Reference World Information and Simulation Environment (RWISE 2016)

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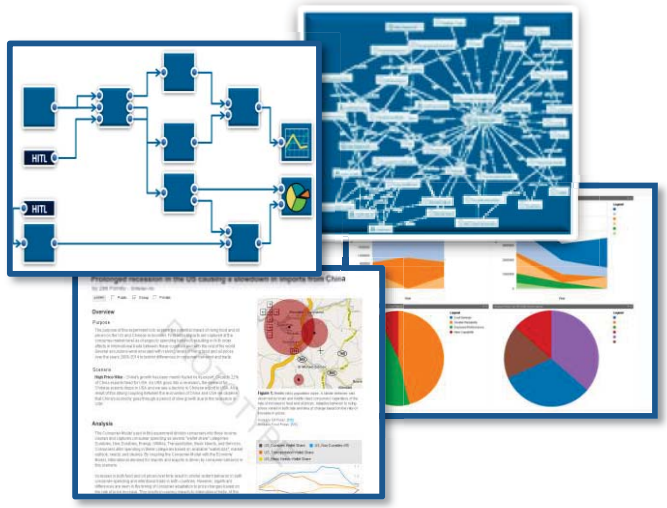
What We Do…

Our Agent based M&S approach

We:

- build a synthetic fabric of layered facets into an environmental model from multiple sources, structured and unstructured.
- model systems as a collection of autonomous decision-making entities call agents
- agents respond to and act on external signals and stimuli based on underlying logic for the agent type.
- You can set the duration of a tick of the clock and decide how many ticks you want to run in the simulation.
- Uses both deductive and inductive logic - allowing new patterns to emerge.

=The best choice for simulating a system composed of entities whose behaviors are complex and non-linear



Some past uses

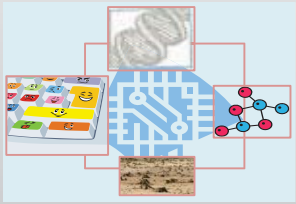
- Criminal Justice Reform policies,
- Kingdom of Saudi Arabia Labor Policies,
- Technology integration
- Consumer behavior modeling,
- Analysis and adaptive planning
- New product launch strategy,
- Cyber offense and defense modeling,
- Identification and analysis of social networks,
- Supply chain security and defense,
- More DoD and DHS applications

RWISE vision – Bringing World in a Box

RW Information Service (RWIS)

Continuous Data Streams
Multi-source triangulation

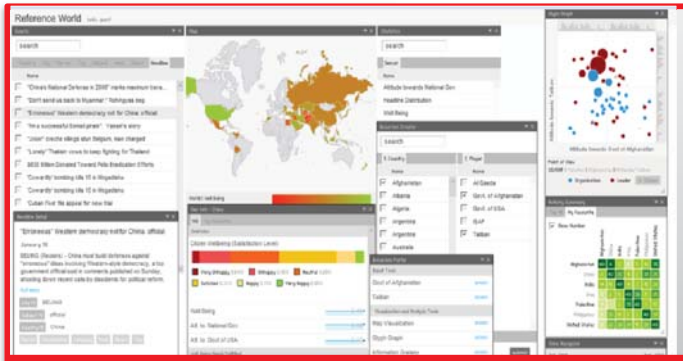
RW Simulation Service (RWSS)



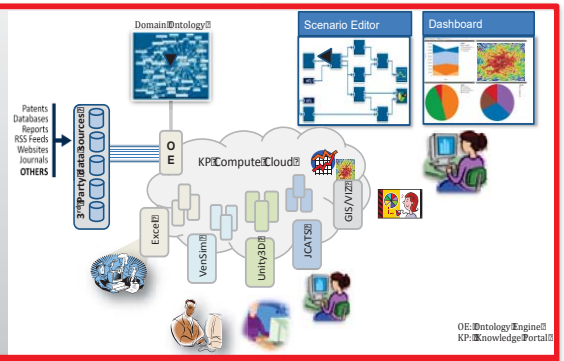
Continuously running multi-paradigm models

RW Collaboration Service (RWCS)

Collaboration: People, Models, & Data

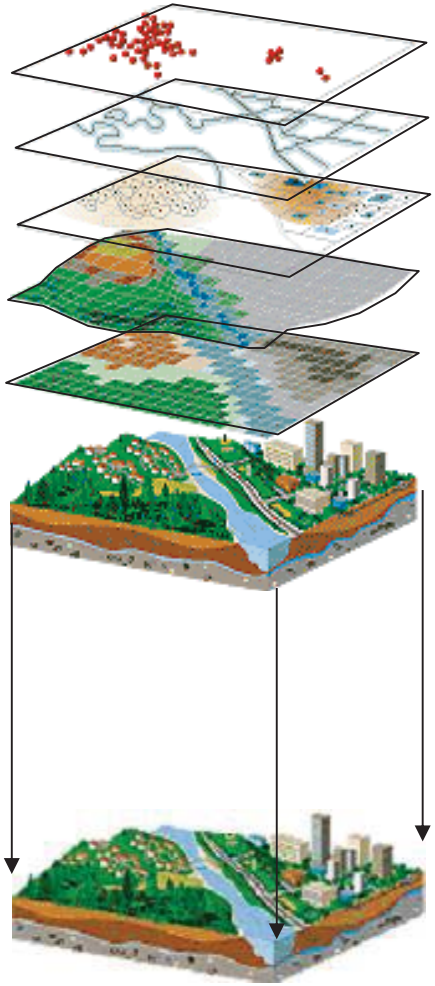


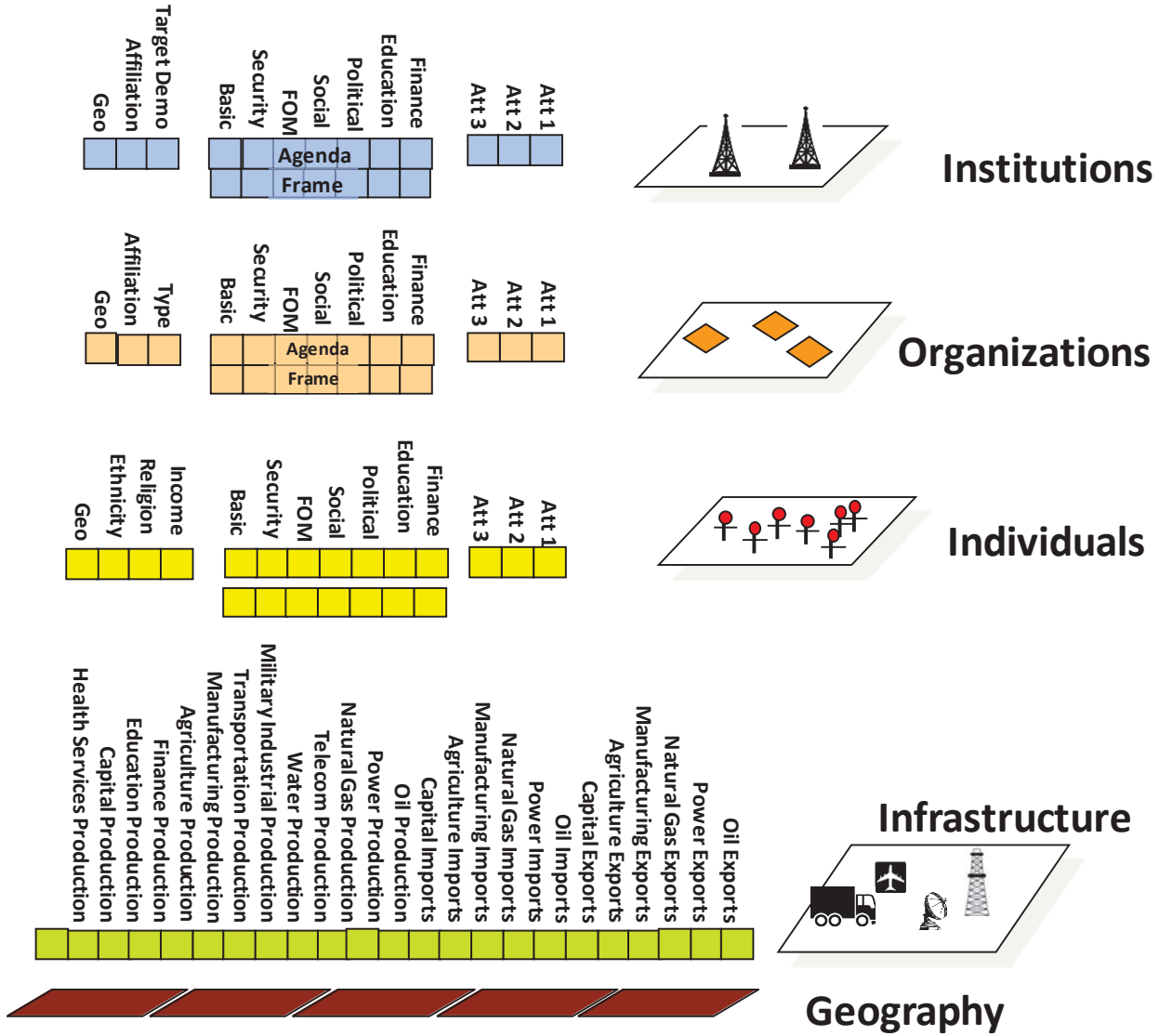
World in a Box



Reference World Information and Simulation Environment

Weaving the Synthetic Fabric

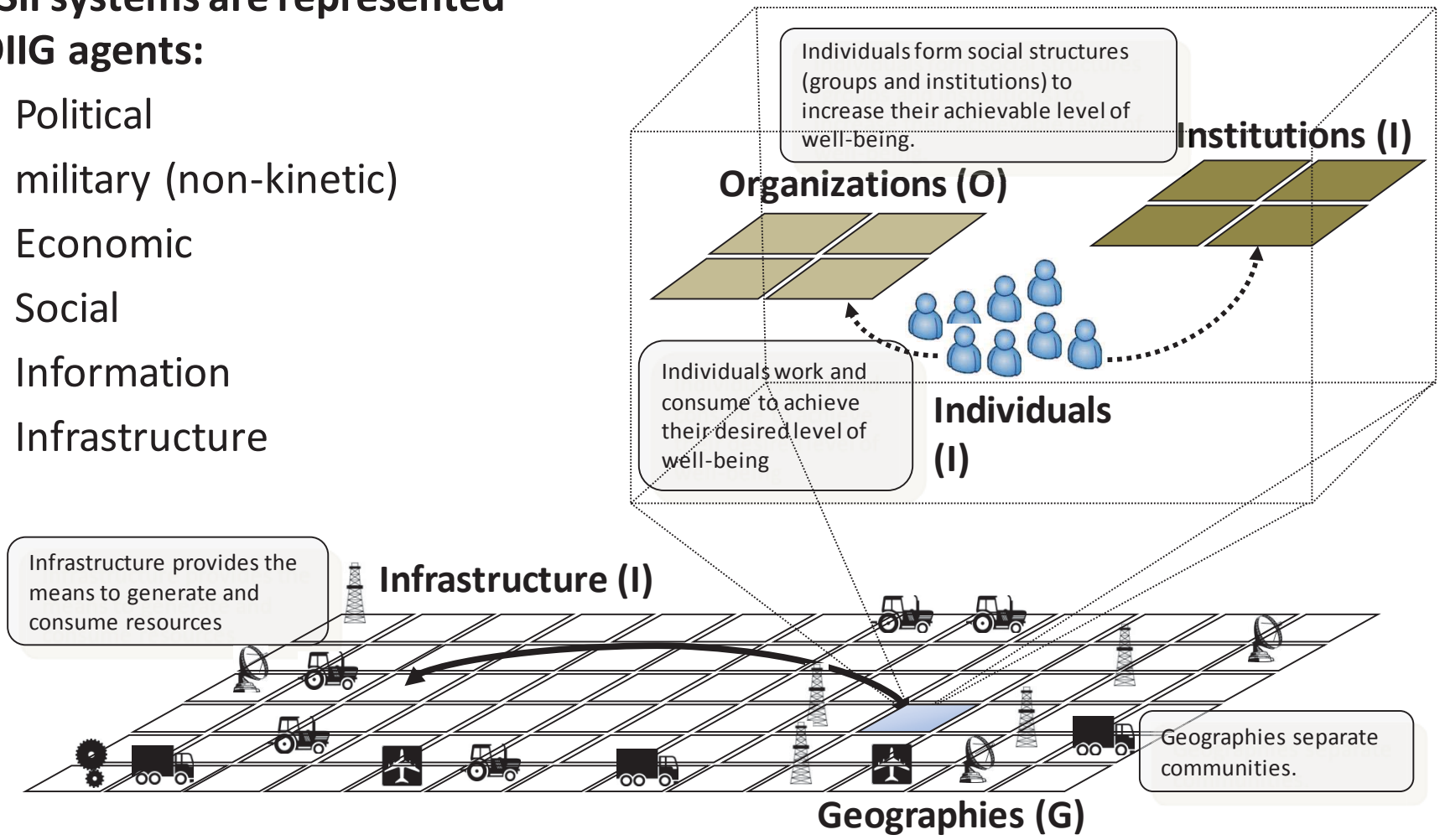




Models: Agent based Representation of Societies

PmESII systems are represented as IOIIG agents:

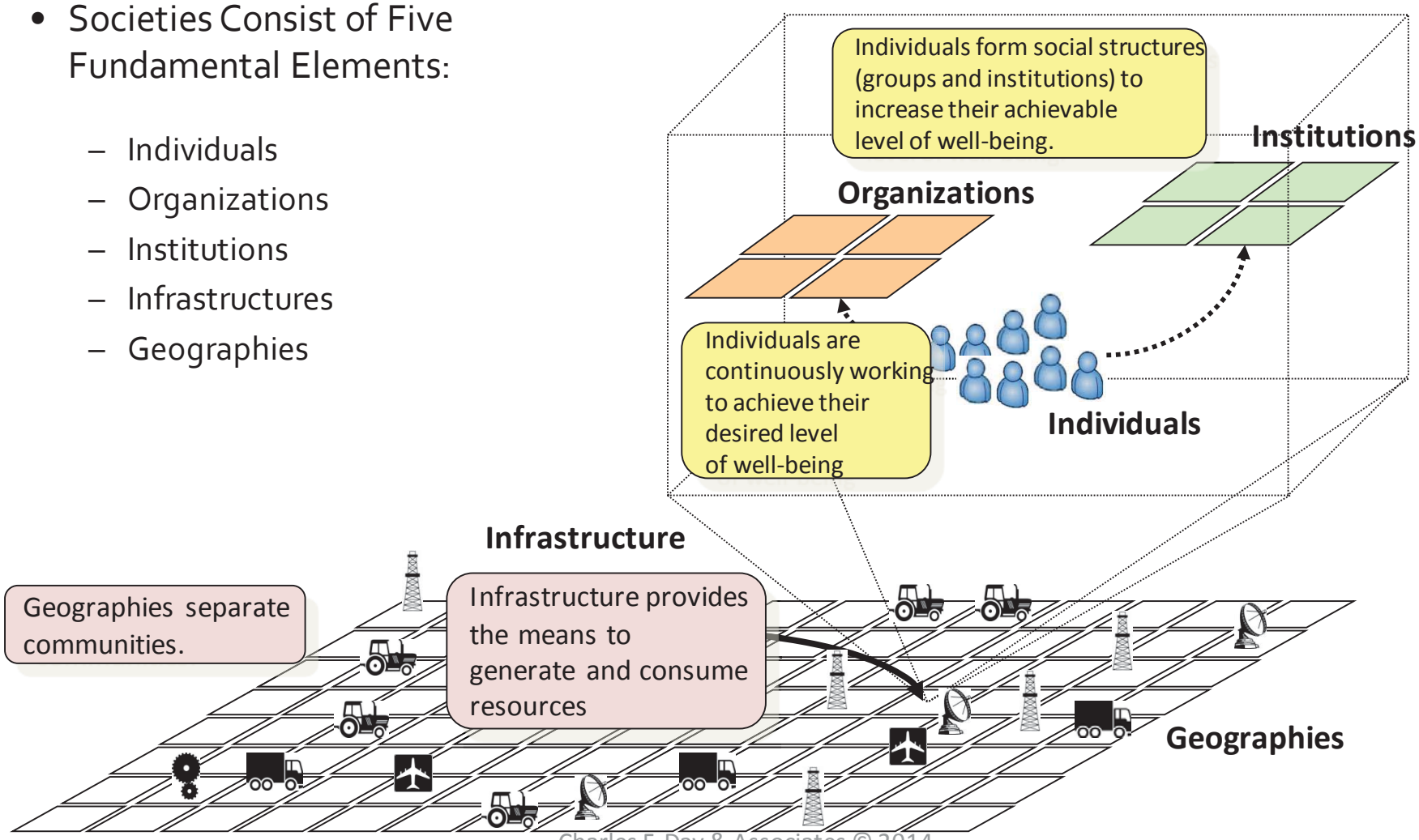
- Political
- military (non-kinetic)
- Economic
- Social
- Information
- Infrastructure



Agents act and behave in a rich synthetic environment …

Synthetic Environments

- Societies Consist of Five Fundamental Elements:
  - Individuals
  - Organizations
  - Institutions
  - Infrastructures
  - Geographies



Cognitively Sophisticated Agents …

Fractal like representation – All agents within the system structured similarly

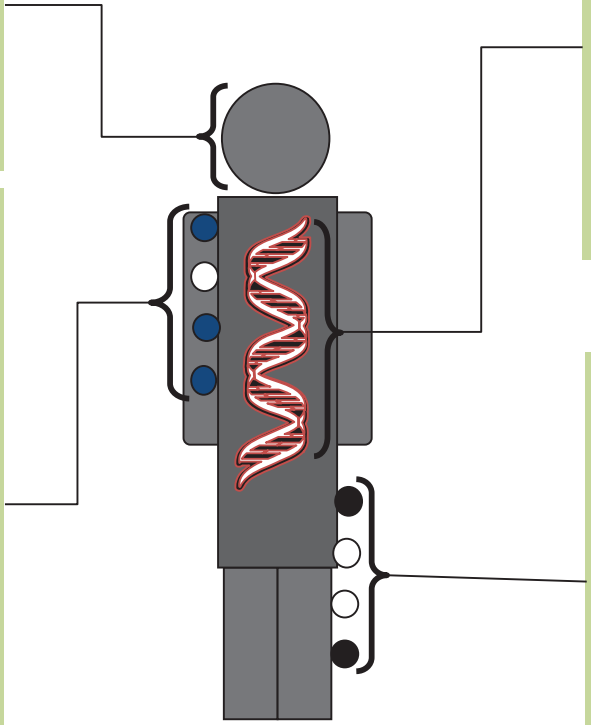
Cognition

- Memory
- Well being perception
- Goal prioritization and activation
- Adaptation
- Sensor management
- Sampling rate selection

Sensors

- Sensors represent the probes through which an agent retrieves information from the rest of the synthetic world
- Sensors are categorized into:
  - o Message Sensors sense communication messages from other agents or avatars
  - o Action Sensors sense interactions with other agents
  - o Environment Sensors sense the synthetic world around the agent

Biological and VLSI Metaphors



Traits

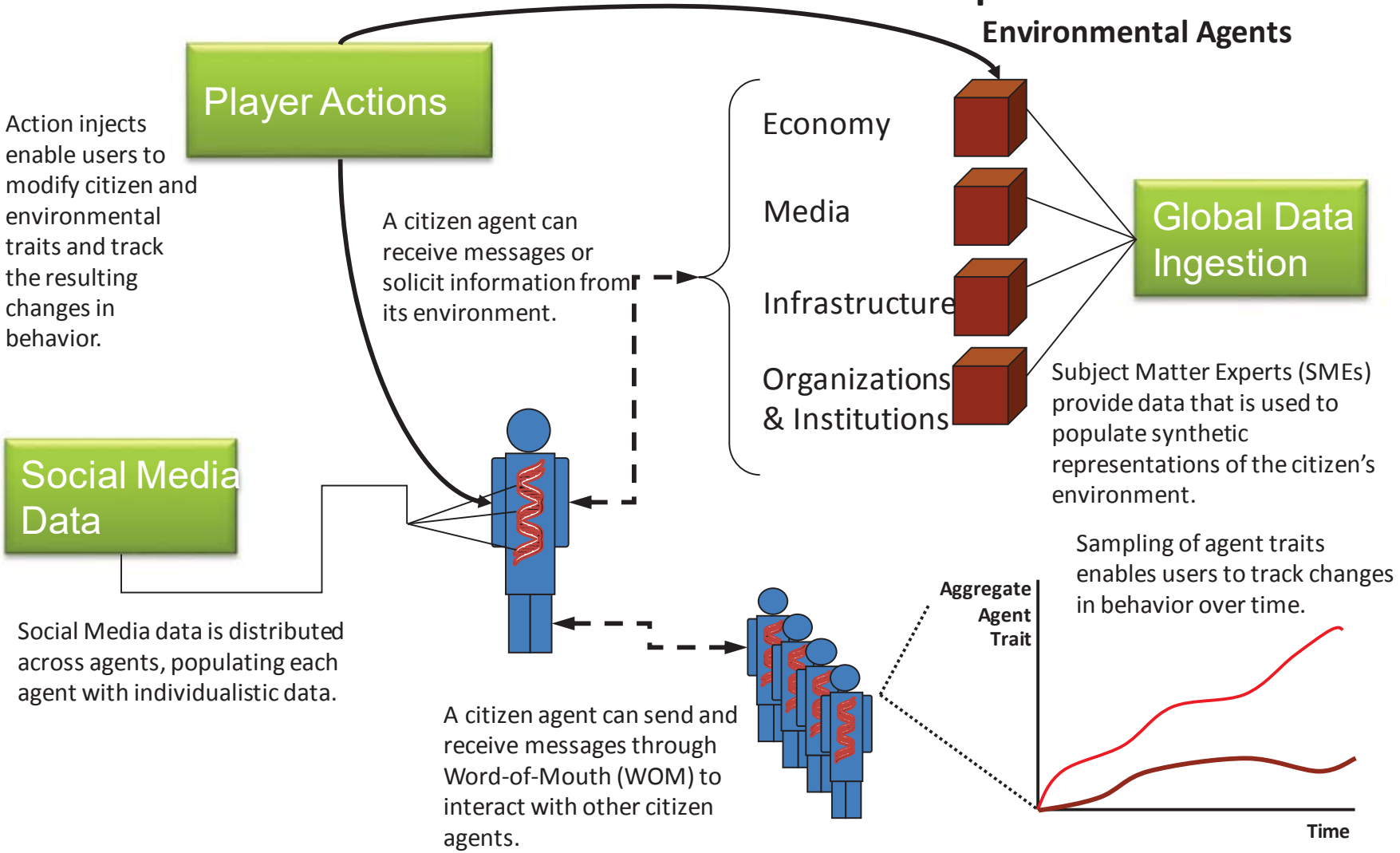
Traits capture the characteristics of an agent. E.g.:

- o Demographics (ethnicity, age, gender, etc.)
- o Behavioral (pleasure seeking, pain avoidance)
- o Physiological (height, immunity to certain virus)

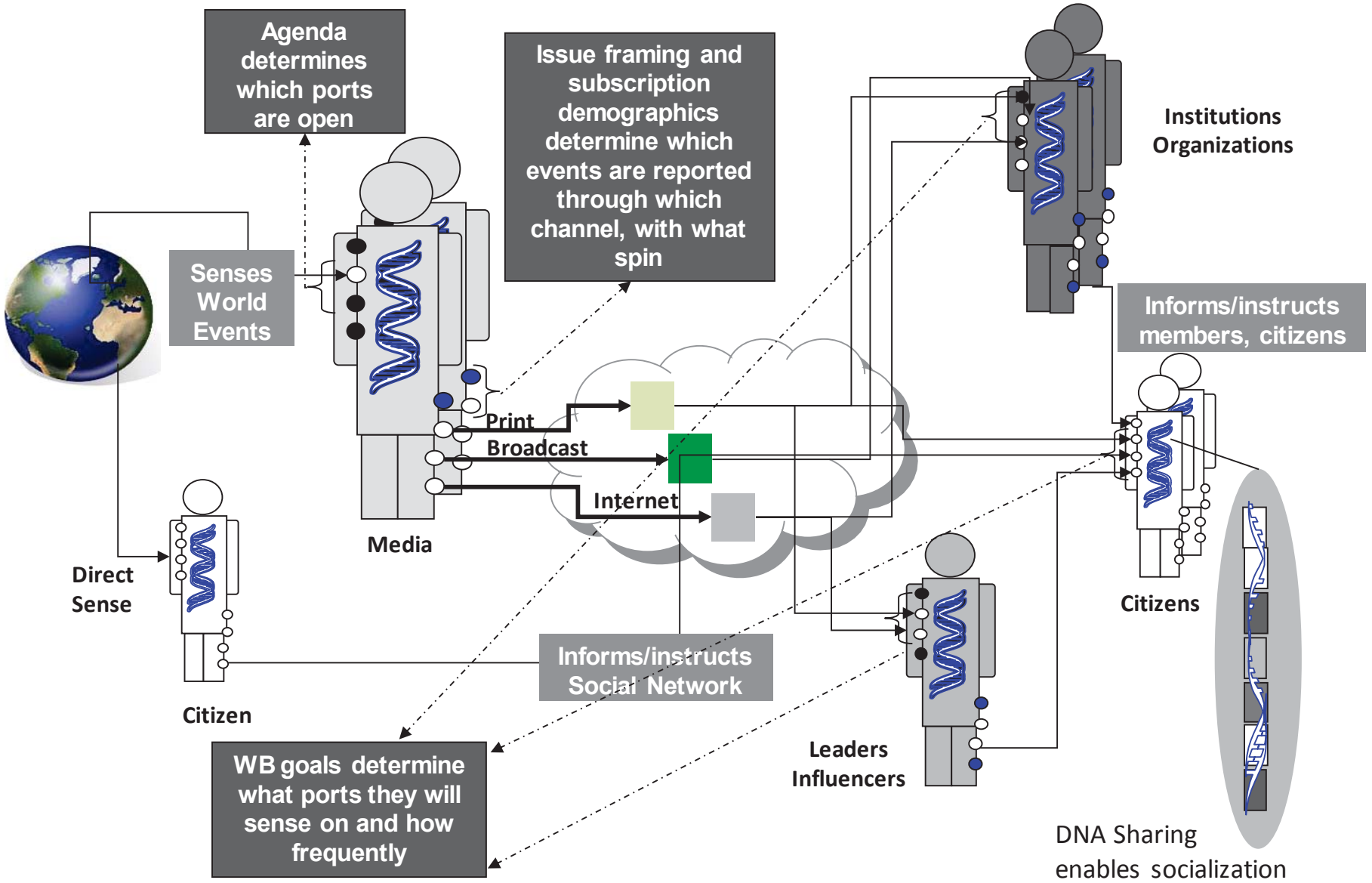
Actions

- Actions represent the interactions of one agent with the synthetic world
- Actions can be directed against:
  - o Self
  - o Another agent
  - o A group of agents
  - o Infrastructure
  - o Economy

… That act on and respond to external signals and stimuli. For example…



… With Socially Sophisticated Agents



Agents share a common architecture, but underlying logic varies according to segment profile

Cognition is the underlying "rule-set" guiding an agent

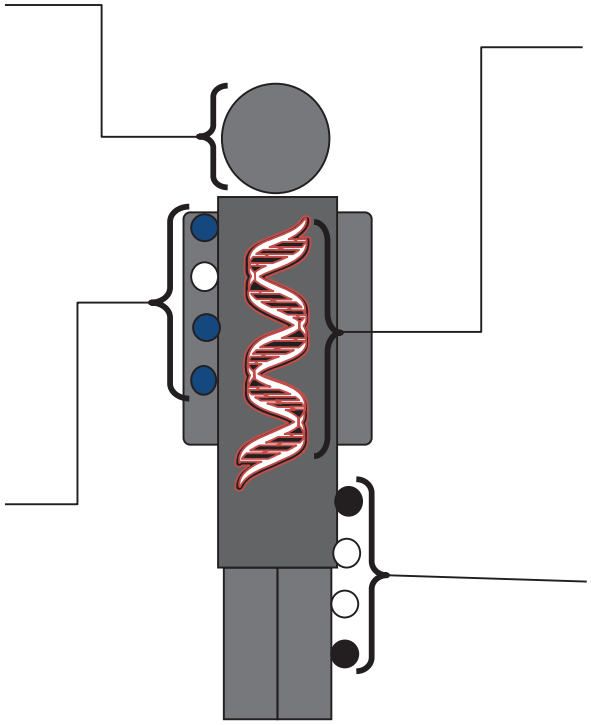
Drug X example:

Positive experiences with previous Drug X doses make an agent more likely to adhere to future doses

Sensors interact with the rest of the synthetic world by sending and receiving information

Drug X example:

Agents can receive and send word of mouth messages to other agents



Traits capture the particular segmentation and characteristics of an agent

Drug X example

An agent could in the Prevention First patient segment, in Georgia, with a mild case of disease

Actions occur between the agent and the synthetic environment

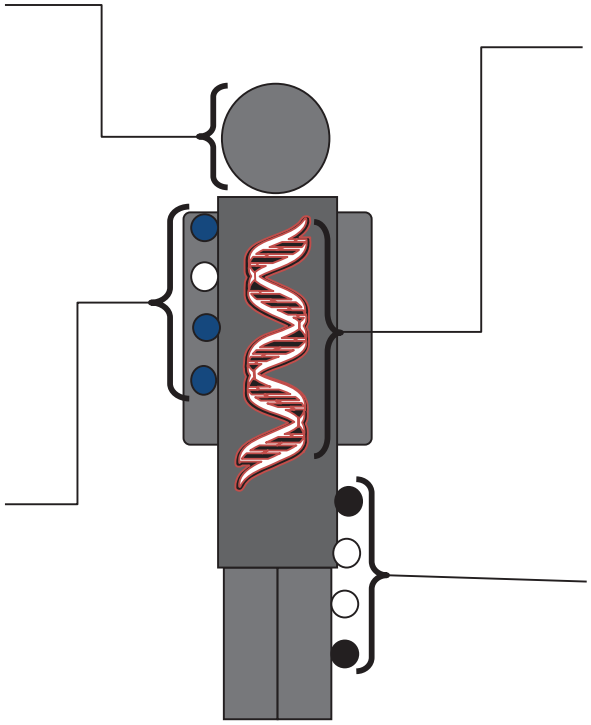
Drug X example:

An agent can visit the physician, then fulfill and comply with a prescription for Drug X

…Or for modeling systems as diverse as self-organizing communications networks…

Cognition is the underlying "rule-set" guiding an agent
Communications example:
Can use algorithms from;
Optimization
Artificial Physics
Genomics

Sensors interact with the rest of the synthetic world by sending and receiving information
Communications example:
Agents (antenna and satellite) can receive and send electronic signals to other agents



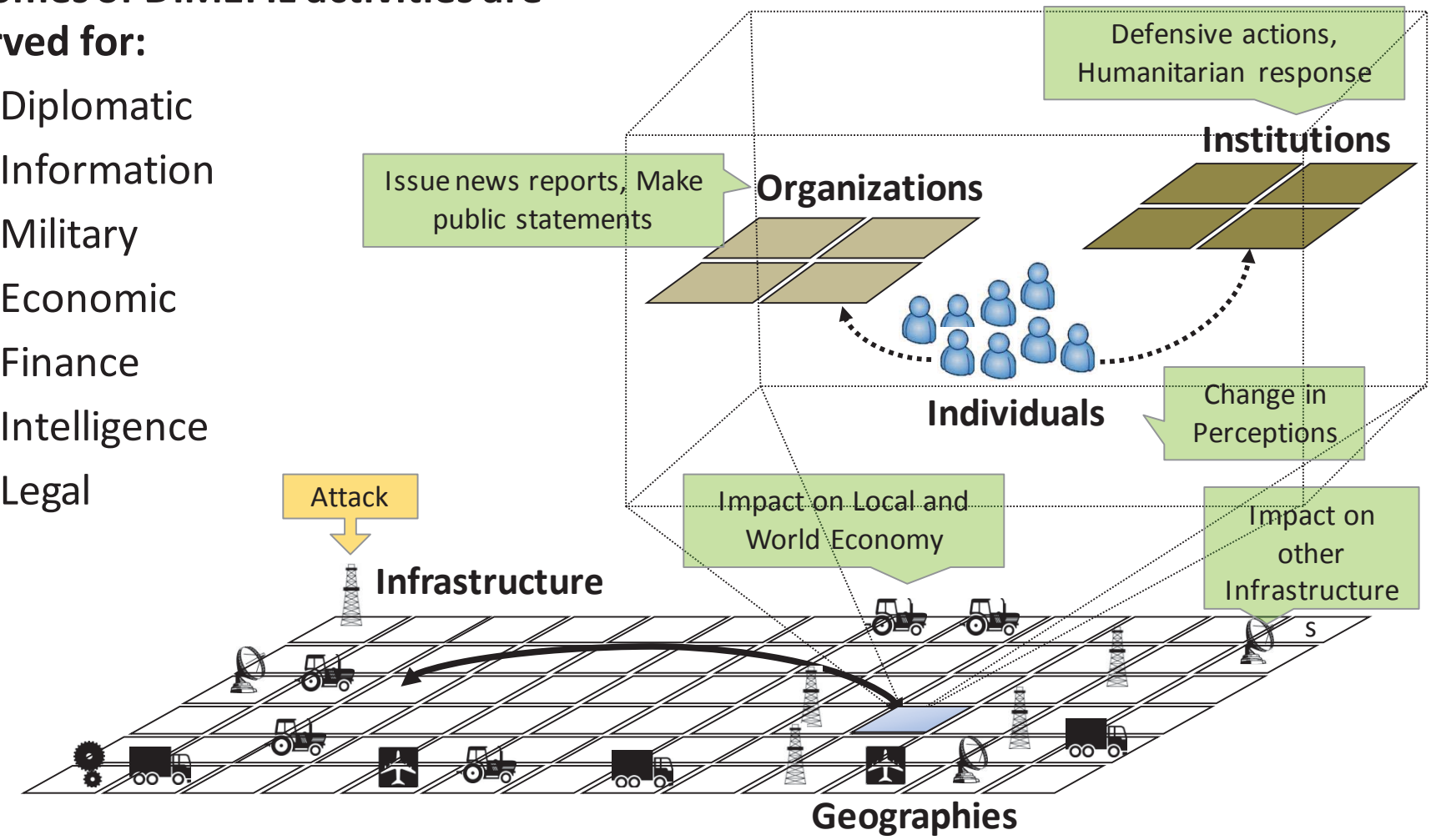
Traits capture the particular segmentation and characteristics of an agent
Communications example:
Antenna bandwidth
Signal strength
Signal/power decay rates or cycles
Line of Sight or curvatures

Actions occur between the agent and the synthetic environment
Communications example:
Agents can self organize on the ArcGIS to maintain signal viability throughout the simulated timeframe.

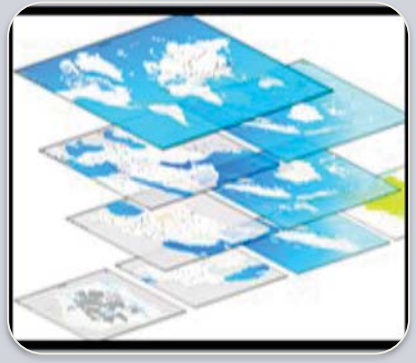
Simulation: Observing outcomes

Outcomes of DIMEFIL activities are observed for:

- Diplomatic
- Information
- Military
- Economic
- Finance
- Intelligence
- Legal



RWISE Capability for Consequence of Execution Analysis

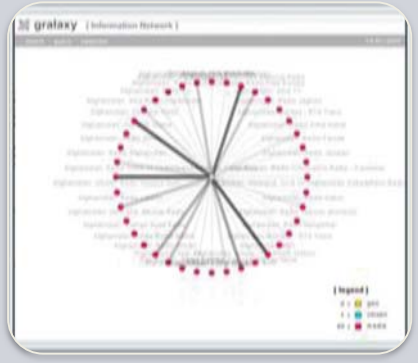


Multi-scale Geography

- Operationally tested at ISAF
- PmESII models of over 80 countries
- Over 200 DImEFIL actions
- Highly scalable and SOA based computational Infrastructure
- Continuously updated

Economy & Infrastructure

- Integrated model of micro-macro economies of 80+ countries
- Over 40,000 infrastructure nodes
- 16 Economic sectors
- Configured, calibrated and validated with real world data



Information

- Over 500 media outlets
- Their subscribers and their demographics
- Stance on issues
- Agenda and framing
- Thousands of media/information infrastructure
- Strategic Communication

Political & Social

- Local, Provincial, and National Governments
- Types and duration of regimes
- Over 1000 political and social leaders
- Over 12M citizen
- Hundreds of population segments
- Hundreds of organizations

SELECT CURRENT / PAST PROJECTS

Case Study: Consumer Behavior Models

Overview:

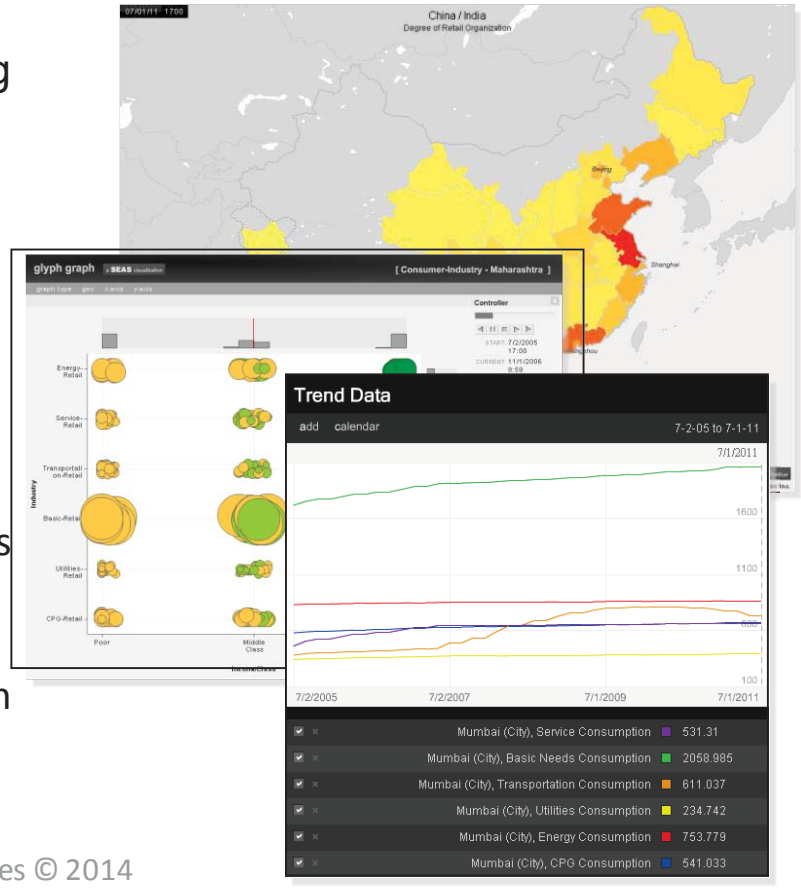
Synthetic representation of consumer markets and their spending behavior through industry wallet shares. Used by large corporations to better understand how changing economic and environmental conditions in India and China will affect consumer spending.

Helps Market Strategists Understand:

- The impact of government actions and competing industries on household consumption and wallet shares
- How and why consumer wallet size changes
- How and why consumer wallet shares change

Examples of Key Insights:

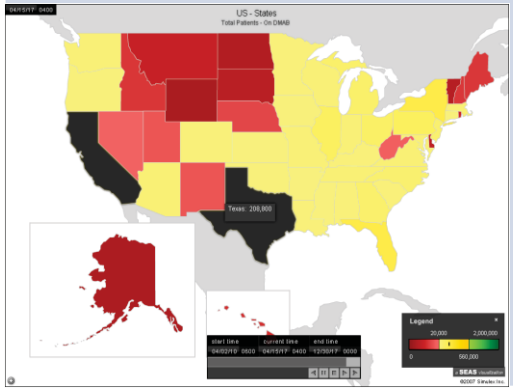
- **Market Analysis in India:** The introduction of the "People's Car" by Tata Motors is projected to significantly shift spending from basic needs products to transportation in highly urbanized areas with slower adoption following in rural areas
- **Market Analysis in China:** Planned infrastructure expansion will likely increase overall consumption in rural areas, but increased advertising spending will yield only a limited increase in CPG wallet share



Case Study: Virtual product launch

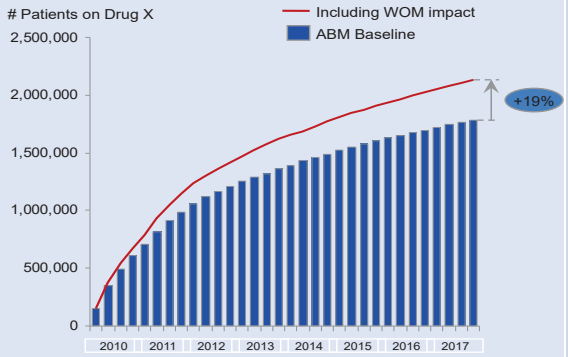
Need

- Develop a launch strategy to maximize consumer uptake
- Anticipate and shape physicians' behavior
- Anticipate and shape consumers' behavior
- Incorporates robust model of word of mouth and social network effects
- Identity patient segments with heterogeneity in behaviors

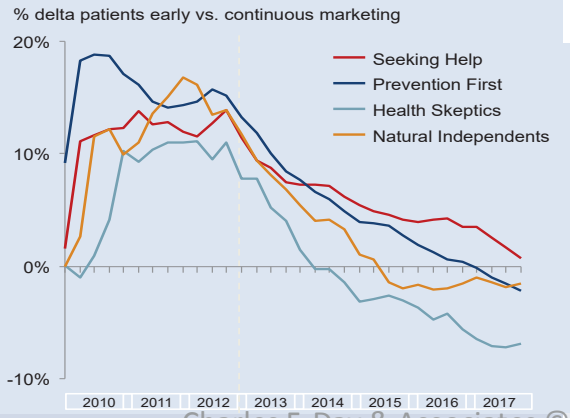


Solution

Including WOM drives patient growth higher than baseline scenario



The impact of marketing and word of mouth varies by patient segment



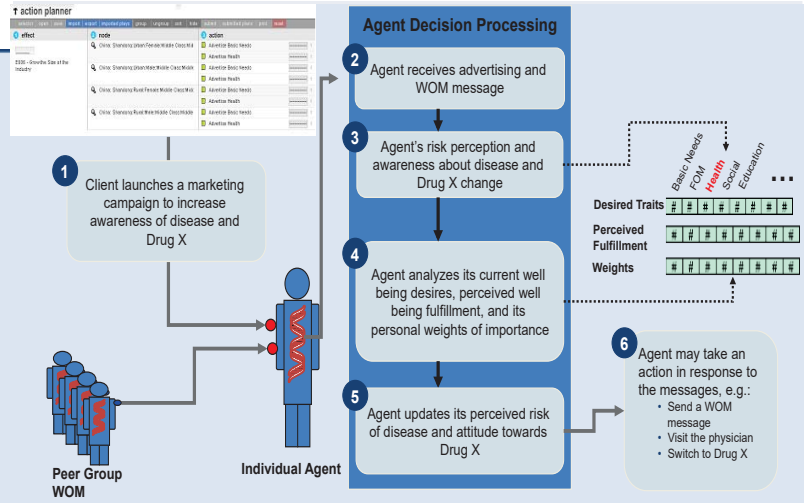
Benefits

Developed strategies for:

- Increasing preference for Drug X
- Intensifying WOM effect
- Improving patient adherence decision

Key Insight:

- A front loaded marketing campaign generates more "buzz" than a continuous, lower intensity marketing effort
- Segment that focuses on prevention is the most responsive to marketing / word of mouth and could be a quick win



Case Study: Analysis and Adaptive Planning

Overview:

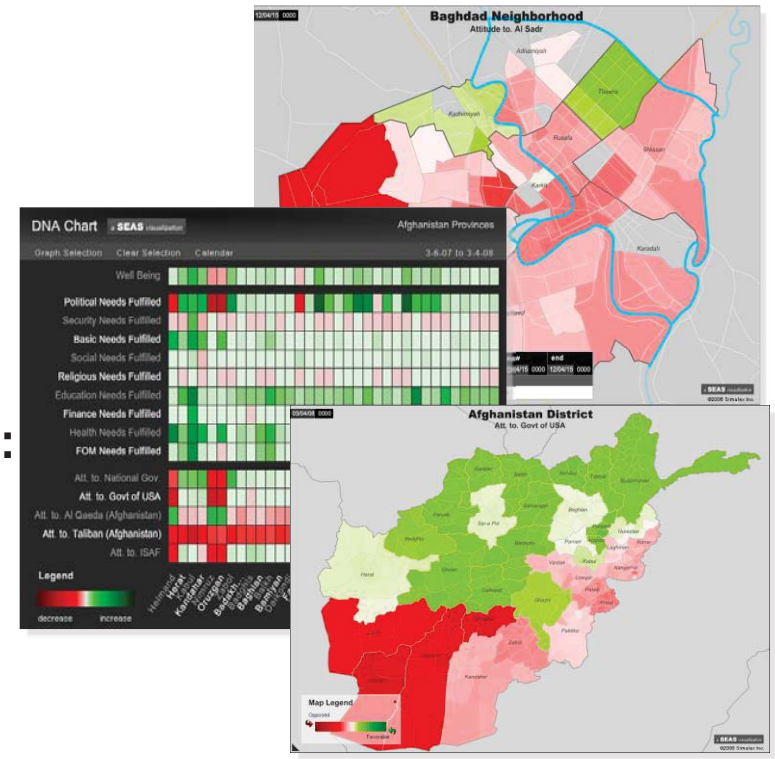
RWISE SEAS-VIS) offers a representation of geographies as Political, Military, Economic, Social, Information, and Infrastructure (PMESII) nodes at any level of granularity. Users can play the role of any entity within the relevant scenario, taking related actions against other nodes. This provides experimentation capabilities that capture environmental complexities far beyond any single model. *The ability of RWISE to maintain a continuously updated, dynamic simulation environment allows users to maintain up-to-date strategies through adaptive planning.*

Helps Leaders Understand:

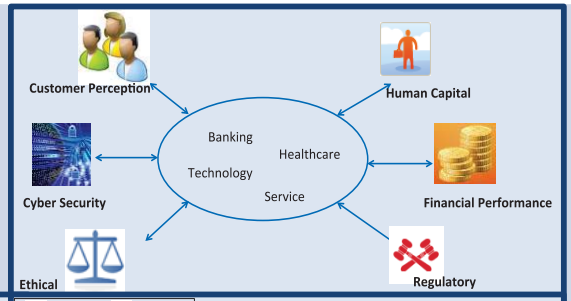
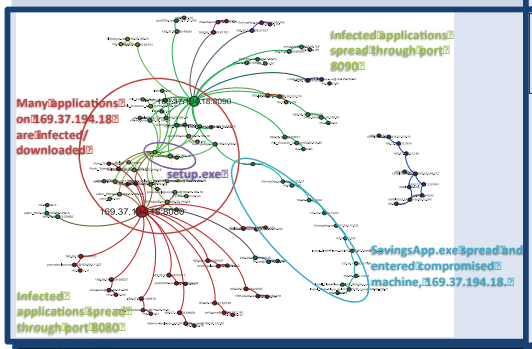
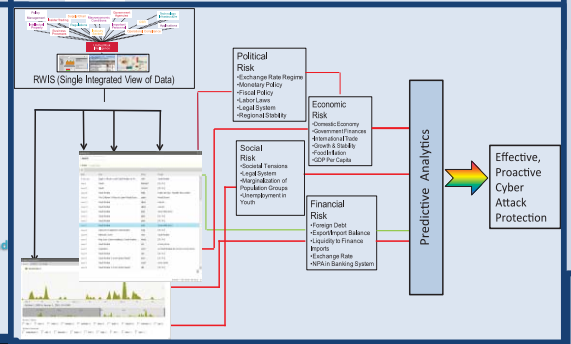
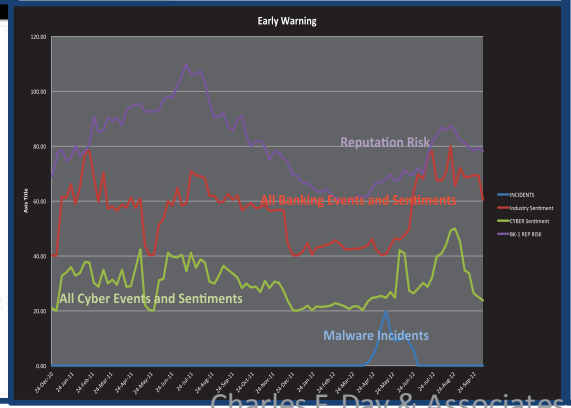
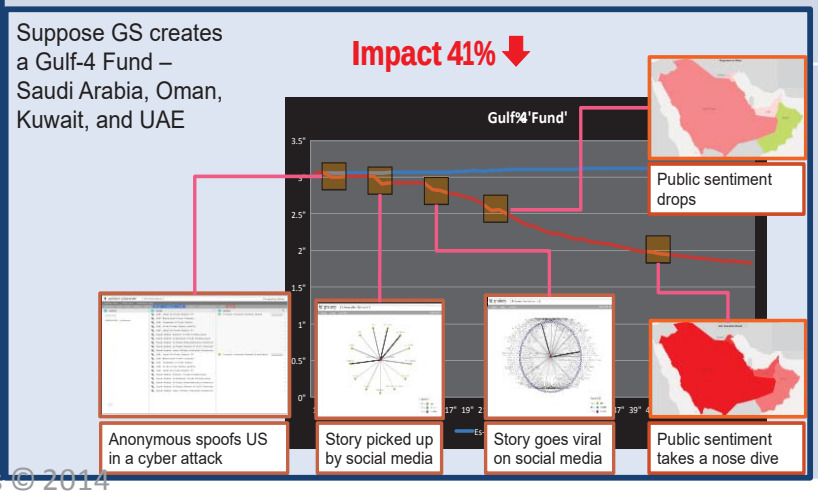
- The impact of different operations (Diplomatic, Information, Military, and Economic) on needs and opinions of the general public
- Optimal courses of action in different regions throughout the country to achieve specific goals
- How complexities of interactions among different operations may yield unexpected outcomes

Some Benefits and Insights from Past Projects:

- Used to shape numerous strategies in the field and train personnel in Effect-Based Operations, including a 14 month deployment in Afghanistan



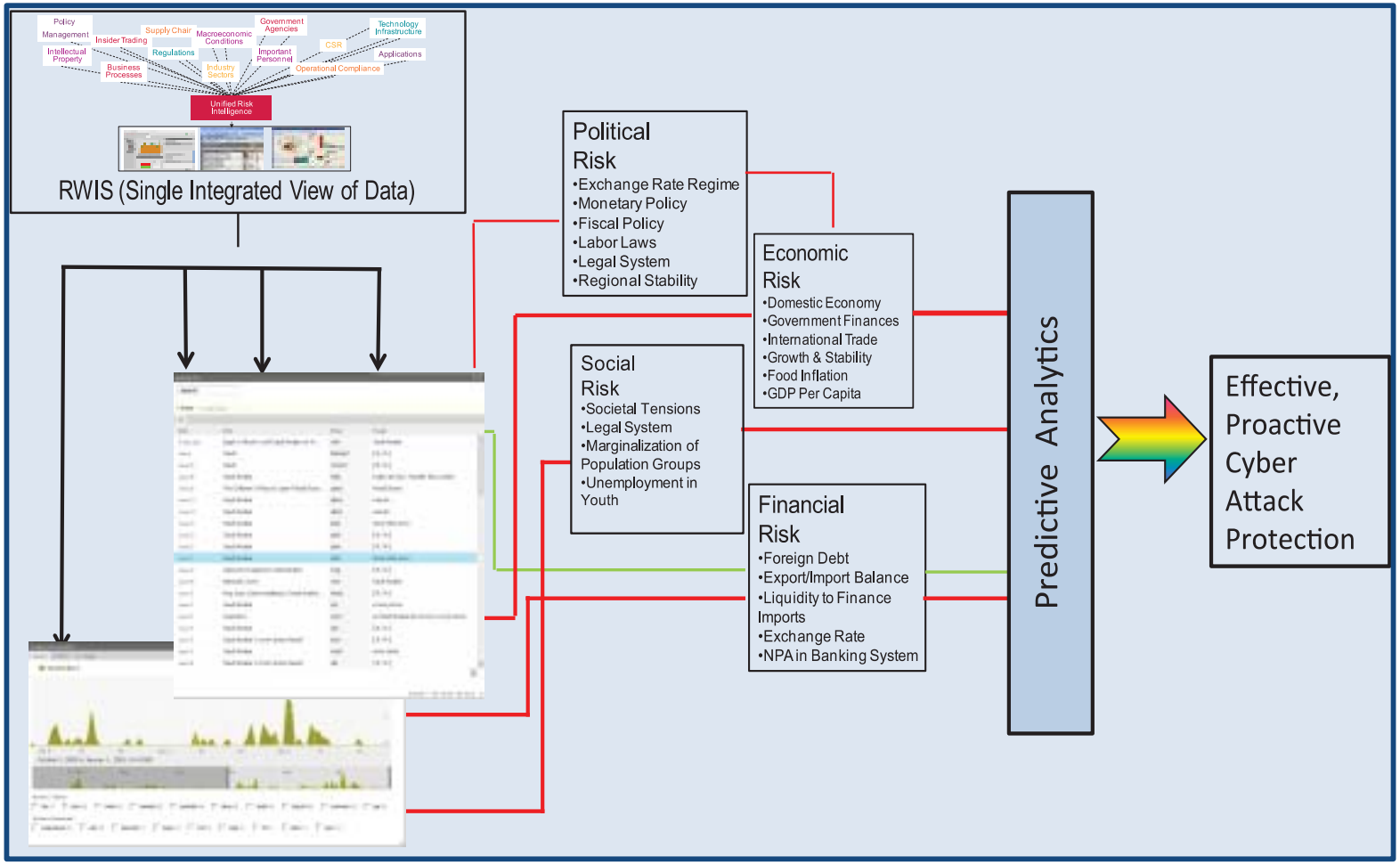
Case Study: Modeling Reputation Risk in the Financial Sector

Need	Solution	Benefits
Early warning system through analysis of malware incidents and social media chatter		• Quantifying reputation risk as a function of political, Economic, Financial, social, and cyber risks • Identifying hidden linkages in variety and velocity of data • Identifying the origin and propagation for threat and incident
		
		
		
		
		

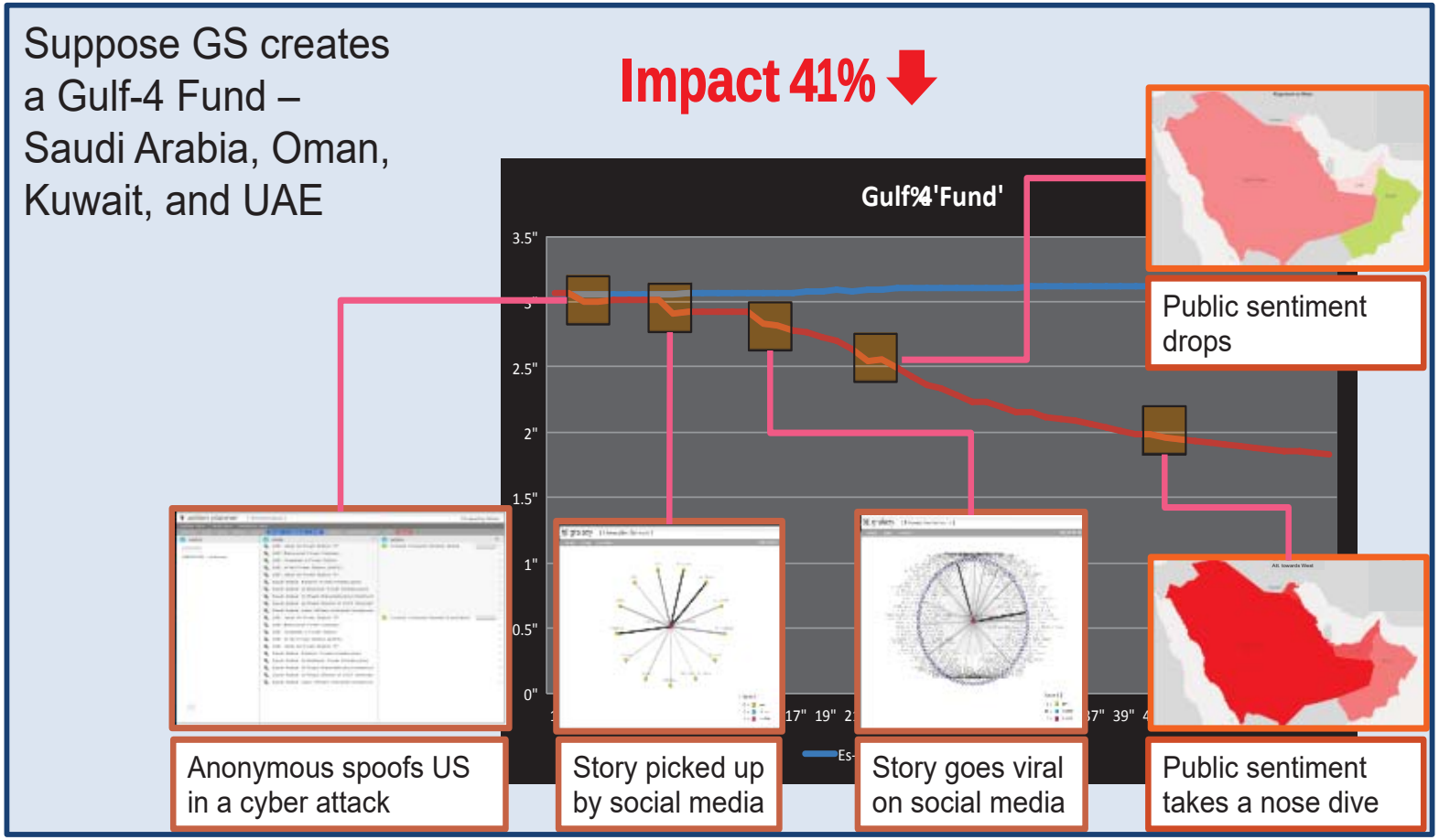
Suppose GS creates a Gulf-4 Fund – Saudi Arabia, Oman, Kuwait, and UAE

Reputation Risk Facet: Competitive Risk Analysis

Reputation Risk Facet: Business Risk Analysis

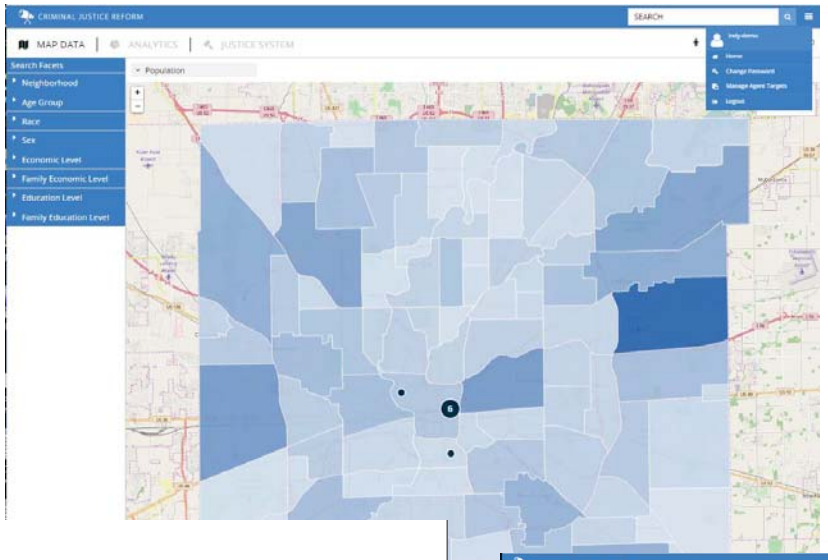


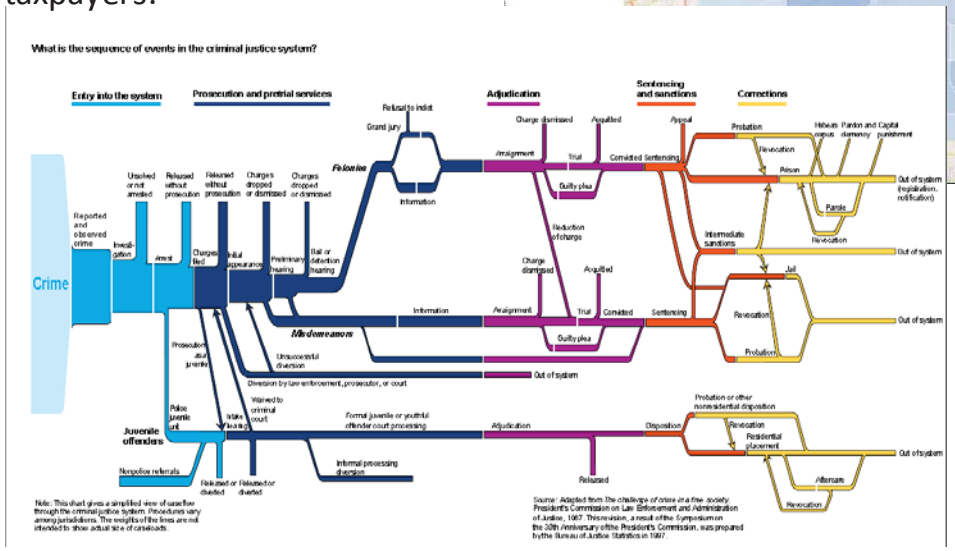
Reputation Risk Facet: Reputation Risk Analysis

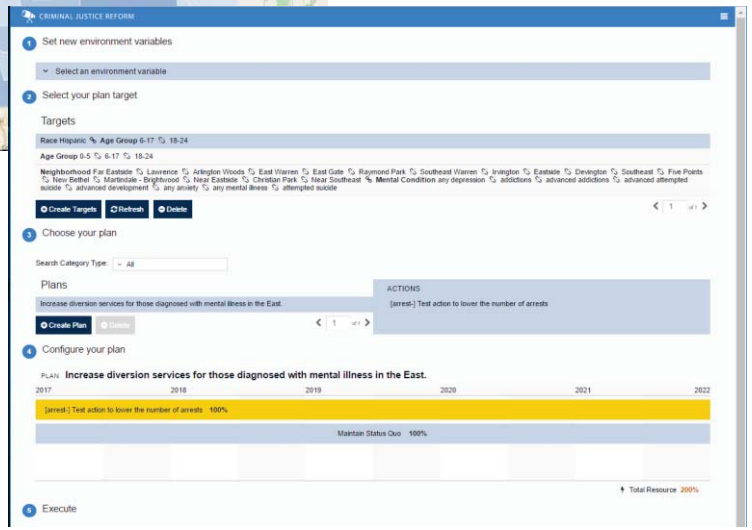


Case Study: Criminal Justice Reform

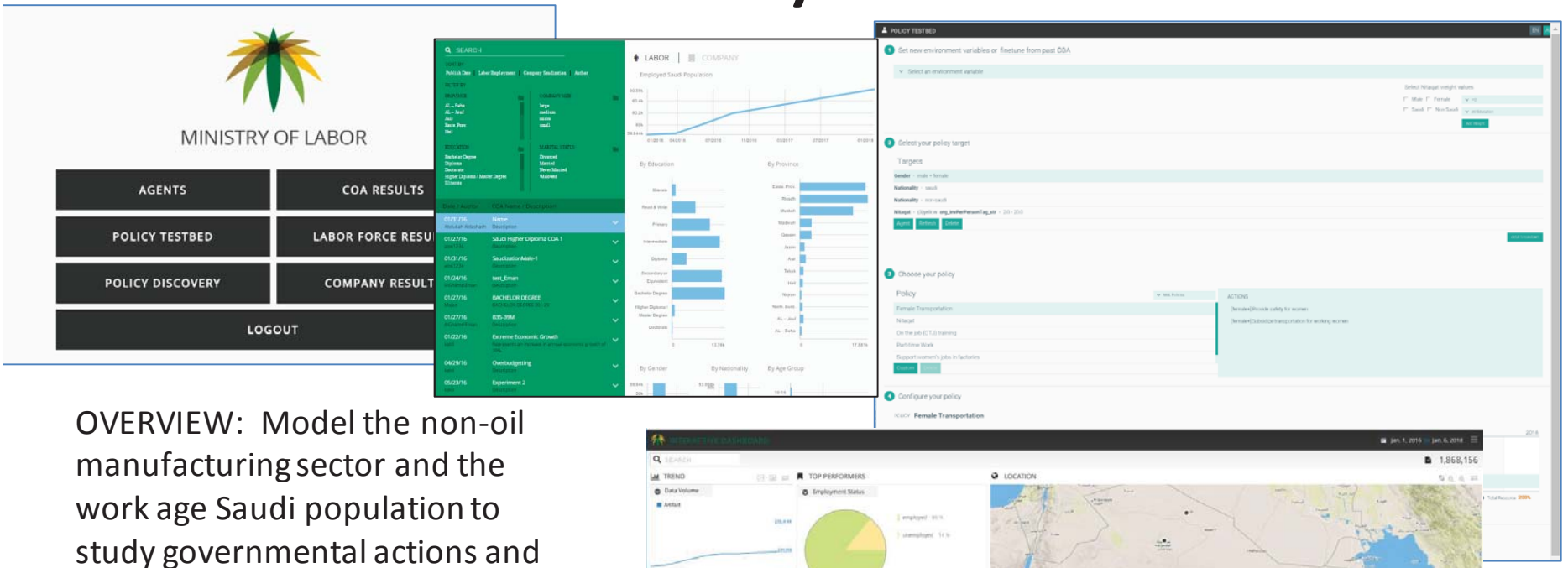
OVERVIEW: Model the Criminal Justice System within Indianapolis / Marion County to study the effects of policy intended to maintain safety and security while improving services to reduce incarcerations and improve reintegration of offenders into society – all while reducing costs to the taxpayers.







Case Study: KSA MoL

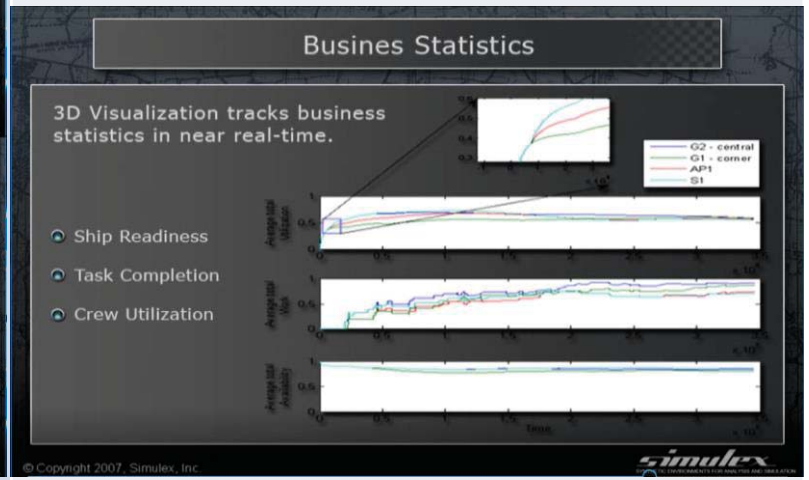


OVERVIEW: Model the non-oil manufacturing sector and the work age Saudi population to study governmental actions and policies to be taken to increase Saudi workforce participation. Build and test policies of:

- Incentives and penalties to workforce eligible adults
- Incentives and penalties to
- Businesses by size and type
- Economic growth goals and parameters
- Resource commitments

Case Study: Synthetic Environment for Ships

Need	Solution	Benefits
Develop a synthetic modeling & simulation decision support tool for: • Technology insertion effects on infrastructure, configuration, and System of Systems performance • Operational evaluation • Workflow design and evaluation • Model integration • Continuous evaluation and improvement • Sea trial design and evaluation		**Developed strategies for:** • Technology insertion and strategies to reduce infrastructure changes, develop new workflows, and crew composition. **Key Insights:** • "Artificial Physics" models successfully integrated and used with communications models, human behavior models, ect., • Successfully modeled a diverse collection of autonomous decision-making entities to capture emergent phenomenon.



Case Study: Policy Development for Public Education

Overview:

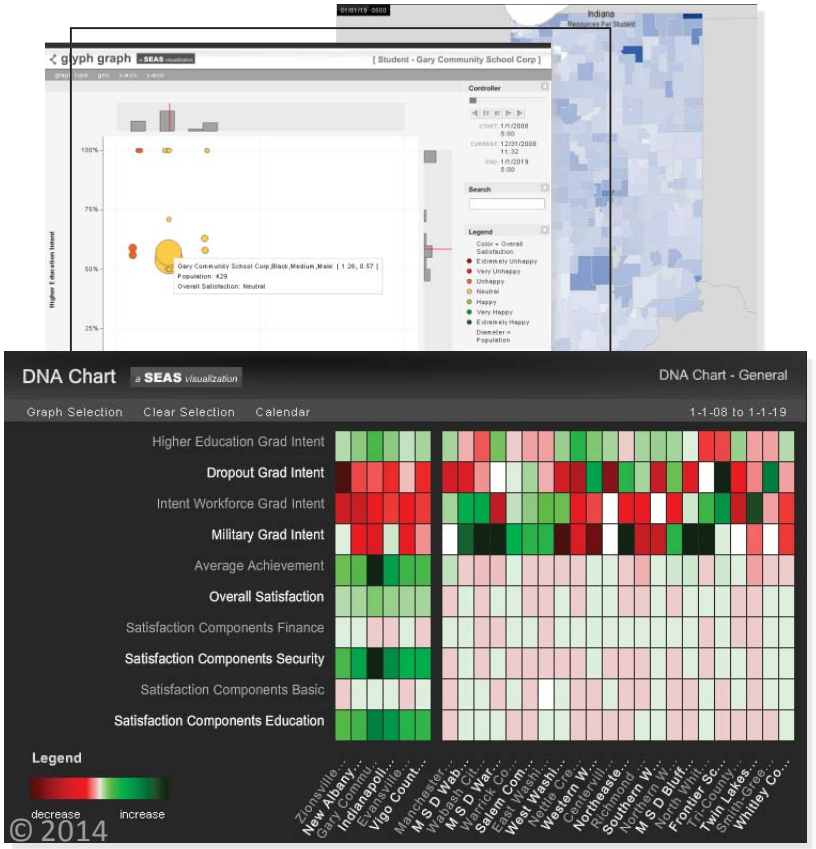
Synthetic representation of the Indiana school system at the district level, enabling users to experiment with policies that directly affect student wellbeing and the resulting impact on achievement and the pursuit of higher education.

Helps State Policy Makers Understand:

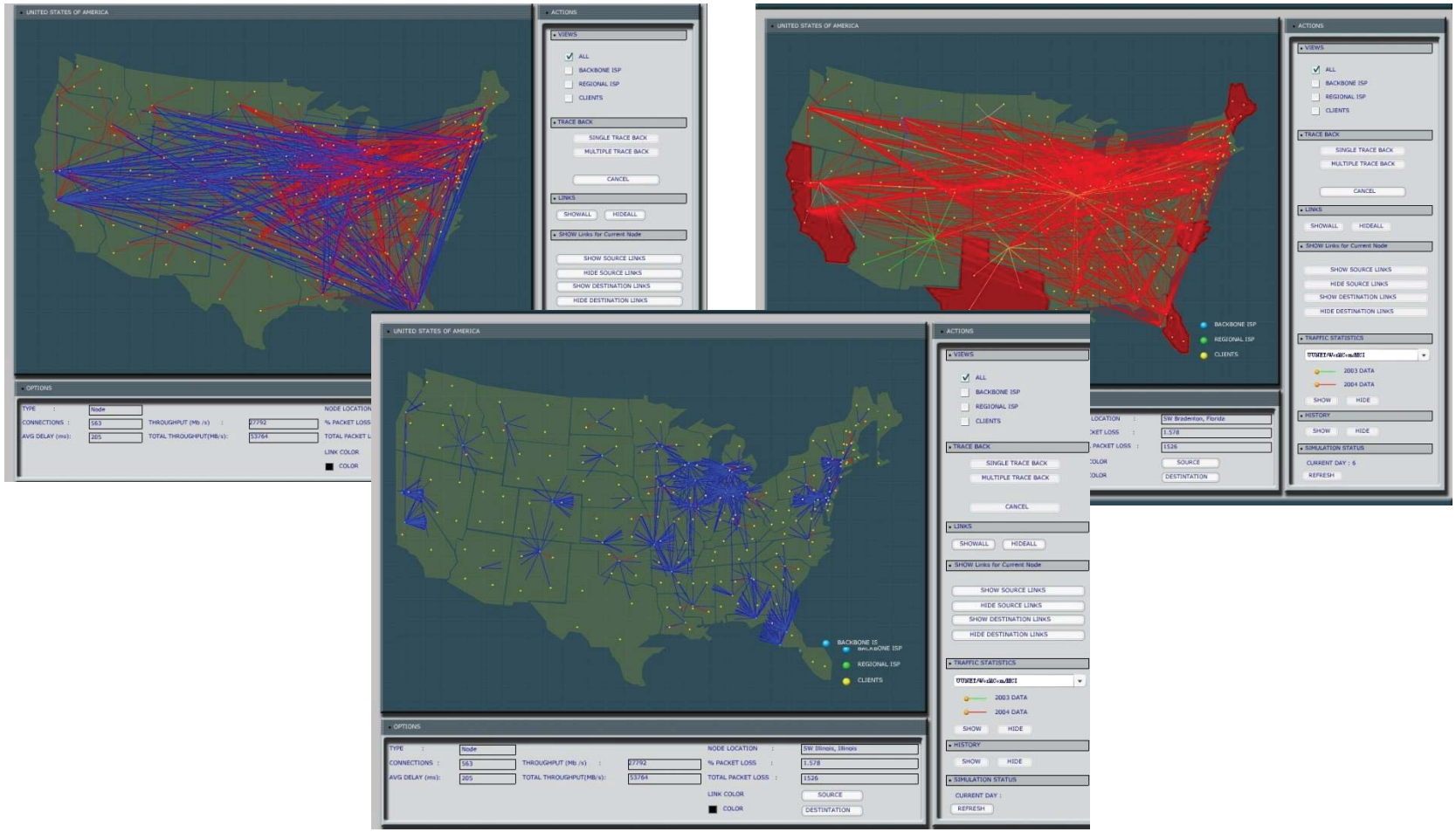
- What student needs are most directly related to performance in the classroom
- How best to address student needs in different districts to yield the greatest improvements in student performance

Some Key Insights from Past Projects:

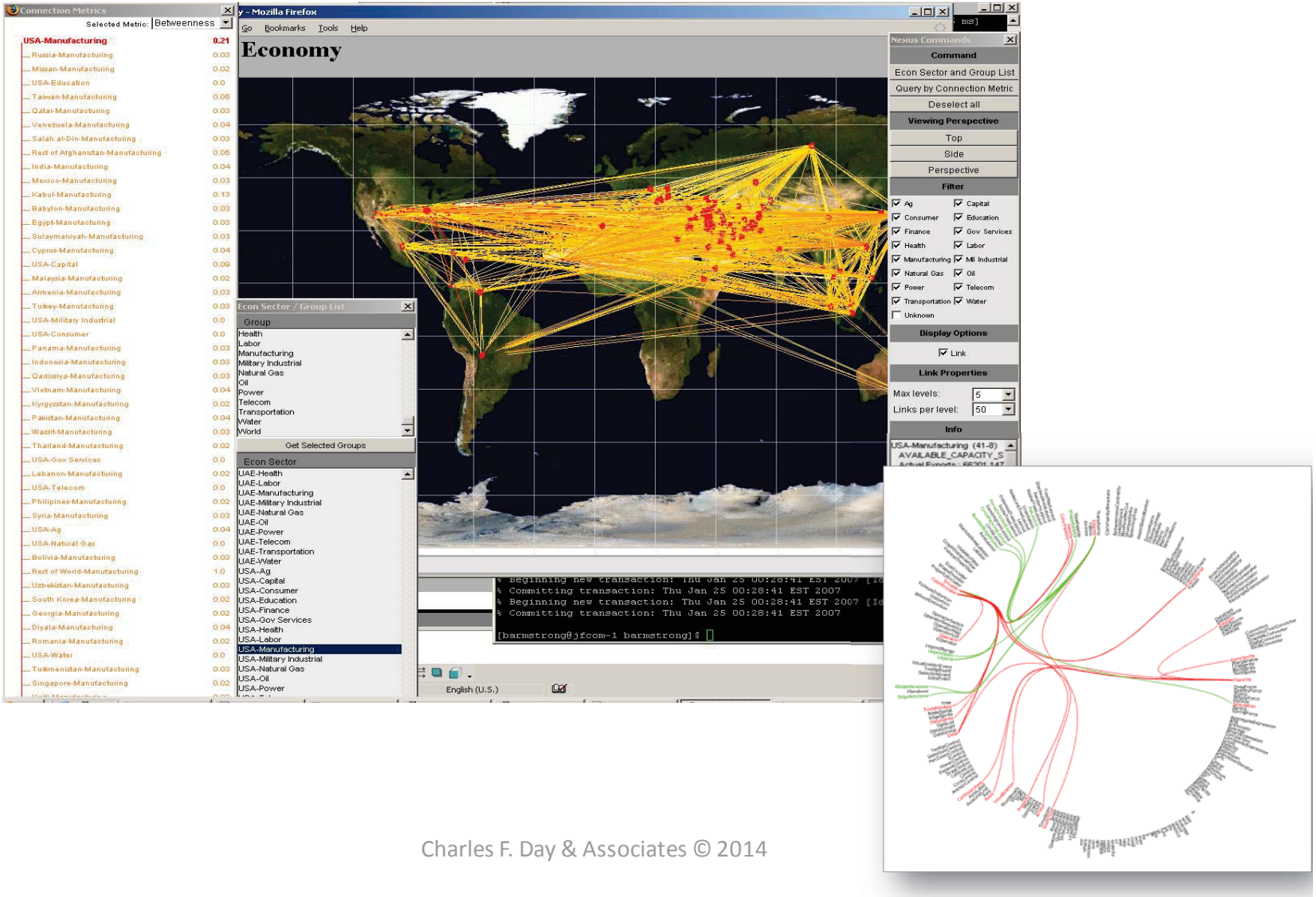
- Two key student needs were identified regarding academic performance: security and education
- Students living in high crime or disruptive environments benefit most from increasing security in the classroom and respond minimally to increased support of education
- Students whose security needs are already met benefit from educational support programs



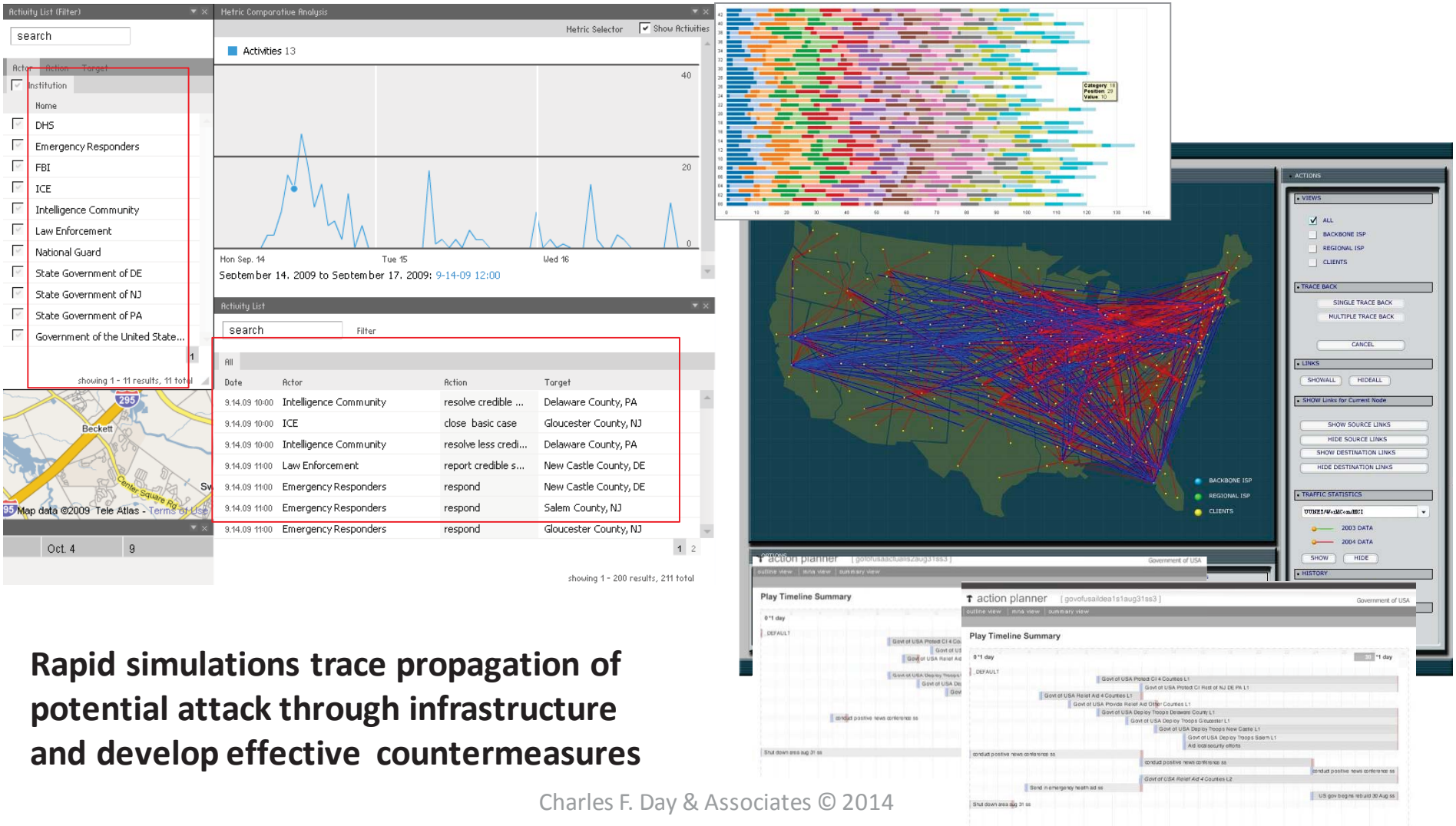
Case Study: Cyber Offense and Defense Modeling



Identification and Analysis of Social Networks of Interest



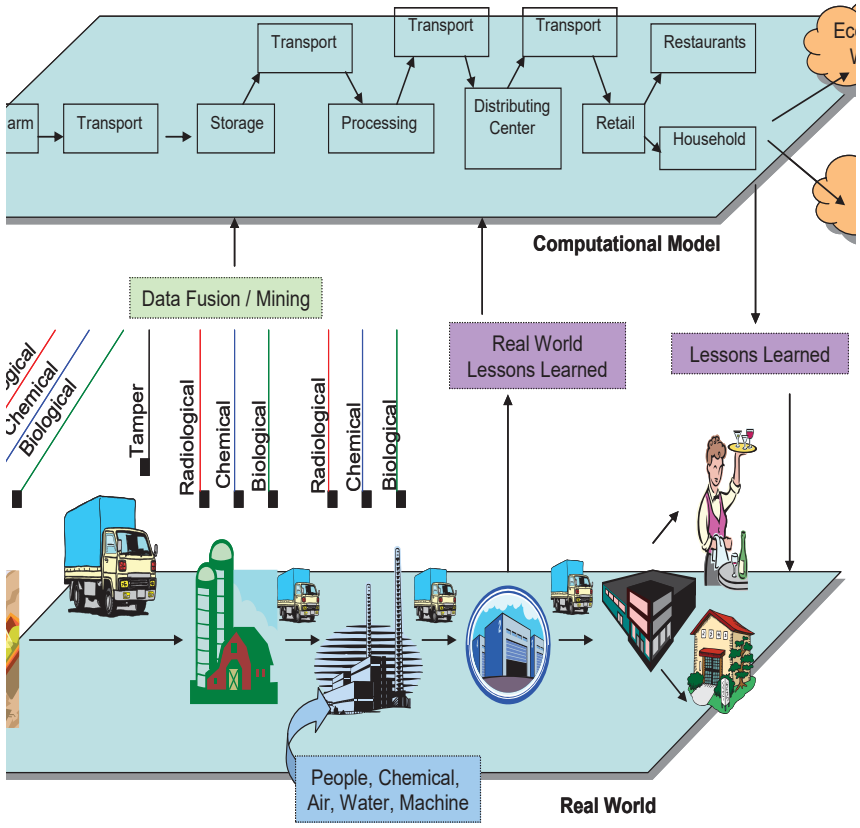
Threat Anticipation and Countermeasure Development



Rapid simulations trace propagation of potential attack through infrastructure and develop effective countermeasures

Case Study: Food Defense Simulation

Model the Supply Chain



General Approach

1. Collect economic, public health, and food production and distribution data (from farm to consumer)
2. Develop computational model to forecast economic and public health impact of simulated crisis
3. Establish teams representing food industry, government and media
4. "Play" the simulation by responding to simulated crisis
5. Facilitate discussion of decision making rationale and public health and economic impacts with after action reviews

SEAS VIS /RWISE History in DoD

Engagement	Purpose
USAARC, Access (Army Recruiting Command)	Artificial Labor Market
US Joint Forces Command (USJFCOM), Breaking Point (BP)	Irregular Warfare
USJFCOM, Unified Vision (UV)	Traditional Combat
USJFCOM Sea Viking (SV)	Traditional Combat
USJFCOM Unified Quest (UQ)	Irregular Warfare
USJFCOM Multi-National Experiment 4 (MNE 4)	Irregular Warfare
USJFCOM Urban Resolve 2015 (UR2015)	Urban Combat
SOUTHCOM, South America Study	Traditional Combat

Engagement	Purpose
OSD PA&E GWOT Study	Irregular Warfare
USJFCOM/NATO, International Security Assistance Force X	Irregular Warfare
US Marine Corps, 9 Innings Capstone Exercise	Irregular Warfare
Army War College, Latin America Study	Irregular Warfare
USJFCOM/NATO ISAF X	Irregular Warfare
French MOD	Irregular Warfare
USSTRATCOM, Gallup, SAIC, RWISE Joint Capability Demonstration	Strategic Deterrence
UK MoD, Boeing, RWISE Joint Capability Demonstration	Cyber Warfare