



712CD

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Name of Principal Author and all other author(s) Mr. Cortez (Steve) D Stephens, USMC
 Dr. Robert Sheldon
 LT Robin Marling, USN

Principal Author's Organization and address:

MCDC Studies and Analysis Division
 Quantico, VA 22184

Phone: 703-784-6029

Fax: 703-784-9547

Email: cortez.stephens@usmc.mil

Please use the same title listed on the 75th MORSS Disclosure Form 712 A/B. If the title of the presentation has changed please list both.)

Original title on 712 A/B: Analyzing Irregular Warfare (IW) using a Narrative Approach and Agent-based Modeling

If the title was revised please list the original title above and the revised title here:
 Analyzing Irregular Warfare (IW) with Agent-based Modeling

PRESENTED IN:

BACKGROUND GROUP: 10	DEMONSTRATION
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SPECIAL SESSION 1:	TUTORIAL:
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Report Documentation Page

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Si ne petes veritatem, Non quereres nos

Analyzing Irregular Warfare (IW) with Agent-Based Modeling

LT Robin Marling, USN

Dr. Bob Sheldon

Mr. Cortez (Steve) Stephens

Operations Analysis Division (OAD)

Marine Corps Combat Development Command (MCCDC)

75th MORSS

WG-16



Purpose

- **Set forth results to date of the U.S. Marine Corps Irregular Warfare (IW) study**
- **IW study problem**
 - **Given**
 - **Joint, Combined, Inter-Agency, Counterinsurgency (COIN) Environment**
 - **Marine Air-Ground Task Force (MAGTF) Area of Operations COIN mission**
 - **Provide**
 - **Plausible range of resultant civilian population behaviors**



Agenda

- **IW Study Quad Chart**
- **IW Modeling Challenge**
- **Insurgency Behavior Model**
- **Pythagoras Counterinsurgency Application**
- **Critical Issues for Analyzing IW**



Irregular Warfare (IW) Study

• Background

The Joint community has called for analyses in IW, yet very little has been done in the detailed development of irregular scenarios, and even less in the analysis of them.

• Study Question

What is a **good methodology** for analyzing Marine Corps **IW** problems **in-house**?

• Findings

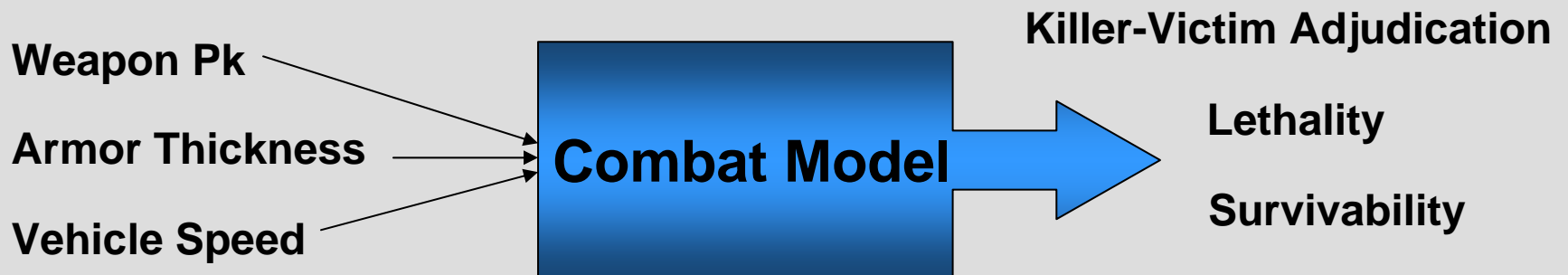
- Rich counterinsurgency literature
- Interagency aspect is a challenge
- **Civilian population is key**
- Population security is critical
- Irregular wars last years, not months
- Two promising methodologies
 - Population Dynamics
 - **Agent-Based Models**



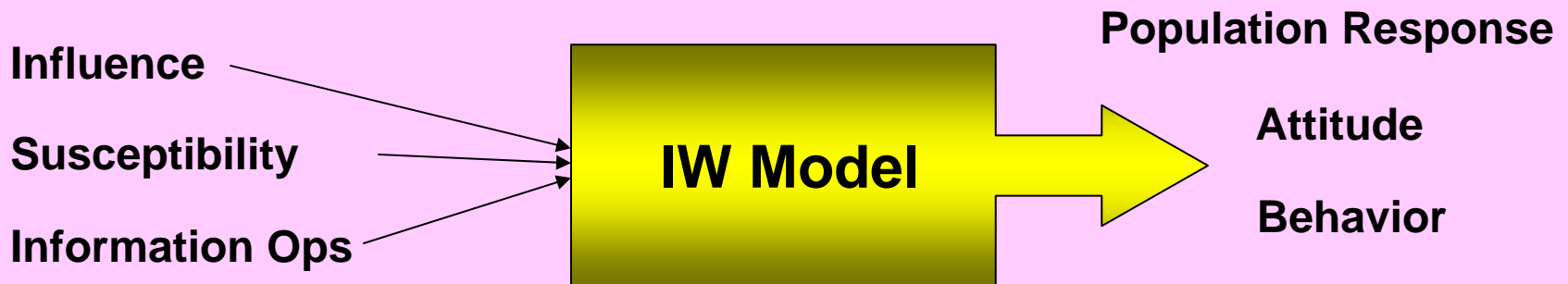


The IW Modeling Challenge

Military OR Analyst Comfort Zone



IW Domain



The Challenge: Different data, different algorithms, different MOEs



IW Modeling: Expectation Management

“Soft Sciences” typically have much lower statistical correlation than “Hard Sciences”

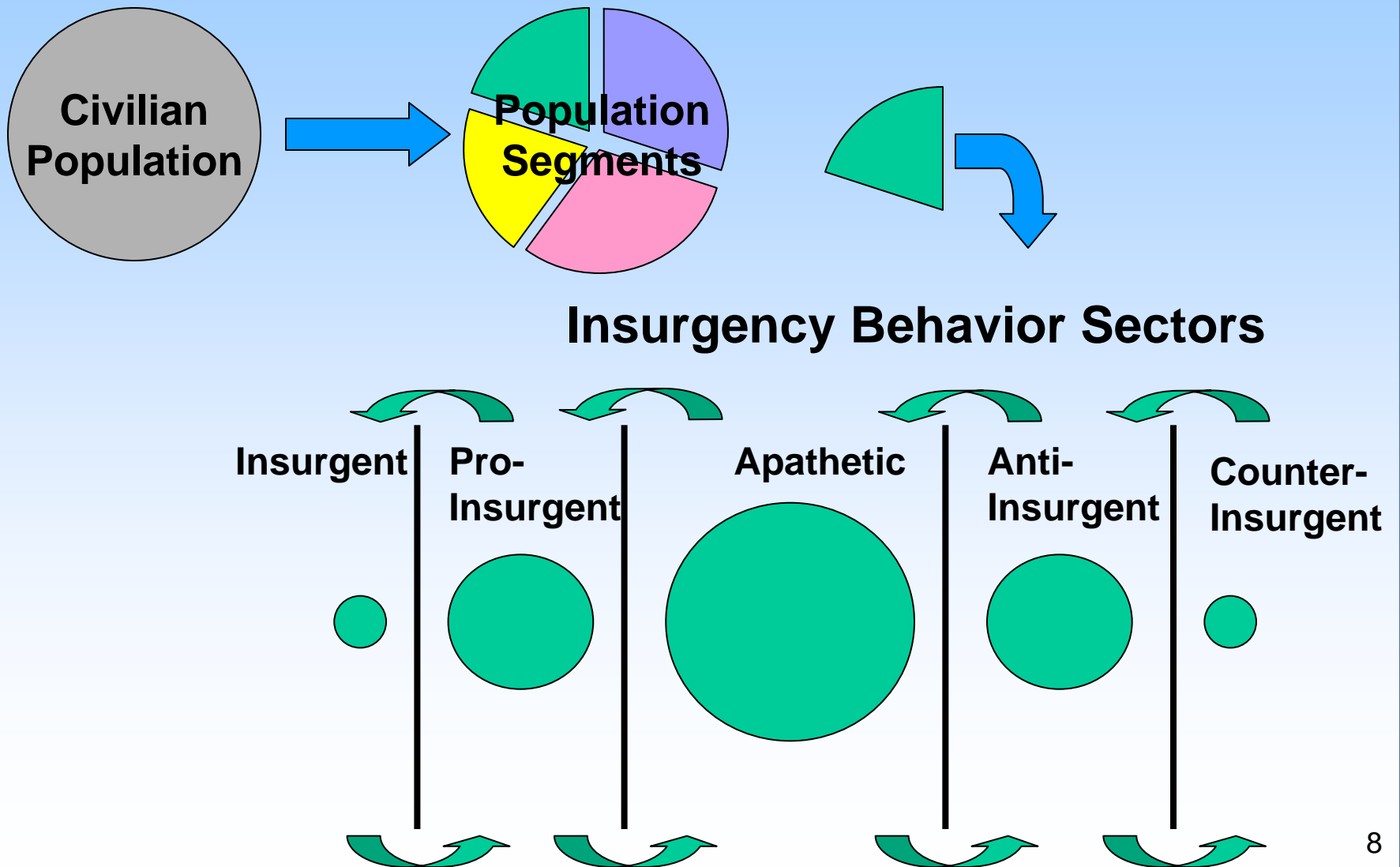
- As a practical matter, for typical data found in the social sciences, values of r^2 as low as **.25** are often considered useful. For data in the physical and medical sciences, r^2 values of **.60** or greater are often found; in fact, in some cases, r^2 values greater than **.90** can be found.***

Modeling human behavior involves a higher level of uncertainty than modeling traditional force-on-force combat

*** *Statistics for Business and Economics* by Anderson, Sweeney, and Williams⁷**



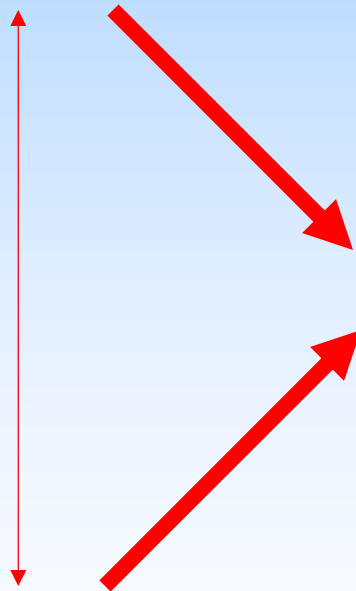
Civilian Population



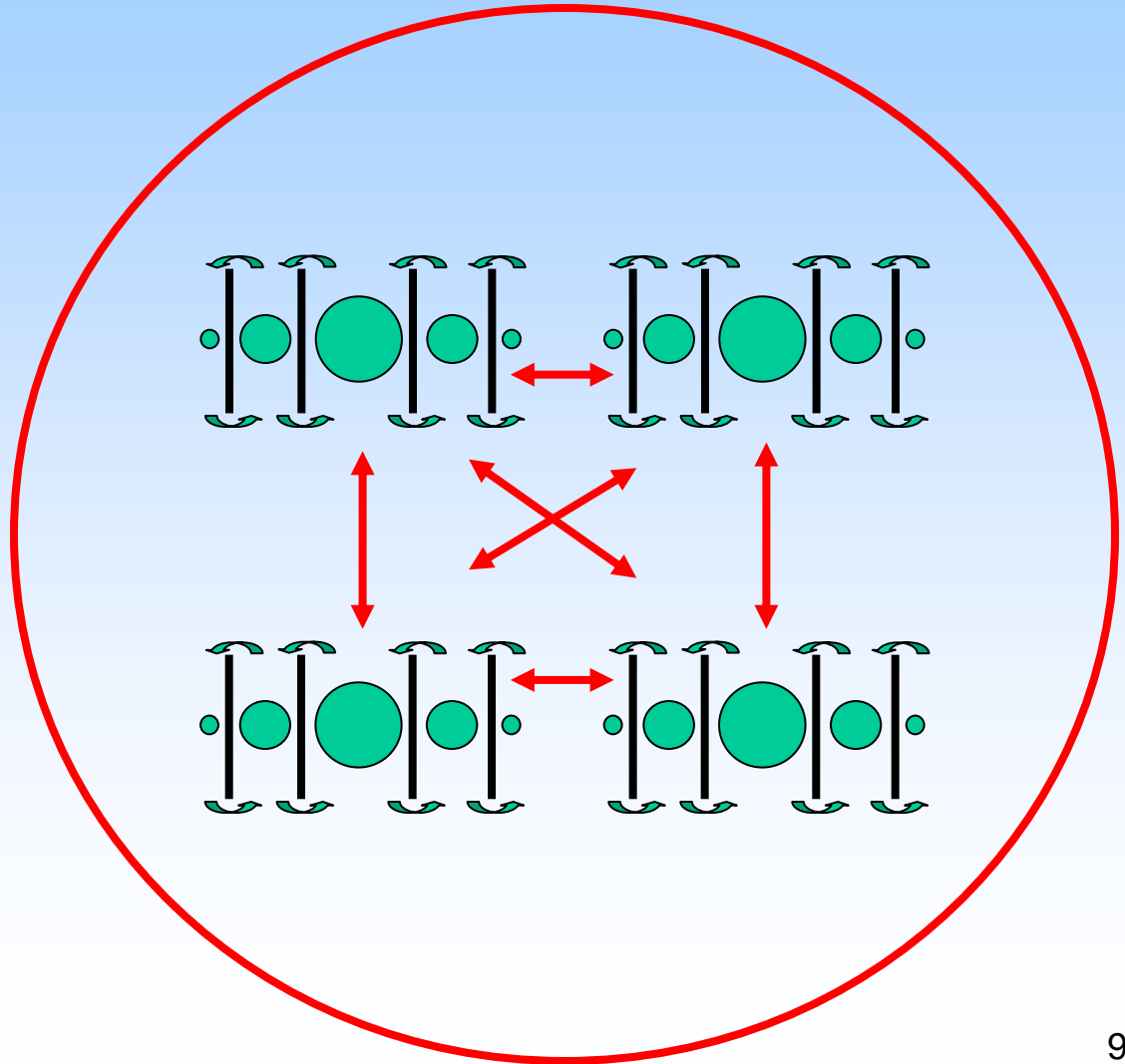


Insurgency Behavior Model

Insurgents



Counterinsurgents





Pythagoras

Counterinsurgency Application

Akela Province

Fictitious “Troubled Country”
Developmental Scenario

Troubled Country’s government is stressed and has turned to the United Nations for assistance combating the insurgency. A combined task force consisting of U.S. and British ground forces (including a MAGTF) has entered the country.

Colombia

Fictitious Scenario: “Operation Pacific Breeze” - - Humanitarian assistance / disaster relief

Deploy a Marine Expeditionary Unit (MEU) and a Marine Expeditionary Brigade (MEB)





Pythagoras Input

- **Population segments & sectors**
- **Population segment demographics**
- **Scenario event list**
- **Population segment behaviors, interrelations, vulnerabilities, & influences**



Pythagoras Input, cont.

- **Data required**
 - Prevalence of current behavior patterns
 - Susceptibility from unfulfilled perceived needs
 - Influence effect of events
 - Interactive influence effect of others
 - Attractiveness of others
- **Probabilities, percentages, and ordinal numbers (quantitative, but non-empirical)**
- **Data sources**
 - Culture-ware SMEs

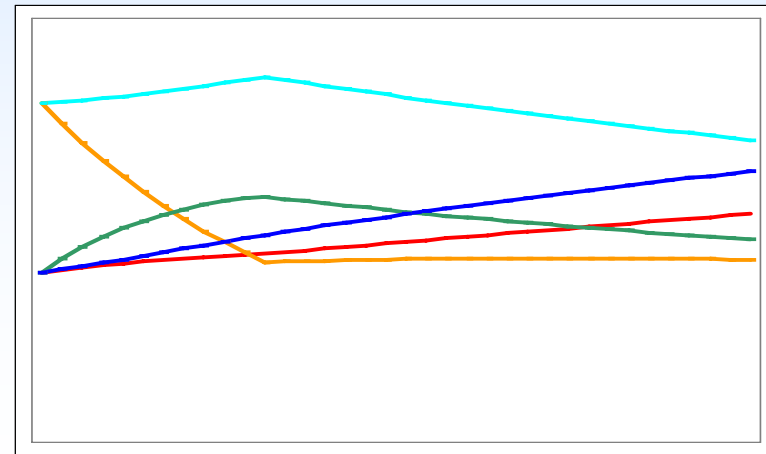
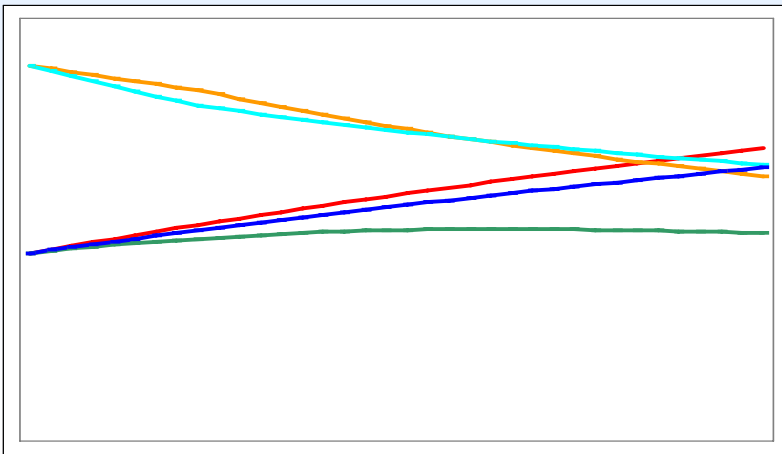
“It’s the data, Stupid!” Dr. Akst



Output

- **Change in population segment behaviors over time**
 - **Experimental design**
 - **Independent variable: MAGTF COA**
 - **COA example: Minimize footprint ashore vs. Establish base camp**

Notional Output





Critical Issues for Analyzing IW

- **Credibility**
- **Analytical rigor**
- **Time**
- **Distance**
- **Resolution**
- **Scalability**
- **Population shifts**



Questions?

- **LT Robin Marling, USN**
 - **Robin.Marling@usmc.mil**
- **Dr. Bob Sheldon**
 - **Robert.Sheldon.ctr@usmc.mil**
- **Mr. Steve Stephens**
 - **Cortez.Stephens@usmc.mil**



Backup Slides

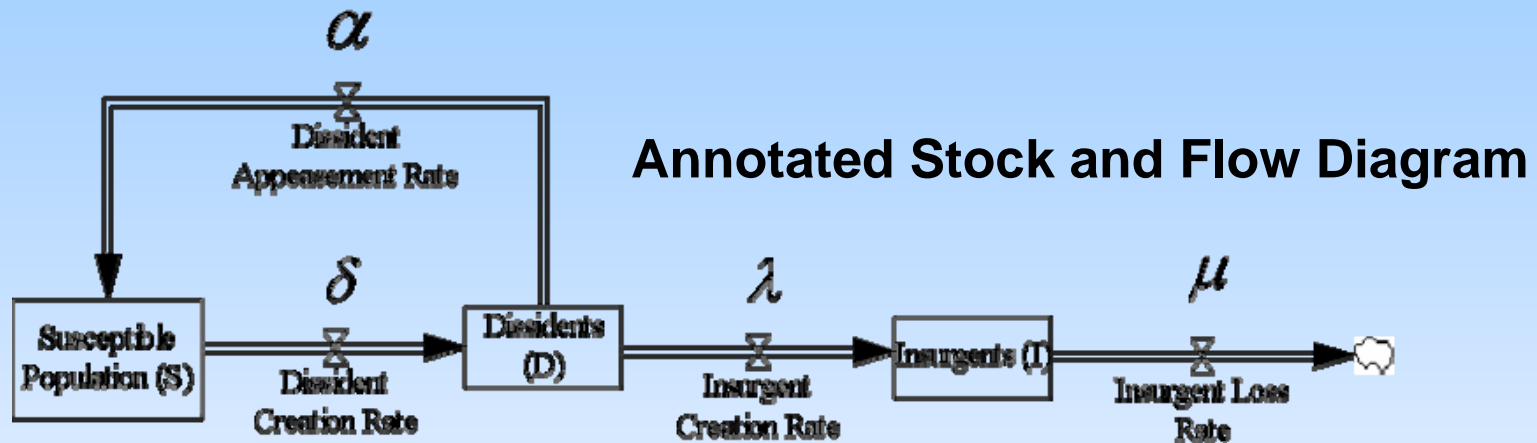


Agent-Based Simulation VV&A

- **1-2 May 2007 ABS VV&A Workshop Goal: Develop general, institutionally acceptable processes and criteria for assessing the validity of agent-based simulations used as part of DoD analyses**
- **Workshop summary**
 - **Elements of validation: results, referent, bounding principle**
 - **ABS validation**
 - **Validation techniques: data validation, SME validation**
 - **Data validation**
 - **Requirements for declaring an ABS valid for an application**



Insurgency System Dynamics Model



Mathematical Model

$$\frac{dP}{dt} = \frac{dS}{dt} + \frac{dD}{dt} + \frac{dI}{dt}$$

$$\frac{dS}{dt} = \alpha - \delta$$

$$\frac{dD}{dt} = \delta - \lambda - \alpha$$

$$\frac{dI}{dt} = \lambda - \mu$$