The Scenario Method Application

An Overview with Examples

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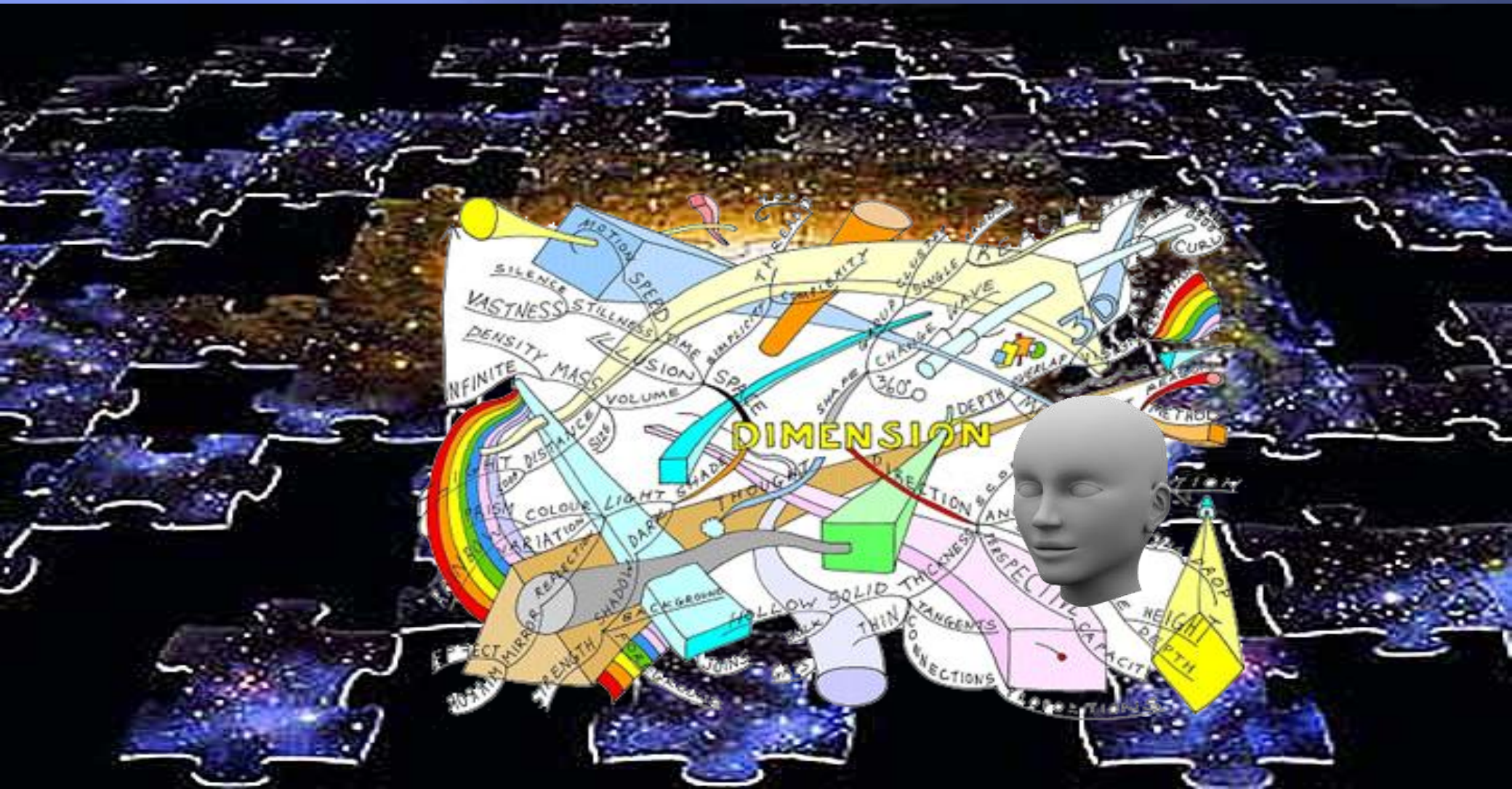
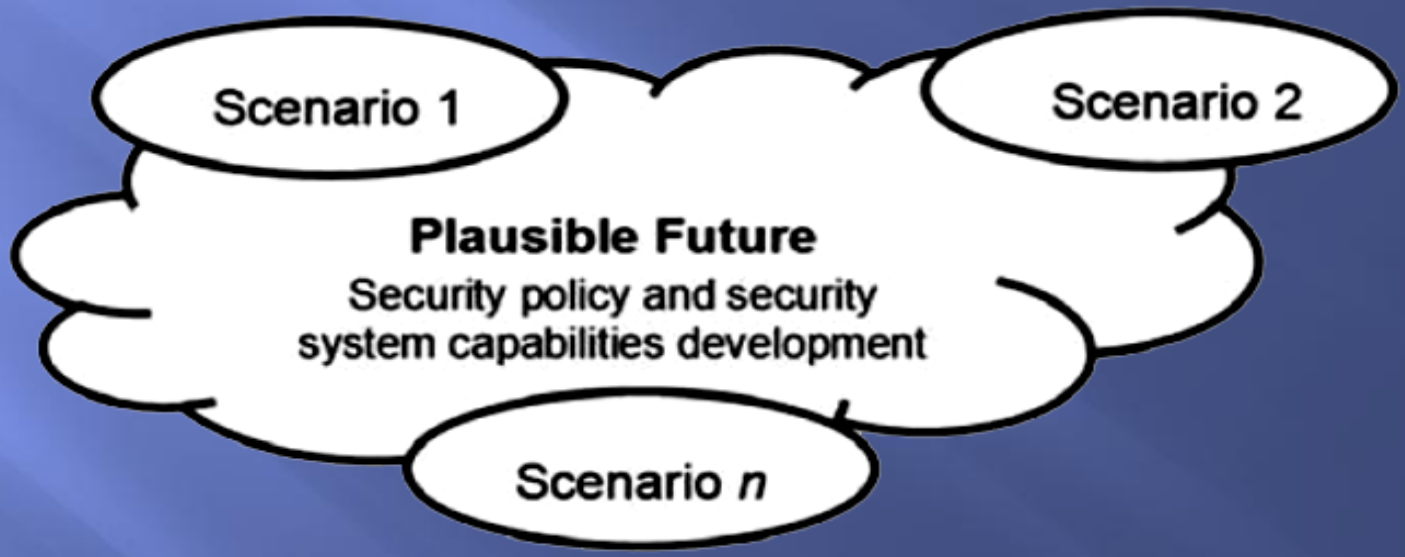
The Great Complexity of the World Around Us



Building Context

The Scenario Method



EXPERTS' KNOWLEDGE EXTRACTION

- Brainstorming (initial ideas generation);
- Modified Delphi method (filtering process);

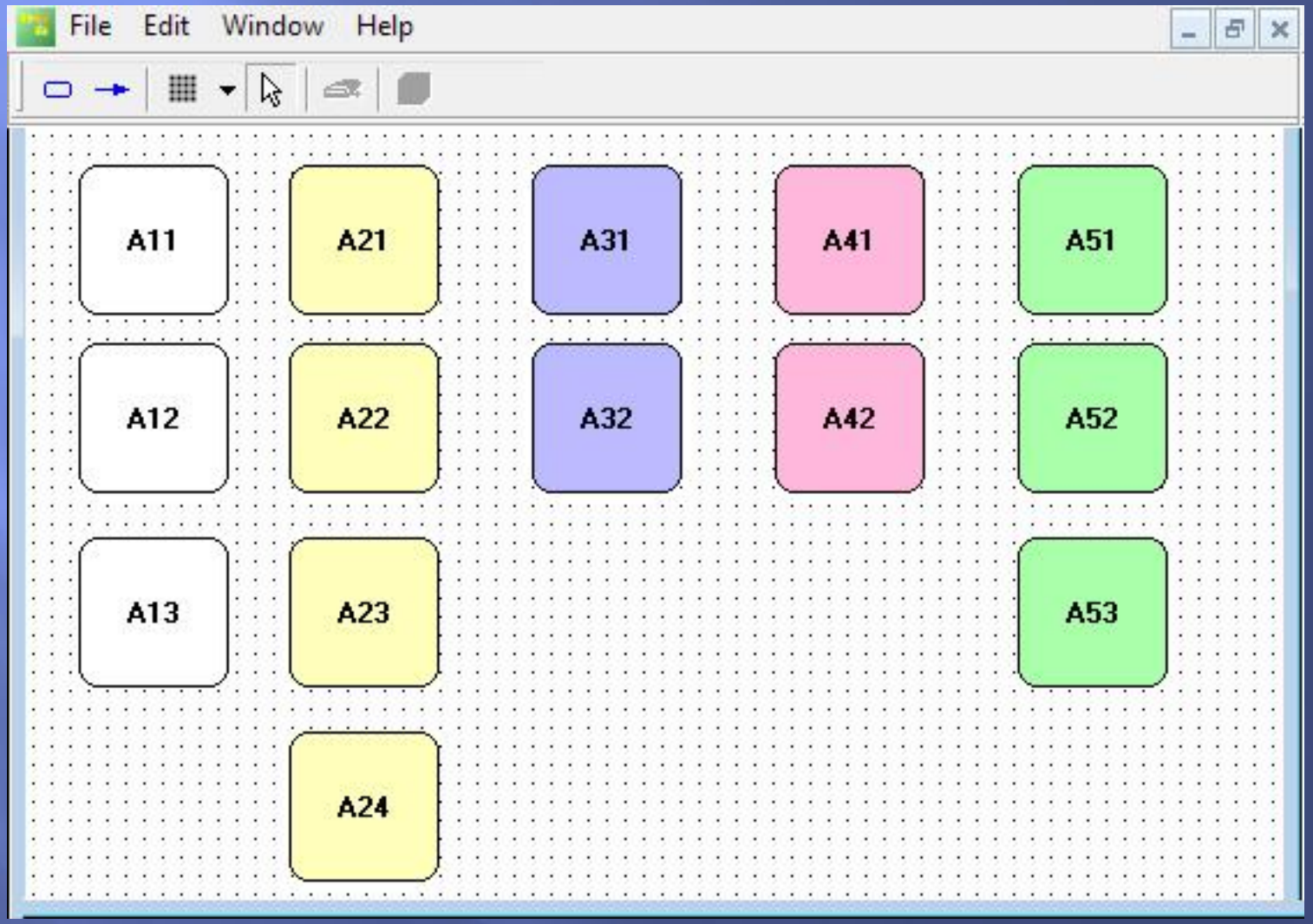
EXTRACTED KNOWLEDGE ANALYSIS

- Techniques:
  - Morphological analysis;
  - System analysis;
- Working environment:
  - MS Office/OpenOffice;
  - Intelligent Scenario Computer Interface Program (I-SCIP).

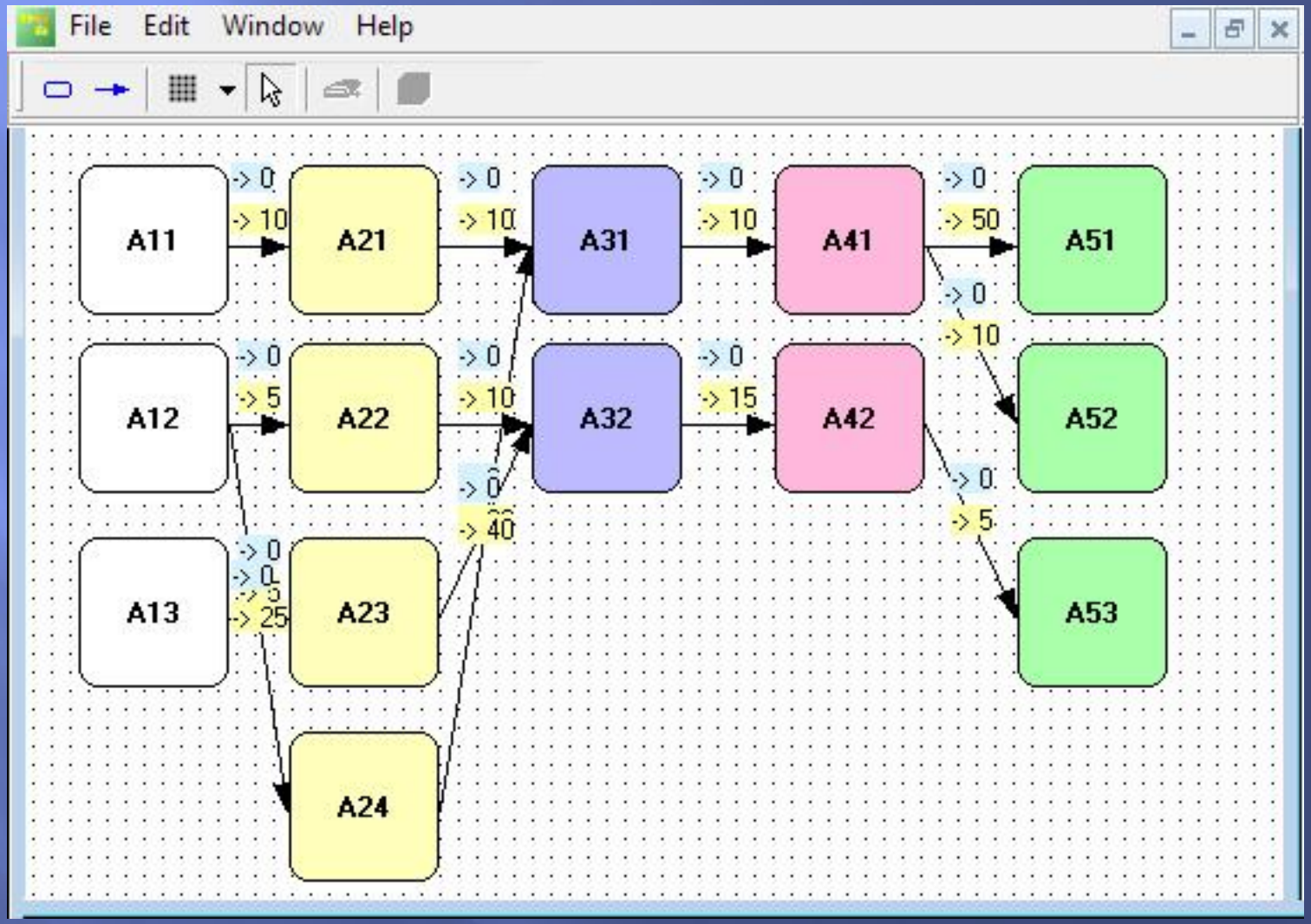
MORPHOLOGICAL ANALYSIS

- Complete task consideration;
- Wide used for classification tasks;
- Familiar to the security & social sciences.

Step 1 Dimensions & alternatives definition



Step 2 Alternatives binding

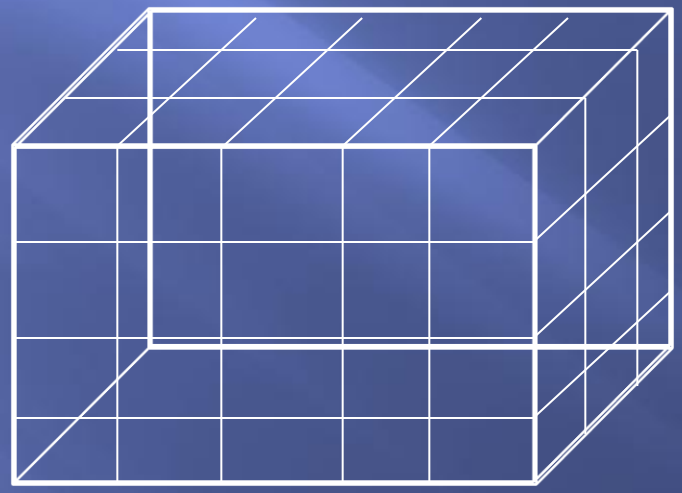


Conflict (cross-consistency) matrix

World order	EU Security Interests	NATO	Russia	Balkans
A11	A21	A31	A41	A51
A12	A22	A32	A42	A52
A13	A23			A53
	A24			

General problem volume

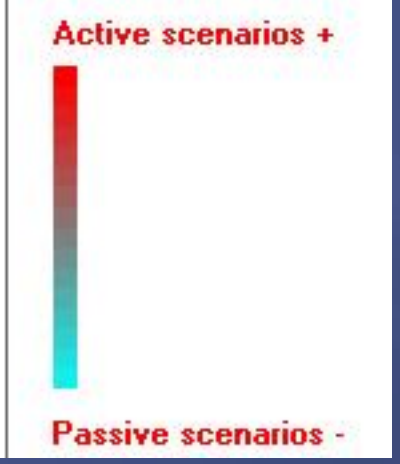
Possible combinations: 3 X 4 X 2 X 2 X 3 X 5 = **720**



Step 3 Scenario building, ranging & naming

World order	EU Security Interests	NATO	Russia	Balkans
A11	A21	A31	A41	A51
A12	A22	A32	A42	A52
A13	A23			A53
	A24			

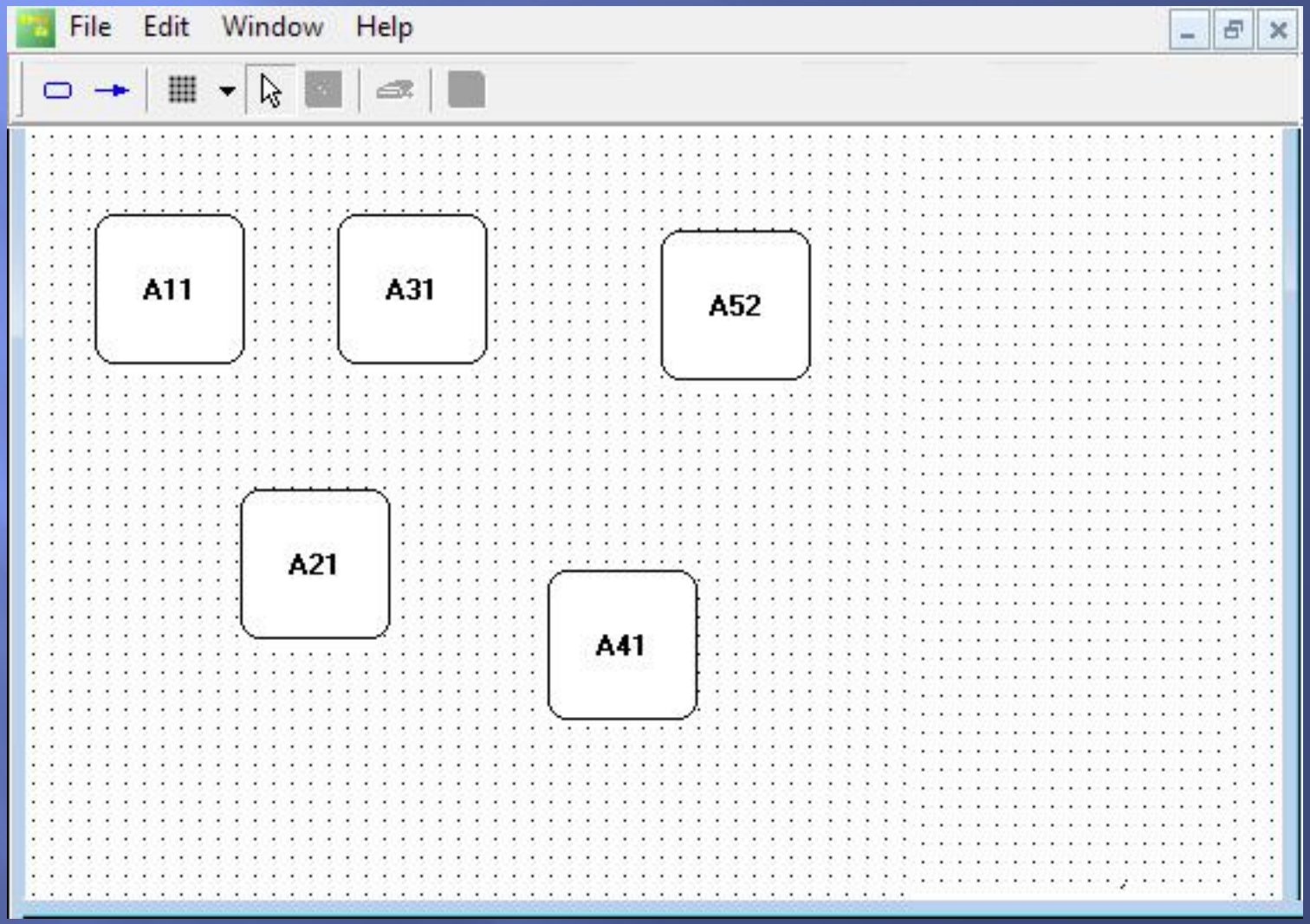
Index	Length	Weight	Name
1	5	40	Scenario1
2	5	35	Scenario2
3	5	85	Scenario3
4	5	45	Scenario4
5	5	80	Scenario5
6	5	125	Scenario6



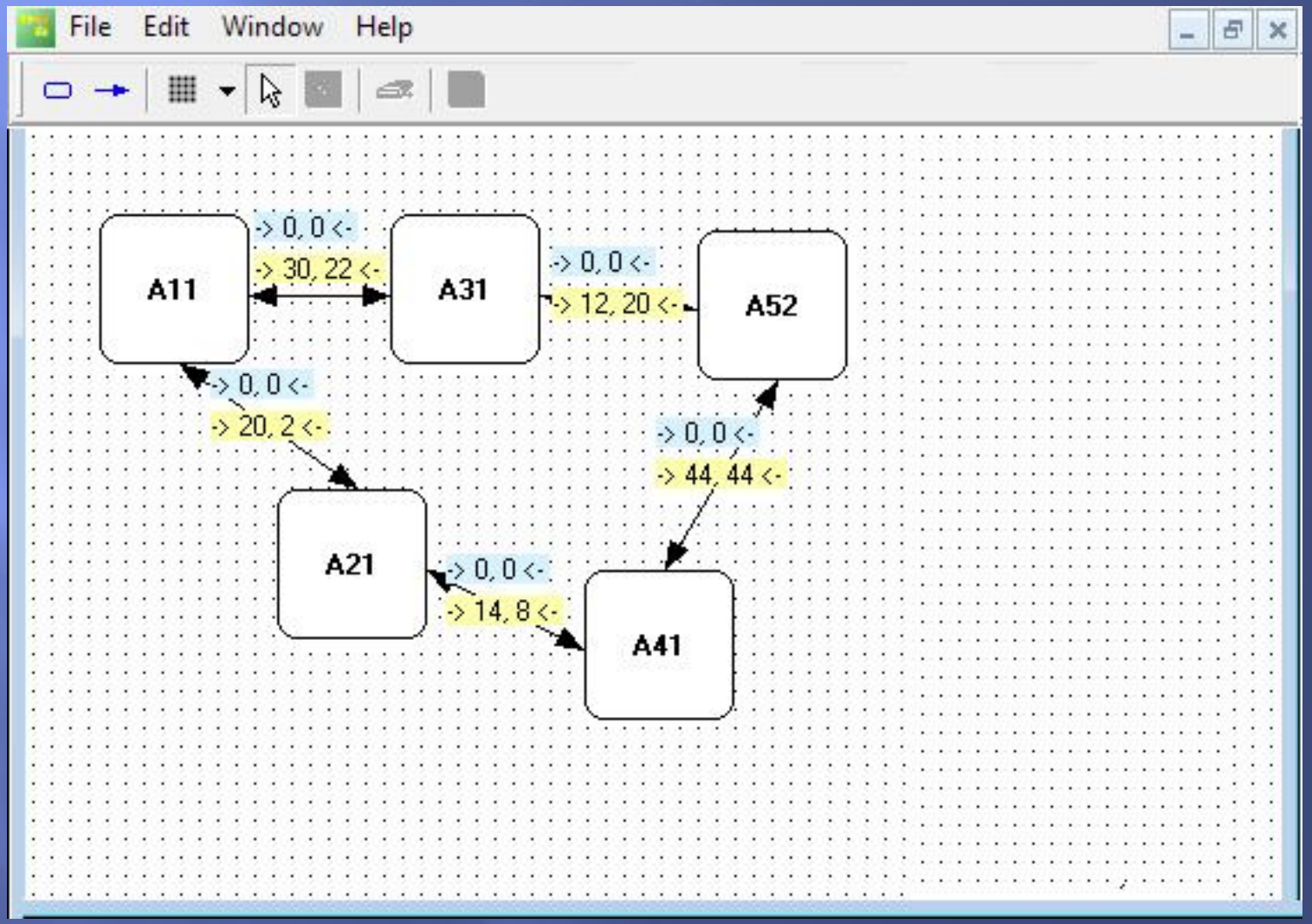
SYSTEM ANALYSIS

- Intuitive entity-relationship notation;
- Details' consideration;
- Familiar to the military & scientific world.

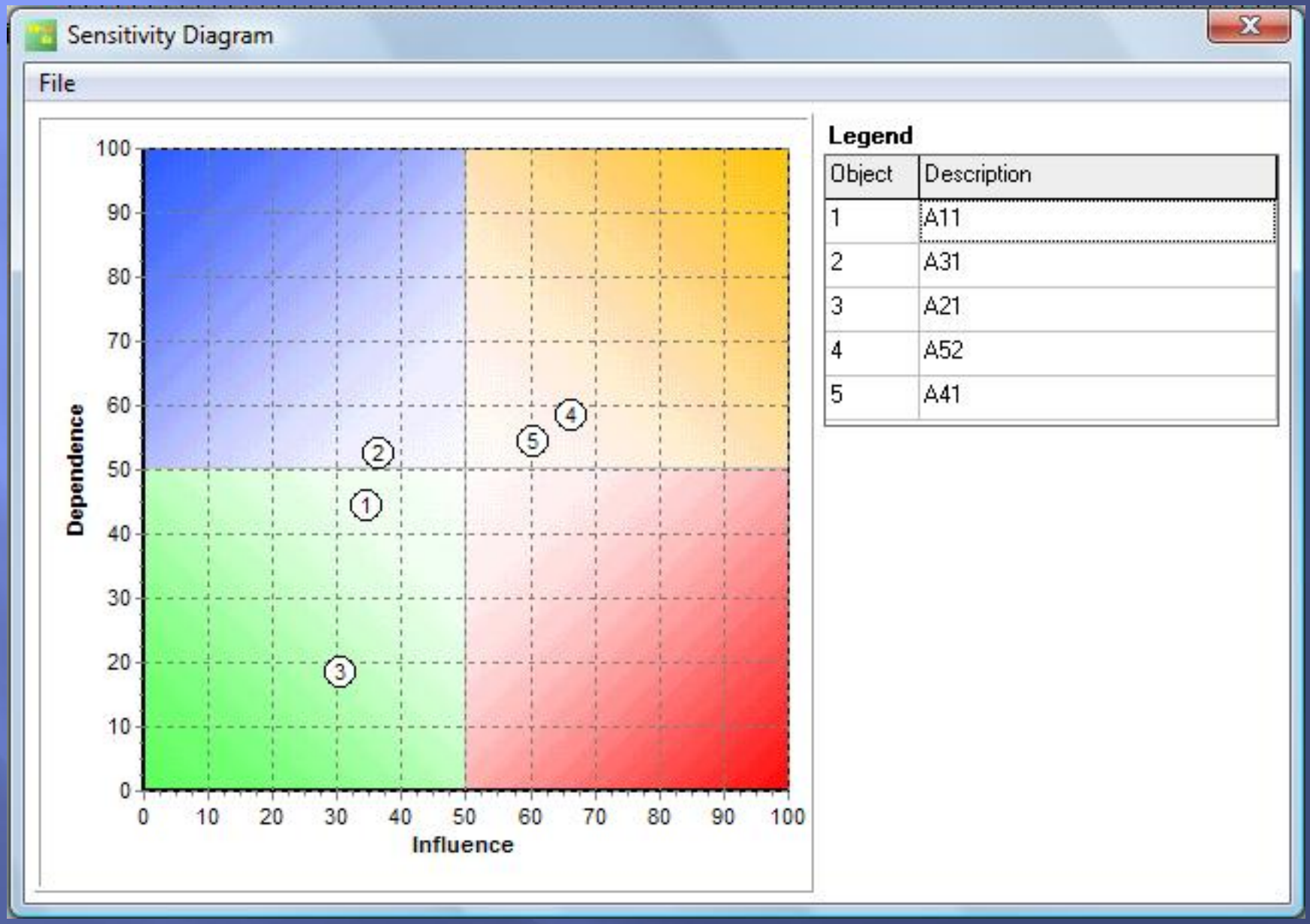
Step 1 Entities definition



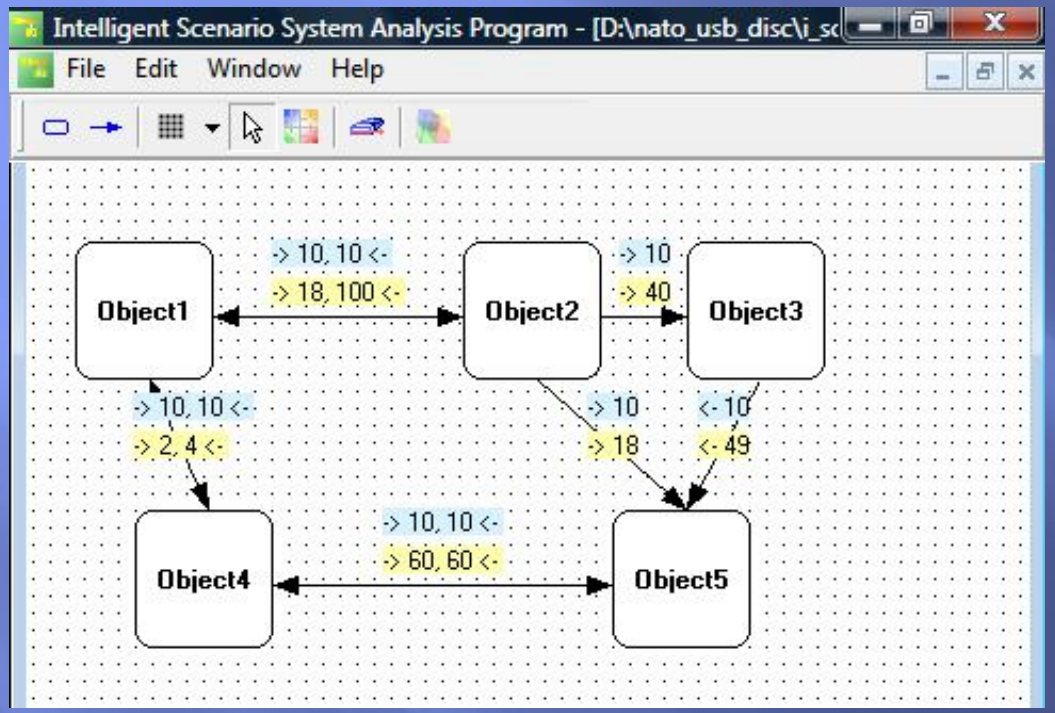
Step 2 Entities binding

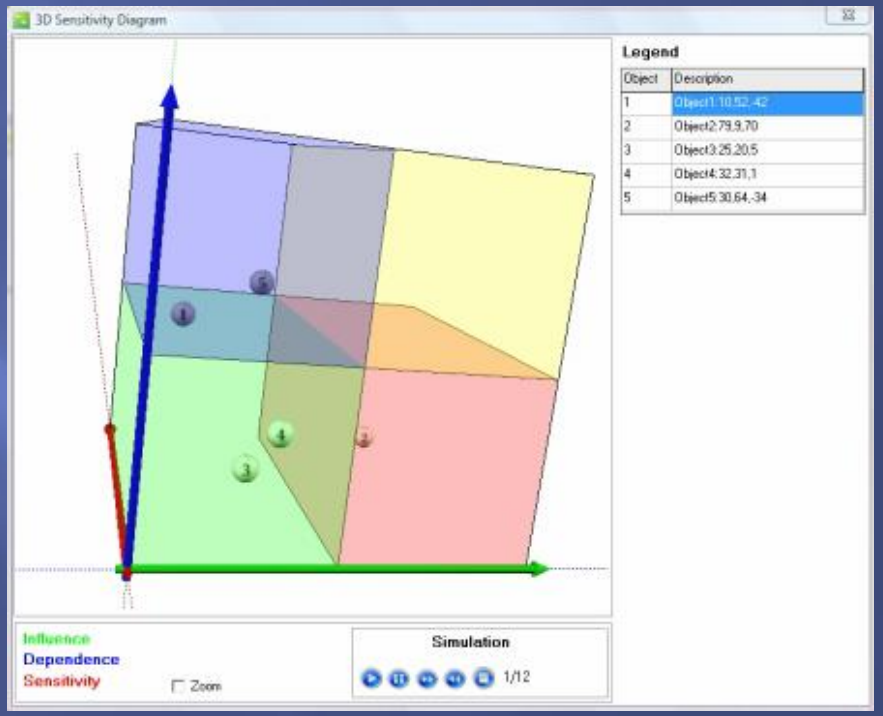


Step 3 Entities classification

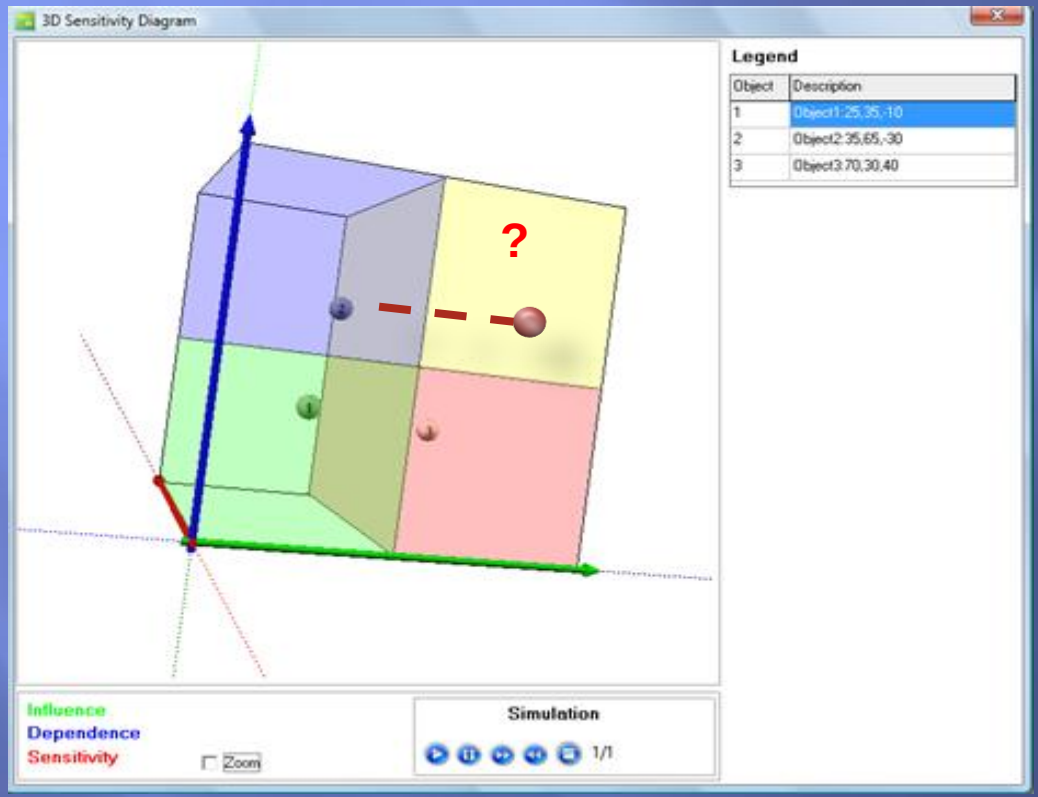


SENSITIVITY ANALYSIS IN 4D

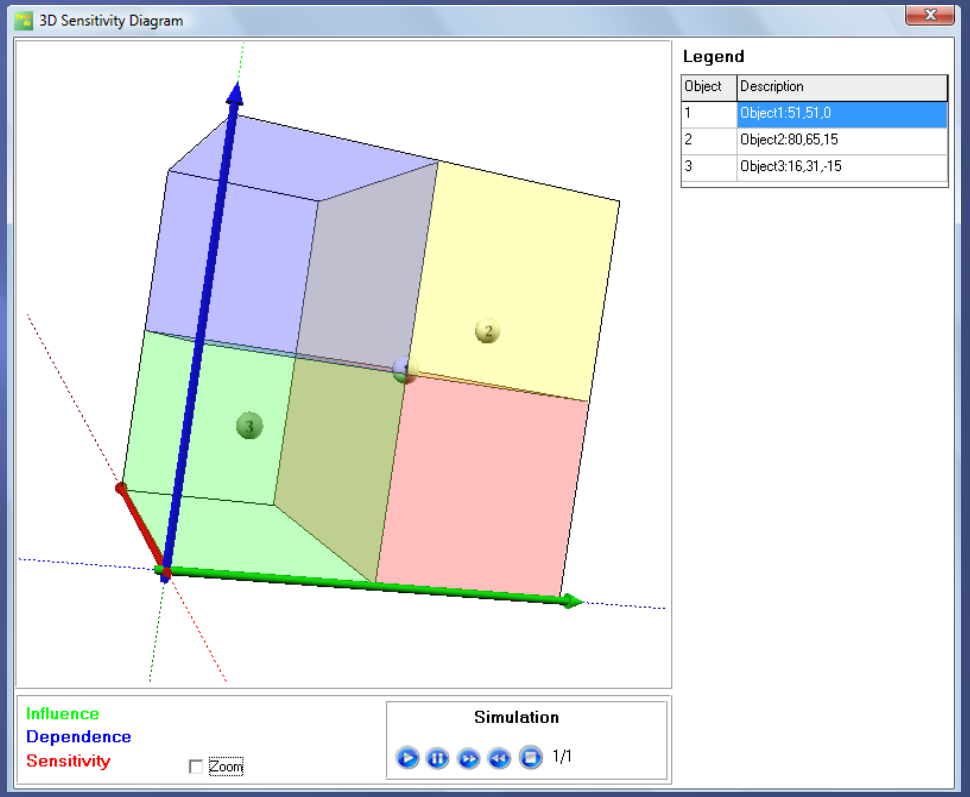




But can we change the experts' believes with I-SCIP SD?



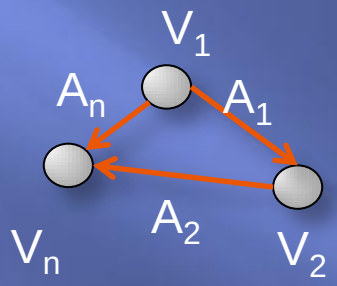
Initial Configuration



New Configuration after Q optimization

An Algebraic Interpretation & Quadratic Optimization Usage

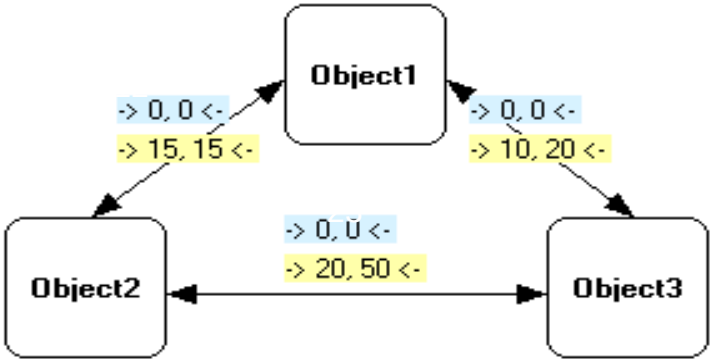
Directed Weighted Graph $G = (V,A)$



$A = \{A_1, A_2, \ldots, q_i, \ldots, A_n\}$ with Q weights, where $Q = \{q_1, q_2, \ldots q_i, \ldots, q_n\}$, $q \in N$, $q \in [1, 100]$

$Z = (\Sigma q_i - \alpha)^2 + (\Sigma p_j - \beta)^2$,
s.t. $0 < \Sigma q_i \leq \alpha$, $0 < \Sigma p_j \leq \beta$
$i=1,\ldots,n$, $j=1,\ldots,m$; α, β - desired position in the cluster set
Minimize $\rightarrow Z$

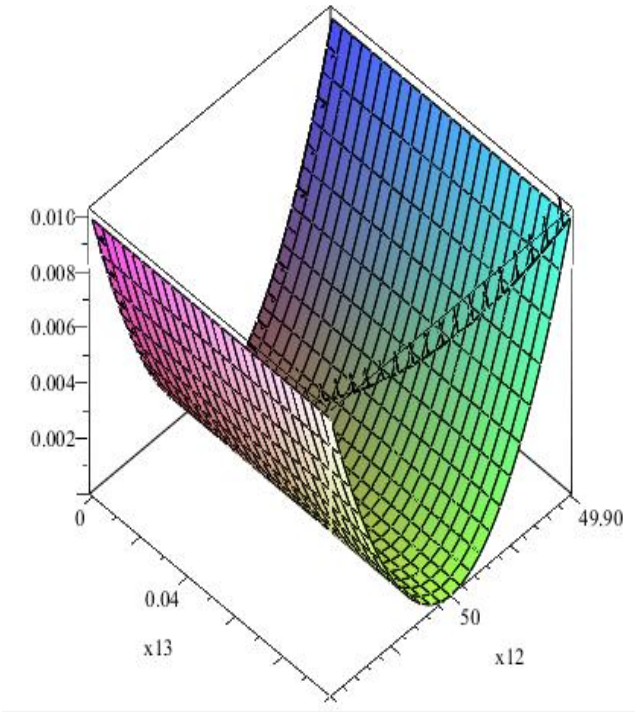
Example



Minimize the Objective Function Z:

$$(x12 + x32 - 65)^2 + (x21 + x23 - 80)^2$$

S.t. the following constraints:

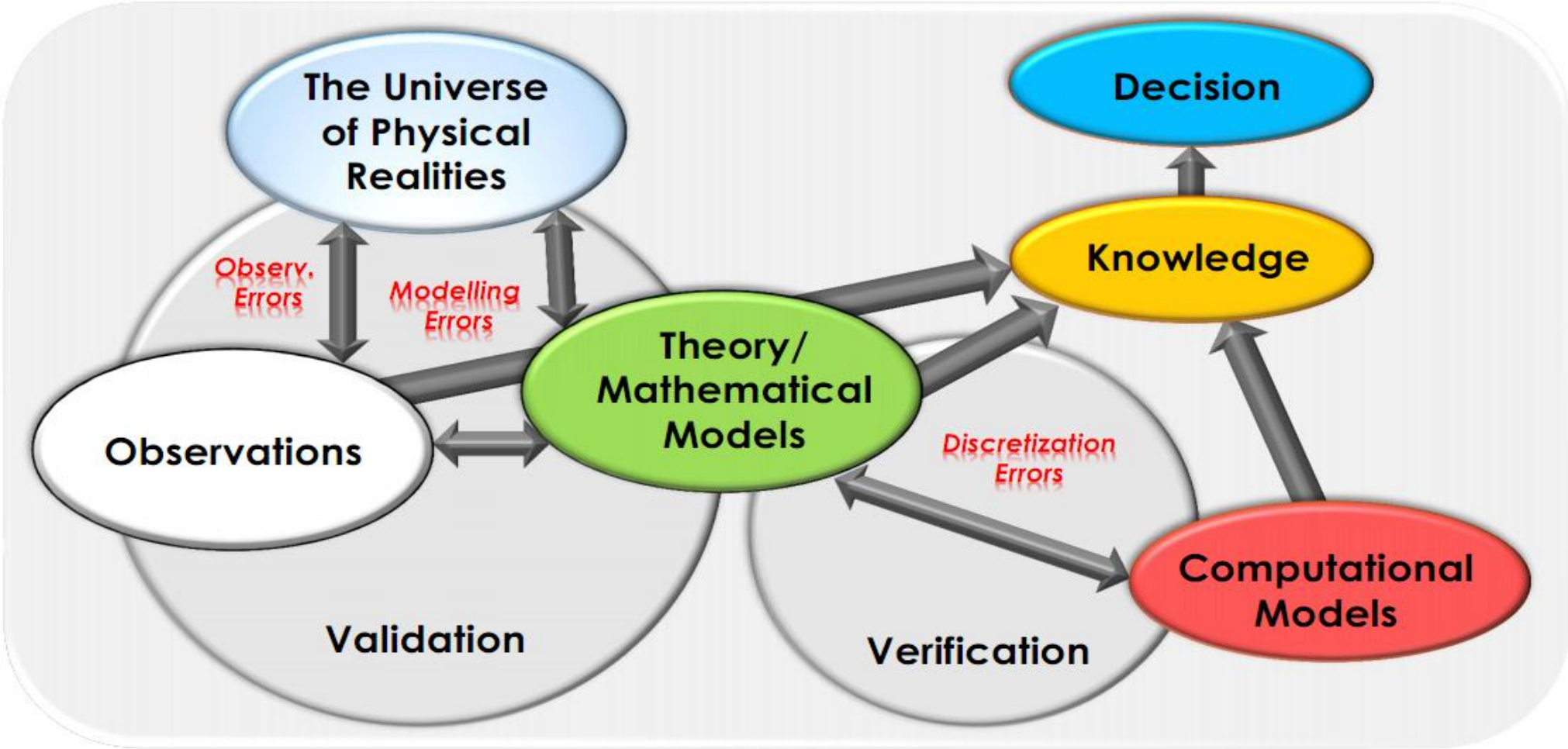


$x12 \in [0, \infty)$
$x13 \in [0, \infty)$
$x21 \in [0, \infty)$
$x23 \in [0, \infty)$
$x31 \in [0, \infty)$
$x32 \in [0, \infty)$
$x21 + x31 \leq 50$
$0 \leq x21 + x31$
$x12 + x13 \leq 50$
$0 \leq x12 + x13$
$x13 + x23 \leq 50$
$0 \leq x13 + x23$
$x31 + x32 \leq 50$
$0 \leq x31 + x32$

Solution:

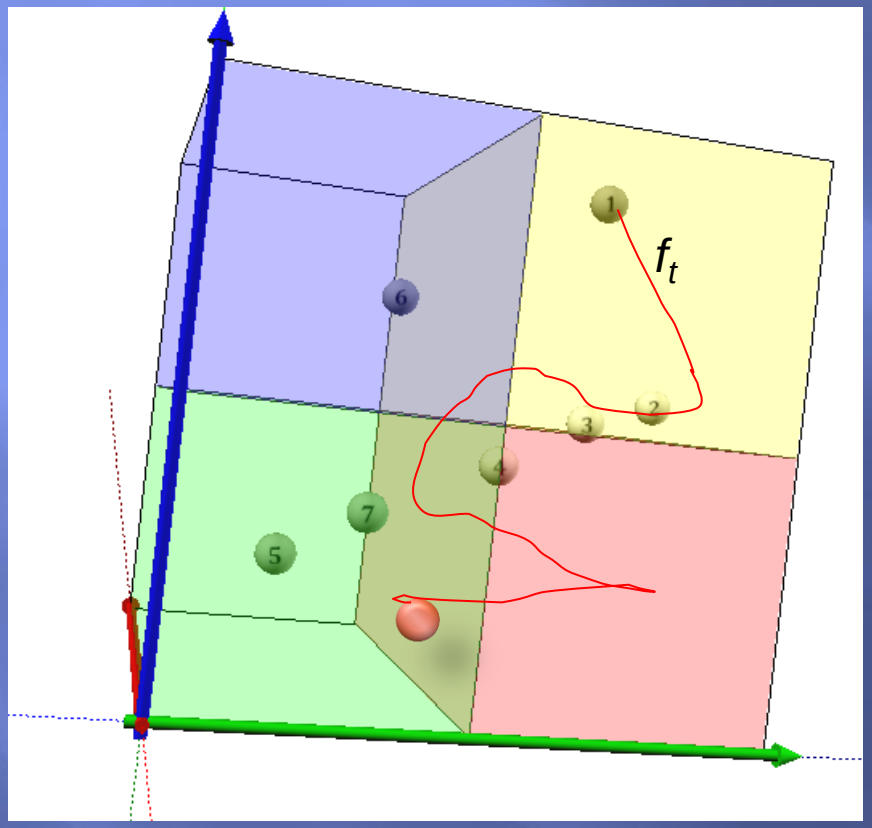
The following warning was issued while solving:
necessary conditions met but sufficient conditions not satisfied
Objective value: 0.
x12 = 50. x13 = 0. x21 = 50. x23 = 30.
x31 = 0. x32 = 15.

And how certain we are?

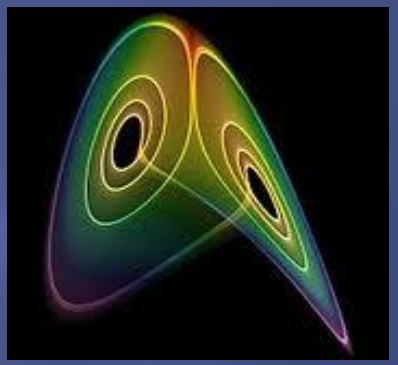


Oden, Moser & Ghattas, “Computer Predictions with Quantified Uncertainty”, SIAM NEWS, November 12, 2010.

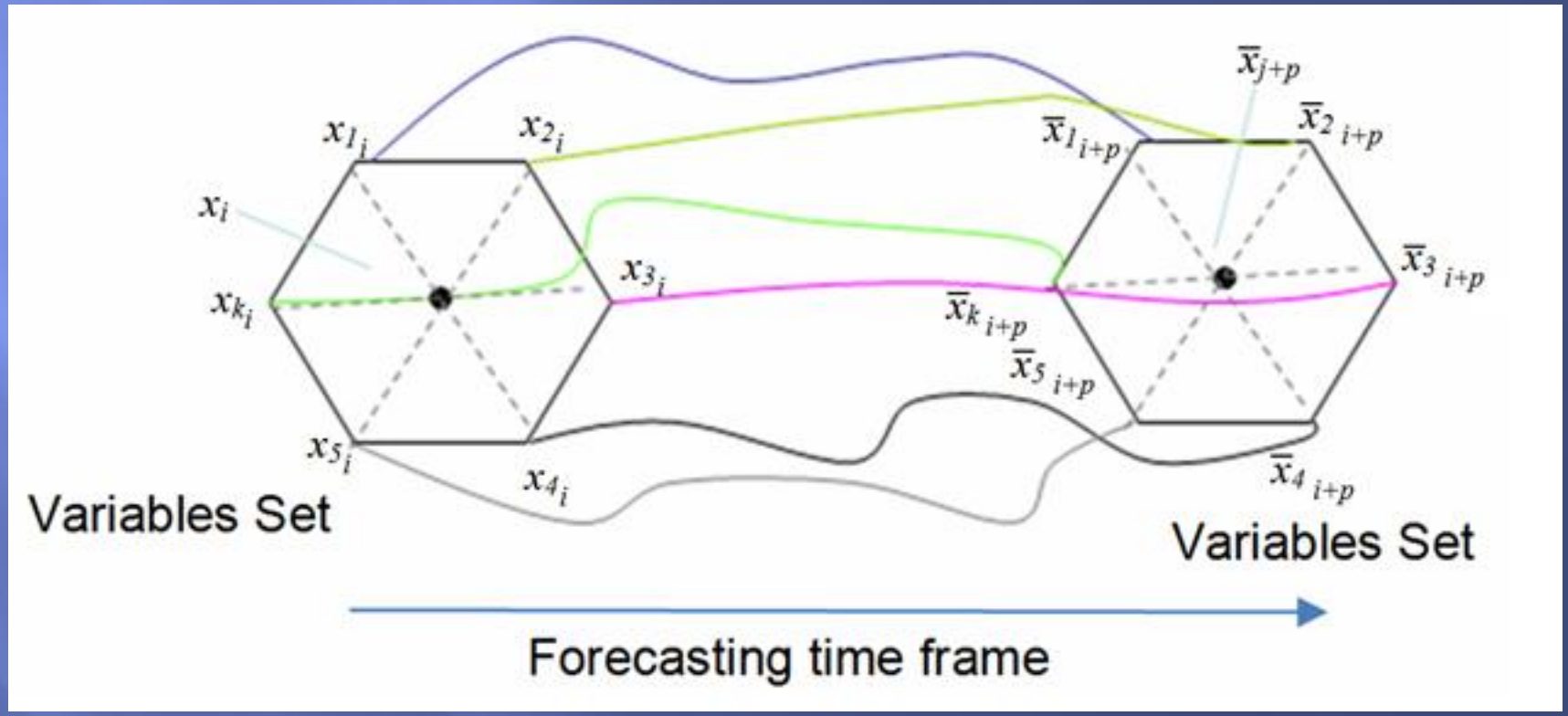
The transition function importance & uncertainty



Example: f_t ~ Lorenz system



Mathematical Scenario Validation & Uncertainty Dynamics Monitoring



$$x_{j+p} = \sum_{i=1}^{M+1} \bar{x}_{k_{i+p}} e^{-\alpha \left\| x_j - x_{k_i} \right\|},$$

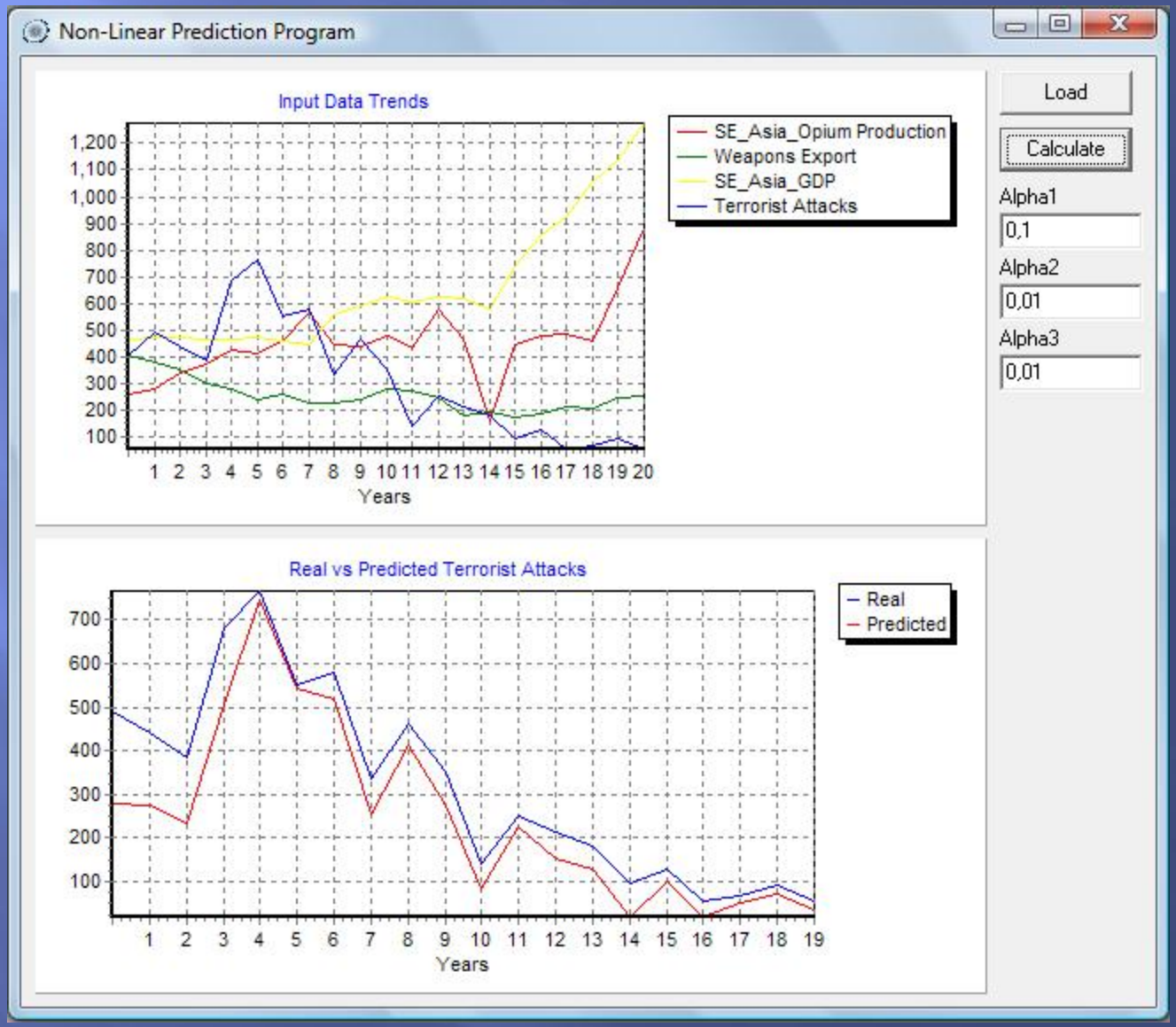
Where:

$\|.\|$ is the Euclidean distance in M dimensional space;
x_{k_i} - k^{th} closest neighbour to x_i;
$i,j > N$, $k + p < N$, N is the first half of data points used for forecasting of the second one;
$\bar{x}_{k_{i+p}}$ - k^{th} closest neighbour to x_i, p steps ahead;

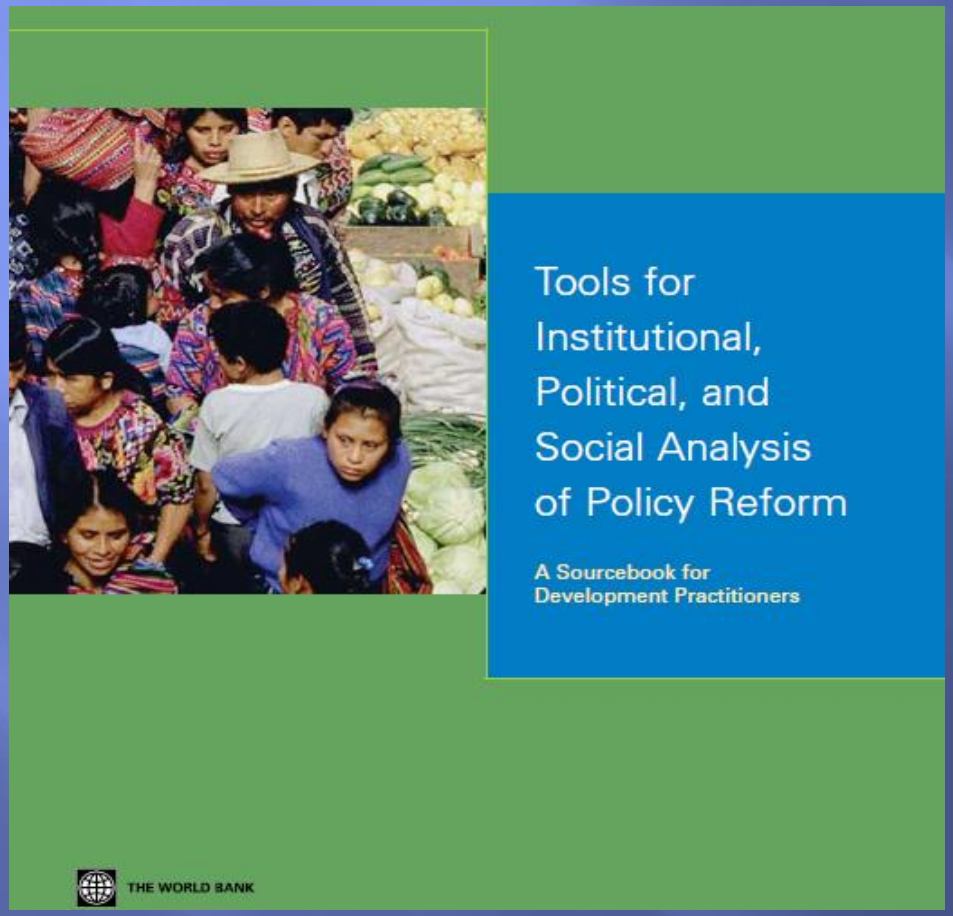
M - work space (embedding in case of single time series reconstruction) dimension;
p - number of steps ahead; α - expert-defined constants defined for the different dimensions M. The notation of space dimension M is used because the real simplex Δ^m dimension m could be initially unknown and $M < m$.
The error ε could be estimated in different ways but what was empirically evident that it is not necessary to consider ε of more than integral cubic degree of accuracy:

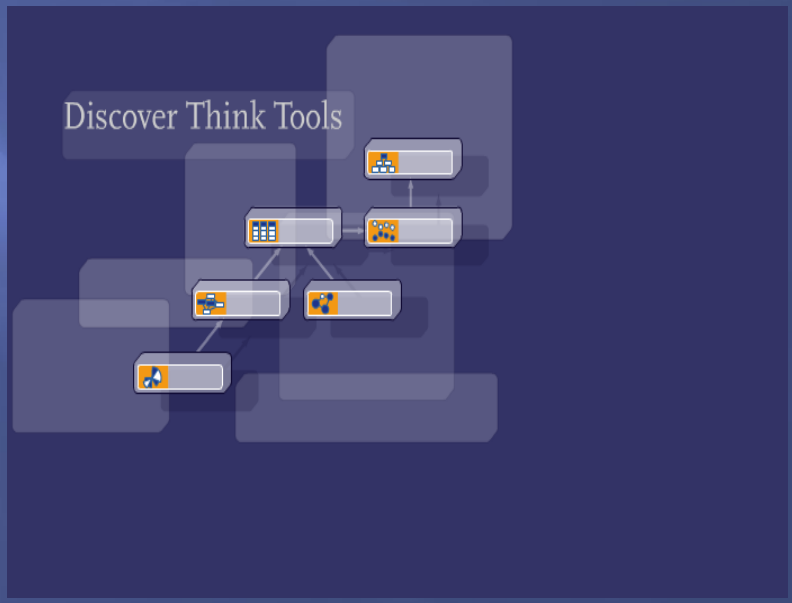
$$\varepsilon = | x_{i+p} - x_i | = O(h^3)$$

Software Support



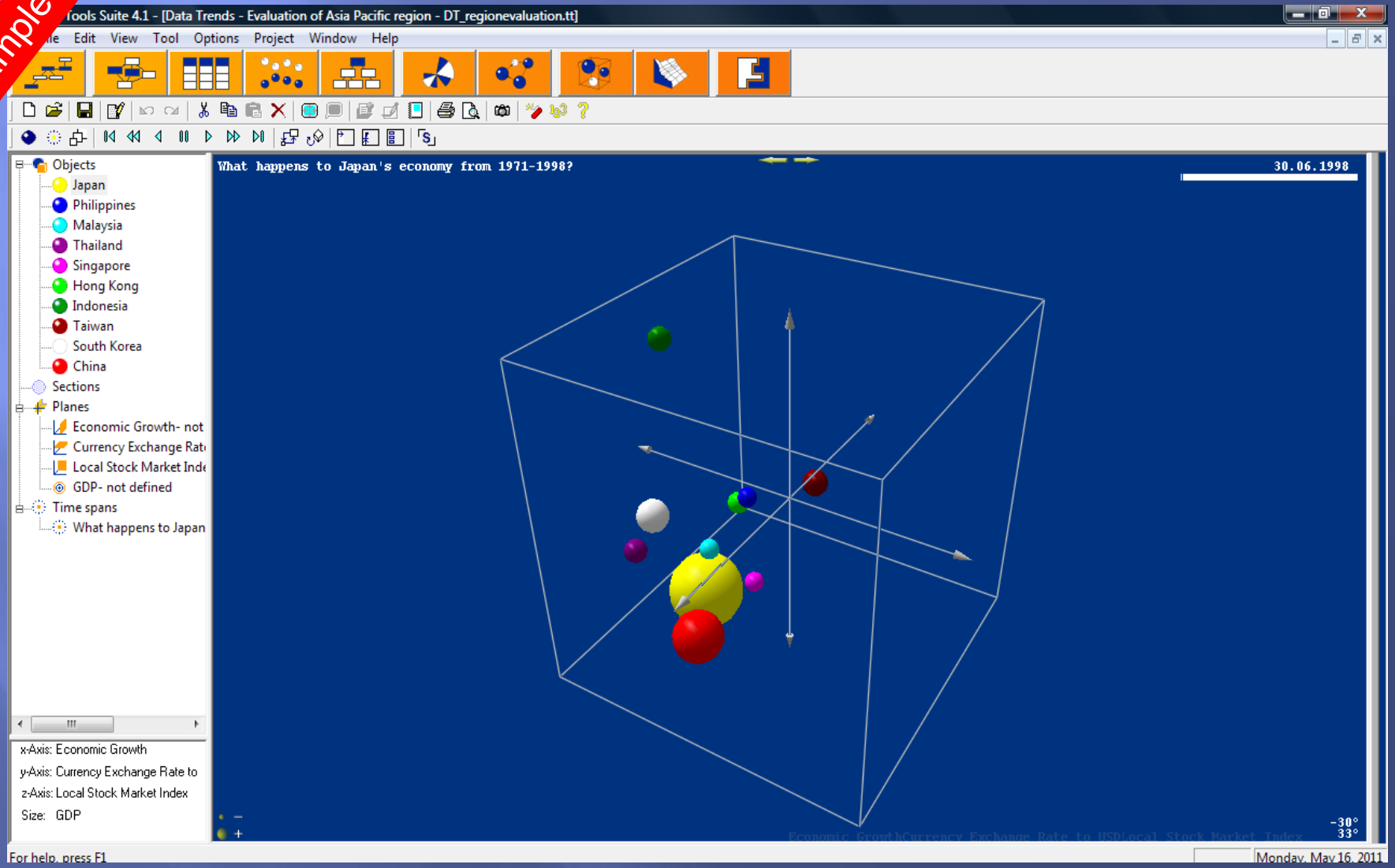
SOME PRACTICAL EXAMPLES





Asia Economy Development

Example



The Phoenix 2010 Exercise

EU Network of Excellence SySSec

WP0: Management

WP1: Dissemination

WP2: Education

WP3: Threats on the Future internet

WP4: Malware and Fraud

WP5: Smart Environments

WP6: Cyberattacks

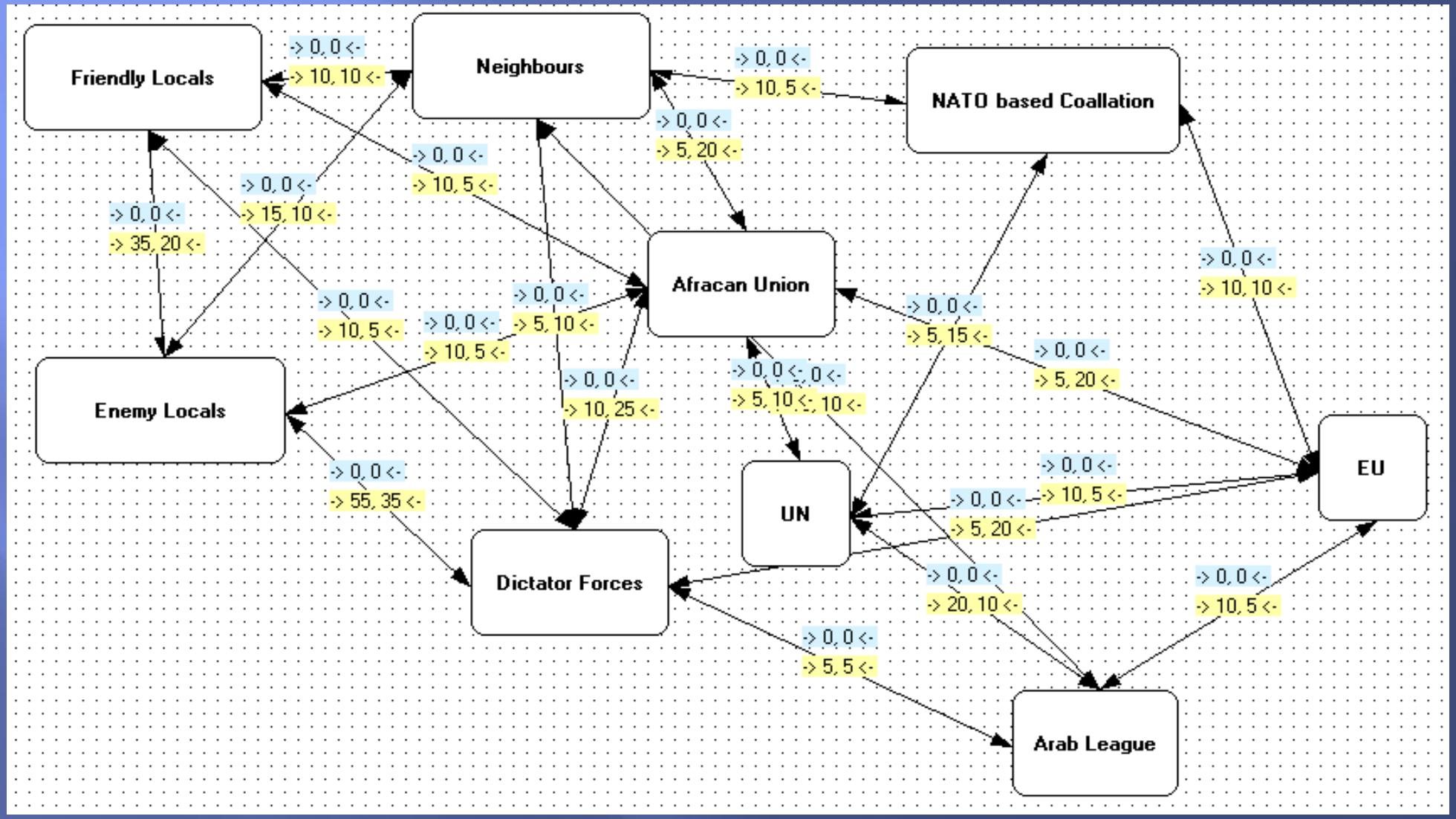
syssec

Cyber Threats Identification & Research roadmap construction

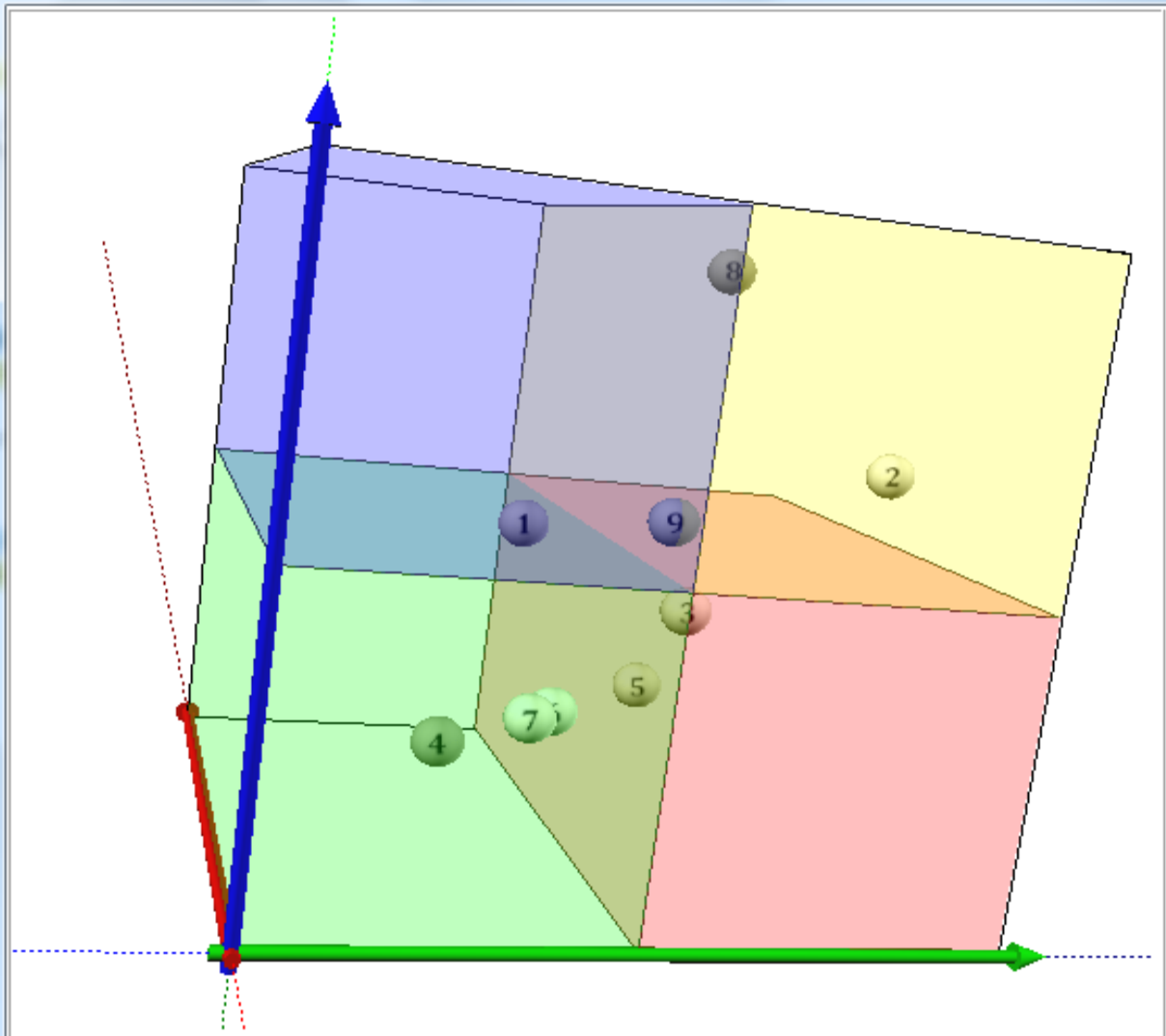
Assets / Threat-Enabler	**Personal** Assets				**Societal** Assets		**Professional** Assets
	Privacy (Human Rights)	Digital Iden-tity	Financial Assets	Health Safety	Critical Infras-tructures	GRIDS Clouds	Data Sales etc.
Anonymous Inter-net Access	Medium	Medium	Low	Low	Medium	Low	Medium
Ubiquitous net-works	High	High	High	High	Low	Low	Low
Human Factors	High	High	High	High	High	High	High
Insider attacks	High	High	High	High	High	High	High
Botnets	High	High	High	High	High	High	High
Program Bugs	High	High	High	High	High	High	High
Scale and Complex-ity	High	High	High	High	High	High	High
Mobile Devices	High	High	High	High	Medium	Low	High
24/7 connectivity	High	High	High	High	Low	Low	High
more private info available	High	High	Medium	High	Low	Low	Low
smart meters	High	High	Medium	High	High	Low	Low
Tracking	High	High	Medium	High	Low	Low	High
Smart Environ-ments	High	High	Medium	High	Medium	Low	High
Unsecured Devices	High	High	High	High	Low	Low	High
Social networks	High	High	Medium	Medium	Low	Low	Low
Cyber-physical con-nectivity for Infras-tructures, cars etc.	High	Low	Medium	High	High	Low	High
Organized Cyber Crime	High	High	High	High	High	Low	High
Mobile Malware	High	High	High	High	Medium	Low	High
SCADA Malware	Low	Low	Low	Low	High	Low	Medium
	Privacy (Human Rights)	Digital Iden-tity	Financial Assets	Health Safety	Critical Infras-tructures	GRIDS Clouds	Data Sales etc.

syssec

North Africa Peacekeeping expenditure operation model



3D Sensitivity Diagram



Legend

Object	Description
1	Friendly Locals:33,54,-21
2	Enemy Locals:87,66,21
3	Neighbours:54,45,9
4	NATO based Coallation:21,25,-4
5	EU:54,29,25
6	UN:37,29,8
7	Arab League:33,29,4
8	Dictator Forces:62,95,-33
9	Afracan Union:50,58,-8

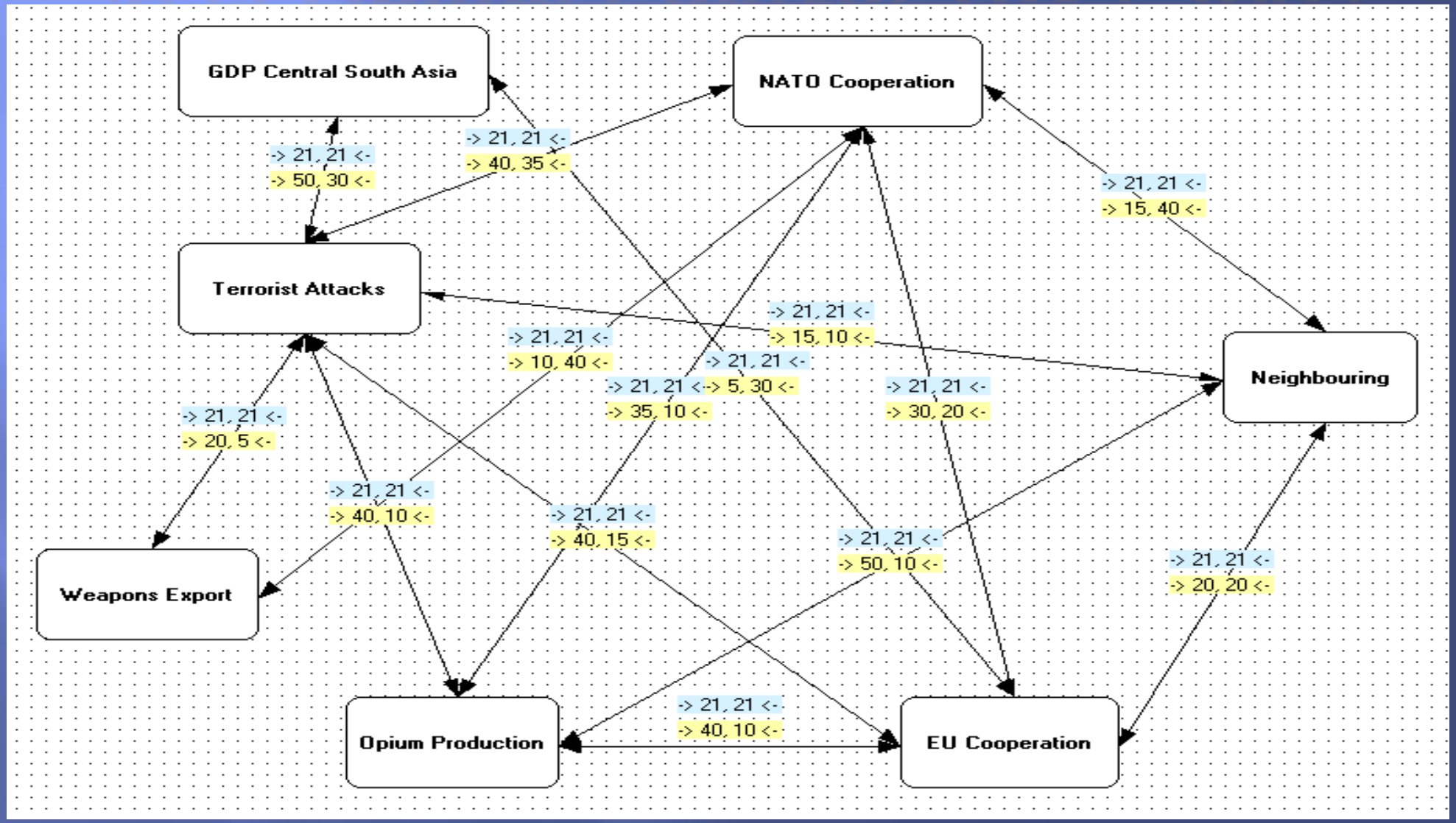
Influence
Dependence
Sensitivity

Zoom

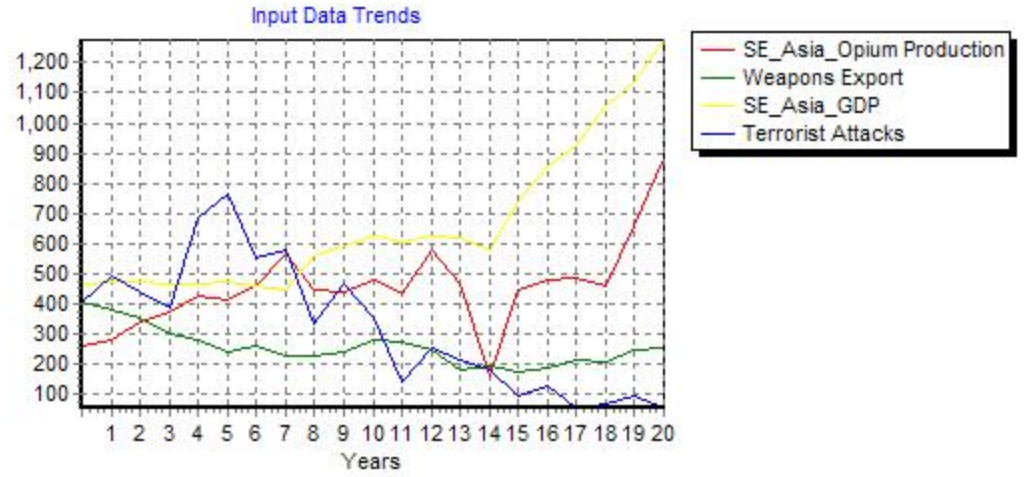
Simulation

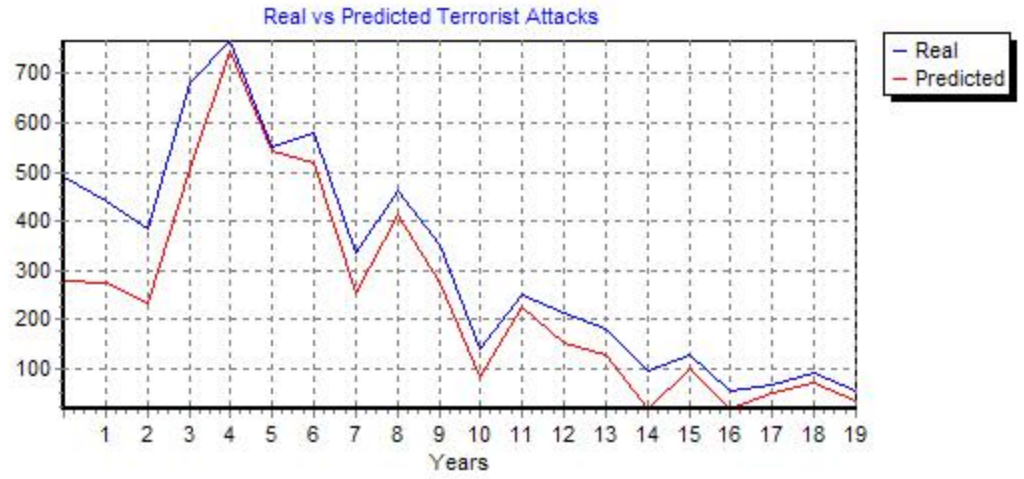
1/1

Asia Opium Control 1987-2007



Non-Linear Prediction Program





Load

Calculate

Alpha1

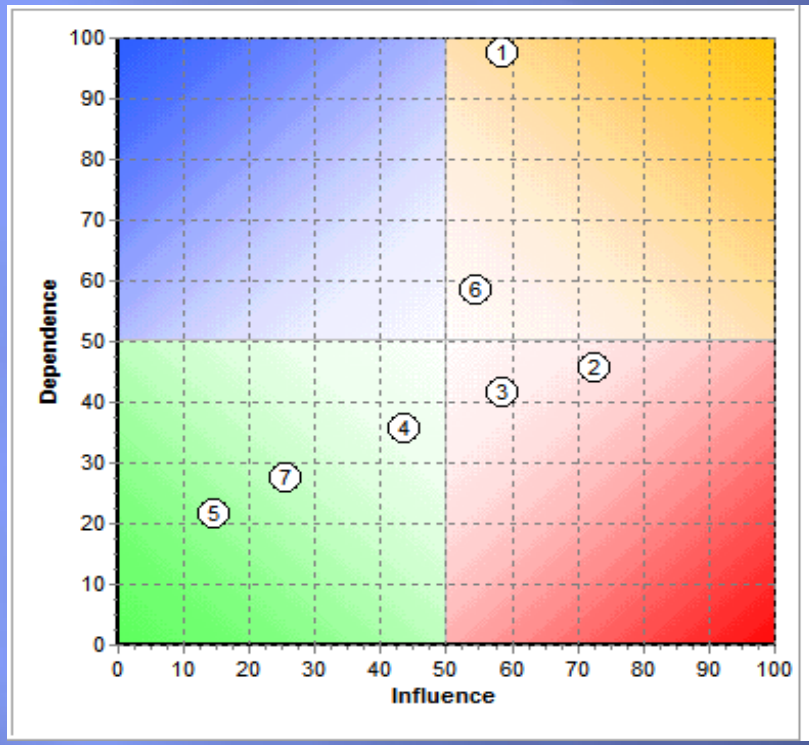
0,1

Alpha2

0,01

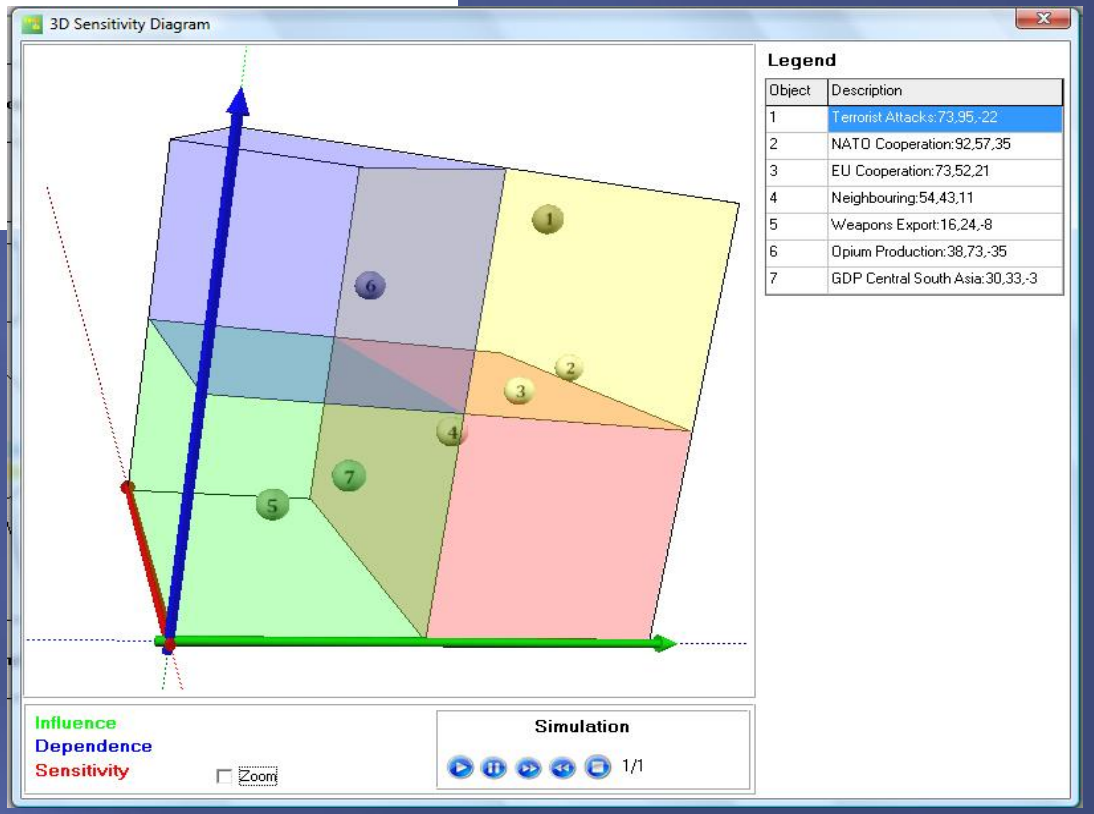
Alpha3

0,01



Legend

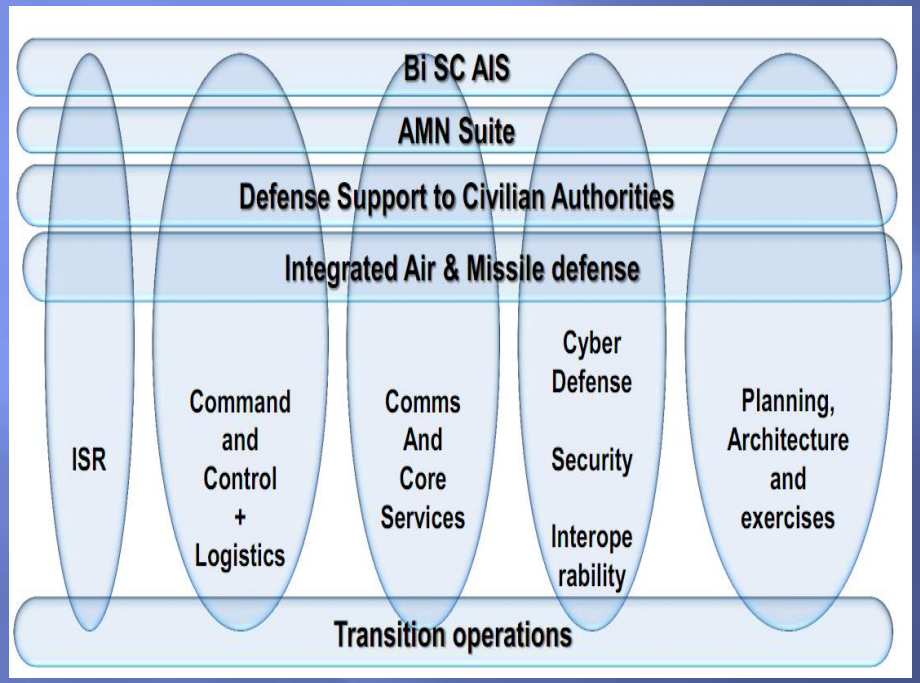
Object	Description
1	Terrorist Attacks
2	NATO Cooperation
3	EU Cooperation
4	Neighbouring
5	Weapons Export
6	Opium Production
7	GDP Central South Asia



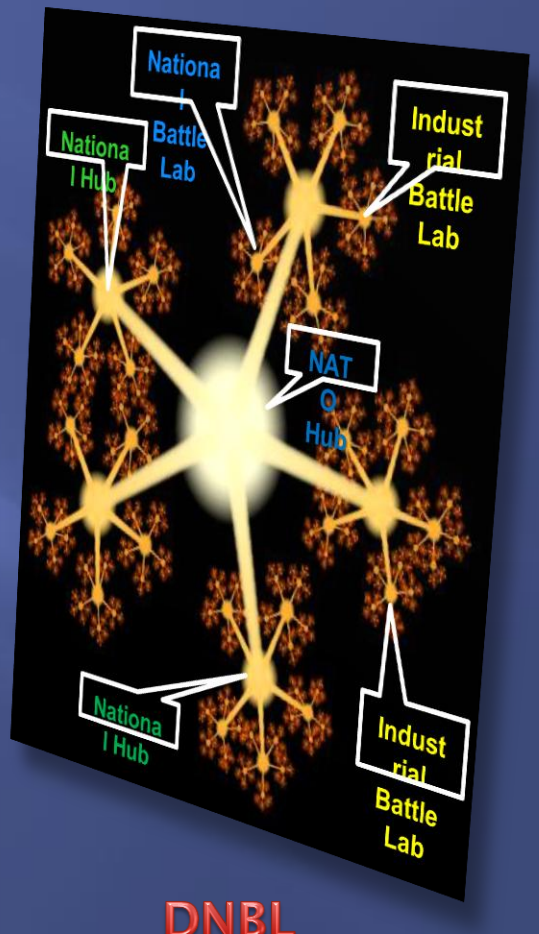
NATO 2020 New Strategic Concept Building

NATO Tour of Opinion Leaders to Allied Command Transformation, 2010.

NATO 'Smart Defence' Initiative

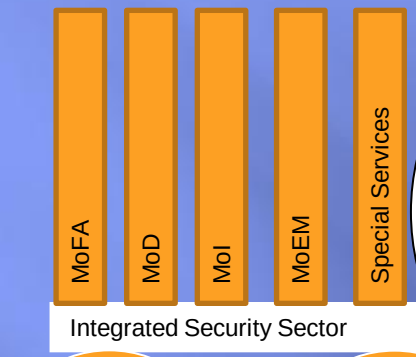


IT Governance



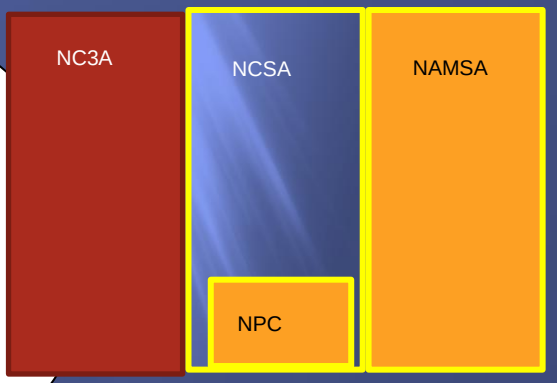
DNBL

The Comprehensive C4ISR Approach

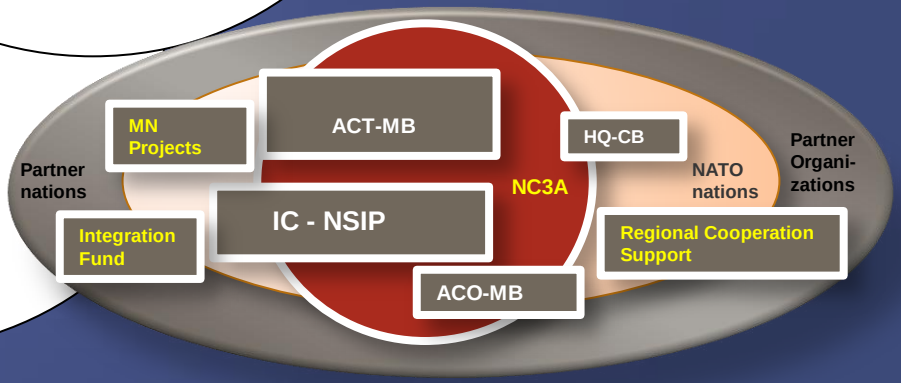


Integrated Security Sector C4ISR Requirements

Life Cycle Cooperative Support



Integrated Funding Model



Complex Crisis Management Operations of the Integrated Security Sector strongly dependent of information

NC3A Bi-Lateral Cooperation Model

New NATO Defense Planning Process

Lisbon Critical Capabilities

Capability Requirement Review

Alliance Declaration

NATO Strategic Concept

Targets

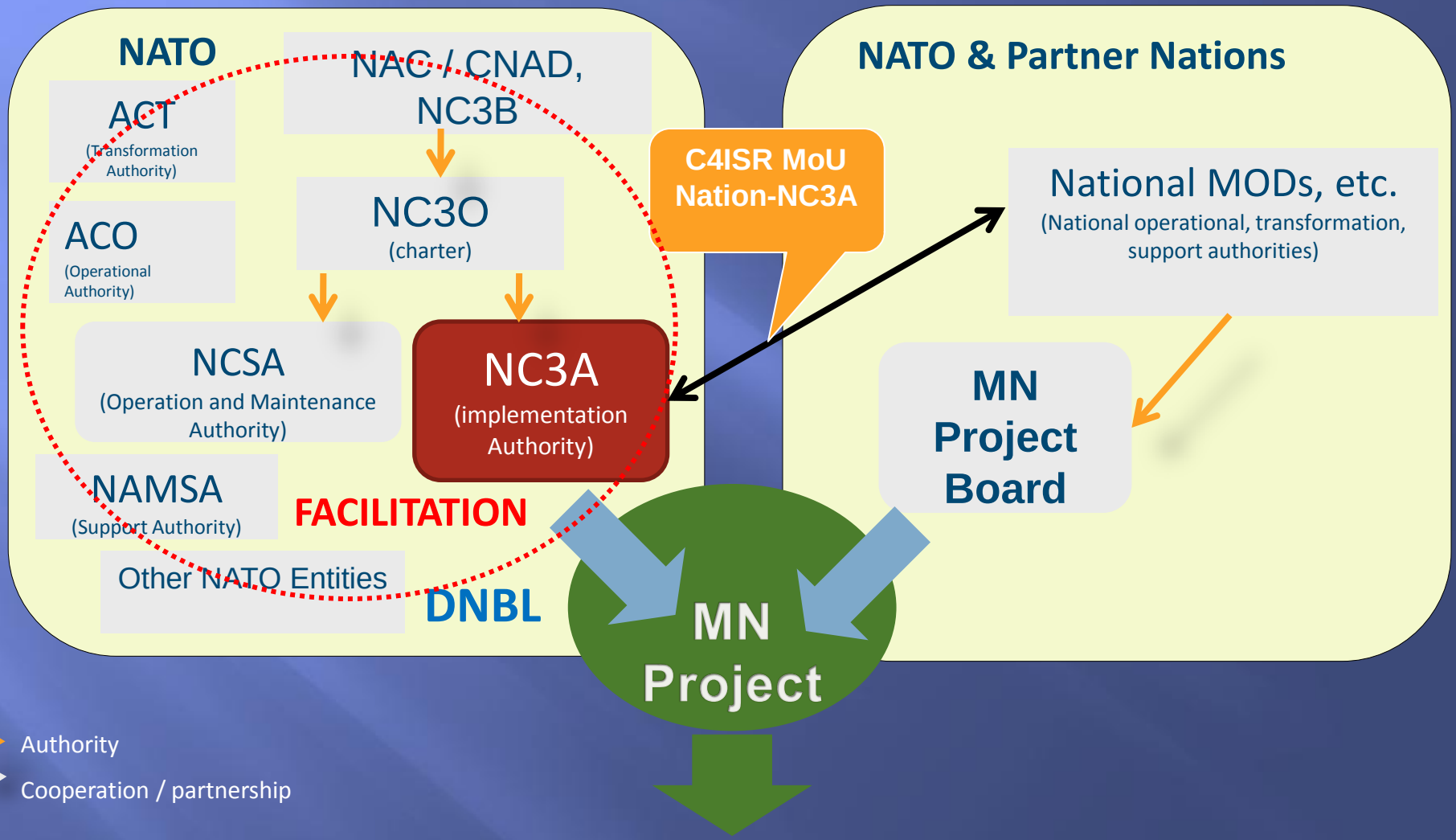
National White Papers

National Investment Plan / C4ISR projects

- Software maintenance and enhancement
- Documentation
- Training
- Helpdesk
- Support to industry
- Acquisition, Legal and Finance management services
- Battle Laboratory Services,
- Implementation support

NATO C3 AGENCY

MN Projects Generation with Embedded Interoperability and Security



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Thank you for the Attention!

Q & A ! ?