck repeaters and Cellular LTE/4G. This project compares these alternatives using a variety of performance metrics including bandwidth, cost, vendor availability, and redundancy. The team is using IMPRINT software developed by ARL to assess the workload of UGV operators during an EOD mission in order to identify potential areas best suited for autonomy integration. The IMPRINT model revealed that navigation to the IED and interrogation of the IED are areas where autonomy/automated functions could improve mission efficiency. The team has identified specific autonomous technologies for integration into these mission areas.

Simulating Army Rail Yard Operations at the Port of Bremerhaven

United States Military Academy
Track: Modeling and Simulation for Defense Applications
Students: Cadets Joshua Bieger, Jadalaine Ferrer, Dillon Riedlinger & William Xu
Advisor: Mr. Jeffrey Demarest

To maintain the United States military's capability to deploy rapidly across the globe, logistical planning tools, simulations, and models enhance leaders' decision making abilities. This research develops a discrete event model designed to simulate military operations within a railyard in order to support the Engineer Research and Development Center's (ERDC) Planning Logistics Analysis Network System (PLANS). The research team chose the Port of Bremerhaven, Germany as a case study due to its relevance to current military operations, granting us access to timely data and stakeholders with recent operational experience. The discrete event simulation (DES) utilizes stochastic processes and multiple layouts in order to analyze the amount of time it takes to move varying amounts of cargo and vehicles and identify potential bottlenecks in the operation.

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A System Dynamics Model Approach to Scalable Shared Vision Planning: The Tigris-Euphrates Watershed

United States Military Academy
Track: Modeling and Simulation for Defense Applications
Students: Cadets Andrew Adams, Michael Houghton, Courtney Smith & James TenBrink
Advisor: LTC Jim Schreiner

Improving the quality of watershed resource management decisions by regional stakeholders, the U.S. Government (USG) interagency, and international investors represents an important capability in addressing increasingly complex global water security challenges. This research presents a scalable 'Shared Vision Planning' (SVP) framework which integrates methods from the fields of System Dynamics with Decision Analysis through visual aids to enhance evaluation of watershed solutions while reducing cognitive load on decision makers. The framework is meant to elevate insights about dynamic attribute tradeoffs and sensitivities such as hydro-power yield, water storage, agricultural yield, and flood risk mitigation. Findings of this research were presented to USACE IWR senior leadership thus confirming initial research aims of framework and interface designs; follow-on beta testing to examine cognitive loads represents follow on research to be performed with USG interagency practitioners and leadership. The Tigris-Euphrates watershed served as the initial proxy for examining efficacy of the SVP framework.

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TRACK 5 – PROBLEM SOLVING

Track Chair: Dr. Tim Elkins
Jefferson Hall, Room 514

Optimizing UAS Mission Training Resource Allocation through Modeling and Cost Analysis

United States Military Academy
Track: Problem Solving
Students: Cadets James Kubisch, Christian Hess, Said Ruelas-Outlaw & Anthony Williams,
Advisor: MAJ Jasmine Motupalli

A 2017 study of the Gray Eagle Unmanned Aircraft System (UAS), conducted by Bearden et al., found that there are inefficiencies concerning the use of operational UAS within the maintenance training program (2017). The current program uses operational aircraft to certify Soldiers in maintenance tasks, while the operational Army suffers from a shortage of Gray Eagle platforms. This research built upon the findings of a previous study to assess the feasibility of entirely replacing aircraft with partial-task trainers (PTTs) for maintenance task certification. Further, this study conducted a comprehensive assessment using discrete-event simulation and cost estimation, which resulted in a decision support tool for the UAS Project Management Office (PM UAS). This project will enable stakeholders to reduce current training program costs, increase the number of Gray Eagles in the operational Army while maintaining an adequate training throughput, and predict the optimal resource allocation given mission training needs.

Wheelchair Interface For Eye-Tracking (WIFE)

SUNY Binghamton
Track: Problem Solving
Students: Ms. Jane Towery, Mr. Zachary Keuerleber, Mr. Owen Santangelo, Mr. Aleksey Kats &
Mr. Casey Stengel
Advisors: Mr. William Howe, Mr. Brendan Barnes & Mr. Steven Popovich

The purpose of this project is to improve upon a wheelchair prototype with speed and direction controlled using eye movements of the user. The prototype was unable to function in poor lighting conditions or without a large barrier to block out background motion. There were few zones for eye-tracking, which affects the smoothness when transitioning between different speeds and directions. A new camera and updated software with infinite eye-tracking zone capability has been integrated which allows for more precise speed control, background noise reduction, and infrared capabilities for use in low light conditions. The bulkiness of the design made it difficult to fit through doorways and elevators. Ergonomic functionality has been improved by redesigning the previous bulky camera mount, control box, and changing the layout of hardware components. These improvements have expanded the functionality of the wheelchair in different conditions and provide more safety for the user.

Origins of Intelligence: Discerning Corroboration vs. Replication in Open Source Intelligence Production

United States Military Academy
Track: Problem Solving
Students: Cadets Daniel Provaznik, Conor Glancy, Justin McDaniels & Joseph Bosse
Advisor: MAJ Jillian Wisniewski

A well-documented fallacy across the intelligence community (IC) is the evaluation and processing of information through existing analytic products, which too often replicates previous findings instead of contributing an original assessment. The fallacy, which stems from myriad combinations of errors and biases in reporting, allows information to gain unwarranted legitimacy as it proliferates: its replication is often misconstrued as corroboration. Open Source Intelligence (OSINT) is especially vulnerable to such misinterpretation because it is produced from publicly available information (PAI), which, under its

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massive volume, buries source origins. This study computes a bipartite network of citations and derives an interdependence measure of its sources, where high or low measures indicate replication or corroboration, respectively. The application of bibliographic coupling, distance measures, and network centrality to a set of 450 scholarly sources, with over 9,100 citations, provides a foundation on which to build an objective measure of originality for a source document.

Low Cost Electronic Measurement Device

SUNY Binghamton
Track: Problem Solving
Students: Gregg Martin, Eric Rice, Mandell Ross & Evan Spector

Many high school students don't have access to tools that can help enhance their learning. Tools used to analyze signals such as oscilloscopes and spectrum analyzers are included as they aren't very practical and many schools can't afford them. Working with students from the University of West Indies, we have developed a device that is able to process signals and display the functions of the devices on an Android device. The device is able to convert audio signals to be processed and transmitted over Bluetooth to display the functions of the oscilloscope and spectrum analyzer on the Android device. Two sets of code are used with the Raspberry Pi and the Android device for the design to meet all of the listed requirements. With the device, teachers and students will be able to access an oscilloscope and spectrum analyzer with the measurement device and an Android product.

Roll to Roll Inspection Platform: Development of Optical Inspection for Flexible Thin Films

SUNY Binghamton
Track: Problem Solving
Students: Mr. Justin Bové, Mr. Alexander Burzynski, Mr. Ryan Cadwell & Ms. Nora Croutier
Advisor: Dr. Gang Sun

Optical thin film measurement and inspection is a crucial step in Roll-to-Roll flexible microelectronics manufacturing, currently under development at the Center for Advanced Microelectronics Manufacturing of Binghamton University. A light scattering defect sensor and an inline spectroscopic reflectometer, both sensors of SunOptical Systems LLC, are integrated with an existing system of Energy Conversion Device. The defect sensor is mounted above the main roller, at a height determined by focal range characterization, and captures images which are analyzed for scratches or particles with a MATLAB program. The inline reflectometer is calibrated with SiO2 coated Si wafers of known SiO2 thickness. A Filmetrics spectroscopic reflectometer is used to determine the index of refraction for SiO2 and to act as baseline data. A MATLAB program is then developed for the SunOptical reflectometer to determine film thickness from spectrum data.

Optimizing White Sands Missile Range Test Operations

United States Military Academy
Track: Problem Solving
Students: Cadets Andrew Ortiz-Alcauter, John Voit, Jon Paul & Daizjah Morris,
Advisor: Dr. Phillip Bond

White Sands Missile Range (WSMR) seeks to improve the throughput for conducting open air testing on the nation's largest testing range. Concurrently, WSMR seeks to reduce the cost of conducting developmental testing by reducing the cost impact of roadblocks on test customers. WSMR cannot achieve these objectives (increase throughput and reduce costs) and sacrifice safety. Research conducted in support of this project demonstrated that the concern has a large number of potential causes, each of which could require a separate solution. This project utilized a Joint Capabilities Integration Development System (J-CIDS) concept, called DOTmLPF-P (doctrine, organization, material, leadership, personnel, facilities, and policy) to generate a variety of approaches to address some of the causes.

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TRACK 6 – PROJECT AND ENGINEERING MANAGEMENT

Track Chair: Dr. Pat Dubois
Jefferson Hall, Room 121

Capability Traps: A Case Study of Pershing Barracks Reconstruction

United States Military Academy and Texas A&M University
Track: Project and Engineering Management
Students: Cadets Andre Hufnagel, Connor Mullen & Mr. Saksham Gupta
Advisors: Dr. Keith Bruce & Dr. David Ford

Unforeseen delays are common in construction projects and can relegate many projects towards missing the scheduled deadline and estimated project budget. This can create a situation of possible schedule pressure for the project manager and it often forces him or her to implement a policy to add labor hours to reduce the work hour deficit. The current work studies two different strategies in the form of "Working Harder" and "Working Smarter" that can be leveraged by the project manager to reduce the performance deficit. The on-going Pershing Barracks Renovation Project at the United States Military Academy, West Point, New York (USMA) has been considered as a case study project to showcase each of these scenarios and depict how the managerial decision of leveraging only "Work Harder" solution leads to a vicious ruin loop thereby engulfing the project into a capability trap while how incorporating the "Work Smarter" solution leads to a virtuous cycle of reinvestment and allows the system to bootstrap towards higher performance in the long-run.

Automated Logbook

United States Military Academy
Track: Project and Engineering Management
Students: Cadets Taylor Rodenhuis, John Trainor, Brandon Lee & Macauley Hoyt
Advisor: Dr. Roger Burk

The current Universal Ground Control Station (UGCS) for US Army Shadow and Gray Eagle drones require manual input of all flight records into the flight record system. The purpose of creating an IELB is to create a more efficient system to accurately record flight data for Unmanned Aerial Systems (UAS). In utilizing a combined systems approach, this capstone project develops a concept of operations (CONOPs) for PMUAS at Redstone Arsenal to guide the development of an IELB for the Shadow drone platform. The intent of this paper is to provide the background information necessary in generating a CONOPs for the IELB.

APE 1236 Hazardous Waste Incinerator Maintenance

United States Military Academy
Track: Project and Engineering Management
Students: Cadets Carissa Jenkins, Lindsay Kiernan & Tanner Andrews
Advisor: Dr. Kenny McDonald

In order to address the final life-cycle stage of ammunition stockpiles in the United States, munitions must go through the demilitarization process. Incineration provides demilitarization capabilities that are regulated by the federal government. The purpose of this report is to address the maintenance challenges facing the APE 1236, which is the Program Executive Office of Ammunition's (PEO Ammo) ideal method for demilitarization. The System's Decision Process serves as a methodological approach to the analysis and development of solutions for PEO Ammo. The SDP is an iterative and value based approach to decision making that involves four phases: Problem Definition, Idea Generation, Solution Design, and Decision Making. Research determined that the incinerators currently operate on an inconsistent response maintenance program that does not effectively utilize preventative maintenance procedures.

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The solution is an Excel based framework that allows PEO Ammo to record maintenance data and facilitate data analysis for future operations.

NOVA Solar Proposal

George Mason University
Track: Project and Engineering Management
Students: Michael Ham, Shakib Vafaei & William Mudd
Advisor: Mr. George Donohue

In Virginia the cost of electricity has increased by approximately 3.2% over the past ten years. The cost of photovoltaic solar systems has caused the amount of solar panel system users to rise. This leaves electricity distribution companies with the options of either (1) maintaining current business models or (2) adopting a business model that provides customers the option to generate energy through solar panels. Using Geographic Information System (GIS), a model representing the potential solar energy generation for rooftops was created. The output is then compared to total energy demanded by serviced residential homes to find the profitability of each alternative. The initial results lead to the conclusion that, due to Virginia's current regulations and overall state on solar energy, alternative (1) is the most viable. Sensitivity analysis combined with loss mitigation strategies show the environments in which alternative (2) becomes more viable.

Application of Lean Six Sigma to Reducing Repeated Handling of Material at the Tobyhanna Army Depot

United States Military Academy
Track: Project and Engineering Management
Students: Cadets Bradley Gibson, John-Mark MacFarlane, Cory Hazelbaker & Allan Bailey
Advisor: LTC John Richards

The Tobyhanna Army Depot (TYAD) located in Tobyhanna, Pennsylvania focuses on the maintenance and support of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems across the Department of Defense (DoD). Lean Six Sigma (LSS), a process improvement methodology focused on the Define-Measure-Analyze-Improve-Control (DMAIC) process, facilitates improvement in TYAD's manufacturing and fabrication of C4ISR components through the elimination of waste and streamlining of processes. The United States Military Academy's Lean Six Sigma capstone team partnered with the Depot to evaluate and improve the repeated handling of raw materials and end item pick-ups and turn-ins associated with the Machining Branch. The Machining Branch repeatedly handled the same types of materials and/or end items in high numbers over short periods of time, resulting in high transportation and storage costs. Additionally, repeatedly setting up for duplicated runs of fabricated end items was inefficient and increased the changeover time and ultimately the costs associated with these types of material requirements. Applying the DMAIC process, the USMA LSS capstone team reduced the number of repeated material runs for end items and raw materials by 50% in TYAD's Machining Shop, resulting in an estimated annual cost savings of $71,500.

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TRACK 7 – DECISION ANALYSIS

Track Chair: LTC Dave Hughes
Jefferson Hall, Room 002

Design of a Decision Support System for the Scheduling of Workflow Process for a Water Utility Company

George Mason University
Track: Decision Analysis
Students: Mr. Christopher Pertsch & Mr. Jose Soberanis

Water Utilities must maintain the functionality of water mains and their components even as the infrastructure ages. This must be accomplished without budget increases. For example, the water utility for the District of Columbia has experienced an increasing backlog of open work orders. An analysis of daily repair schedules identified two opportunities of improvement. First, the first-come/first-served assignment of repairs to crews did not consider the travel time between repair sites. Second, idle time occurs at the repair site when a crew wait for another function to complete their task (e.g. urban forestry). This paper describes a web-based tool that: (1) groups repair sites for a crew based on minimizing travel time, and (2) identifies nearby "quick" repairs that can be completed while the crew is waiting. A simulation analysis of these two features showed and 55% reduction in travel time, and a 6.2% reduction in backlogged work orders.

Model-Based Systems Engineering in Support of TALOS System Integration

United States Military Academy
Track: Decision Analysis
Students: Cadets Fred Kamuzinzi, Shemar McCuller, Brendan McGuire & Blake Warnock
Advisor: MAJ Stephen Gillespie

The Tactical Assault Light Operator Suit (TALOS) was a project initiated by Admiral McRaven after a Navy Seal lost his life passing through a doorway when clearing a room. United States Special Operations Command (USSOCOM) took charge of the project with the idea of an exoskeleton that protects the first person who enters a room during the team operation. USSOCOM is attempting to deliver an operational prototype of the suit in the summer of 2019. TALOS is in the integration phase of the process and attempting to implement a model-based systems engineering approach to this integration. Our project responsibility was to provide a visual representation of the TALOS operator's tasks and requirements that will make this suit a success. We used functional flow block diagrams (FFBDs), use cases, and a functional hierarchy to represent these tasks to allow both the military and civilian personnel to assess the suit's performance measures.

Future Vertical Lift: Engineering Tomorrow's Flight Today

United States Military Academy
Track: Decision Analysis
Students: Cadets Christian Nolasco, Scott Cullinan, Steven Fusco & Nathan Goff
Advisor: Dr. Tim Elkins

The purpose of this research is to use the Systems Decision Process (SDP) to help provide an analysis of different vertical lift alternatives in support of the Future Vertical Lift (FVL) Initiative. There are four phases in the SDP method, Problem Definition, Solution Design, Decision Making, and Solution Implementation. An initial functional hierarchy was built by conducting a thorough stakeholder analysis, and this functional hierarchy is the basis of the value model used to score the different alternatives generated. The value model is able to score each alternative based on client preference. Given the parameters set by the client, each alternative is scored. The score of each alternative and their associated cost are compared to one another and an optimal solution can be determined. This report provides an interactive tool clients can use in order to determine an optimal vertical lift solution.

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Total Value Model Tradeoff Analysis of Soldier Equipment

United States Military Academy
Track: Decision Analysis
Students: Cadets Brook Solheim, Seamus Hurley, Jeremy Mortensen & Shane Ko
Advisor: LTC David Hughes

The purpose of this capstone project is to build a total value model that helps a decision maker understand the effects/tradeoffs of Soldier load. Currently, Program Executive Office (PEO) Soldier, an organization responsible for the acquisition/integration of all individual Soldier equipment/weapons, does not have a way to quantify the value of soldiers based on their equipment configurations. To address this, we built a model which will quantify the values of each individual piece of equipment and provide a total value for the specified type of soldier (Squad Leader, Team Leader, Riflemen, Grenadier, Automatic Riflemen). In addition to the type of soldier, our research looks at five characteristics that determine the soldier's overall capability/value (Lethality, Survivability, Sustainability, Mobility, and Command and Control). Equipment specifications provided by PEO Soldier has allowed our team to develop a model to value the soldier from a holistic perspective. This data combined with feedback from Infantry Officers and Non-commissioned Officers has enabled us to better understand the importance of each characteristic based on the five types of soldier positions. The analysis shows that each characteristic for a given soldier type is weighted differently. For example, a squad leader needs to be able to have more command and control than an automatic riflemen. The intent behind this model is to provide PEO Soldier with a tool that enables them to value a soldier based on their equipment configuration and provide tradeoff analysis when purchasing new equipment.

Strategic Business Intelligence Framework: A Method of Analyzing Normative and Descriptive Data Signals

United States Military Academy
Track: Decision Analysis
Students: Cadets Jon Browning, Benjamin Coleman, Anders Freiberg & Daniel Roman
Advisor: LTC James Schreiner

The United States Army Corps of Engineers (USACE) is the nation's lead engineering agency in program, project, and construction management of strategic infrastructure programs. The uncertain and complex environment of legislative authorities and variable appropriations require forward-looking, anticipatory data interpretation of the strategic environment to facilitate quality decisions about organizational structure/policy, process improvement, human capital investment, knowledge management, and communication strategies. A systems thinking framework which enables balanced analysis of normative and descriptive data inputs is required to look across Scientific, Technology, Environmental, Economic, Political, and Social (STEEPS) domains. This paper will present a USACE Strategic Business Intelligence (SBI) Framework aimed at informing enterprise leadership about weak and strong indicators which might require further monitoring, research, or action through the application of normative Group Method of Data Handling (GMDH) model analytics and a structured approach to capturing descriptive, expert-based heuristic assessments through Likert-scale assessments along vertical levels of the enterprise and geographic regions. Economic domain indicators such as energy, construction industry capacity, and critical construction commodity costs were examined; results identified a number of confirming objective and subjective data assessments requiring immediate action, and some divergent data thus warranting further studies and observation. The framework is scalable to strategic management efforts across multiple industries where heuristic-based, descriptive frameworks are prevalent due to the application of systems thinking about the STEEPS environmental domains, and focus on the appropriate level of strategic governance. Analysis of remaining STEEPS domains are projected to occur as the framework becomes integrated into existing USACE executive governance forums.

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Modeling Medical Staff Requirements: Balancing Workload while Satisfying Variable Patient Demand

United States Air Force Academy
Track: Decision Analysis
Students: Cadets Todd Link, Michael Rieker, Ryan Silva & Mary Zimmerman

Pediatric Intensive Care Units currently represent an under analyzed sector of the healthcare industry. These units focus decision-making processes primarily on ad-hoc instincts of providers, and thus represent an excellent opportunity for data analysis and management science approaches to both scheduling and classification of workload. The Pediatric Intensive Care Unit at the Children's Hospital of Colorado is the premier provider of critical care for young patients with acute illnesses in a five-state region, but is currently overworking providers. Given the highly variable demand and the general unpredictability of an intensive care environment, the Pediatric Intensive Care Units struggle to accurately predict how much strain, or workload, the unit will be under at any given time. In this study, we develop a composite measure of strain felt by the medical staff of the Pediatric Intensive Care Unit and then use this to create an associated scheduling model that best fits the variable needs of the patients. The scheduling model will focus on healthcare providers, including medical doctors and advanced practice providers. To generate a strain metric, we use principal component analysis to identify 4 highly-correlated variables indicative of strain: admits, discharges, number of orders, and census data. This highlights the model inputs which will determine strain. From this exploratory data analysis we create a logistic regression model, with medication errors as the response variable in order to test the validity of these strain identifiers. This model is expected to validate the relationships between factors most influencing strain and adverse events. Using these factors, a strain metric will be created that can be used for predictive scheduling in the Pediatric Intensive Care Unit to mitigate occurrence of adverse events and facilitate intelligent provider scheduling.

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TRACK 8 – MODELING AND SIMULATION

Track Chair: LTC Brent Morrow
Jefferson Hall, Room 301

Quantifying the Effects of Weapon Weight on Lethality through Holistic Modeling

United States Military Academy
Track: Modeling and Simulation
Students: Cadets Justin Byers, Ryan Leemans & Stephanie McDermott
Advisor: Dr. Vikram Mittal

Though it is widely known that weapon weight affects shooter stability, the quantitative effects on lethality and survivability are not well known. This issue stems from weapon lethality primarily being captured by equipment properties. A more holistic analysis can be performed by treating the soldier as a system by incorporating human factors with equipment performance specifications. This analysis requires the building of human factor models to appropriately capture lethality. The model development effort started with the collecting of data from experiments where the shot group accuracy was measured for weighted rifles. The resulting data was used to generate a mathematical model. This model, along with other human factor models, was integrated into the Weapon Lethality Service (WLS), a cloud-based simulation. The WLS was then set up to represent possible combat situations; the results were used to quantify the change in soldier lethality and survivability from changing the weapon weight.

Sustaining Small Business Growth through System Dynamics

Track: Modeling and Simulation
Student: Cadet Robert Fenton
Advisor: MAJ Jillian Wisniewski

Modeling and Simulation One of the most widely regarded opportunities associated with the American dream is the chance to establish and sustain a successful business. While the common perception of the American economy is that it is driven by large Standard and Poor's 500 (S&P 500) firms, it is startup companies that form the true cornerstone of the American economy. Due to market freedom many companies have aspirations to achieve S&P status. Often after initial success there comes a critical decision point for every growing company, whereby they must choose where and how to invest their time, money and resources. Using System dynamics thinking as a foundation, this study dissects large scale companies in incredibly competitive free markets in order to provide a framework of decision making for growing companies. An accurate decision making model could highlight the correct time, and or the correct acceptable percentage of funds dedicated towards expansion.

Migration Dynamics

United States Military Academy
Track: Modeling and Simulation
Students: Cadets Cody Akers, Amanda Ramirez, Haley Robinette & Patrick Wall
Advisor: Dr. Bruce Keith

The purpose of our research is to study the interactive relationships among water resources, food production and population on migratory patterns within the Nile River Basin using a System Dynamics approach. This modeling process seeks to manage the complex feedback systems that are present overtime in our region of focus. The research conducted and data collected validated our model over a historical period in an effort to develop an interactive tool for future water management within the Nile River Basin.

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Regatta Rules Adjudication System

George Mason University
Track: Modeling and Simulation
Students: Mr. Rhett Zimmer, Mr. Daniel Burke, John Drummey & Abdullah Alqahtani

Yacht series racing, known as a regatta, occurs around the world in both the amateur and professional competitive scene. However, as rules and boat designs evolve, adjudication systems at the amateur level have not. Professional regattas use cutting edge technology in real-time to adjudicate their races while amateur races must rely on competitor testimony in post-race meetings due to lower budgets and complexity at the cost of accuracy and objectivity. Our team has developed five systems of monitoring, including GPS, UAV, Aerostat, and ship mounted cameras to monitor races for both real-time and post-race adjudication. Alternative evaluation, with criteria including precision, simplicity, and other factors was aided by experimentation, a predictive 2-dimensional simulation, and sensitivity analysis. In conclusion, our project aims to assist with regatta adjudication by providing a technical system of monitoring devices and a prediction tool to objectively analyze and report potential rule violations.

Capacity Planning Team for Company X

SUNY Binghamton
Track: Modeling and Simulation
Students: Allyson Arias, Erin Foley, Michael Hindin, Connor Kiley & Ruan Zorgman

The Capacity Planning Team was assigned the task of assisting Company X to optimize and improve the current build process of the Energy Storage System Top Carrier, a component that is used in the completion of the battery circuit for hybrid vehicles. Company X plans to increase their throughput. Their current build process allows for approximately 105 Top Carriers a week with a projected volume increase close to 375 units per week for the year. Working alongside Manufacturing Engineers, the Capacity Planning team has started a methodology of conducting precise repeatable time trials along with a running log containing the data. Using the time trials gathered a simulation is being made to help show Company X's current process layout along with interpreting the results. With this, Company X will be able to keep a history of prior assemblies of the Top Carries in order to help fluctuations in demand.

Design of a Ski Lift Inspection and Maintenance System

George Mason University
Track: Modeling and Simulation
Students: Katherine Barthelson, Pritika Sondhi, Miguel Mitra & Shallu Darhele
Advisor: Lance Sherry

Ski lifts transport 51.8 million passengers annually and have increased their operating days from 117 to 204 days on average. However, ski lift inspection frequency has remained constant due to the danger of climbing lift towers. A safer inspection system is needed to increase frequency without increasing cost or risk. This cost-benefit analysis compares the current manual inspection method to two new design alternatives: a stationary tower platform and a mobile aerial platform with HD and thermal cameras for automated image processing. A stochastic simulation was developed to compare system performance. Based on a value hierarchy of personnel safety, accuracy, availability, and inspection time, the utility for each design alternative was calculated: Manual inspection (0.466), tower platform (0.670) and mobile aerial platform (0.691). Based on cost-benefit analysis, it is recommended that ski resorts implement the mobile aerial platform for safer, more frequent, and more accurate ski lift tower inspections.

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Understanding Mass Killing in America: A System Dynamics Approach

Track: Modeling and Simulation
Student: Cadet Dillon Riedlinger
Advisor: MAJ Jillian Wisniewski

This study explores the replication effect of mass killings across the United States. Often news outlets sensationalize emotional stories, such as mass killings, because they increase readership. Increased readership perpetuates the spread of the ideation to commit a mass killing through imitation, with each new incident having the possibility to spark several more throughout the country through increased exposure. This study places greatest focus on the imitation and does not analyze feedback mechanisms that affect other influences of violence. System dynamics modeling provides the framework for examining imitation incidents as an effect of increased exposure via the media.

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TRACK 9 – HONORS

Track Chair: Dr. Kenny McDonald
Jefferson Hall, Room 103

Addressing the MLB Draft: How Draft Strategy Can Lead to Organizational Success Over Time

United States Military Academy
Track: Honors
Student: Cadets Steven Bushold
Advisor: MAJ Jillian Wisniewski

This study examines the effectiveness of traditional draft strategies over time. Specifically, this study will focus on the impacts of the Major League Baseball (MLB) First-Year Player Draft on organizational success. Three strategies to be examined are drafting by (1) positional need, (2) best player available, and (3) forecasting. Deciding how a team drafts will determine their future success, thus it is vital a team drafts effectively. Teams with different availability of resources will place different emphasis on the MLB Draft; for a team with more resources, drafting optimally is less important than a team with fewer resources. Using a Systems Dynamics approach, these draft strategies will be compared to each other, providing a recommendation based on team characteristics which could maintain success over time. This study will take into account the draft, development through the minor leagues, and the ultimate impact a drafting strategy will have for an organization.

Analysis of Cyber Security Methodologies: A Direct Comparison of Current vs Possible DoD Cyber Assets

United States Military Academy
Track: Honors
Student: Cadet Sai Kumar
Advisor: Dr. Vikram Mittal

Recent years have shown an increasing reliance on the cyber domain to maintain national and military operability, resulting in cyber exploits having a more profound impact on victim nations. As the United States seeks to maximize its ability to capitalize on these exploits and minimize its susceptibility, a decision must be made on the most effective way to accomplish these tasks. Currently, each military service is building up isolated cyber assets to accomplish these tasks. However, there has been a recent proposal to create a separate Cyber Department. This paper evaluates the comparative value between the two alternatives through value modeling. The value model is based on each alternative's ability to achieve the end state cyber goals of the Department of Defense. Strong indicators point towards a separate Cyber Department as the more valuable alternative to achieve the nation's goals, while highlighting the current weaknesses within the current cyber structure.

A Value Modeling Approach to Major League Soccer Expansion

Track: Honors
Student: Cadet William Ratliff
Advisor: LTC David Hughes

The purpose of this study is to examine the pending expansion of Major League Soccer (MLS) by utilizing value- models and other systems decision making tools. The MLS is currently undergoing a period of high levels of growth and plans to expand their number of franchises from 24 to 28 teams by the year 2022. This study, creates quantifiable metrics that MLS officials evaluate when considering expansion franchise bids. These metrics combine to form a total value model that is weighted based on the value measures that are most closely correlated to success rates of previous expansion franchises. The result is a weighted value model that numerically ranks the 12 markets competing for an expansion franchise.

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This model also provides opportunities for further research into what metrics are most important to consider in professional sport expansions.

Modeling the Growth of Boko Haram Using System Dynamics

Track: Honors
Student: Cadet Jadalaine Ferrer
Advisor: MAJ Jillian Wisniewski

This study uses a systems dynamic approach to understand how the attacks conducted by Boko Haram influence the group's growth. Boko Haram originated in the early 2000s under Muhammad Yusuf, but the group did not become known for its violence until 2009 (Oftedal, 2013). In 2013, the United States designated Boko Haram as a Foreign Terrorist Organization (U.S. State Department, 2013). The Nigerian government's efforts to eliminate the group's influence in northern Nigeria and neighboring countries has not been successful. As Africa enters the world spotlight, the need for curbing the influence of Boko Haram strengthens. The system dynamics modeling process provides a method of understanding the relationships within the underlying structures that drive the scope of influence of Boko Haram, including organizational growth, media coverage, and attack efficacy. A formalized system dynamics model provides a basis for policy recommendations to counteract the group's efforts.

On Mass Killing in America: Using Markov Analysis to Challenge Conventional Understanding & Policy Design

Track: Honors
Student: Cadet Dillon Riedlinger
Advisor: MAJ Jillian Wisniewski

This study uses a systems approach to define and connect ideas on imitation, competing interests of societal agents, societal acceptable levels of violence, and differing cohorts of perpetrators. After defining the system within which to understand mass killings, a Markov chain provides a method to understand the agents behind these killings. A killer's progression toward conducting a mass killing has stochastic characteristics and can therefore be modeled as an absorbing Markov chain with five transient and two absorbing states. Defining the system and agents with these techniques provides a means to understand mass killing in America and inform effective policy. The findings challenge conventional understanding and mitigation of mass killing because they highlight the significance of early stage transitions in the timeline of a killer.

Modeling Diffusion of Information in an Increasingly Complex Digital Domain

Track: Honors
Student: Cadet Daniel Provaznik
Advisor: MAJ Jillian Wisniewski

Honors Projects Offering entertainment, discussion, and information, social media provides users with a stimulating online experience. Within the last five years, it has also become an increasingly popular medium for the consumption of news. News outlets publish articles and reports through social media, and by doing so influence their users in a way that corresponds with the outlet's political leaning. Because social media outlets provide users with tailored content, the prevalence of biased news reporting reinforces the user's political values and polarizes their beliefs. This thesis attempts to examine the relationships that give rise to this political polarization in social media and discusses possible opportunities to mitigate it.

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Track 10 - The Hollis Award

Track Chair: LTC Kristin Arney
Jefferson Hall, Haig Room

Developing Accuracy Measurement and Anomaly Detection Processes for Categorical Data in Defense Maintenance Records

Track: Hollis Award
Students: Cadets Kameron Grubaugh, Nicholas McAfee, Emily McGowan & Zachary Zimmerman
Advisor: LTC Paul Evangelista

The Department of Defense (DoD) recently initiated an effort to compile all inter-service maintenance data for equipment and infrastructure, requiring the consolidation of maintenance records from over 40 different data sources. This research evaluates and improves the accuracy of this maintenance data warehouse by means of value modeling and statistical methods for anomaly detection. The first step in this work included the categorization of error-identifying metadata, which was then consolidated into a weighted scoring model. The most novel aspect of the work involved error identification processes using conditional probability combinations and likelihood measures. This analysis showed promising results, successfully identifying numerous invalid maintenance description labels through the use of conditional probability tests. This process holds potential to reduce the amount of manual labor currently necessary to search and clean the DoD maintenance data records and provide better fidelity on DoD maintenance activities.

Are human bodies really shaped like fruit? Using cluster analysis of 3D body scans to challenge current body shape classification norms

The Hollis Award
Student: Cadet Kevin Talty
Advisors: COL Kevin Bigelman, Dr. Diana Thomas, LTC Michael Scioletti, CPT Patrick Kuiper & CPT Steven Morse

There have been long-standing conjectures on the relationship of classified body shapes and health outcomes. For example, populations classified as either pear shaped or apple shaped are known to differ in cardiovascular health. However, due to the manual burden in collecting numerous anthropometric measures, to date, no large database and systematic data analysis determining body shape classifications have gone beyond using measurements like BMI, waist circumference and hip circumference.

Modeling the Growth of Boko Haram Using System Dynamics

The Hollis Award
Student: Cadet Jadalaine Ferrer
Advisor: MAJ Jillian Wisniewski

This study uses a systems dynamic approach to understand how the attacks conducted by Boko Haram influence the group's growth. Boko Haram originated in the early 2000s under Muhammad Yusuf, but the group did not become known for its violence until 2009 following several clashes with Nigerian police (Loimeier, 2012). In 2013, the United States designated Boko Haram as a Foreign Terrorist Organization (U.S. State Department, 2013). The Nigerian government's efforts to eliminate the group's influence in northern Nigeria and neighboring countries has not been successful. As Africa enters the world spotlight, the need for curbing the influence of Boko Haram strengthens. The system dynamics modeling process provides a method of understanding the relationships within the underlying structures that drive the scope of influence of Boko Haram, including organizational growth, media coverage, and attack efficacy. A formalized system dynamics model provides a basis for policy recommendations to counteract the group's efforts.

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Quantifying the Effects of Weapon Weight on Lethality through Holistic Modeling

The Hollis Award
Students: Cadets Justin Byers, Ryan Leemans & Stephanie McDermott
Advisor: Dr. Vikram Mittal

Though it is widely known that weapon weight has an effect on shooter stability, the quantitative effects on lethality and survivability are not well known. This issue stems from weapon lethality primarily being captured by equipment properties. A more holistic analysis can be performed by treating the Soldier as a system by incorporating human factors with equipment performance specifications. This analysis requires the building of human factor models to appropriately capture lethality. The model development effort started with the collecting of data from experiments where the shot group accuracy was measured for weighted rifles. The resulting data was used to generate a mathematical model. This model, along with other human factor models, was integrated into the Weapons Lethality Service (WLS), a cloud-based simulation. The WLS was then set up to represent possible combat situations; the results were used to quantify the change in Soldier lethality and survivability from changing the weapon weight.

Origins of Intelligence: Discerning Corroboration vs. Replication in Open Source Intelligence Production

The Hollis Award
Students: Cadets Joseph Bosse, Conor Glancy, Justin McDaniels & Daniel Provaznik
Advisor: MAJ Jillian Wisniewski

A well-documented fallacy across the intelligence community (IC) is the evaluation and processing of information through existing analytic products, which too often replicates previous findings instead of contributing an original assessment. The fallacy, which stems from myriad combinations of errors and biases in reporting, allows information to gain unwarranted legitimacy as it proliferates: its replication is often misconstrued as corroboration. Open Source Intelligence (OSINT) is especially vulnerable to such misinterpretation because it is produced from publicly available information (PAI), which, under its massive volume, buries source origins. This study computes a bipartite network of citations and derives an interdependence measure of its sources, where high or low measures indicate replication or corroboration, respectively. The application of bibliographic coupling, distance measures, and network centrality to a set of 450 scholarly sources with over 9,100 citations provides a foundation on which to build an objective measure of originality of a source document.

Fortress West Point

The Hollis Award
Student: Cadet Virginia Brawley
Advisor: MAJ Julia Lensing

As a team, we were tasked with creating an immersive, geographically based augmented reality (AR) application that enhances West Point's historical experience surrounding the implementation of the "Great Chain" during the American Revolution. Our stakeholder required an app that existed on an iOS iPhone specific platform and could be downloaded on the App Store. In order to develop the product, we had to closely coordinate within a diverse and interdisciplinary team, consisting of Information Technology, Computer Science, American History, and Engineering Management majors. On the technical side, we divided the group into two teams, one that focused on the AR development within ARKit and XCode, and another that focused on user interface design using XCode and Google Maps technology. As different features of the application were completed, we integrated the two teams in order to mesh both the design and development sides, thus creating a relatively complete application. Our greatest challenge was the placement of the 3D AR Great Chain on the Hudson River, as the natural

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terrain and occlusion created numerous obstacles. We leveraged the expertise of advisors at Apple as well as 3D designers in order to come up with our own unique and innovative solution that utilized the newest and most cutting-edge AR technology. We also had to work closely with the historical experts on our team in order to create a compelling and accurate narrative surrounding the story of the Great Chain back in 1775.

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