

Homeland Security & Defense

Transportation

Virtual Environments

Business & Supply Chain

V M A S C

Social Sciences

Game-Based Learning

Medical & Health Care



Research Center Faculty & Staff

Interim Executive Director
Dr. John Sokolowski



Charlotte Smith - Executive Assistant

**Director of Administration
and Support**



Sheila Flanagan

D'An Knowles - Marketing Manager
Cheryl Sparrer - Admin Specialist
Karen Thompson - Admin Specialist
Tracey Vann - Admin Specialist

Information Technology

Hector Garcia - Visual Lab Manager
Richard Howell - Systems Support
David Ralph - Systems Support

**Director of Research/
Social Sciences**



Dr. John Sokolowski

**Director of
Business
Development**



Thomas Reese

**Research Assistant
Professor**



Dr. Cathy Banks

**Business &
Supply Chain**



Dr. Rafael Diaz

Defense/HLS



Dr. Barry Ezell

**Medical &
Health Care**



Dr. Mohammed Ferdjallah

**Virtual
Environments**



Dr. Yiannis Papelis

Transportation



Mike Robinson

**Game-Based
Learning**



Dr. Yuzhong Shen

Social Sciences



Dr. Josh Behr

Analysis



Dr. Andrew Collins

VMASC Visiting Scholar



LTC Chris Fleming
Senior Service War Fellow

Board of Advisors



John Dannon



Craig Langman

Chairman

Vice-Chairman



Research Center
Faculty & Staff

VMASC Project Scientists



Menion
Croll



Saikou
Diallo



Peter
Foytik



Hector
Garcia



Kaleen
Lawsure



Suchitra
Manepalli



Will
Richards



Solomon
Sherfey



James
Stacia



Chuck
Turnitsa

Old Dominion University Modeling & Simulation Faculty



Dr. Patrick
Hester
EMSE



Dr. Jiang
Li
ECE



Dr. Zia-ur
Rahman
ECE



Dr. Andreas
Tolk
EMSE



Dr. Rani
Kady
Eng. Mgt.



Dr. Julie
Hao
ME



Dr. Mecit
Cetin
Trans.



Dr. Dean
Chatfield
Business



Dr. Gianluca
De Leo
Health Sci.



Dr. Tal
Ezer
Oceanography



Dr. Holly
Gaff
Health Sci.



Dr. Poornima
Madhavan
Psychology



Dr. Ginger
Watson
Gaming



Dr. Stacie
Ringleb
Medical

Modeling and Simulation Academic Program



M&S Workforce Development

Partners in Providing World-Class M&S Education for Hampton Roads

**Commonwealth
Of Virginia**

**Old Dominion
University**

**Virginia
Community
Colleges**

**Public
School
Systems**

Doctoral Degrees
ODU

Master's Degrees
ODU

Bachelor's Degree
ODU

Associate of Science Degree
Associate of Applied Science Degree
TCC; TNCC

High School Diploma
Virginia Beach ATC

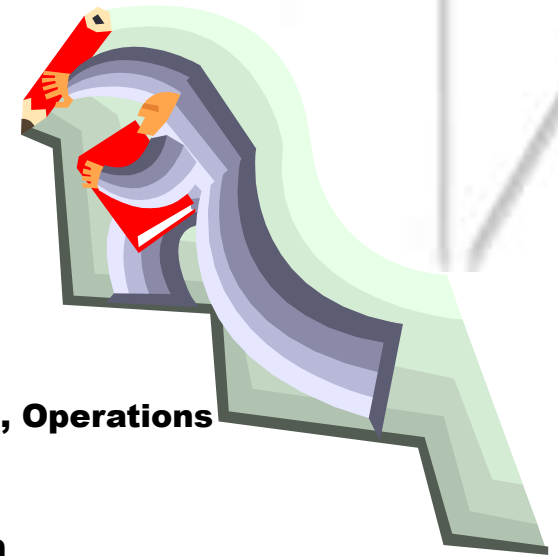
Scientist
Research, Development

Engineer
Design, Analysis

Technologist
Implementation, Operations

Technician
Maintenance,
Support

and the Commonwealth



**M&S will be nearly a \$1B
Enterprise in Hampton
Roads
By 2010**

M&S Program Productivity

	2006	2007	2008	2009
PhD Degrees	1	0	4	2
MS/ME Degrees	15	9	18	19
PhD HC Enrollment	27	31	32	34
PhD HC Active	42	45	48	49
MS/ME HC Enrollment	45	44	40	32
MS/ME HC Active	52	50	46	45

VMASC Research



Engaging VMASC Researchers

- ▼ Periodic applied research area meetings (military/homeland security, medical and health care, transportation)
- ▼ VMASC web site
- ▼ VMASC news letter
- ▼ VMASC summary of awarded research projects

Transportation



Currently Funded Projects

- ▼ **VDOT Volume Delay Functions**
- ▼ **Hampton Roads Transportation Alternatives**
- ▼ **Norfolk Signal Light Delay**

VDOT Volume Delay Functions

- ▼ Three primary equation forms
- ▼ Factors include road volume, capacity, physical road characteristics, time of day
- ▼ Which of the equations (or a hybrid) best represents observed flows?
- ▼ Apply revisions to Hampton Roads, Fredericksburg, Charlottesville

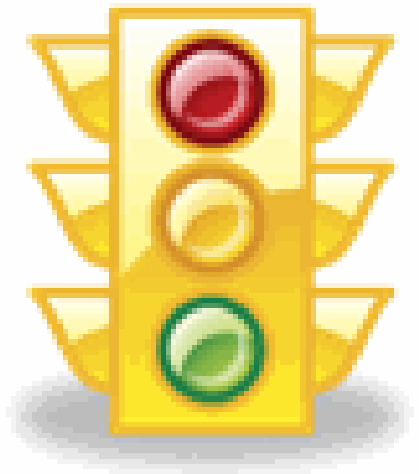
Hampton Roads Transportation Alternatives

- ▼ Peak-hour congestion model
- ▼ Primary arterials included in analysis
- ▼ Refined accident-incident forecast (location, frequency, and severity)
- ▼ Recurrent and incident induced congestion analysis
- ▼ Direct, objective ranking using transportation metrics
- ▼ December 2010



Traffic Signal Priority for the Tide Light Rail System

- ▼ Safe and efficient operations of both highway vehicles and LRT trains
- ▼ Special signal control mode for the servicing railroad crossings, emergency vehicle passage, mass transit vehicle passage, and other special tasks



Unfunded Research

▼ Evacuation Simulations

- Congested conditions decisions
- Accident and incident injection
- Presentations to Transportation Research Board Annual Meeting (DC) and National Evacuation Conference (New Orleans)

▼ Transportation simulation dynamic traffic additions

Work in Planning

Maritime Port Security

- ▼ Universities of Genoa and Calabria
- ▼ Three main sections
 - Shipping to/from terminal
 - Internal terminal operations
 - Freight transfer from terminal (trucking, rail)
- ▼ Threat identification and simulation
 - Information fusion analysis
- ▼ Initial goal – training.

VMASC

Old Dominion University



***Research Focus: Medical & Health
Care***

by
Mohammed M Ferdjallah, Ph.D.
Research Associate Professor

Dr. Gaff's Research Projects

- **Tick-Borne Diseases: Rift Valley Fever – Modeling and Bio-surveillance (*NIH-K25*)**
 - *ODU, Johns Hopkins, U. Maryland, U. Michigan*
- **Optimal Strategies for Controlling Cholera Outbreaks (*NSF*)**
 - *ODU, Murray State U., Marymount U., U. Tennessee*

Dr. Scerbo's Research Projects

- **Surgical Workload Assessment Task**
 - ***ODU, EVMS***
- **Detection Accuracy for Maternal-Fetal Heart Rate Tracings**
 - ***ODU, EVMS***
- **Selection Instrument for Standardized Patients**
 - ***ODU, EVMS***

Dr. Ringleb's Research Projects

- **Developing an internet based rehabilitation program for war-fighters with functional hearing loss secondary to blast and/or mTBI (*OSD, SBIR-phase I and II*)**
 - ***ODU***
- **Developing VR assessment modules to determine return to duty and affective (*OSD*)**
 - ***ODU***
- **Improving VR based rehabilitation systems to treat stroke patients and collecting fMRI data on these patients (*ODU's Office of Research*)**

Dr. De Leo's Research Projects

- **GaMeTT: Create a computer game-based software tool to track, assess, and train medical support teams to operate under stressful conditions. (*Mymic LLC*)**
 - ***VMASC/ODU, Mymic LLC, Forterra Inc***
- **Iphone Application for Emergency Preparedness (*Hampton Roads Planning District Commission*)**
 - ***VMASC/ODU***

Dr. McKenzie's VMASC-Related Research Projects

- **Virtual Pathology Stethoscope**
 - ***ODU, EVMS***
- **Augmented Standardized Patient EKG Tracking**
 - ***ODU, EVMS***
- **Virtual Pathology Sonography**
 - ***ODU, EVMS***

Dr. Ferdjallah's Research Projects

- **Monarch Virtual Hospital Project**
 - ***Nursing/ODU, VMASC/ODU***
- **Proton Therapy Modeling & Simulation**
(pending)
 - ***VMASC/ODU, PTI/HU***
- **Diabetic Data Mining** ***(pending)***
 - ***VMASC/ODU, EVMS***

Dr. Ferdjallah's Research Projects

- **Electromagnetic Interferences Modeling & Simulation (*pending*)**
 - ***VMASC/ODU,***
- **Virtual Patient Library (*working project*)**
 - ***VMASC/ODU, EVMS***
- **Assessment of Virtual Online Learning & Training (*working project*)**
 - ***VMASC/ODU, English/ODU***

Virtual Environments

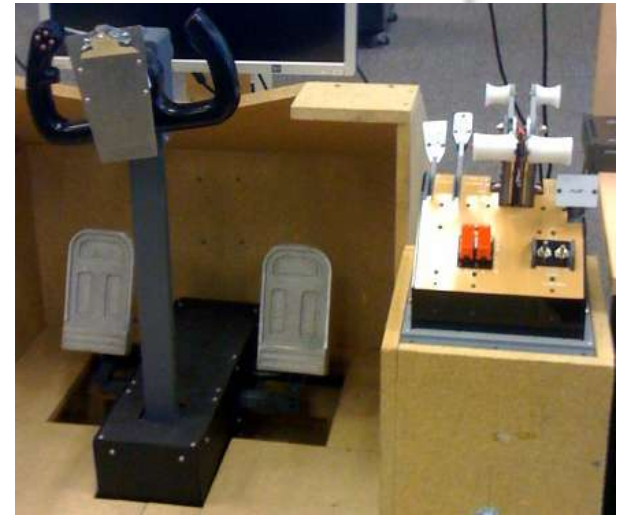


Focus Areas

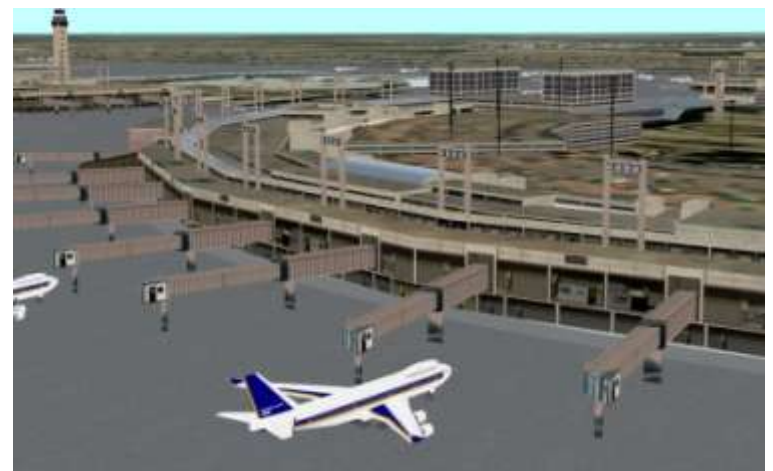
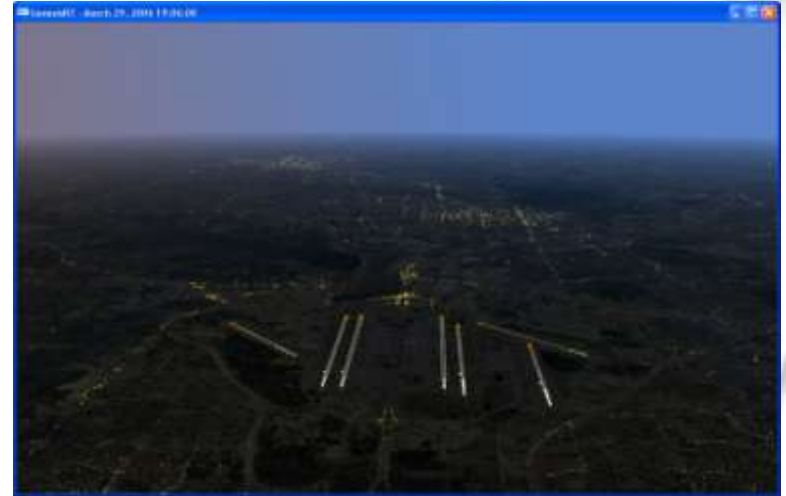
- ▼ All aspects of virtual environment modeling
 - Agent-Based modeling
 - Human behavior modeling
 - Task and performance modeling
 - Autonomous systems
 - Virtual environment representation
 - 3D visual representations
 - Semantic modeling
 - Immersive virtual environments
 - Driving/flight simulation

Example Project – NASA Air-Ops Lab

- ▼ Enhance NASA Air-Ops Lab
 - Augment autonomous pilot model with hardware inceptors
 - Develop high fidelity visual model of Dallas/Ft. Worth airport
 - Integrate with NASA software to provide simulator out-the-window view
 - Enhance aircraft model to support landing



Dallas/Ft. Worth Model



Example Project – Port Simulation

- ▼ Sponsored by Opportunity Inc., addressing immersive demonstration of Port careers
- ▼ Develop game-like simulation of port operations
- ▼ Allow user to “take-on” various roles
 - Crane/transtrainer operator, longshoreman, coordinator etc.
- ▼ Project utilizes rich multi-media combined with 3D environment

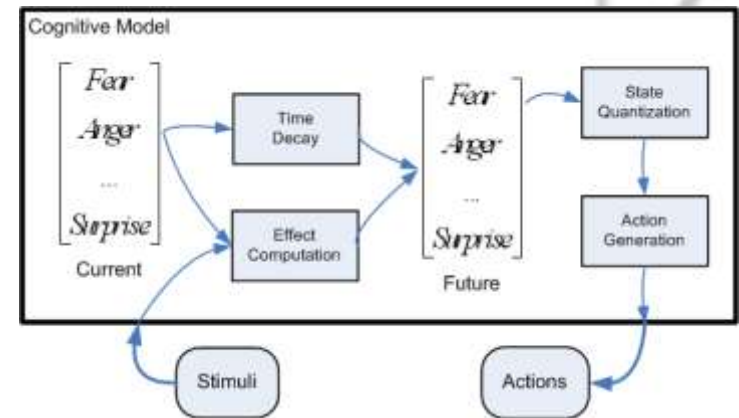
Selected Port is NIT

- ▼ Supported operations include: tugboat ship guidance, crane scheduling, container unloading, sea and land-side container movement.



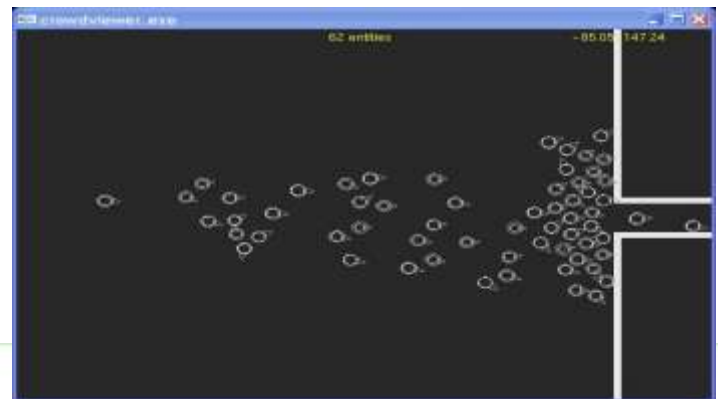
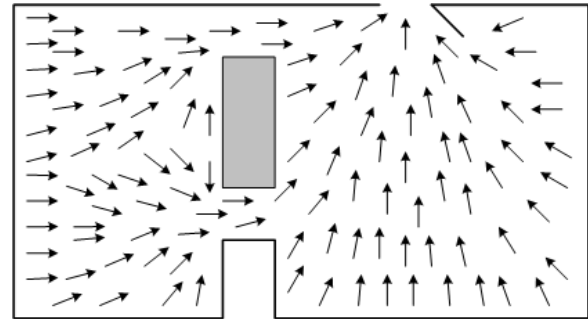
Example Project – Crowd Modeling

- ▼ Various sponsors
- ▼ Fusion of cognitive and physical movement model
- ▼ Higher fidelity than the simple movement models used in planning & evacuation



Crowd effort highlights

- ▼ Active Denial System demonstration
- ▼ Flow field use for short-term guidance
- ▼ Cognitive model driving social-forces movement behavior



Military/Homeland Security



National Program for Small Unit of Excellence

- ▼ Vision: A National Program that advances the tactical art of high performing small units that when unleashed can operate autonomously in regular and irregular complex environments and prevail every time.
- ▼ Mission: The National Program for Small Unit Excellence serves as the hub for cross-community integration of military and civilian communities of practice to focus on the problem sets for enabling small unit excellence, providing collaborative knowledge-management, fora and venues to present and debate new research for unleashing the power of small units and to *transition new competencies, concepts and capabilities* with metrics and assessments to small units.
- ▼ Research, provide assessments, transition planning, planning support documents, recommendation papers, and briefings on development services in support of the Center.



**Recent Hire: Mr. James Stacia
VMASC NPSUE Program Manager**

Hampton Roads Urban Area Working Group (UAWG)

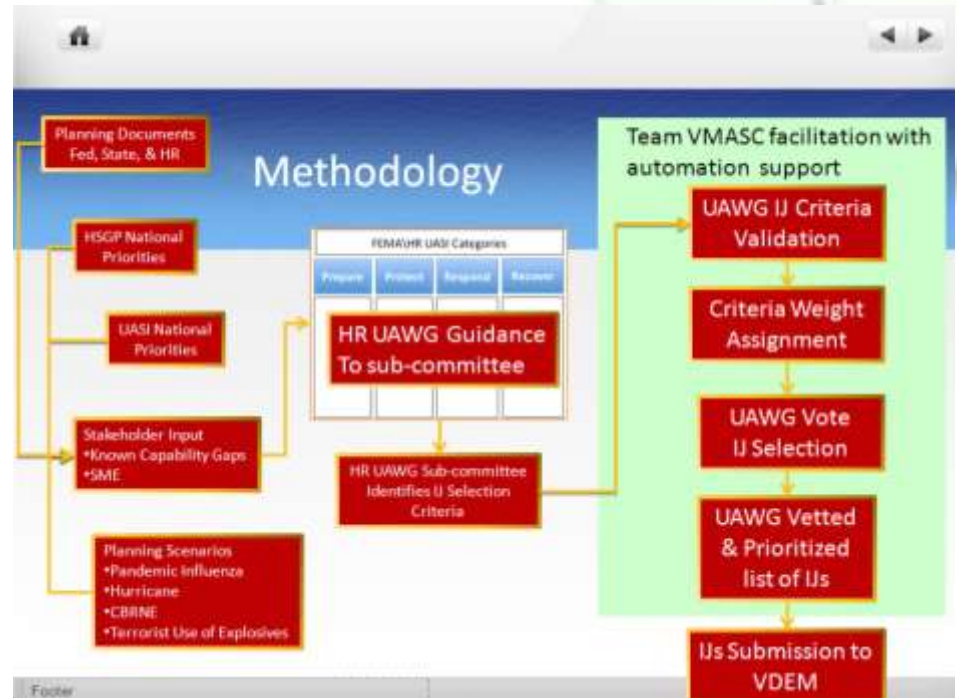
Urban Areas Security Initiative (UASI)

Investment Justification (IJ) Prioritization Methodology

FY2010

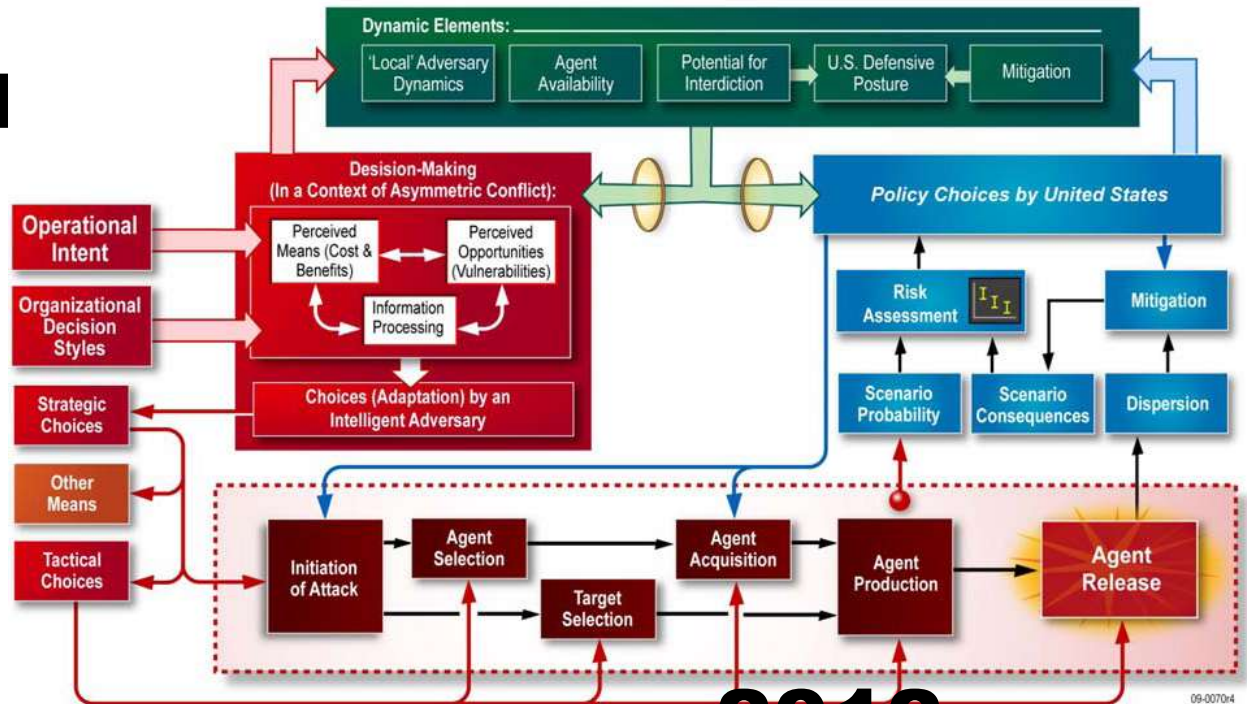
Team VMASC

- Dr. Barry Ezell, ODU
- Ms. Heather Warren Noell, EBR
- Mr. Donald G. Owen, EBR
- Ms. Lisa Izuma, LMCO



Bioterrorism I Assessment

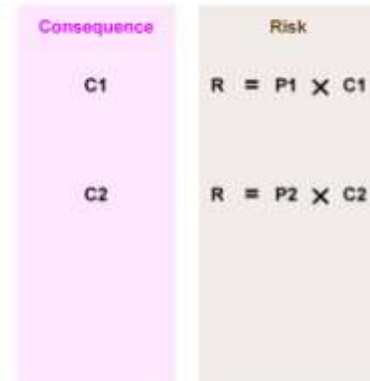
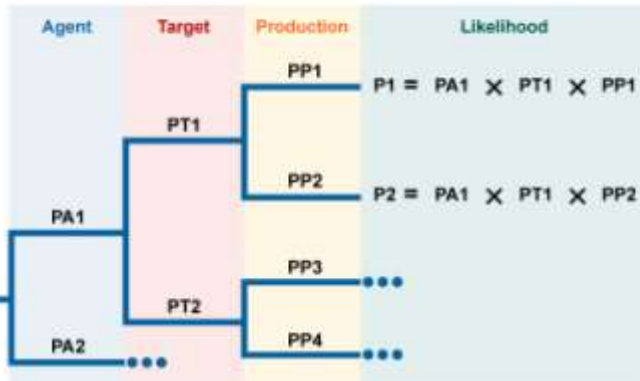
- Project Number: 702981
- Sponsor: Battelle National Biodefense Institute
- Principal Investigator: Dr. Barry Ezell



Threat Analysis

Consequence Modeling

Integrated Risk



2012

2006-2010



Homeland Security

Additional Projects Underway

- ▼ JTEOW/JCOM - development of processes and products to help with a Joint Common Object Model
 - an architectural neutral method for federating systems (C2 and M&S)
 - development of a Joint Warfare Taxonomy that can be used as metadata for semantic search across existing solutions in a repository (a customer would search this repository to see if existing Object Model candidates serve his need).
- ▼ PEO Soldier - making a federation of US Army entity level simulators working with the new MATREX Federation Object Model (FOM) work together
 - identifying Primitives of Meaning that define doctrinal tasks and actions, and then using that analysis to modify the FOM to allow for representing these primitives, so that other doctrinal tasks can be composed easily
 - Research based on Turnista's findings from 2006 Masters Thesis
- ▼ CBML - this project, under the BattleLab support contract, is in support of the Coalition Battle Management Language standardization effort.
 - VMASC's role: to ensure that the needs and requirements and capabilities of JFCOM
 - work done at the Joint Advanced Training Technologies Laboratory, JATTTL is represented in the standardization process, and also to bring back findings from the standardization work to JFCOM

PI: Dr. Andreas Tolk

Project Scientist: Chuck Turnitsa

Additional Research Activity

- ▼ Guest speakers from Hampton Roads, DHS and DoD on analytic challenges facing the government (4-6 weeks)
- ▼ Risk-informed Decision Making Course Development (3 day, 24 hour hands-on for managers and analysts)

Business & Supply Chain



Content

▼ Research:

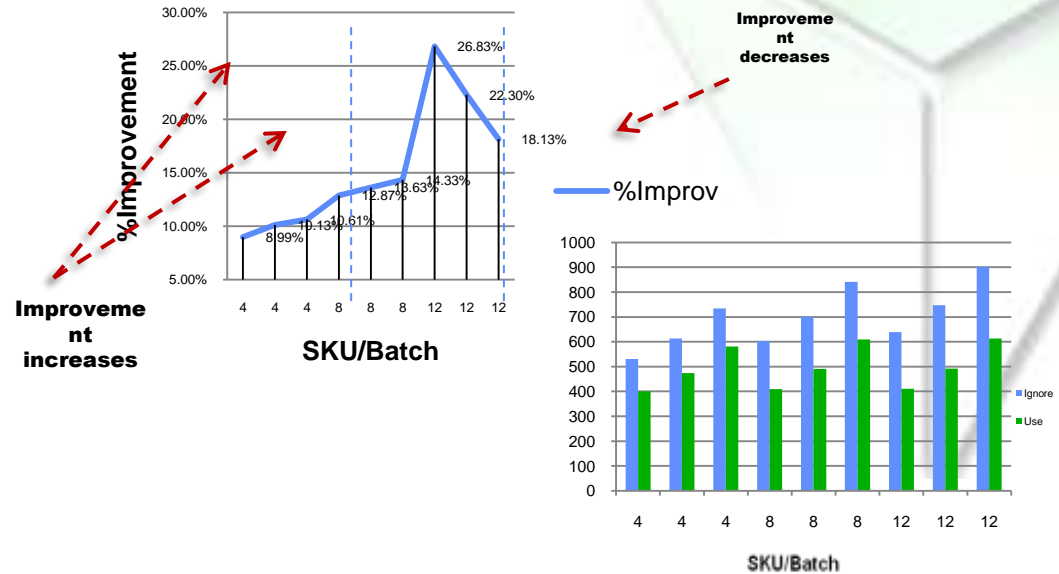
- Supply Chain and Reverse Logistics
- Throughput and Resource Allocation
- Economic/Environmental Impact Modeling

▼ Looking ahead

Supply Chain and Reverse Logistics

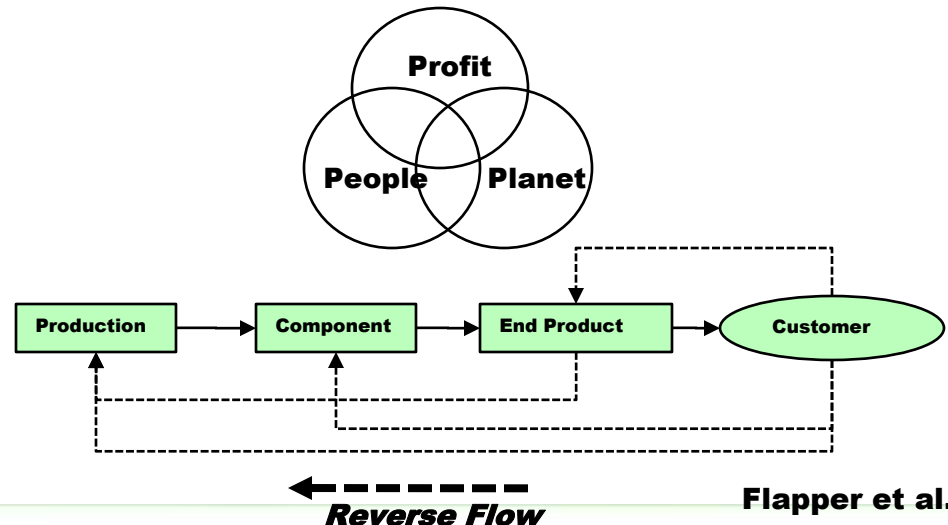
Warehouse simulation study: Combining Optimization and Simulation for improving material handling

- Combined Optimization and Zoning Simulation: Correlations, Throughput, and weighs
- Invited: International Journal of Production Economics - Special Issue



Educating Supply Chain, Reverse Logistics, and M&S

- **In the U.S. Logistics Cost: \$950 billion/year**
- **Return Costs 5%: \$43 billion/year**
- **Empty containers costs globally 7.9 billion/year**
- **Spring 2010**



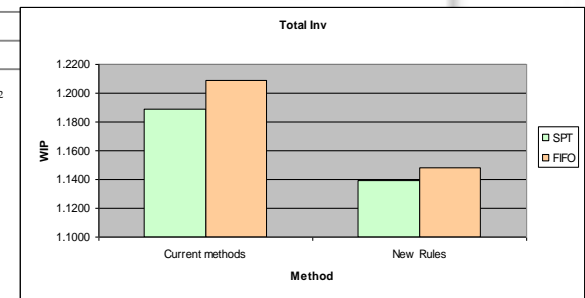
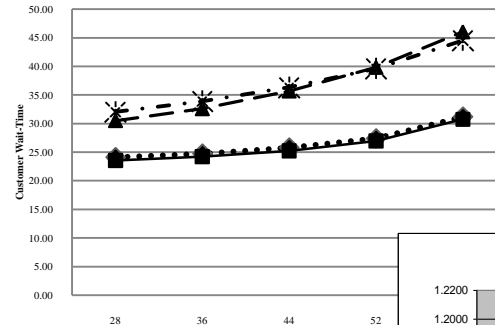
Flapper et al. 2005



Throughput and Resource Allocation

Innovative JIT / CONWIP production systems

- Analyzed and designed intelligent priority rules for Job Shops and Flow Shops
- Reduce waiting time 40%-60%
- Reduce WIP inventory up to 5%
- Published: *Journal of Production and Operations Management* (2 more papers)

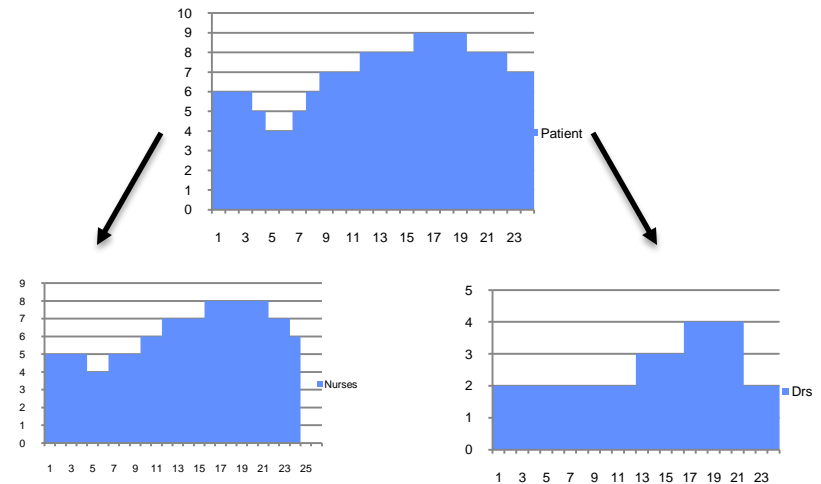


An Application of Simulation-based Optimization in ER's Resource Allocation

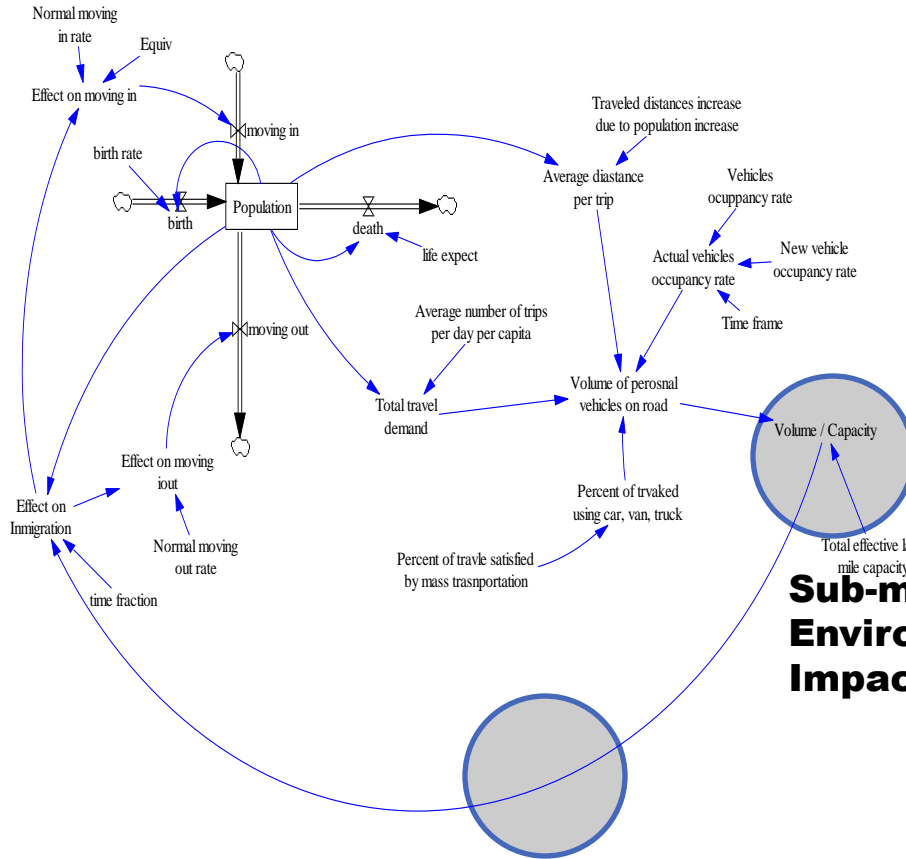
- **Reduced Length of Stay (LOS)**

A System Dynamic Approach to Modeling the Sensitivity of Inappropriate Emergency Department Utilization

- **Presented: INFORMS 2009 - San Diego, CA**

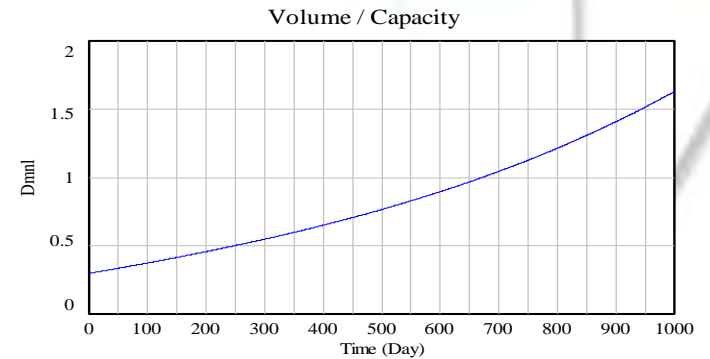


System Dynamics Simulation Model

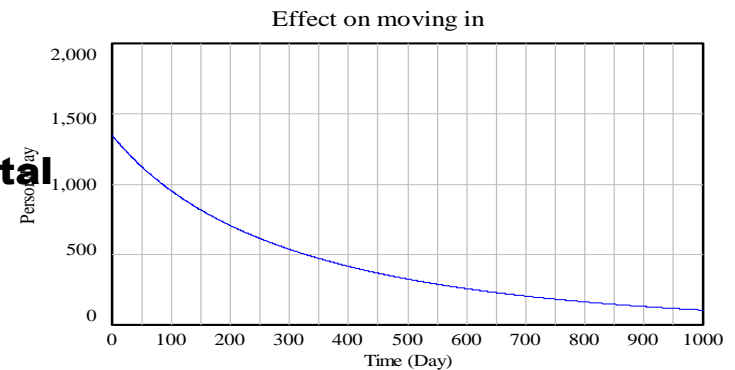


**Sub-model:
Economic Impact .**

**Sub-model:
Environmental
Impact**



"Volume / Capacity" : Current



Effect on moving in : Current

Presented: ModSim World 2009 – Virginia Beach, VA



Looking Ahead

- ▼ Capstone conference - April 2010
- ▼ POMS – Vancouver, Canada. May 2010
- ▼ Course: Supply Chain and Reverse Logistics
–Spring 2010
- ▼ Routing Optimization
- ▼ Economic Impact Transportation
Way/Infrastructure projects
- ▼ Reverse Logistics

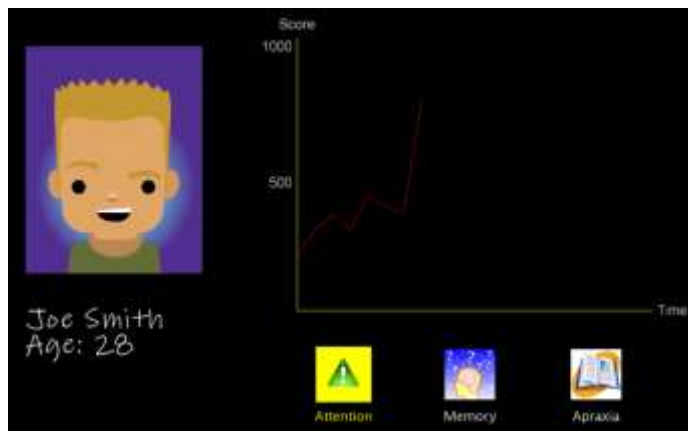


Game-based Learning Update

Dr. Yuzhong Shen, Assistant Professor
Dept. of Electrical and Computer Engineering (ECE)
Virginia Modeling, Analysis, and Simulation Center
(VMASC)

Using Xbox 360 for Rehabilitation of Brain Injured Patients

- ▼ SBIR Phase I with MYMIC LLC.
- ▼ Sponsored by Office of the Secretary of Defense, DoD.
- ▼ Improve patients' cognitive and motor skills.



Virtual VMASC

- ▼ Sponsored by VMASC.
- ▼ Provides virtual tour, directory, and other information of VMASC using gaming technologies.



2009 ODU Game Development Summer Camp

- ▼ Held June 22 to 26, 2009
- ▼ 20 participants from 6 cities of Hampton Roads.
- ▼ Taught Game Maker, Google SketchUp, and Google SketchyPhysics.
- ▼ Reported by WAVY 10 and Daily Press.



Course: Introduction to Game Development

- ▼ Offered in Spring 2009 at both undergraduate and graduate levels for the first time.
- ▼ C# and Microsoft XNA Game Studio were utilized.
- ▼ Students developed educational games.
- ▼ Games can be played on Windows PC, Microsoft Xbox 360, and Zune



(a)



(b)



(c)



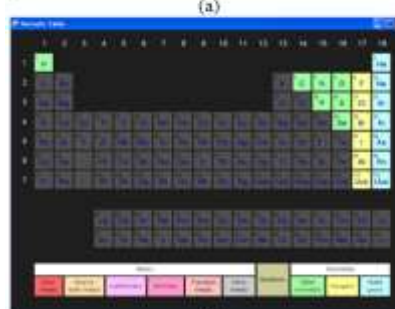
(d)



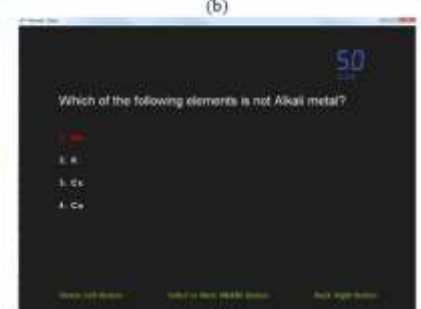
(a)



(b)



(c)



(d)

Social Science

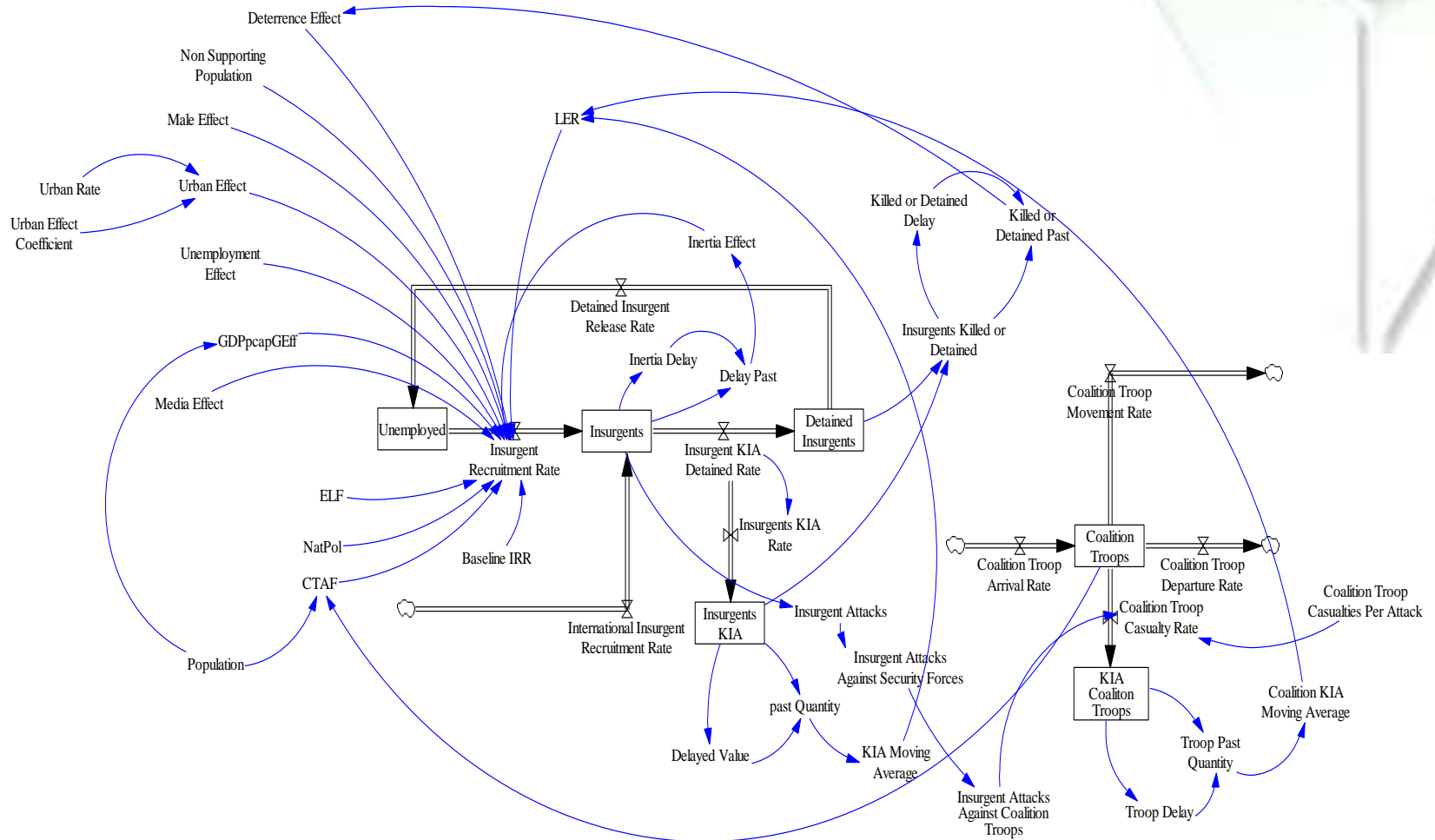


Case Studies

- ❑ **Insurgency Modeling**—complex model of population dynamics
- ❑ **Colombia**—war on drugs . . . population dynamics
- ❑ **Nigeria**—oil, poverty, corruption . . . in a pivotal state
- ❑ **Afghanistan**—opium, religion, state-building . . . amidst conspiracy theories
- ❑ **Ireland**—Easter Rising 1916 and Anglo-Irish War . . . unequal protagonists

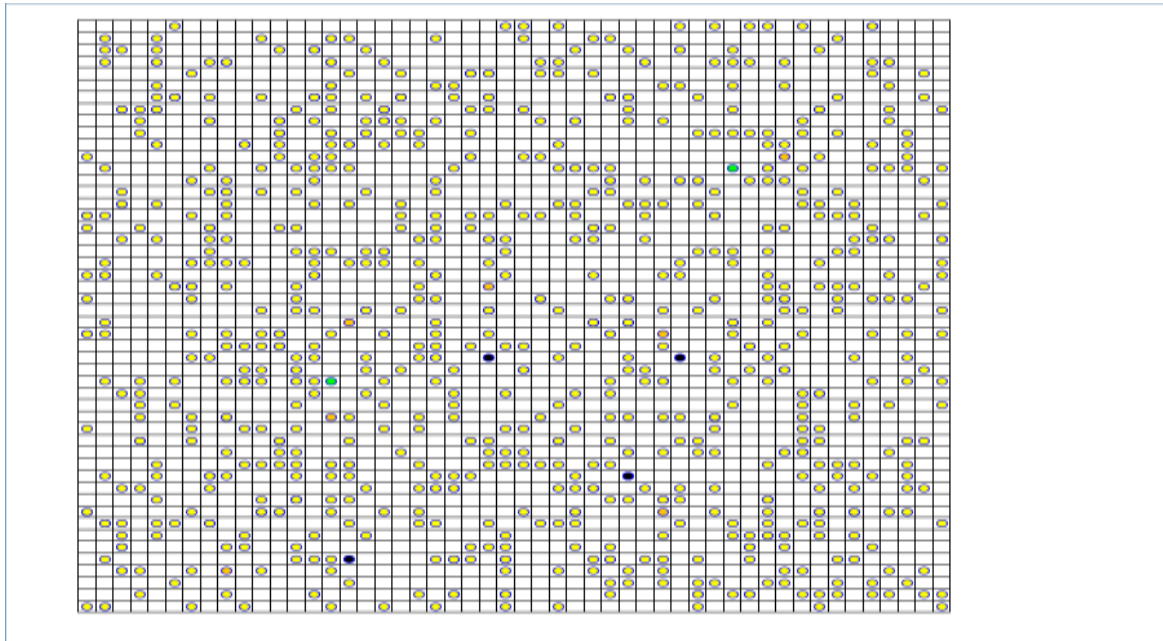
Modeling Global Events: A Focus on Insurgency

A model for stability and reconstruction



Nigeria

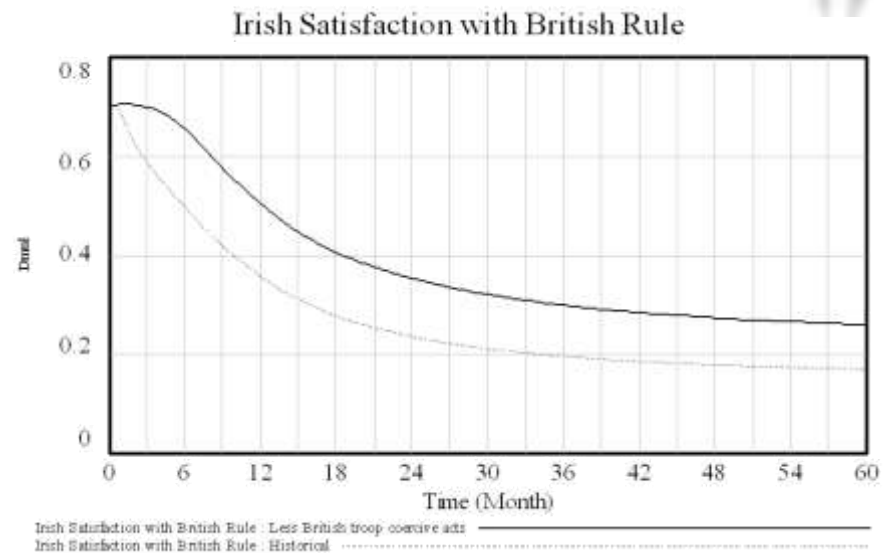
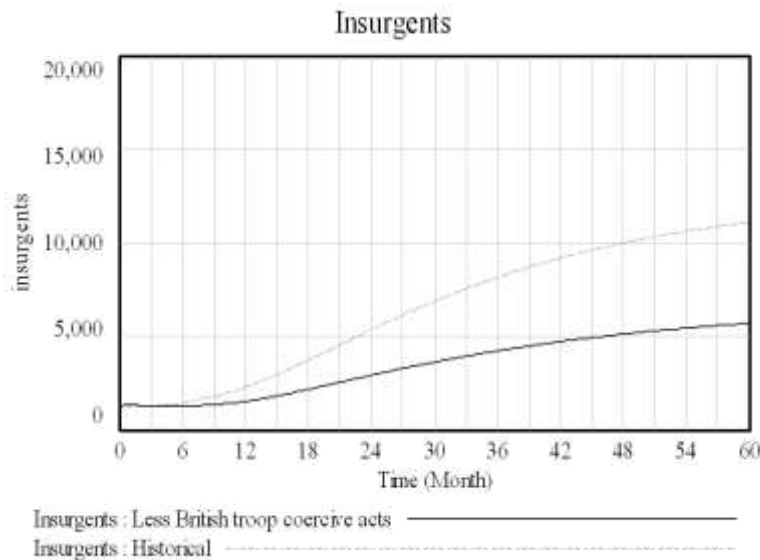
black circles represent the oil assets,
yellow the tribesmen
green represents the police forces,
orange for insurgents



Agent Cellular Grid

Ireland

- what if . . . reduce the *max coercive acts* parameter, which governs the number of coercive acts committed by each British soldier on a monthly basis
- result was based on a value of 0.2 for this parameter
- Suppose the British government implemented a policy that better controlled how the soldiers behaved and the number of acts was reduced to 0.1 acts per soldier



Getting Theoretical . . .

Agent-based Modeling: Personifying the Agent

□ a Social Sciences methodology to **objectively personify agents**

□ agent-based modeling is **intrinsically social** actions and characteristics of the agents are influenced by the actions and characteristics of the other agents in the social system

□ fundamental aspects of agent-based modeling, a necessary paradigm for characterizing, assessing, and validating global events, call attention to the precision needed in developing the key component: the agent. ***I am, therefore I think***

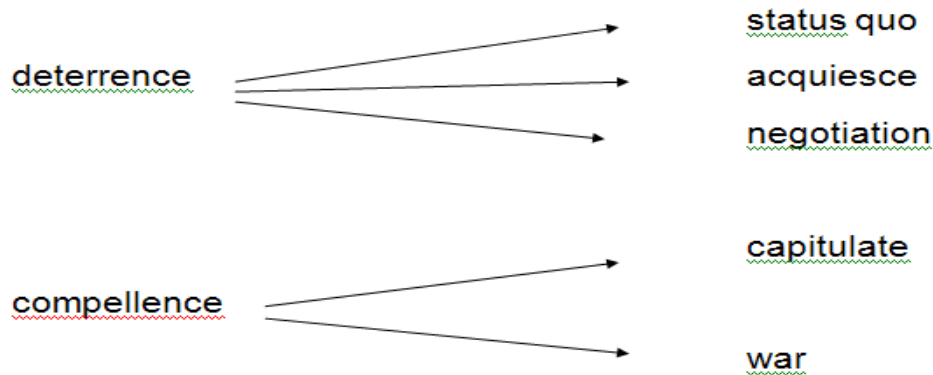
Getting Theoretical . . .

Advancing Game Theory

□ Integrating theory and concepts with endgame state engagements

Political Theory/Concepts

Outcome of State Engagements



Political Theory/Concepts

Pay-off of State Engagements



Getting Theoretical . . .

Engaging Multi-Modeling Paradigms

- ❑ **transitioning from SD, ABM, GT, and SN Modeling to holistically, non-deterministically, and continuously represent a real-world event**

Social Network Modeling

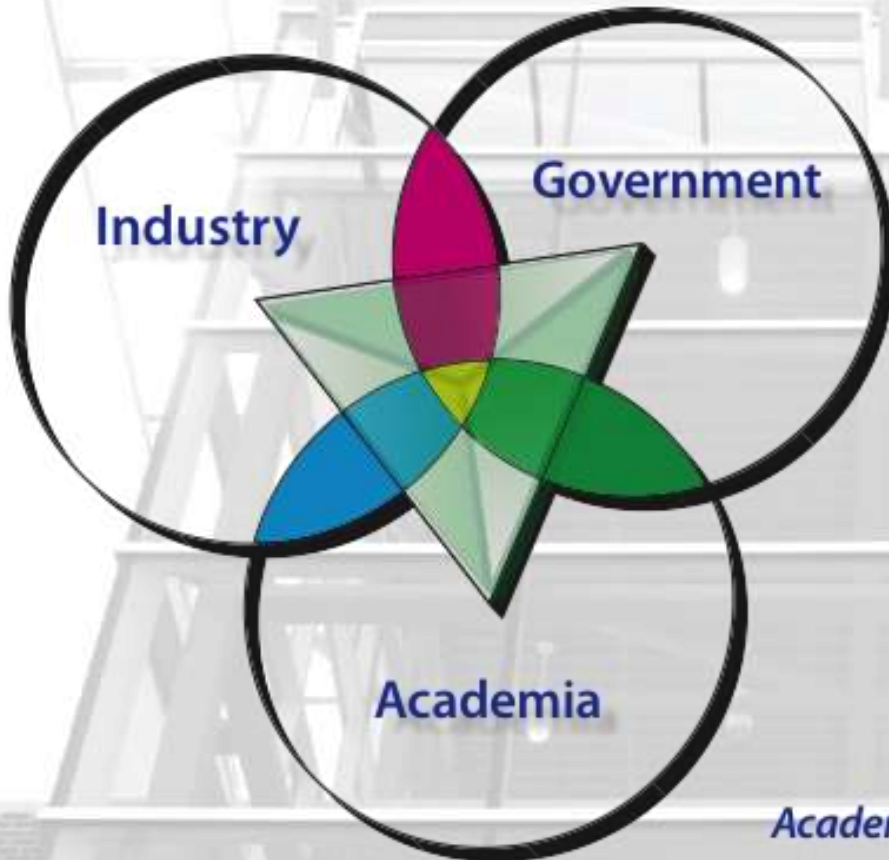
- ❑ **exploring the criminal infrastructure vis-à-vis migration**
- ❑ **assessing disruptive communication vis-à-vis gang and terrorist organizations**



VMASC
Old Dominion UNIVERSITY

Government

Embrace M&S as a discipline and as a serious problem solving and decision support tool.



Industry

Leverage new developments in M&S to provide solutions to the market place and conduct collaborative research with academia.

Academia

Develop new M&S IP to help solve complex problems for industry and government and to provide Industry with the basis for new product development. Provide knowledgeable students to industry and government as part of the workforce development process.

Homeland Security & Defense

Transportation

Virtual Environments

Business & Supply Chain

V M A S C

Social Sciences

Game-Based Learning

Medical & Health Care