Supreme
Allied
Commander
Transformation

M&S and Data Science to support commander's white picture
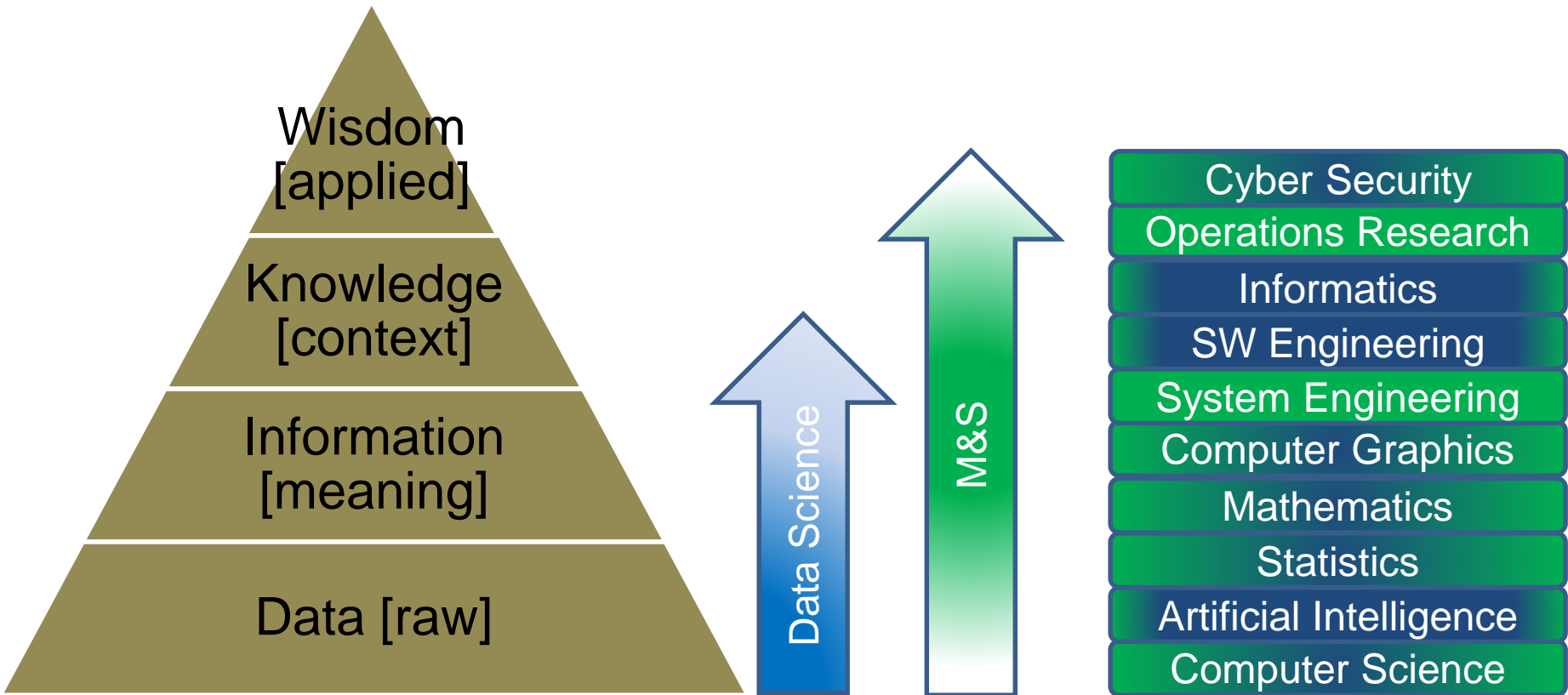
Jan Hodicky

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HQ SACT JFD MSTT

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Shaping tomorrow,
Bridging the two**

Agenda

- Introduction (M&S and Data Science)

- Problem Statement

- What we have so far in NATO Resilience?

- What we want to reach in the close future in NATO Resilience?

- ACT Resilience projects' key stakeholders

- What is expected to be portrayed in CMX 22?

- Current functionality of Resilience Data Analytics MVP

- Current functionality of Aggregated Resilience Model

- Interface between two ACT Resilience related projects for CMX 22 experiment

- Summary

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Introduction M&S and Data Science

Wisdom [applied]

Knowledge [context]

Information [meaning]

Data [raw]

Data Science

M&S

Cyber Security
Operations Research
Informatics
SW Engineering
System Engineering
Computer Graphics
Mathematics
Statistics
Artificial Intelligence
Computer Science

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Problem statement

- Common Operating Picture
  - Blue picture
  - Red picture
  - ***White picture*** (Civil Environment)

- **How we can increase the understanding of the white picture and its relation to military operations in SACEUR's AoR?**
  - Assessment of National Civil Preparedness
  - Assessment of the Risk in military operations

  While employing and synchronizing:
    - Data Science to bring the quantitative aspect and
    - M&S to bring the qualitative aspect

- White picture is formed in NATO through Resilience

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# What we have so far on Resilience?

- NATO approved Resilience vocabulary (7 Baseline Requirements – 7BLRs)
  - PO (2017) 0094 Evaluation Criteria on Resilience
  - Defense Planning Capability Surveys 2019
  - ACO Interim direction and guidance for resilience through civil preparedness

- Tools:
  - Resilience Data Analytics MVP creates connection to OpenSource data and real time analysis in SACEUR's AOR
    - Work with high level of detailed geo-referenced information
  - Aggregated resilience model brings what if analysis over the 7 BLRs in SACEUR's AOR plus visualization of the key output parameters
    - Work with high level of abstraction using system dynamics simulation paradigm – not geo specific data
  - Both tools has been experimented with end-users during the mini-exercise

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What we want to reach in NATO Resilience?

- Initialize NATO Resilience Capability Development Program

  - Operational Requirement Statements (ORS)
    - All NATO Resilience community operational users' requirements

  - How to get there?
    - Experimentation during Crisis Management Exercise (CMX) 22
      - To inform thee ORS development

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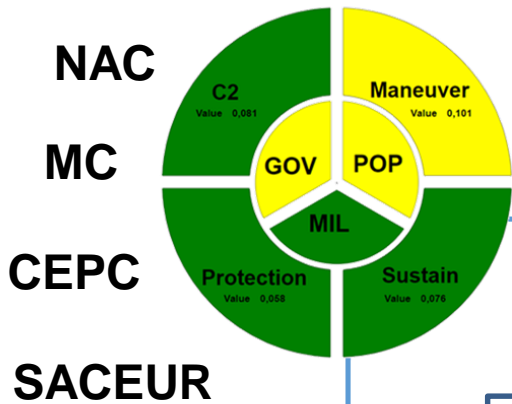
ACT Resilience projects' key stakeholders
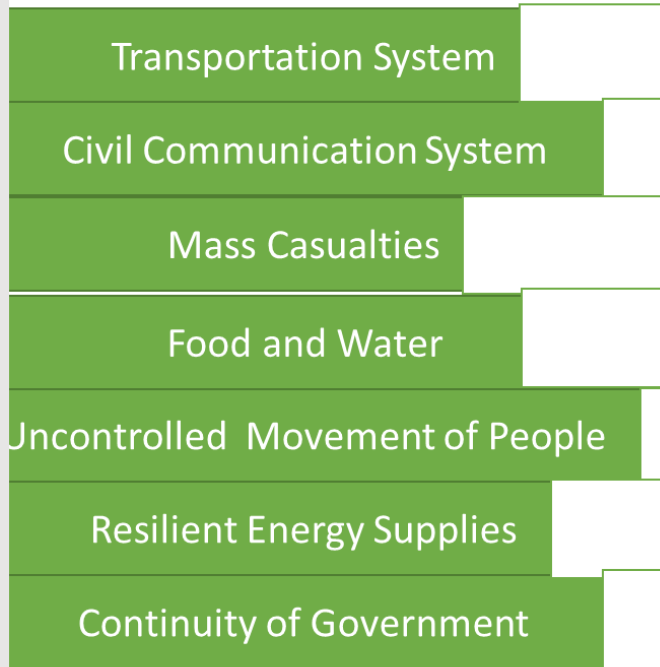
CMX 2022 functionality: SHAPE J9 Resilience Assessment presentation

EXPERIMENT   White Picture D+0

HIGH NORTH REGION

GOV POP MIL

ATLANTIC

GOV CIV MIL

BALTIC REGION

GOV POP MIL

REAR AREA

GOV POP MIL

BLACK SEA REGION

GOV POP MIL

C2 — Value 0,081
Maneuver — Value 0,101
GOV POP MIL
Protection — Value 0,058
Sustain — Value 0,076

CONTINUITY OF GOV'T
ESSENTIAL SERVICES
GOV CIV MIL
CIVIL SUPPORT TO MILITARY

SEVERE IMPACT AT RISK NO IMPACT

PUBLIC RELEASE

Resilience Mission Impact:

SEVERE MODERATE NONE

Key Takeaways:

➢ **Resilience in BSR has progressed since 2016, particularly in energy supply and civil transportation**

➢ **Simultaneous application of shocks inhibits system performance, but support to the military is largely retained**

➢ **Delivery of essential services to the population is most severely impacted by strategic shocks**

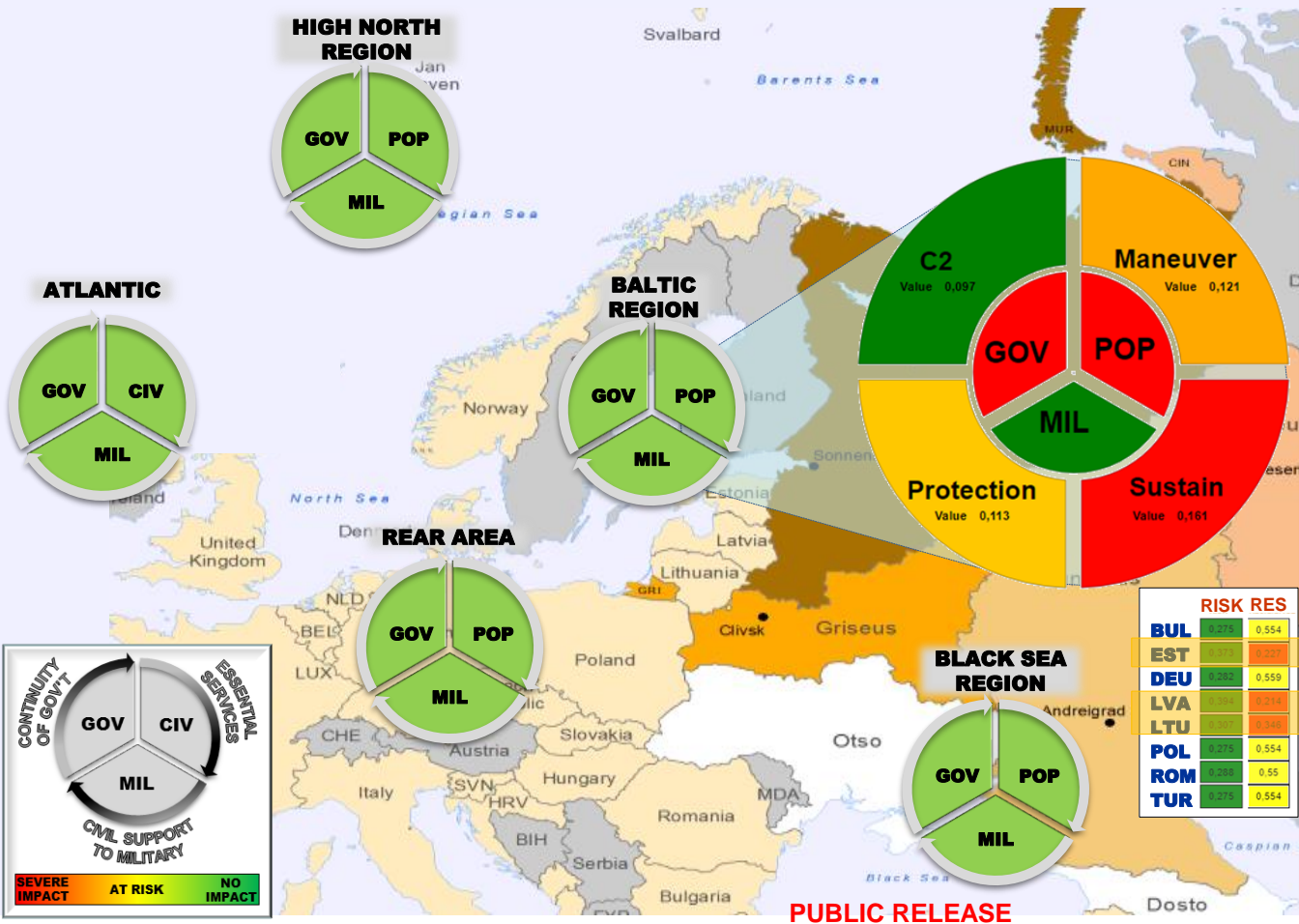➢ **The system can withstand localized shock and demonstrates a reasonable period of recovery**

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CMX 2022 functionality: SHAPE J9 Resilience Assessment presentation (effects of electric blackout/cyber/ pandemic strategic shocks)

EXPERIMENT   White Picture Simulation D+11

Resilience Mission Impact:
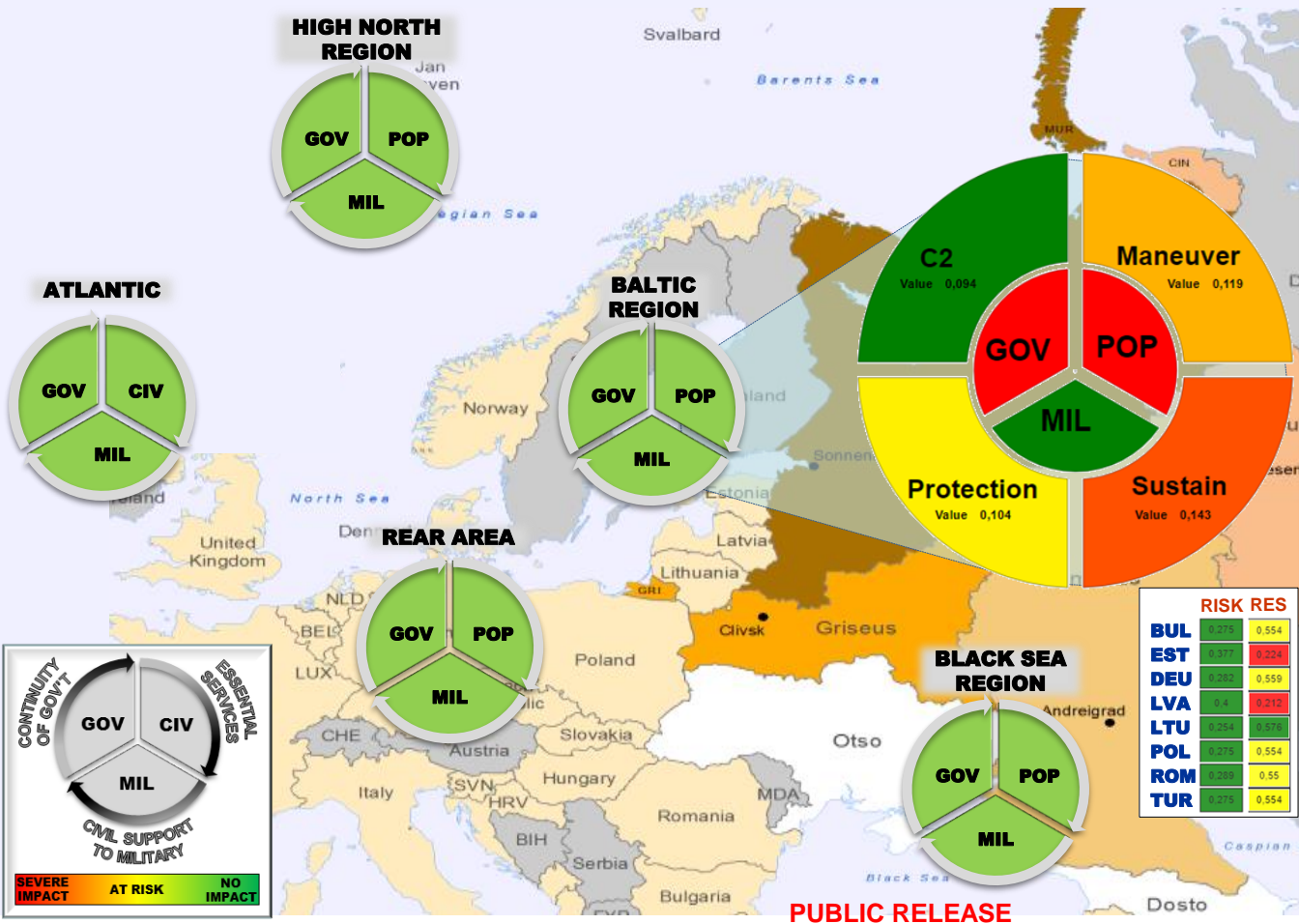
SEVERE — MODERATE — NONE

Key Takeaways:

➢ Resilience in BSR has progressed since 2016, particularly in energy supply and civil transportation

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➢ The system can withstand localized shock and demonstrates a reasonable period of recovery

HIGH NORTH REGION
GOV | POP | MIL

ATLANTIC
GOV | CIV | MIL

BALTIC REGION
GOV | POP | MIL

C2 Value 0,097
Maneuver Value 0,121
GOV | POP | MIL
Protection Value 0,113
Sustain Value 0,161

REAR AREA
GOV | POP | MIL

BLACK SEA REGION
GOV | POP | MIL

CONTINUITY OF GOV'T | ESSENTIAL SERVICES
GOV | CIV | MIL
CIVIL SUPPORT TO MILITARY
SEVERE IMPACT | AT RISK | NO IMPACT

	RISK	RES
BUL	0,275	0,554
EST	0,373	0,227
DEU	0,282	0,559
LVA	0,394	0,214
LTU	0,307	0,346
POL	0,275	0,554
ROM	0,288	0,55
TUR	0,275	0,554

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CMX 2022 functionality: SHAPE J9 Resilience Assessment presentation (effects of electric blackout/cyber/ pandemic strategic shocks)

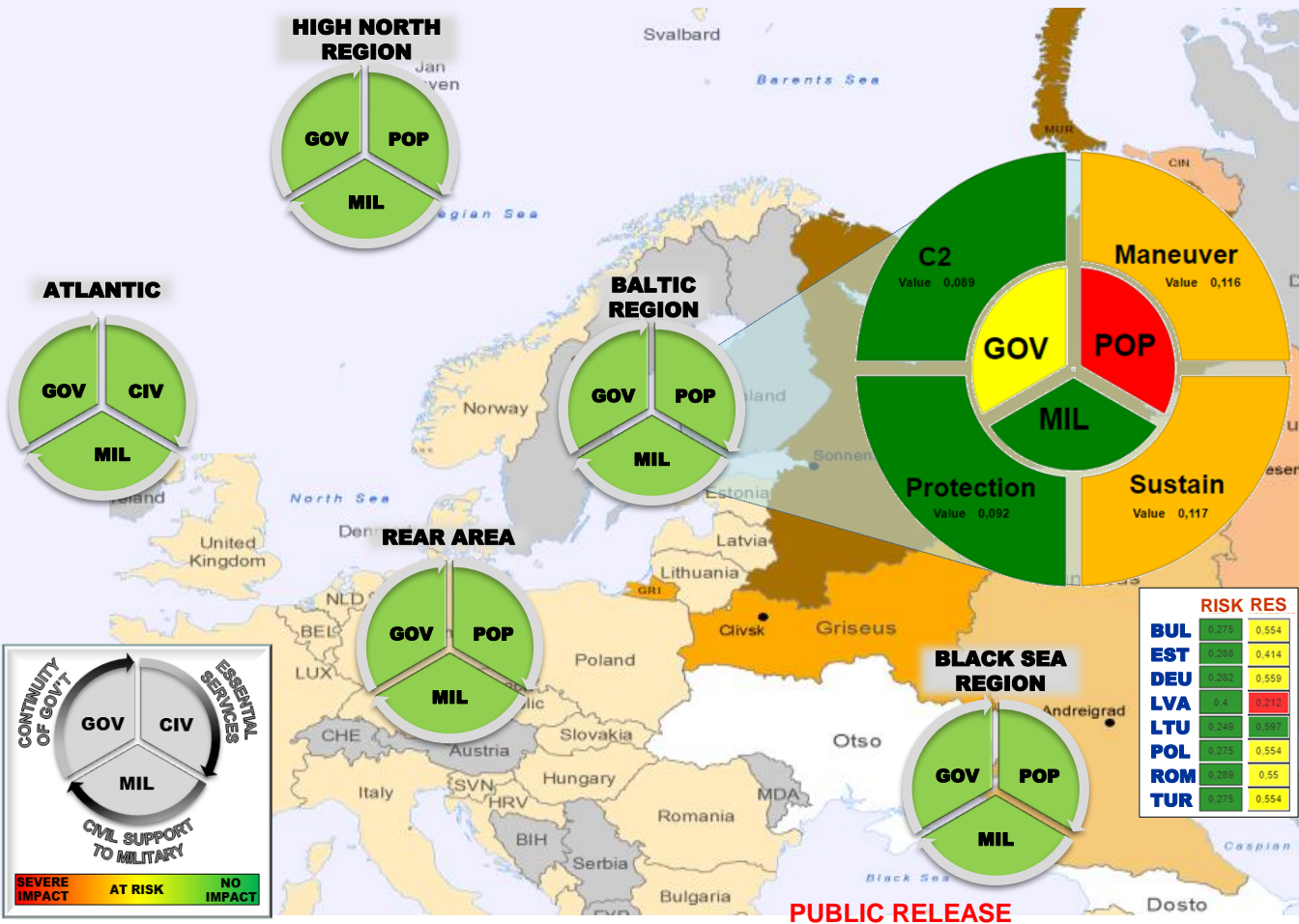## EXPERIMENT White Picture Simulation D+23

HIGH NORTH REGION

ATLANTIC

BALTIC REGION

REAR AREA

BLACK SEA REGION

C2 — Value 0,094

Maneuver — Value 0,119

Protection — Value 0,104

Sustain — Value 0,143

GOV | POP | MIL

	RISK	RES
BUL	0,275	0,554
EST	0,377	0,224
DEU	0,282	0,559
LVA	0,4	0,212
LTU	0,254	0,576
POL	0,275	0,554
ROM	0,289	0,55
TUR	0,275	0,554

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Resilience Mission Impact:

SEVERE — MODERATE — NONE

Key Takeaways:

➤ Resilience in BSR has progressed since 2016, particularly in energy supply and civil transportation

➤ Simultaneous application of shocks inhibits system performance, but support to the military is largely retained

➤ Delivery of essential services to the population is most severely impacted by strategic shocks

➤ The system can withstand localized shock and demonstrates a reasonable period of recovery

CONTINUITY OF GOV'T — ESSENTIAL SERVICES — GOV CIV MIL — CIVIL SUPPORT TO MILITARY

SEVERE IMPACT — AT RISK — NO IMPACT

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CMX 2022 functionality: SHAPE J9 Resilience Assessment presentation (effects of electric blackout/cyber/ pandemic strategic shocks)

EXPERIMENT   White Picture Simulation D+28

HIGH NORTH REGION

ATLANTIC

BALTIC REGION

REAR AREA

BLACK SEA REGION

C2 — Value 0,089
Maneuver — Value 0,116
Protection — Value 0,092
Sustain — Value 0,117

GOV / POP / MIL

Resilience Mission Impact:

SEVERE — MODERATE — NONE

Key Takeaways:

➢ Resilience in BSR has progressed since 2016, particularly in energy supply and civil transportation

➢ Simultaneous application of shocks inhibits system performance, but support to the military is largely retained

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	RISK	RES
BUL	0,275	0,554
EST	0,288	0,414
DEU	0,282	0,559
LVA	0,4	0,212
LTU	0,249	0,597
POL	0,275	0,554
ROM	0,289	0,55
TUR	0,275	0,554

CONTINUITY OF GOV'T — ESSENTIAL SERVICES
GOV / CIV / MIL
CIVIL SUPPORT TO MILITARY

SEVERE IMPACT — AT RISK — NO IMPACT

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# Current Resilience Data Analytics MVP functionality

- Run by ACT Innovation Hub

- Agile methodology

- Main end-user is operational command – JFC Brunssum

- Leverage large amounts of information, open source data, social media and diverse media outlets to build a system level understanding of the civil environment

- Strong focus on data science methodology

  - Predictive analytics and forecasting

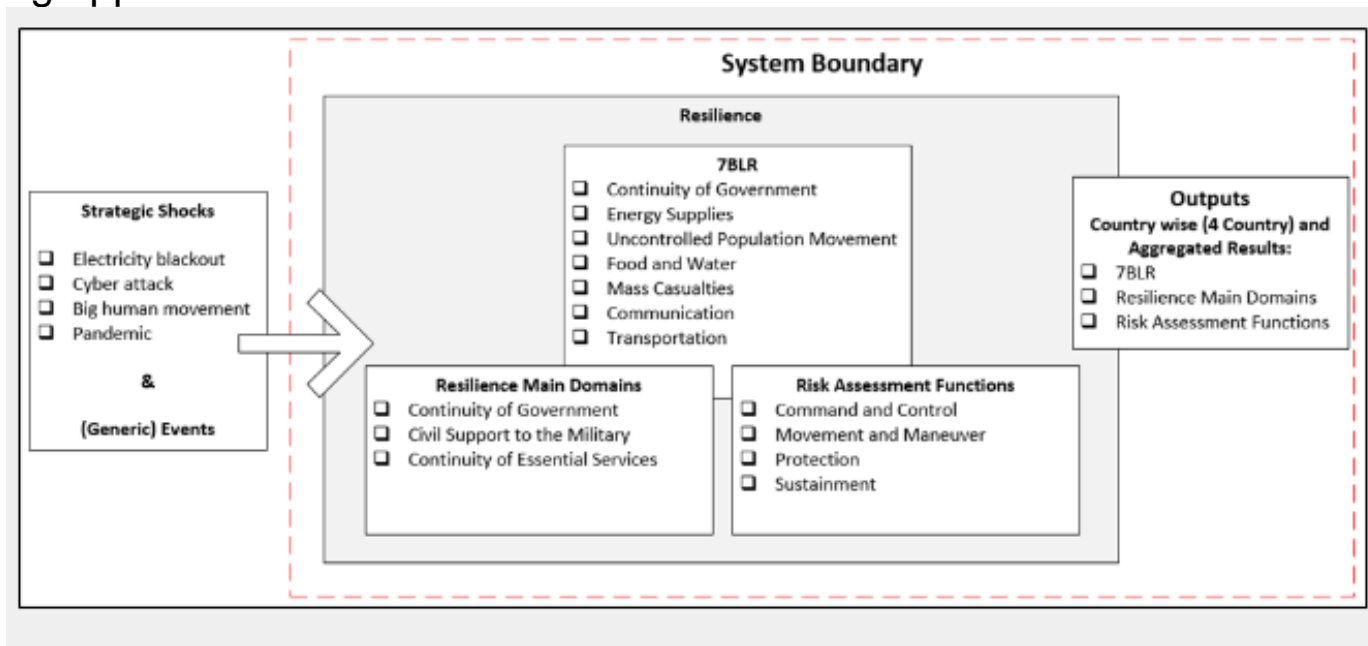 - Machine learning methods

  - Natural Language Processing (NLP)

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Energy BLR

Natural gas reserves

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Transantportation BLR

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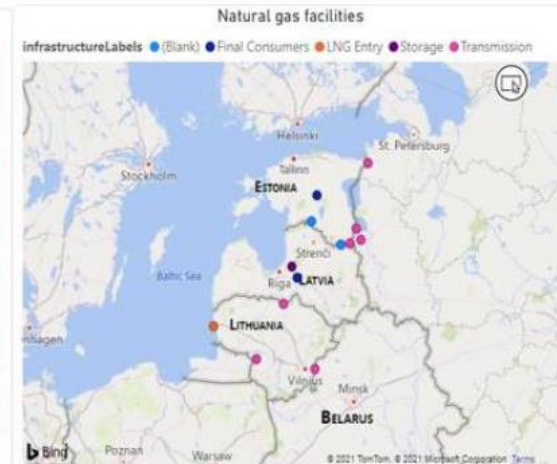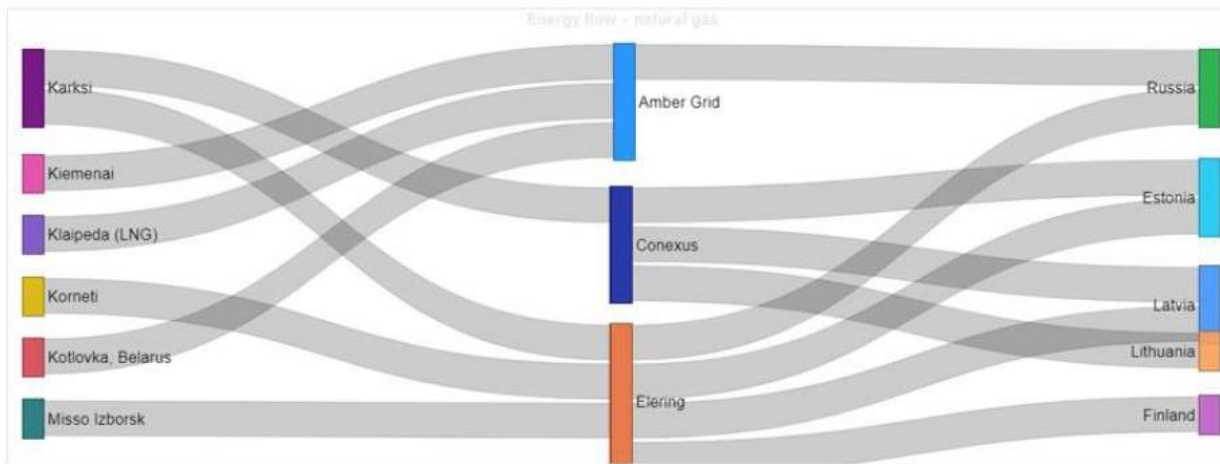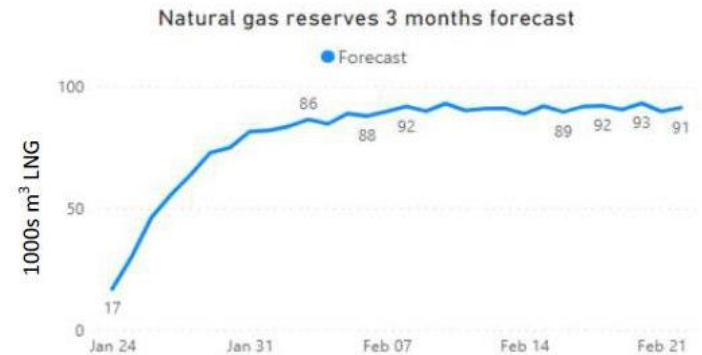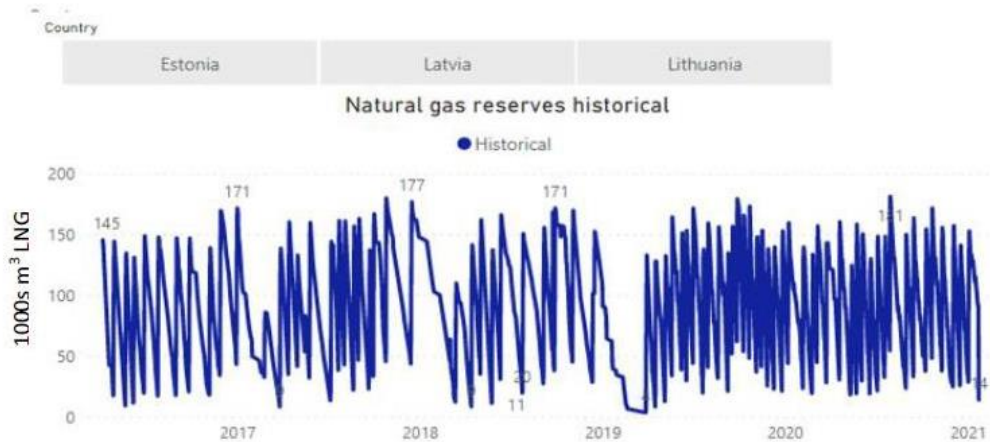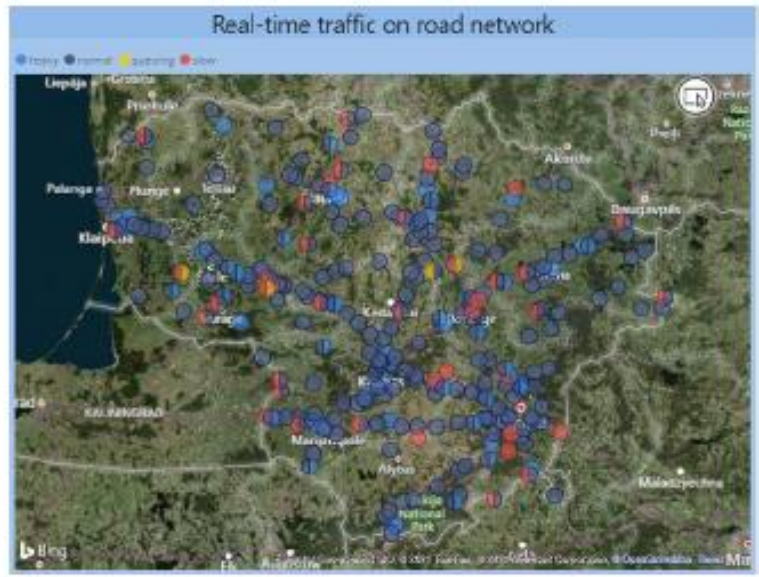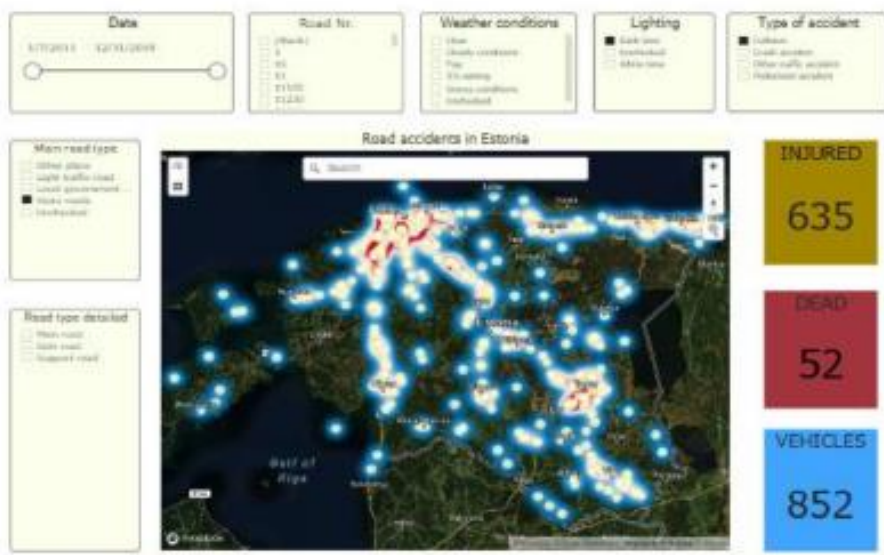
Current Aggregated resilience model capacity

- System Dynamics M&S paradigm and Stella Architect used
- 7 BLRS Casual Loop Diagrams (CLDs) modeled and validated with CEPC's SMEs (around 300 model's parameters)
- NATO Resilience assessment is based on Nations Resilience Assessment
- Aggregation mechanism to merge National Resilience Assessment (4 countries) through weighting approach

System Boundary

Resilience

7BLR
- ☐ Continuity of Government
- ☐ Energy Supplies
- ☐ Uncontrolled Population Movement
- ☐ Food and Water
- ☐ Mass Casualties
- ☐ Communication
- ☐ Transportation

Strategic Shocks
- ☐ Electricity blackout
- ☐ Cyber attack
- ☐ Big human movement
- ☐ Pandemic

&

(Generic) Events

Outputs
Country wise (4 Country) and Aggregated Results:
- ☐ 7BLR
- ☐ Resilience Main Domains
- ☐ Risk Assessment Functions

Resilience Main Domains
- ☐ Continuity of Government
- ☐ Civil Support to the Military
- ☐ Continuity of Essential Services

Risk Assessment Functions
- ☐ Command and Control
- ☐ Movement and Maneuver
- ☐ Protection
- ☐ Sustainment

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CLD example

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Current Aggregated resilience model capacity

Aggregated Resilience Model for CMX22

COUNTRY PAGES
- Estonia Pages
- Latvia Pages
- Lithuania Pages
- Poland Pages

OUTPUT PAGES
- Aggregated Resilience Main Domains
- Aggregated Risk Assessment Functions
- Aggregated Resilience Decision Support System

INFO PAGE

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Current Aggregated resilience model capacity

- For each Nation input parameters needs to be set up prior the model use
- User is offered the limited set of parameters for what-if analysis

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Current Aggregated resilience model capacity

Baseline Assessment Day 0 and effects of strategic shocks

- Outputs for each BLRs and each Nation are calculated

Communication
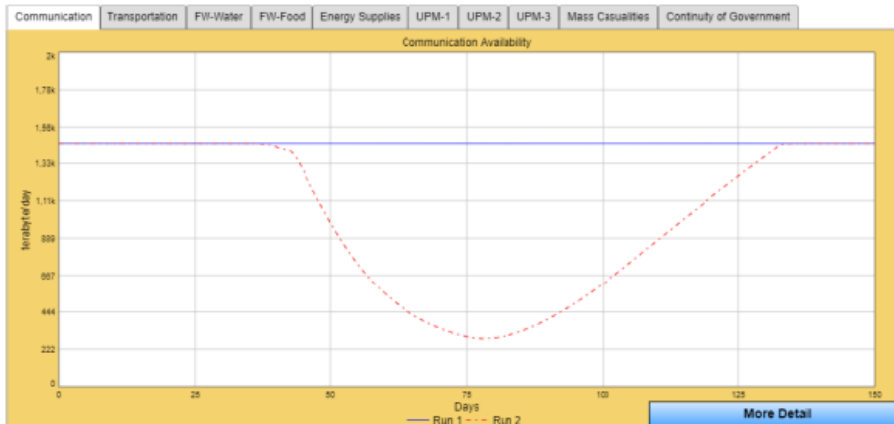
Transportation
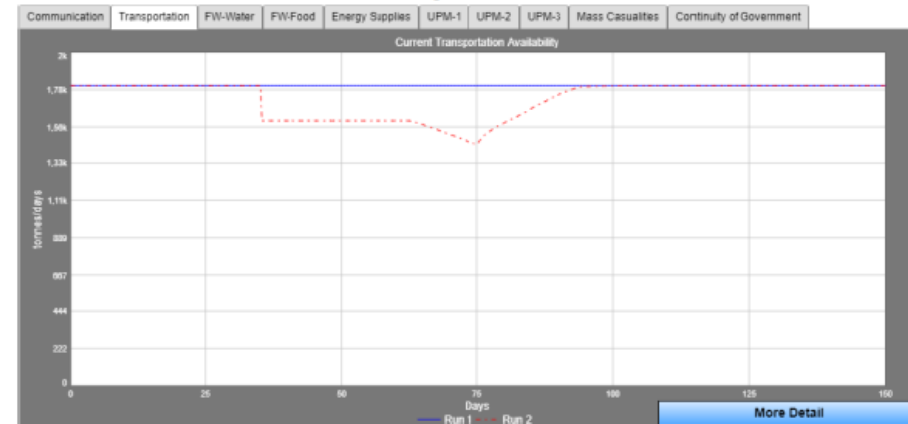
FW - Water
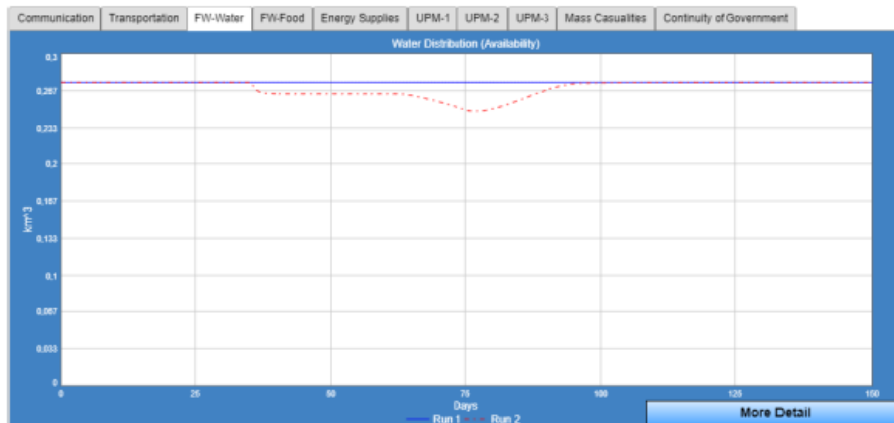
FW - Food
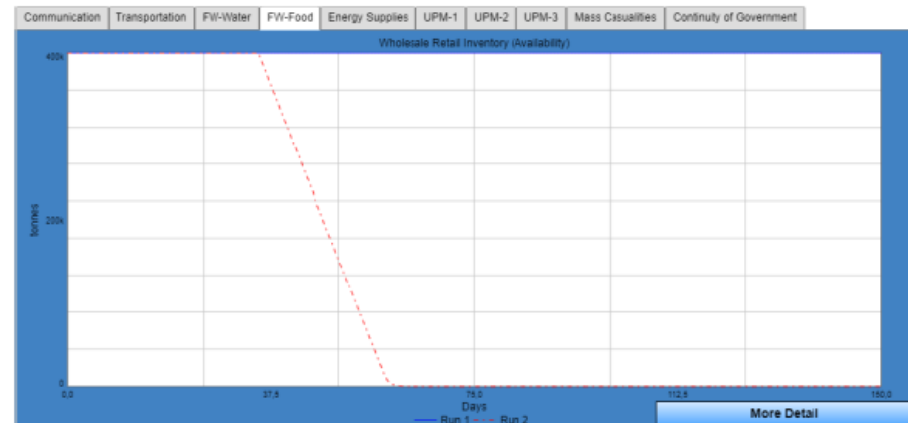
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Current Aggregated resilience model capacity
Strategic shocks and generic event inputs

- 4 categories of strategic shocks can be defined

Poland Strategic Shocks Input Page

| 7BLRs Input | Strategic Shocks Input Page | Events Input Page | 7 BLR Output Page | Resilience Main Domains Page | Risk Assessment Functions Page |

PANDEMIC

Start Time of Pandemic (?) : 35   End Time of Pandemic (?) : 75

Pandemic Staff Loss Fraction

Food and Water: 0,05 0,075 0,1   Transportation: 0 0,5 1   Communication: 0 0,5 1

0 0,5 1

Mass Casuality, Medical Staff

Pandemic Demand Effects

Comm Multiplier: 0 50 100   Cargo Transportation Increase Rate: 0 0,5 1   Passenger Transportation Decrease Rate: 0 0,5 1

CYBER ATTACK

Start Time of Cyber Attack: 10   End Time of Cyber Attack: 75

Cyber Attack Demand Effect

Communication Multiplier: 0 50 100

ELECTRICITY BLACKOUT (?)

ON   OFF

BIG HUMAN MOVEMENT

Start Time of Big Human Movement: 20   End Time of Big Human Movement: 75

Big Human Movement Demand Effects

Transportation Increase Rate: 0 0,5 1   Comm Multiplier: 0 50 100   Food and Water Increase Rate: 0 0,5 1

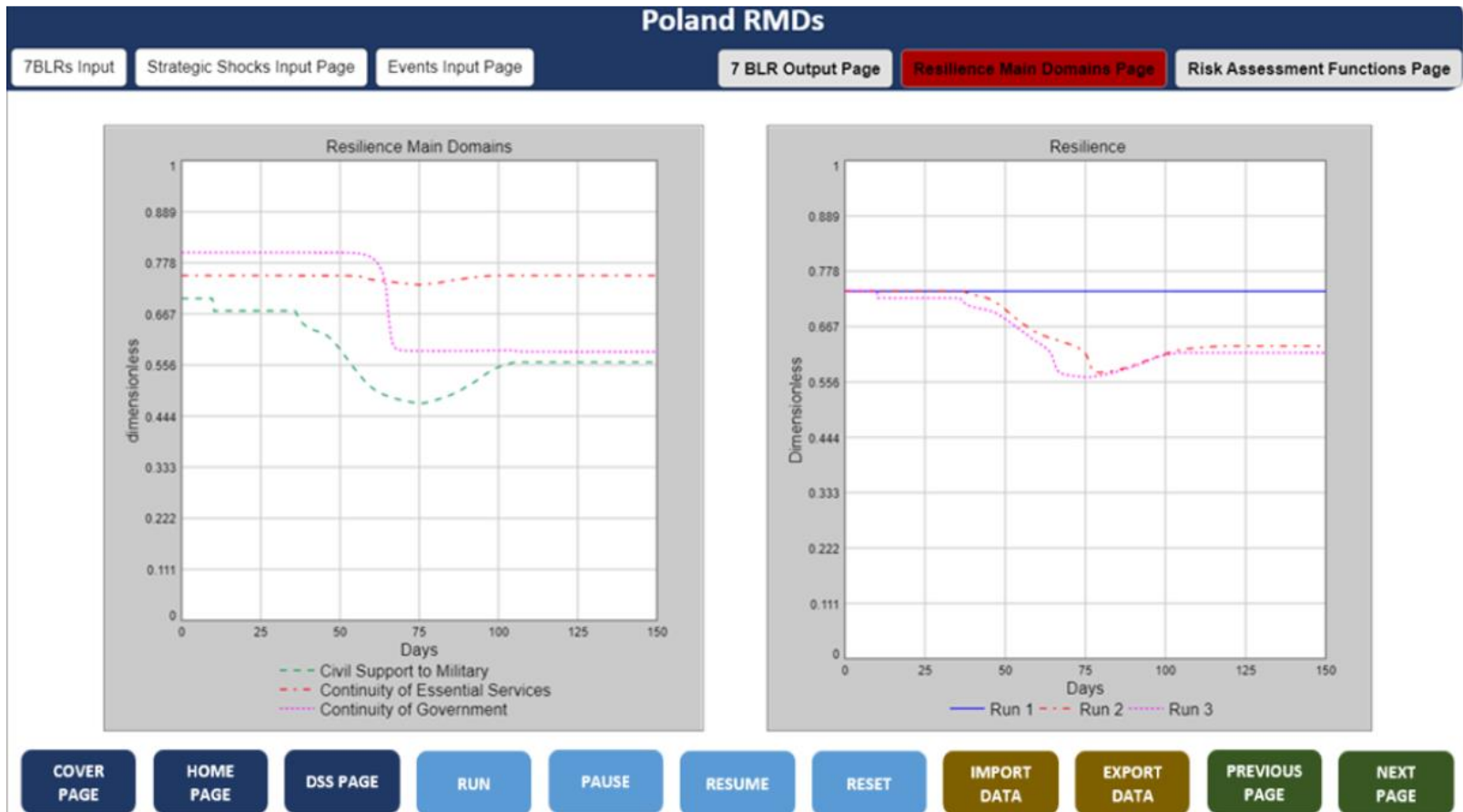**Alternative Shock Input Page (Graphical)**

| COVER PAGE | HOME PAGE | DSS PAGE | RUN | PAUSE | RESUME | RESET | IMPORT DATA | EXPORT DATA | PREVIOUS PAGE | NEXT PAGE |

Current Aggregated resilience model capacity
Strategic shocks and generic event inputs

- An event can be defined causing decrease in the capacities in one of 7BLRs

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Current Aggregated resilience model capacity
Strategic shocks effects

- 3 Resilience main domains

Poland RMDs

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Current Aggregated resilience model capacity
Strategic shocks effects

- Risk in four military functions

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Current Aggregated resilience model capacity
Strategic shocks effects

- Aggregated strategic dashboard

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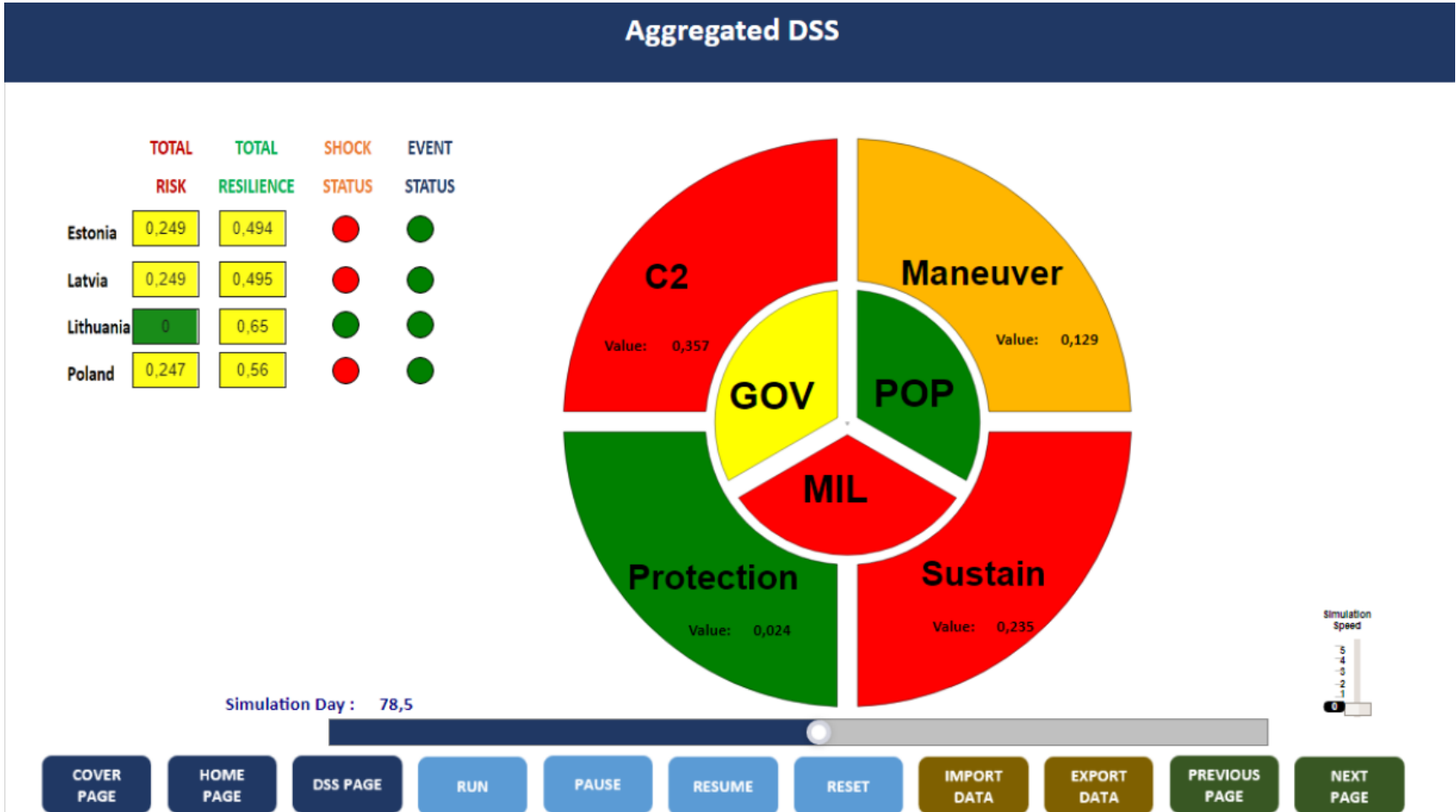
Current ACT Resilience projects capacity and CMX 22 experimentation

Resilience Data Analytics MVP (Open Source)

Resilience Baseline Assessment

7 BLRs & 4 Countries

Aggregated Resilience Model (7 BLR & 4 Countries)

Strategic Shock (MEDIA: Resilience Data Analytics MVP)

Shocks/Events

Real world

Simulated world

Shocks/Events

Strategic Shock (CMX 22 CEL)

- Understanding most likely resilience behavior
- What-if analysis
- Base-case simulation for 150 days
- No prediction

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Summary

- Two ACTs' projects on Resilience will be used in CMX 22 by SHAPE J9 in the form of the experiment for the benefits of NATO Resilience Capability Development
- The experiment will not interfere the execution of CMX 22
- Model and Interface validation work was the critical moment of the project
- Open Source Data is simply not enough for the NATO Resilience assessment

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