



› M&S SUPPORT IN THE OPERATIONS PROCESS

NATO MSG-143 Symposium "Ready for the Predictable, Prepared for the Unexpected - M&S for Collective Defence in Hybrid Environments and Hybrid Conflicts " | Guido Veldhuis, Nico de Reus

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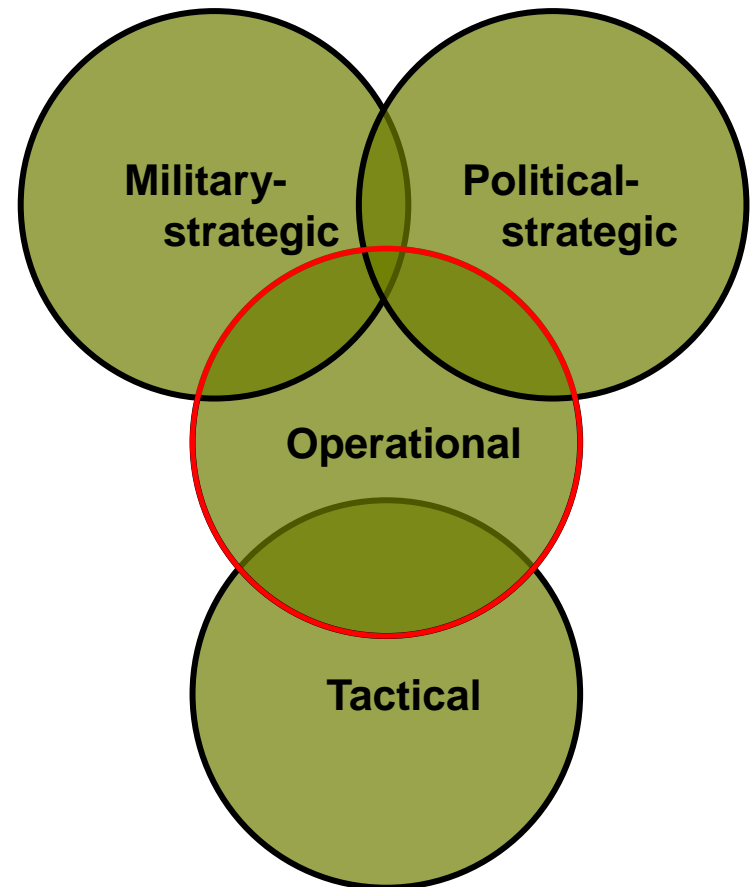
MEANWHILE... SOMEWHERE ELSE ON THE PLANET



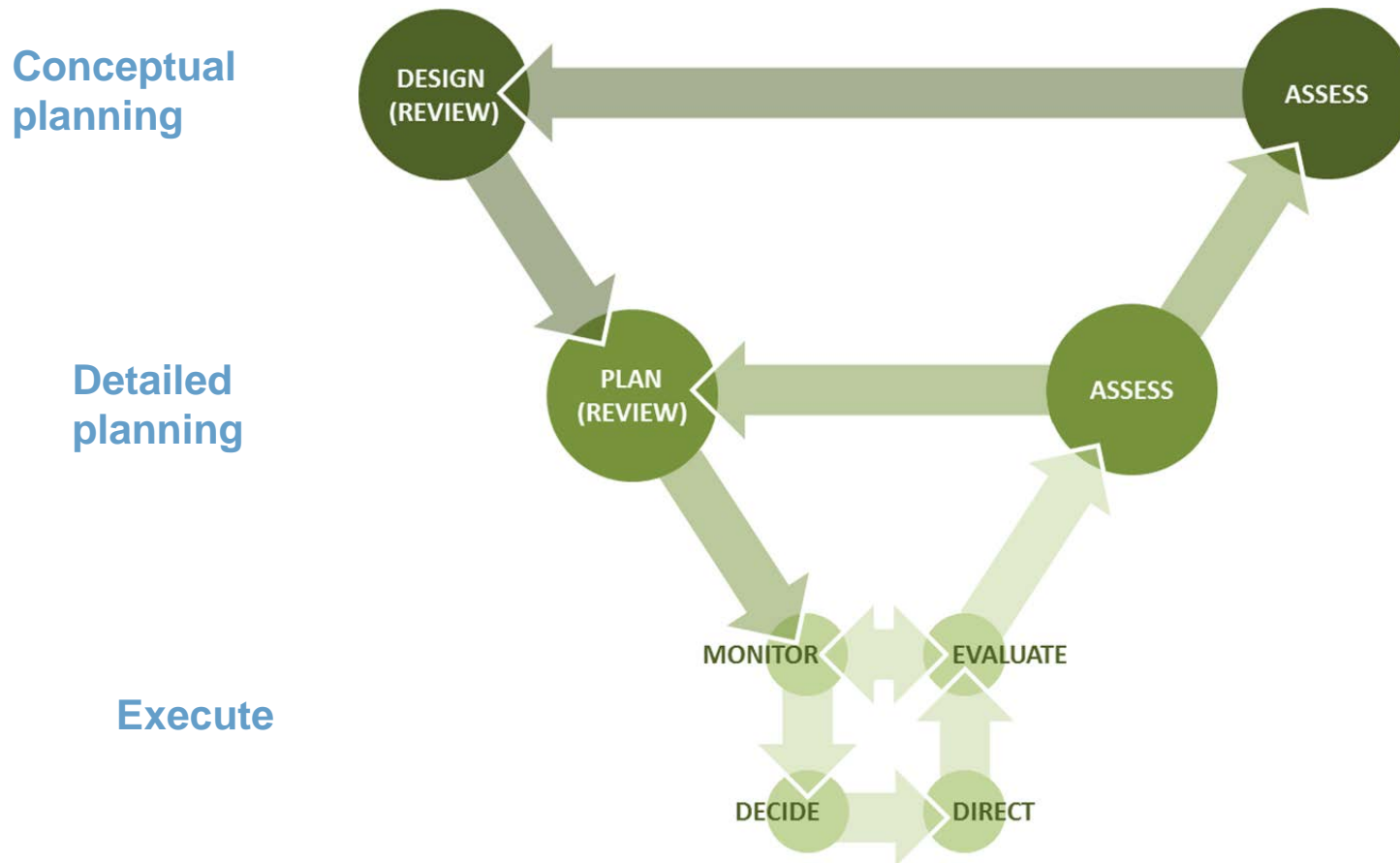
Credits: Sean Swan (ITN)



M&S SUPPORT TO OPERATIONS



THE OPERATIONS PROCESS



MILITARY OPERATIONS THE CHALLENGE

Short vs. long term

Effects and Side
effects

Different
perspectives

Handover



Dynamic
complexity

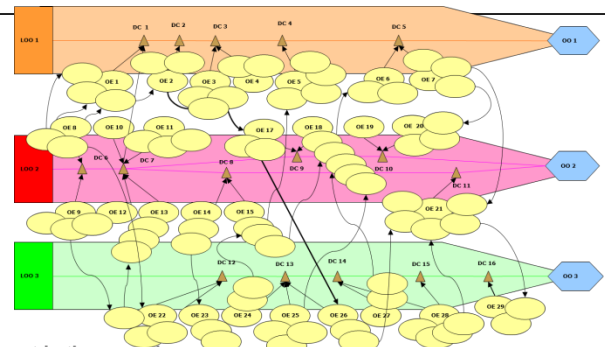
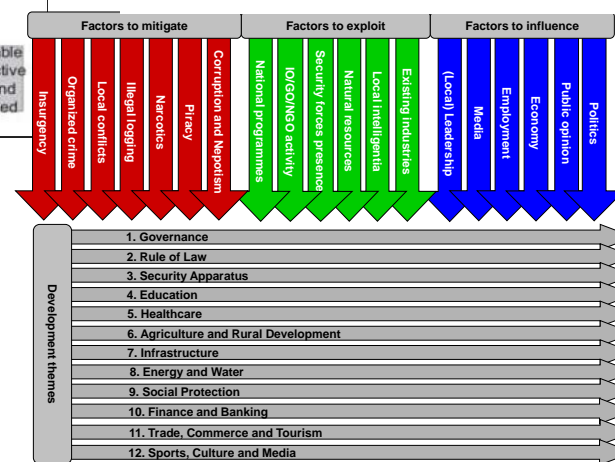
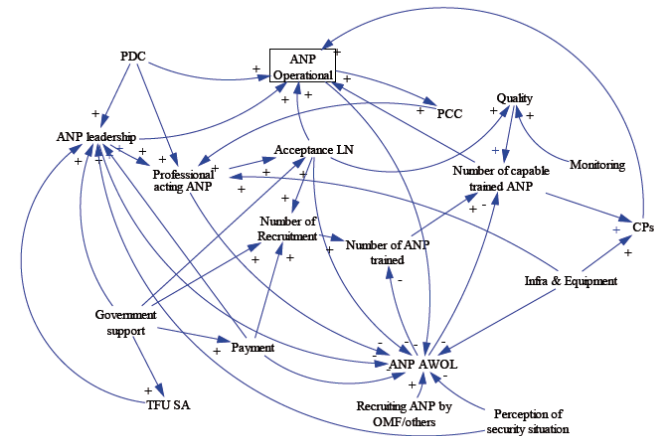
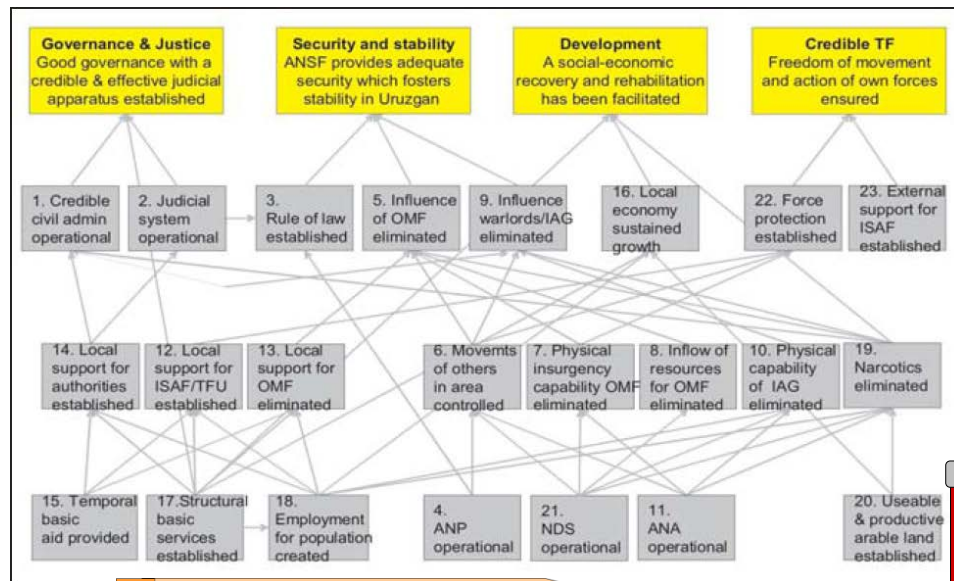
uncertainty

Hybrid

Scarcity

CURRENT APPROACH

EXAMPLES FROM TASK FORCE URUZGAN



MODELLING & SIMULATION SUPPORT AS A SOLUTION DIRECTION

- › M&S enables a user to:
 - › Simulate the behaviour of systems over time
 - › Gain insight into the system behaviour and relations between factors/actors
 - › The modelling process itself stimulates deep reflection on the problem situation. Especially when done in a group it gives insight into each others views.
 - › Models as knowledge repository

- › M&S applications for training and concept development and experimentation have been successful ->

A project was started to investigate the possibilities of M&S for operations

WHERE CAN M&S OFFER SUPPORT?

› Design

- › Create insight in PMESII-PT (f)actors

› Planning

- › Develop and analyse Courses of Action

› Assessment

- › Define relevant MOEs/MOPs
- › Investigate and update assumptions about MOEs/MOPs and PMESII-PT (f)actors



KEY POINTS OF APPROACH

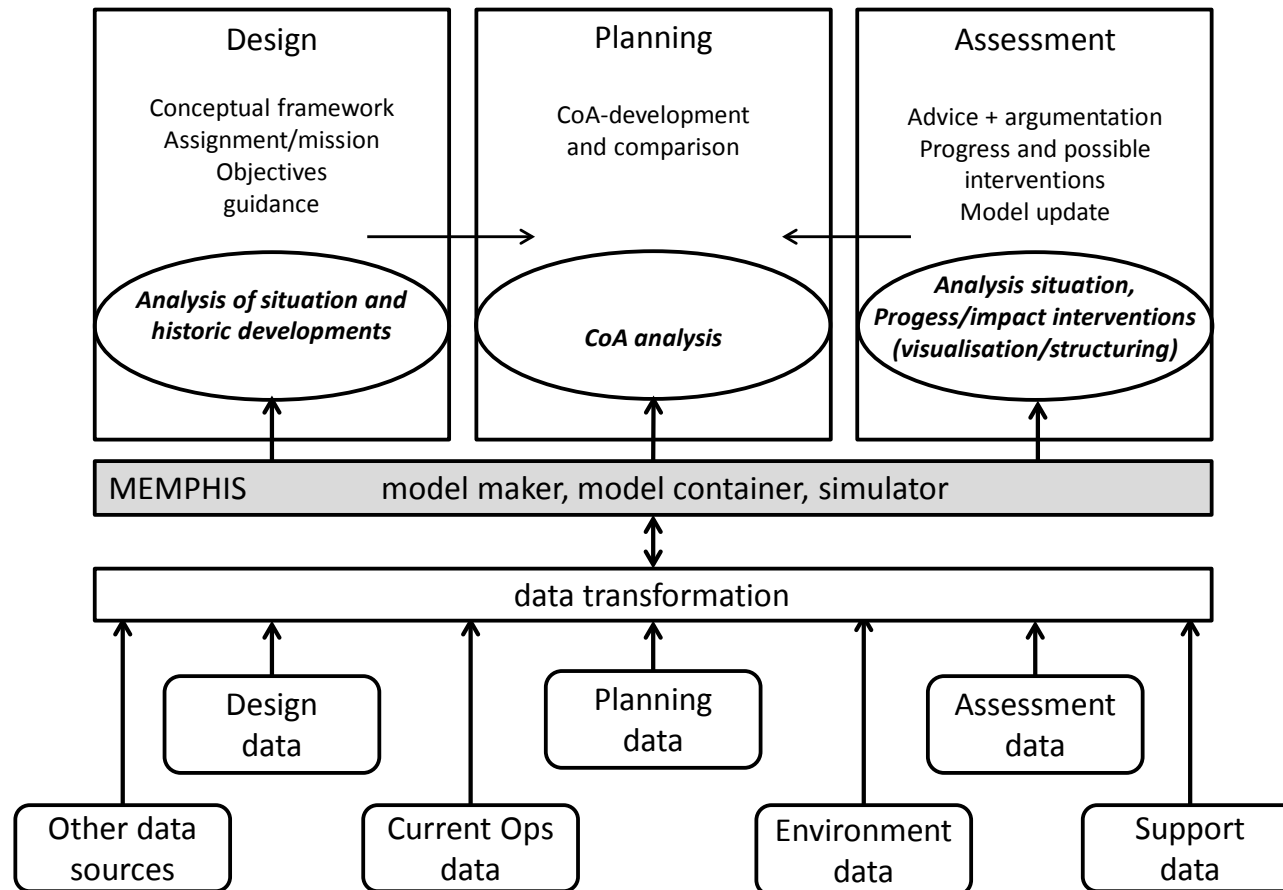
- › **Other frameworks and models exist, such as: COMPOEX, NOEM,...** are/contain **BIG models**, (COMPOEX models typically contain 10,000 state variables and thousands of relations.

Our approach:

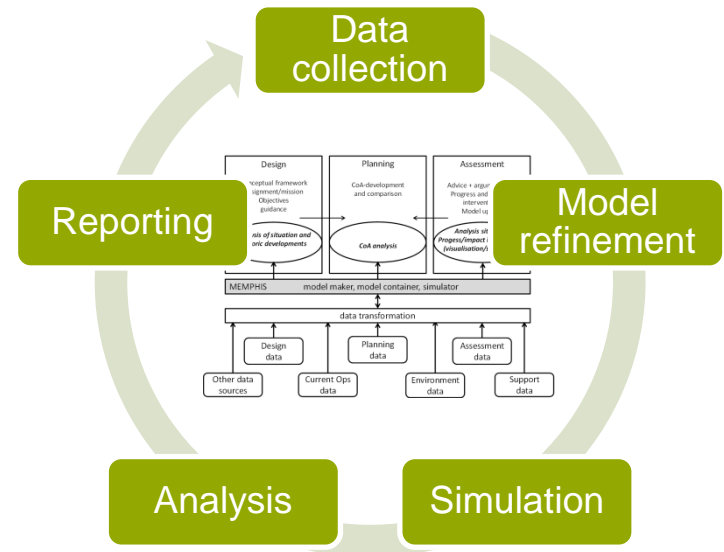
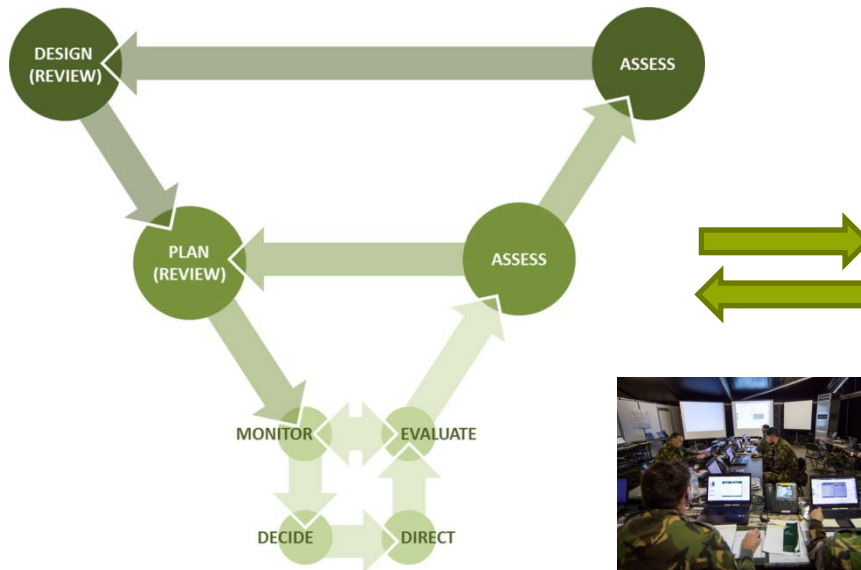
- › Use of smaller models and visual diagrams
 - › More manageable, easier to build
 - › Accessibility, ownership
- › Process is just as important as product: Build with(by) end-user, involved in Group Model Building sessions
 - › Getting mission area insight from the model building process
- › Focus on including uncertainty in analysis
 - › No point predictions but embrace uncertainty
 - › Insight, Robustness and traceability.
- › Support continuous updating
 - › Enable the (re)-use of model parts: 'building blocks'

MEMPHIS CONCEPT

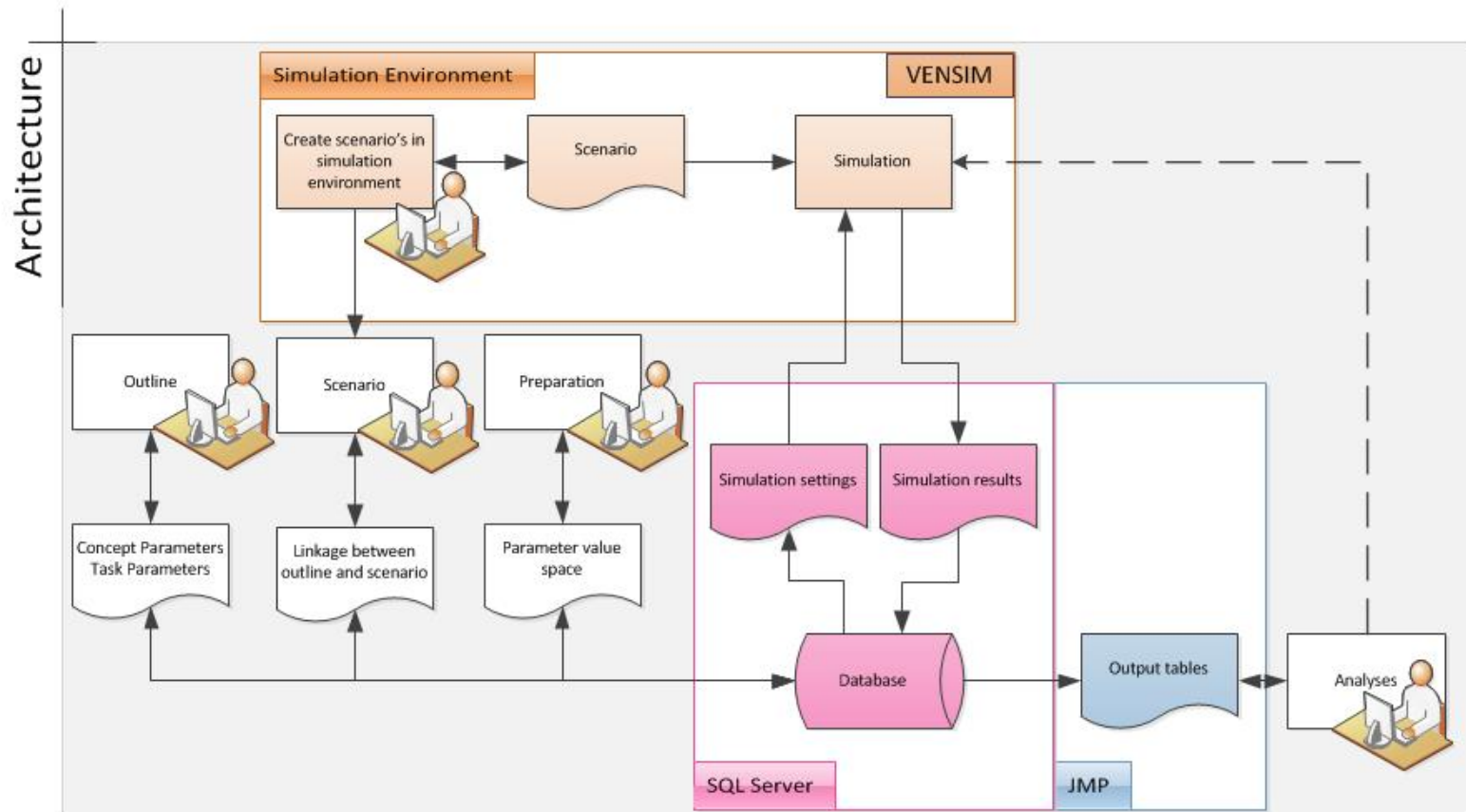
Military Environment Modelling with Physical and Human terrain Information Services



A NOTE ON PROCESS

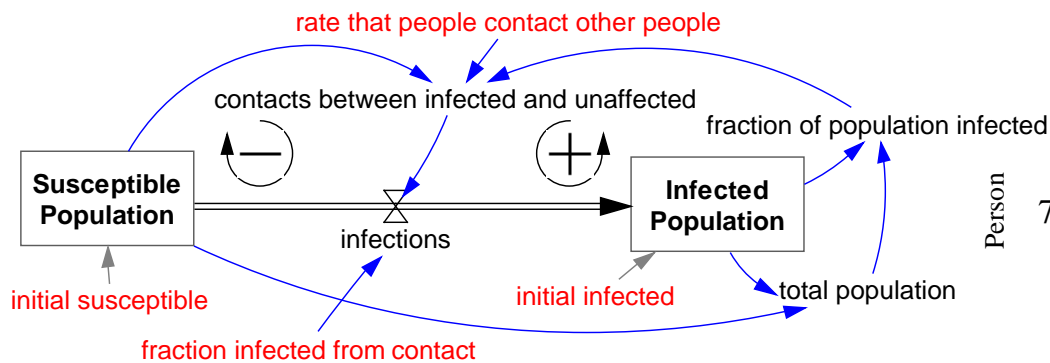


ARCHITECTURE

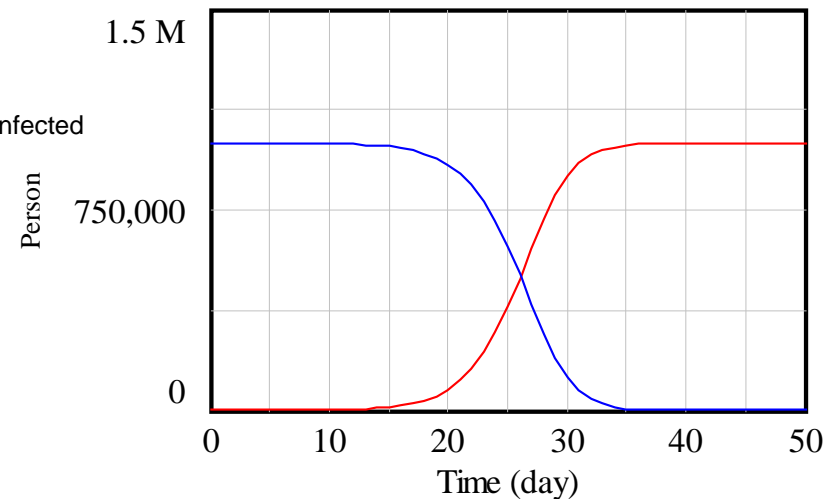


MODEL BUILDING METHODOLOGY: SYSTEM DYNAMICS

‘Structure drives behaviour’



Susceptible and Infected Population

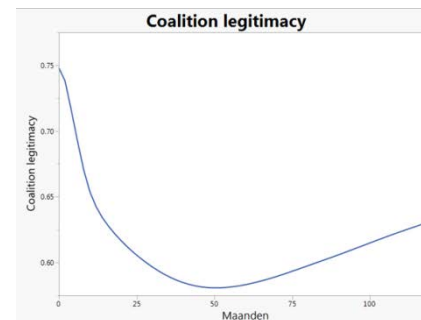


Susceptible Population : Epidemic —————
 Infected Population : Epidemic —————

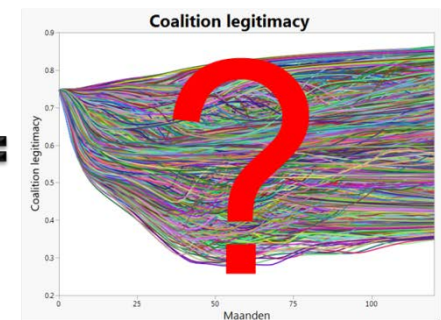
EXPLORATORY MODELLING AND ANALYSIS

› (Deep) Uncertainty will remain about:

- › Appropriate models
- › Relationships amongst factors
- › Correct parameters/probabilities
- › How to value outcomes



=



› Exploratory modelling and analysis

Not one future but thousands
of 'plausible' futures

EXAMPLE CASE: COUNTER-INSURGENCY



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EXAMPLE CASE

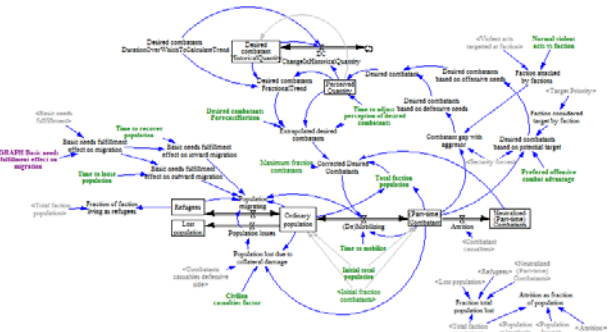
Goal

- › Evaluate developing a model based on knowledge available within an operational unit;
 - › GMB sessions: Operational analysts, Intelligence analysts, Staff chiefs, Soldiers
- › Use the model as a testbed to develop and evaluate EMA techniques;
- › Develop example case to demonstrate the added value of the approach to project stakeholders and receive feedback in an early stage of development.

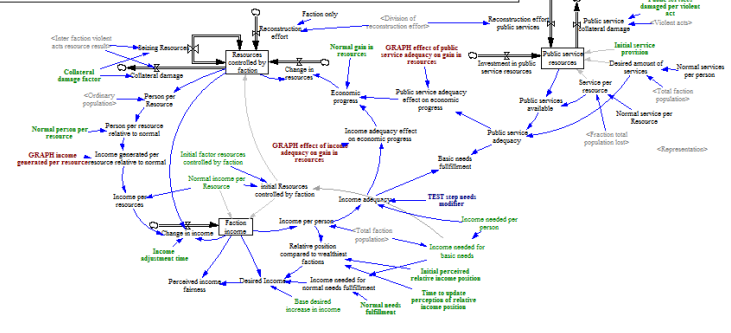


FULL MODEL

Population and Combatants



Economy



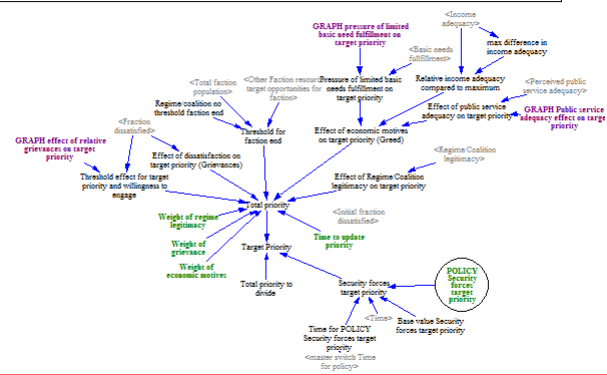
Population satisfaction



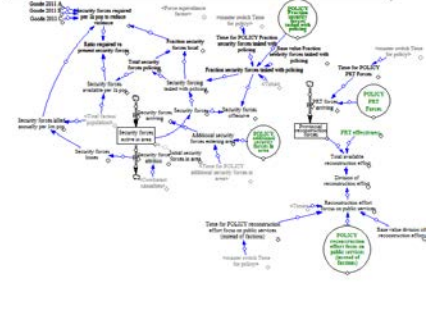
Violence



Target priority

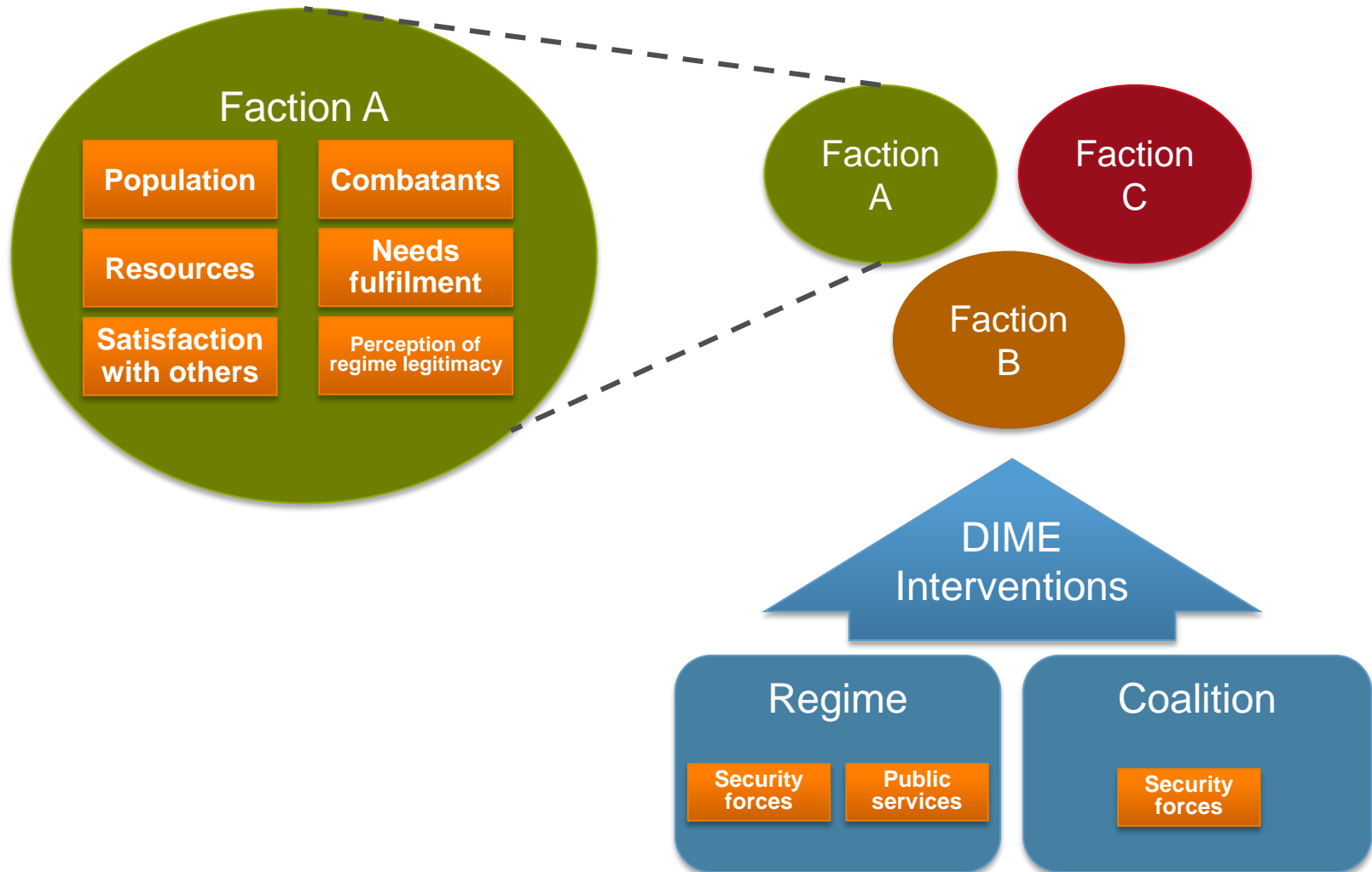


Security forces

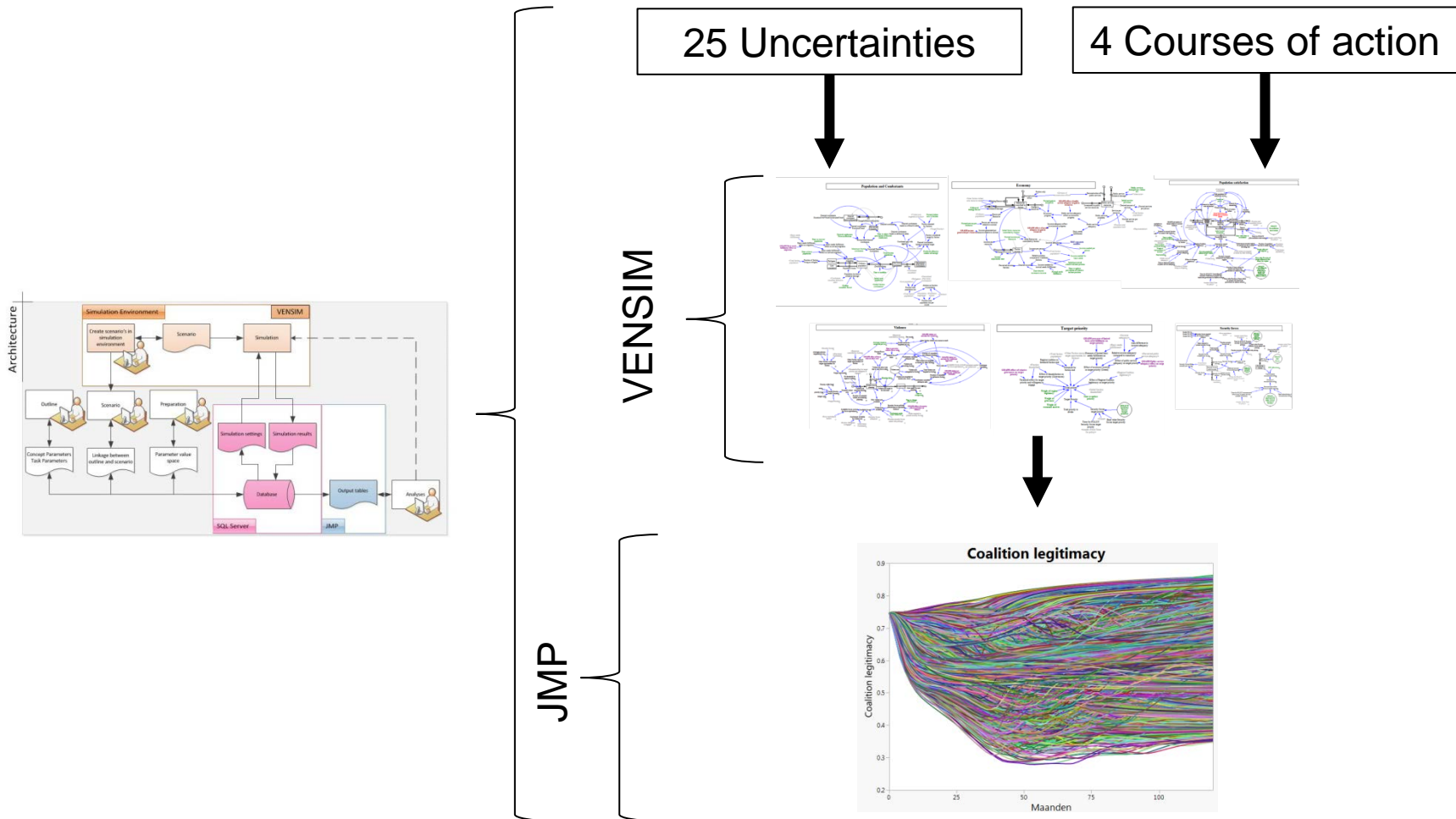


The model and results presented are intended for demonstration purposes only

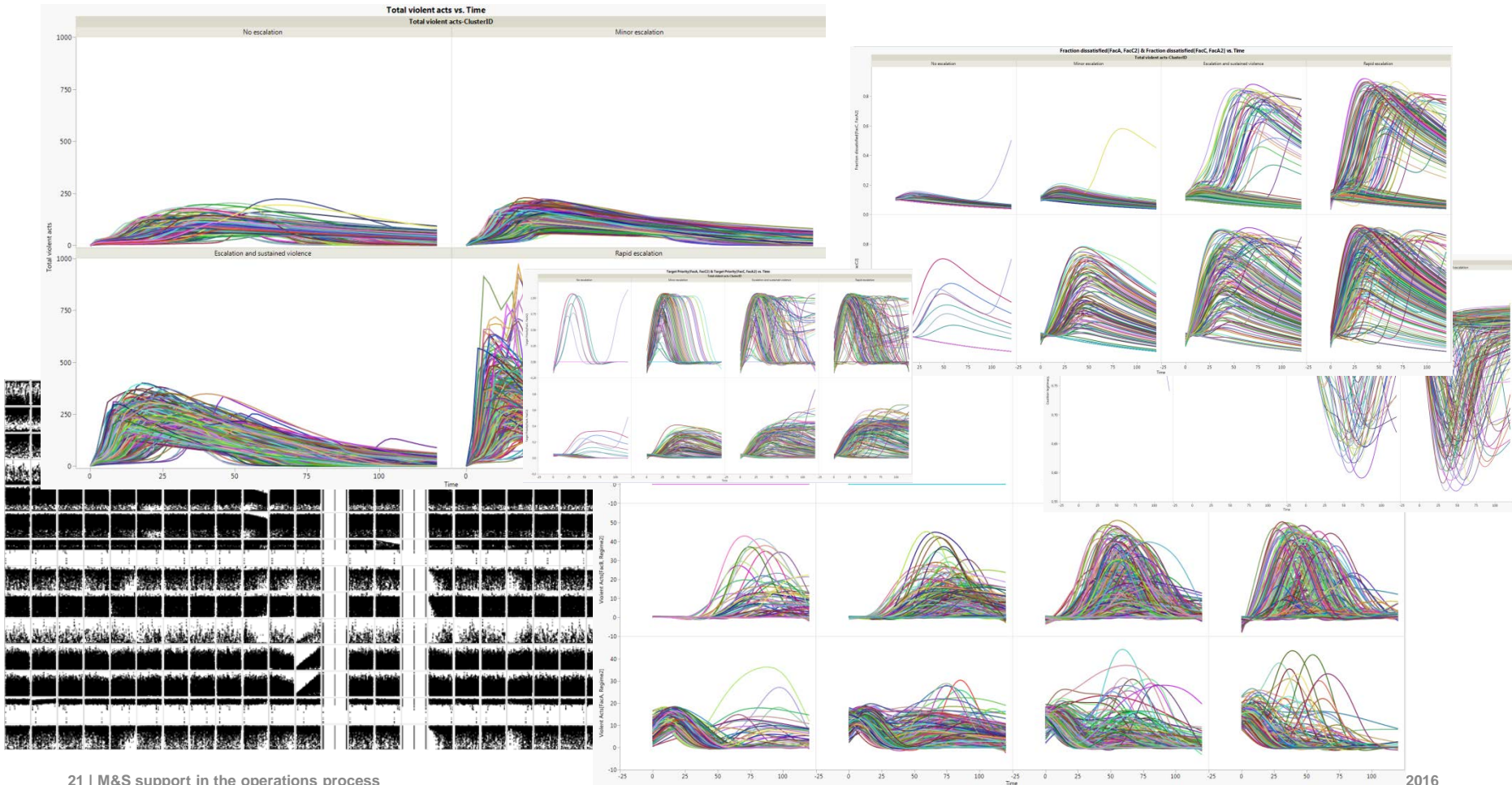
MODEL OVERVIEW



SIMULATION



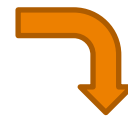
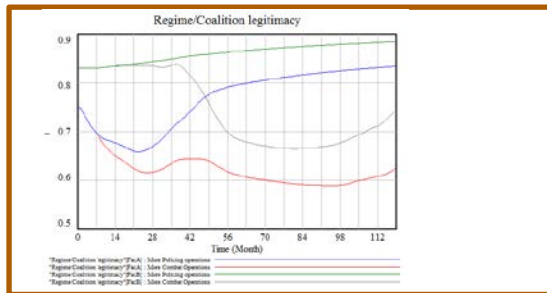
But now what?



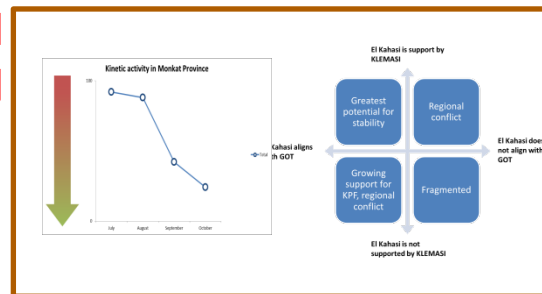
COMMUNICATING THE RESULTS

› Multi-layered approach needed to effectively use model output

Analyst



Plans/ Environment cell

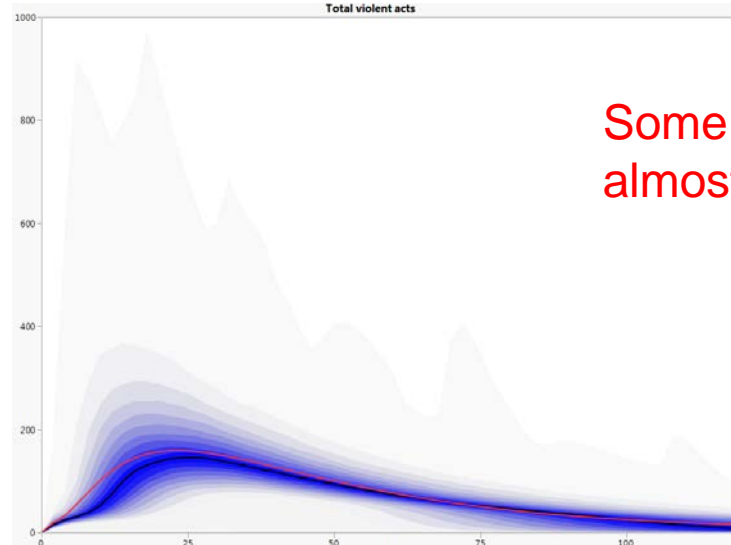
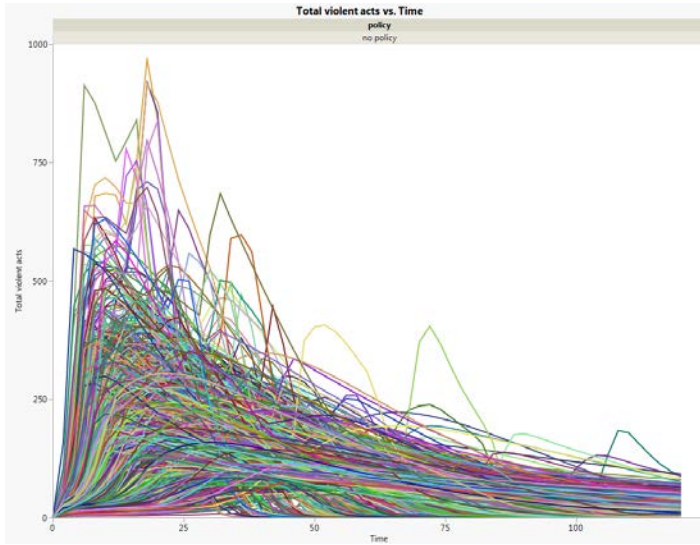


Commander

- CONSIDERATIONS**
- Best outcome: EI Kahasi controls KLEMASI, EI Kahasi collaborates with GoT
 - Partially a political problem, but:
 - KLEMASI part of society and government
 - Avoid separation between KLEMASI and other ethnic groups
 - Efforts should equally benefit KLEMASI
 - Cultural sensitivity, also in relation to KPF motivation
 - GoT should positively engage with KLEMASI
 - Professional policing
 - COLDAM/CIVICAS as a result of engaging KPF might increase support for KPF and decrease support for EI Kahasi
 - KLEMASI should not be blamed for KPF actions

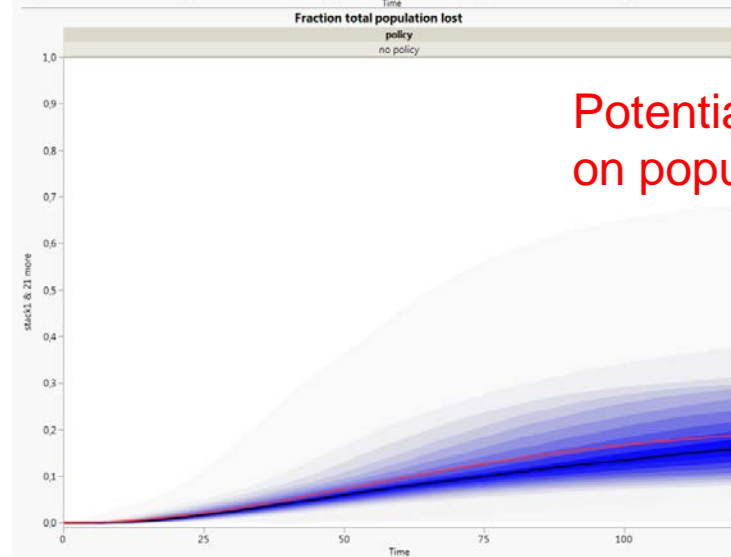
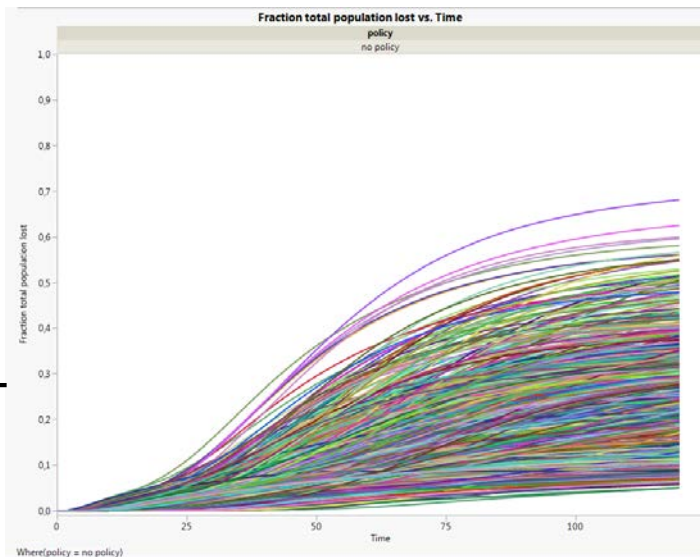
RESULTS - BASE CASE

Total violent acts



Some conflict almost inevitable

Population loss

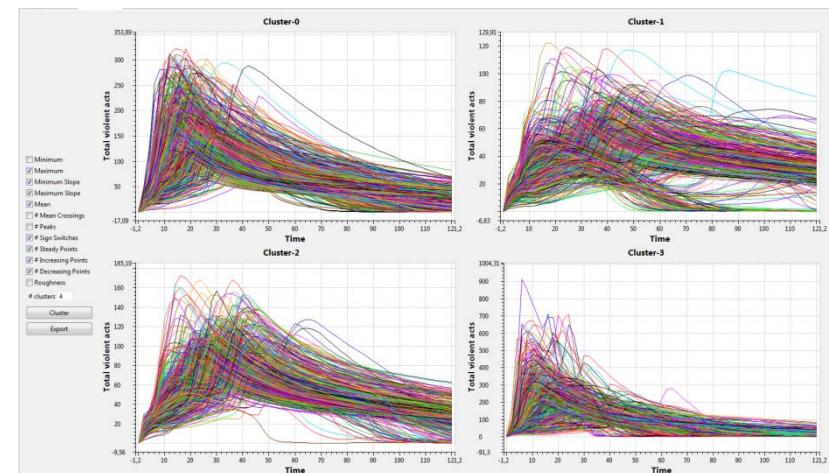


Potential large impact on population

ANALYTICS

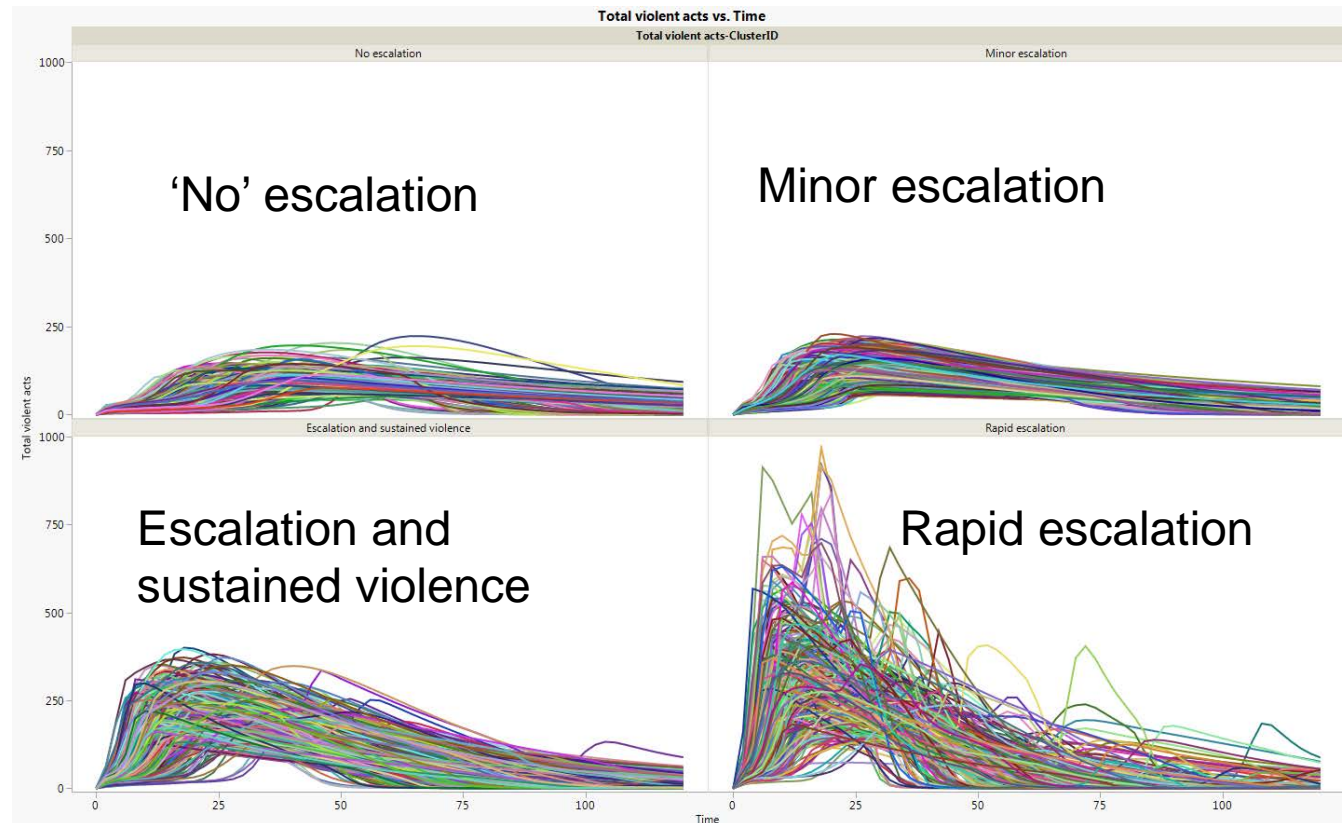
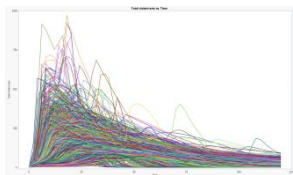
- › Techniques used
 - › Screening
 - › Clustering
 - › Partitioning
 - › Discriminant

- › But most importantly: **Visualization**
 - › Accessible for wide group of users
 - › Support building understanding

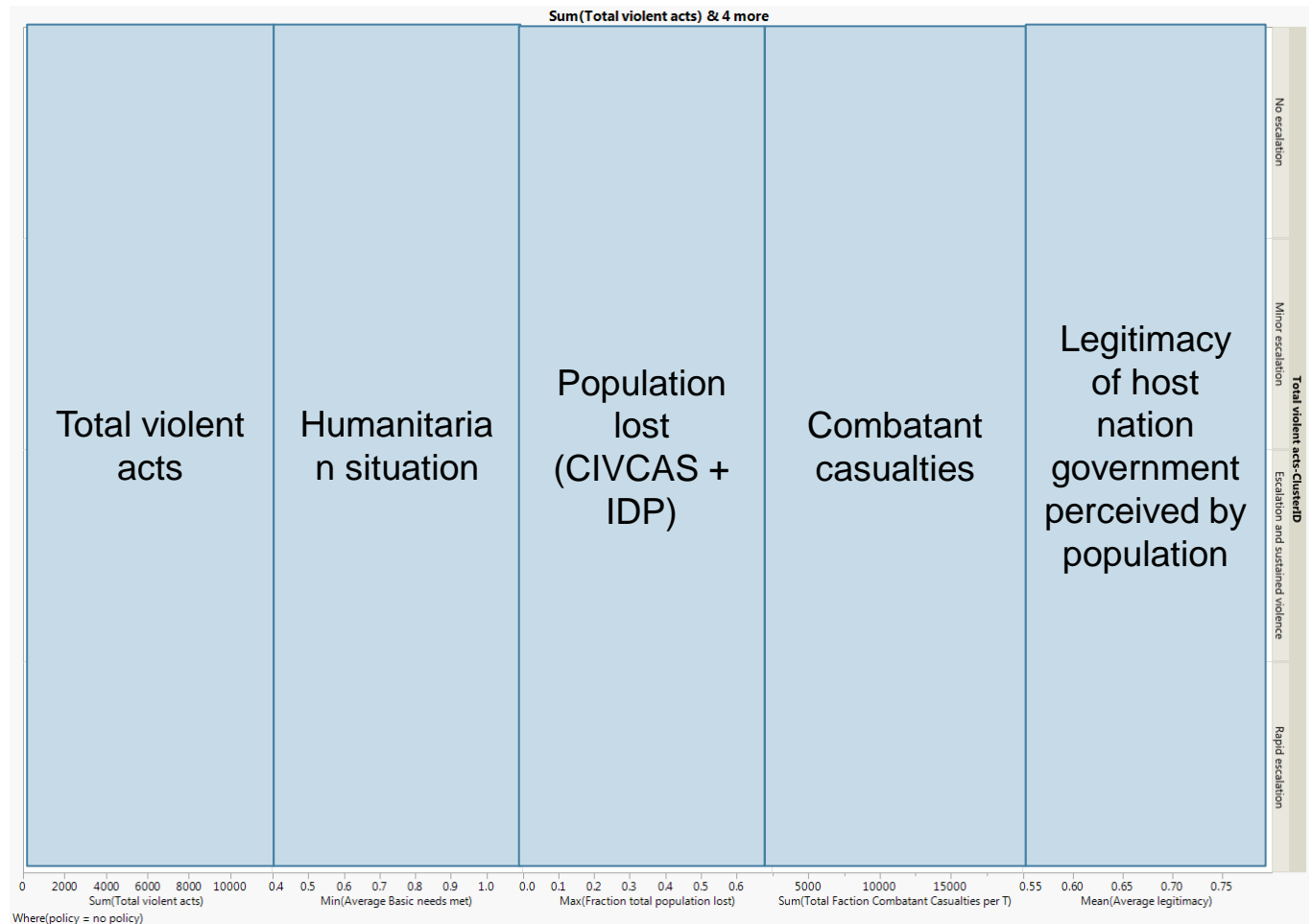
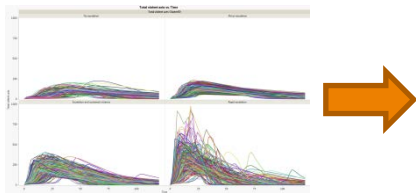


CLUSTERING TO IDENTIFY PLAUSIBLE FUTURE BEHAVIOUR

Total violent acts

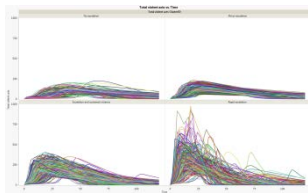
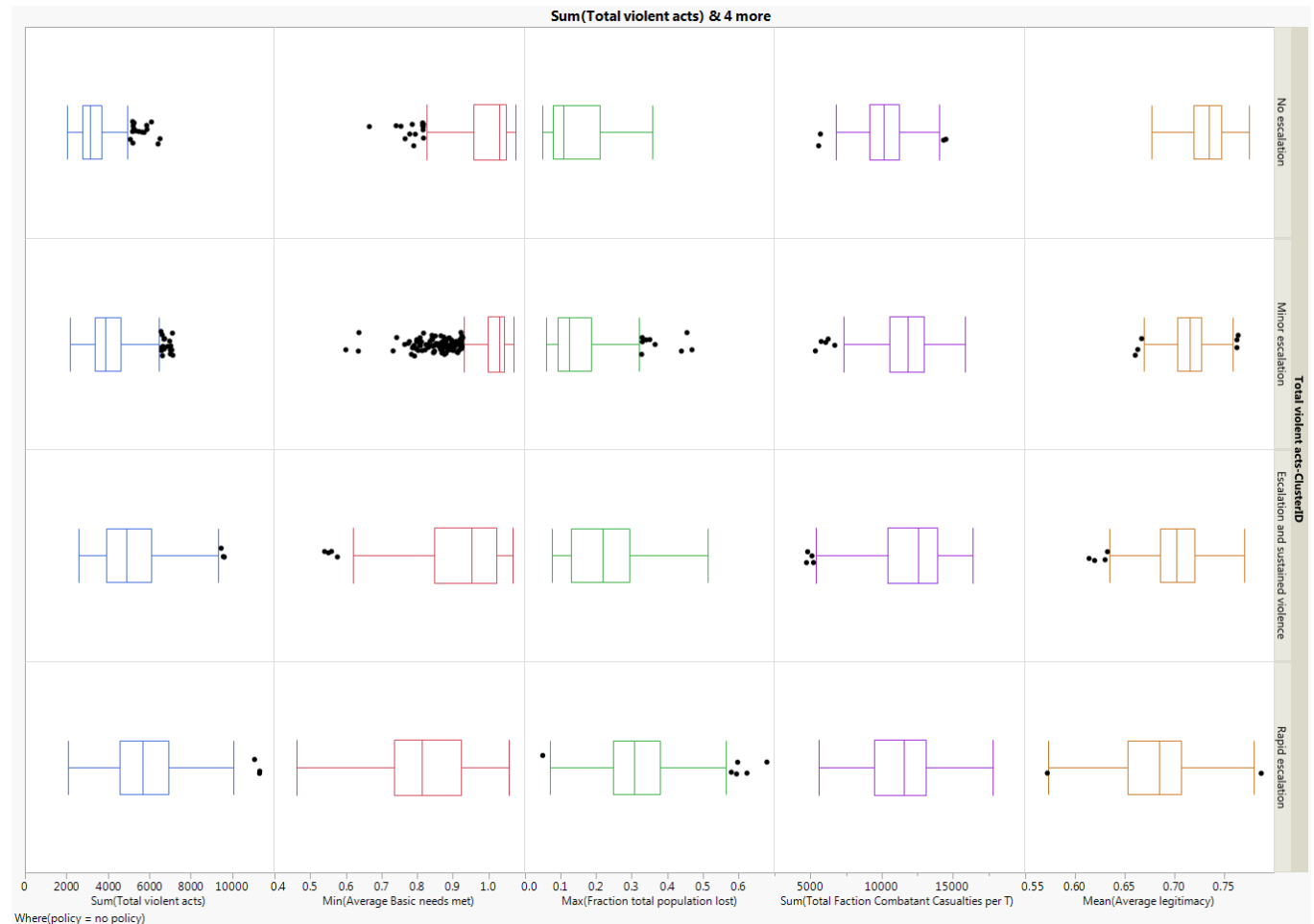


MOE FOR EACH SCENARIO



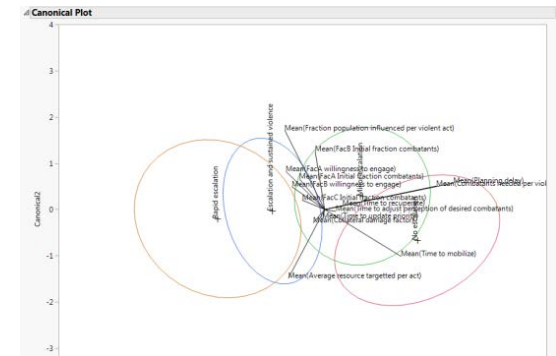


MOE FOR EACH SCENARIO

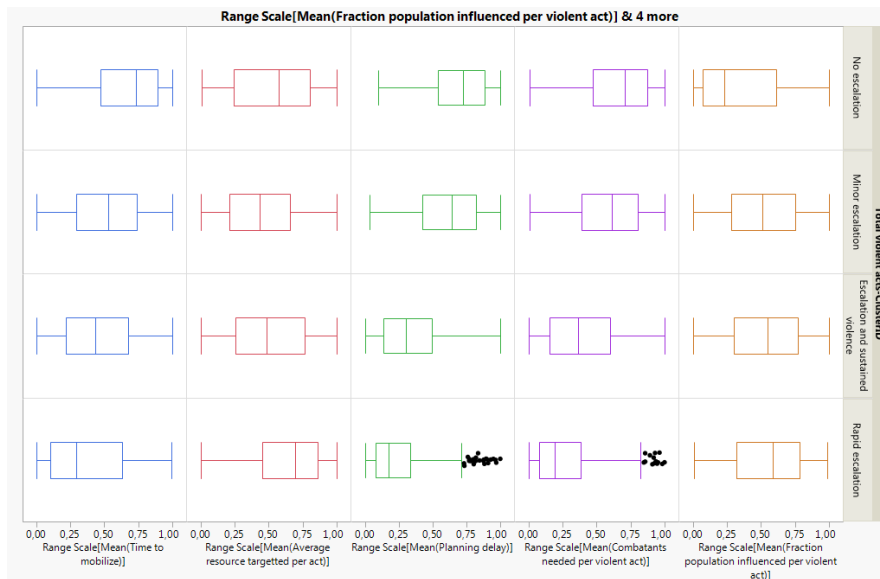
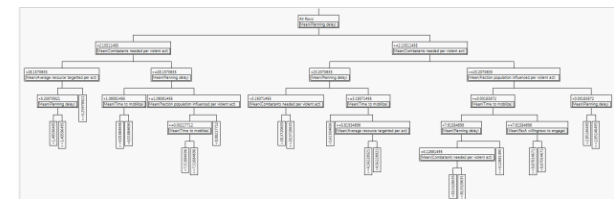


WHICH UNCERTAINTIES MOST STRONGLY INFLUENCE ESCALATION?

- › Planning delay
- › Combatants needed per violent act
- › Time to mobilize
- › Average resources targeted per act
- › Fraction population influenced per act

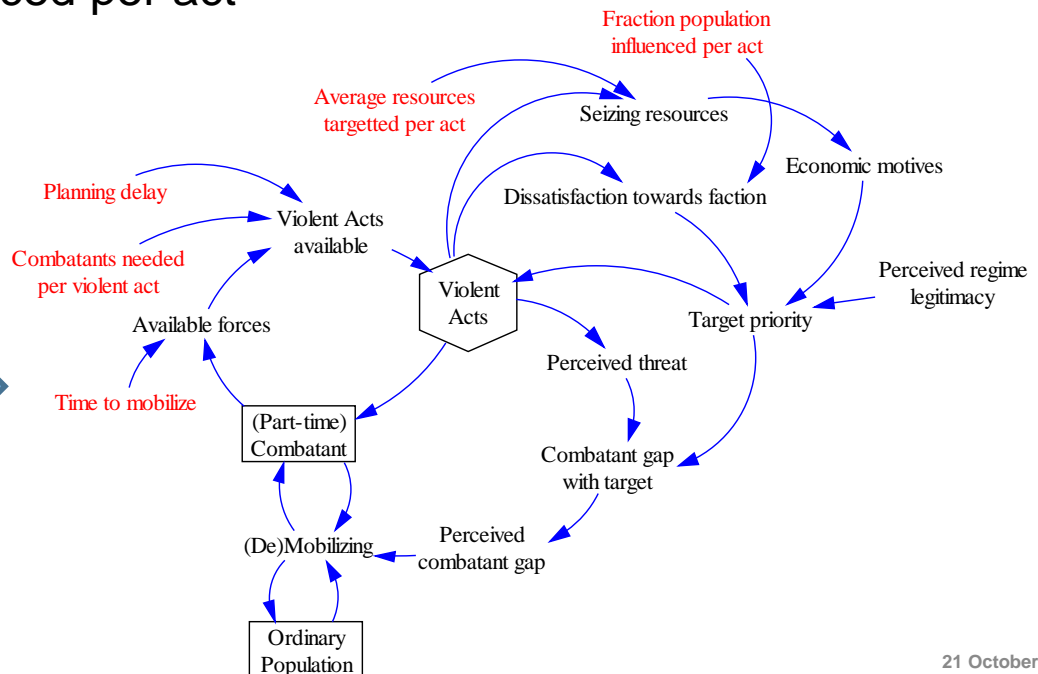
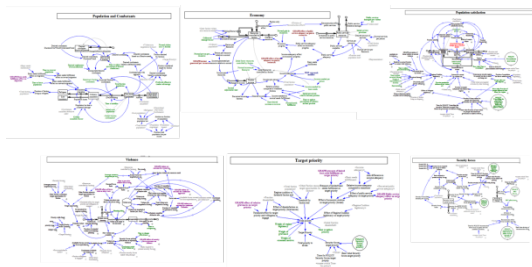


Term	Number of Splits	G^2	Portion
Mean(Planning delay)	6	862,98731	0.4242
Mean(Combatants needed per violent act)	4	585,89215	0.2880
Mean(Time to mobilize)	4	269,027888	0.1322
Mean(Fraction population influenced per violent act)	2	182,523843	0.0897
Mean(Average resource targeted per act)	2	80,7888005	0.0397



WHICH UNCERTAINTIES MOST STRONGLY INFLUENCE ESCALATION?

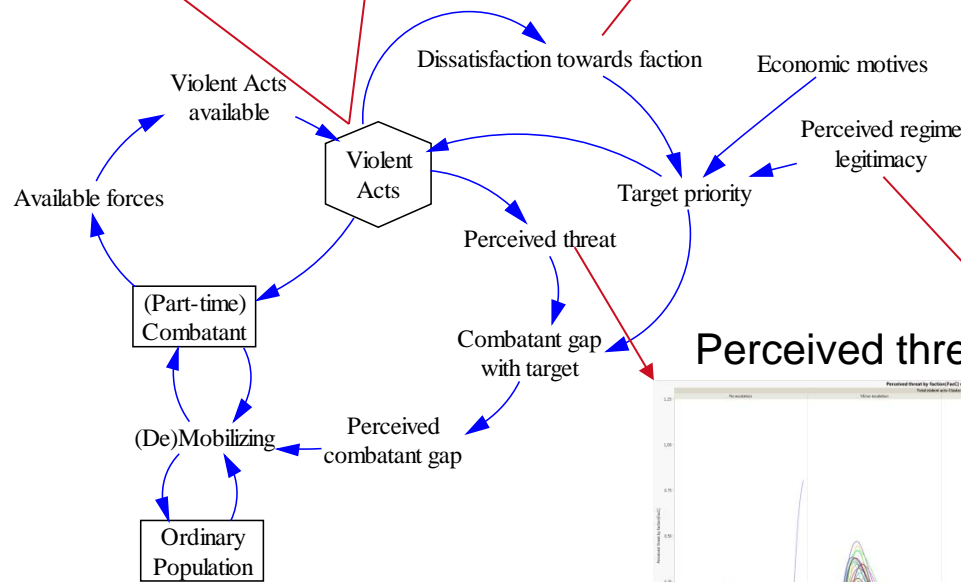
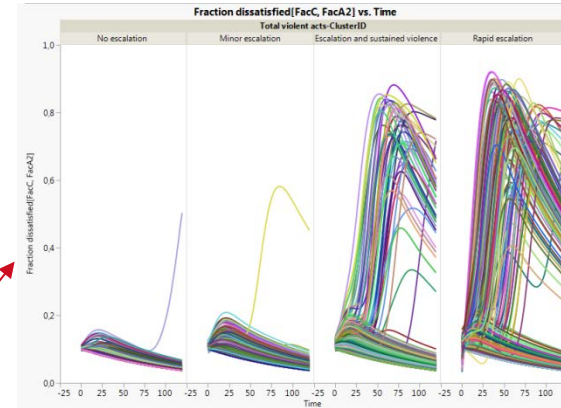
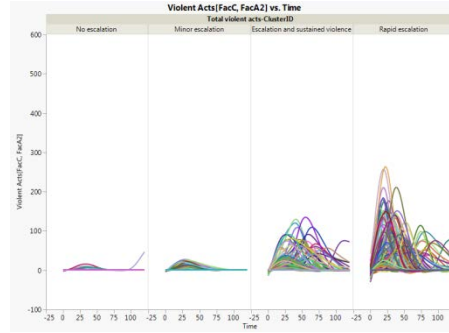
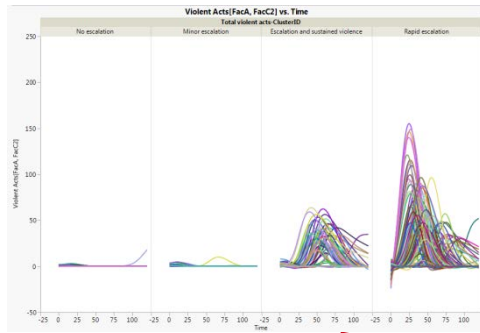
- › Planning delay
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- › Average resources targeted per act
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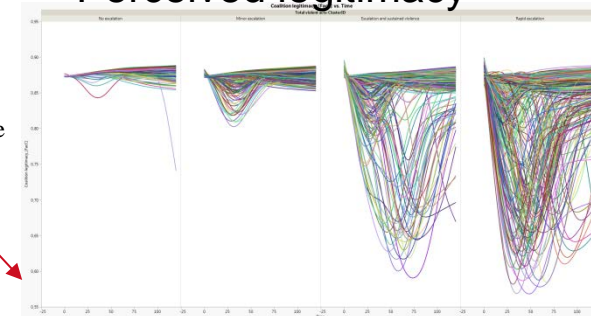
Violence A -> C

A <- C Violence

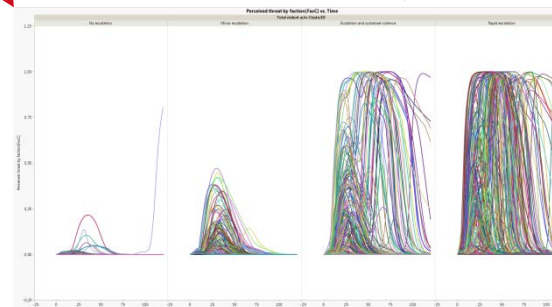
Dissatisfaction C -> A



Perceived legitimacy



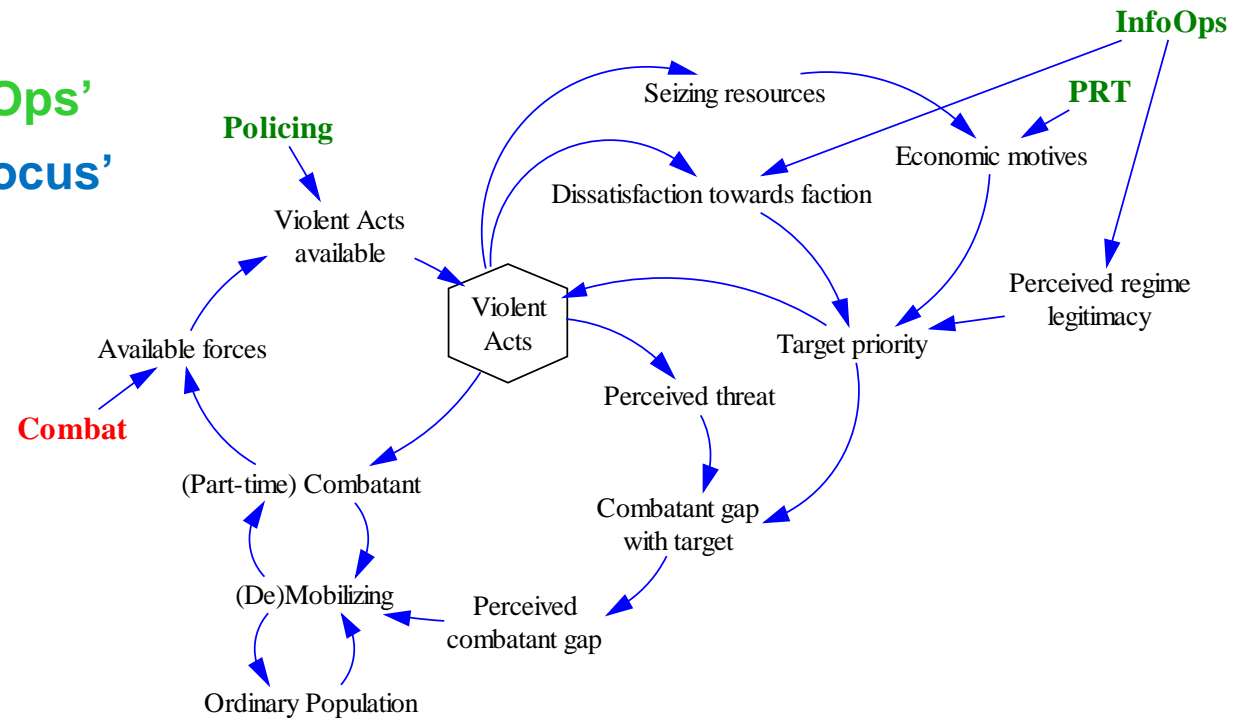
Perceived threat by C



COURSE OF ACTION ANALYSIS

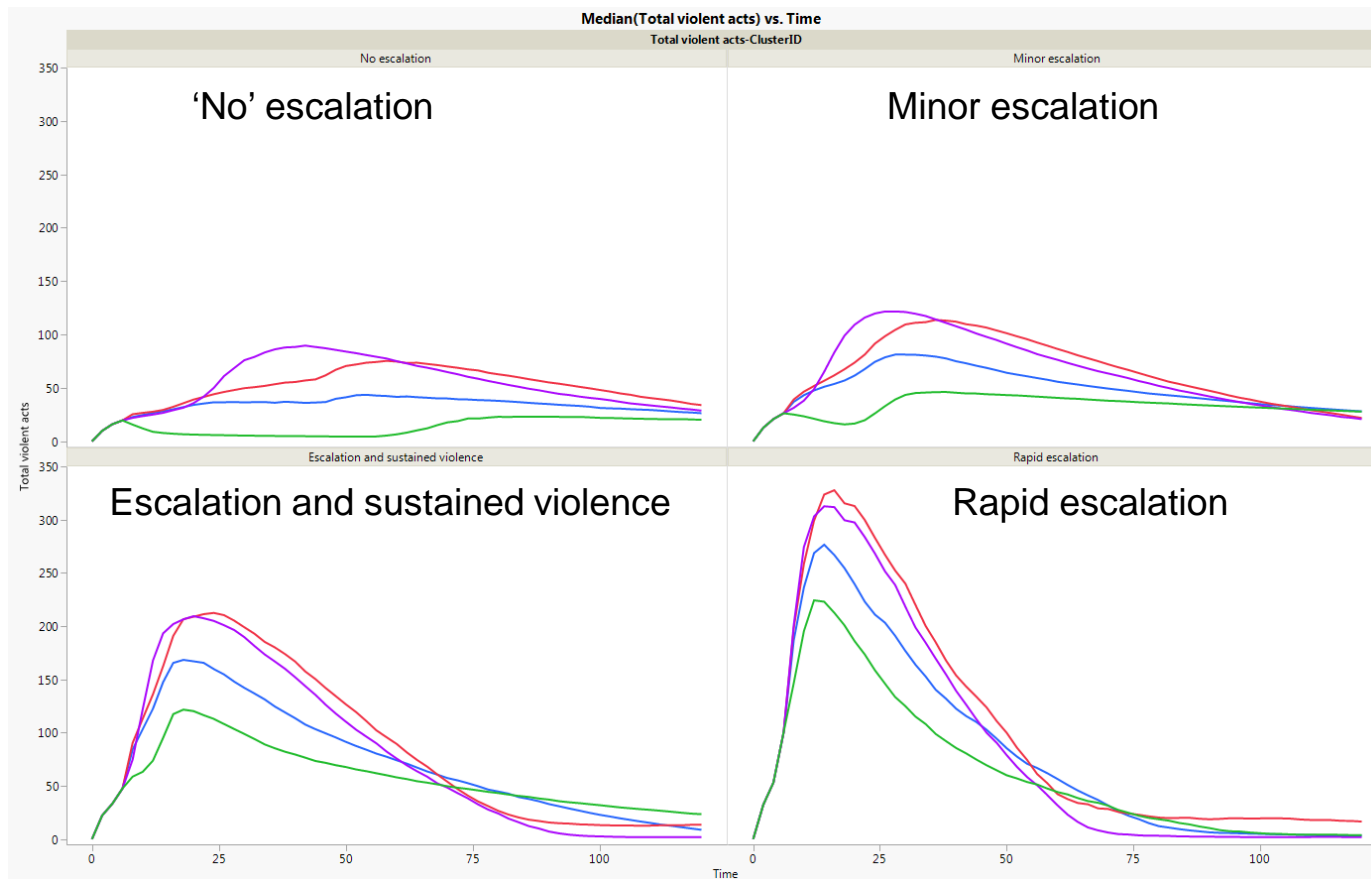
Courses of action

- › Base case: 'None'
- › 'Combat'
- › 'Policing, PRT, InfoOps'
- › 'All with balanced focus'



COURSE OF ACTION ANALYSIS

Total violent acts Median result (per COA, per Cluster)



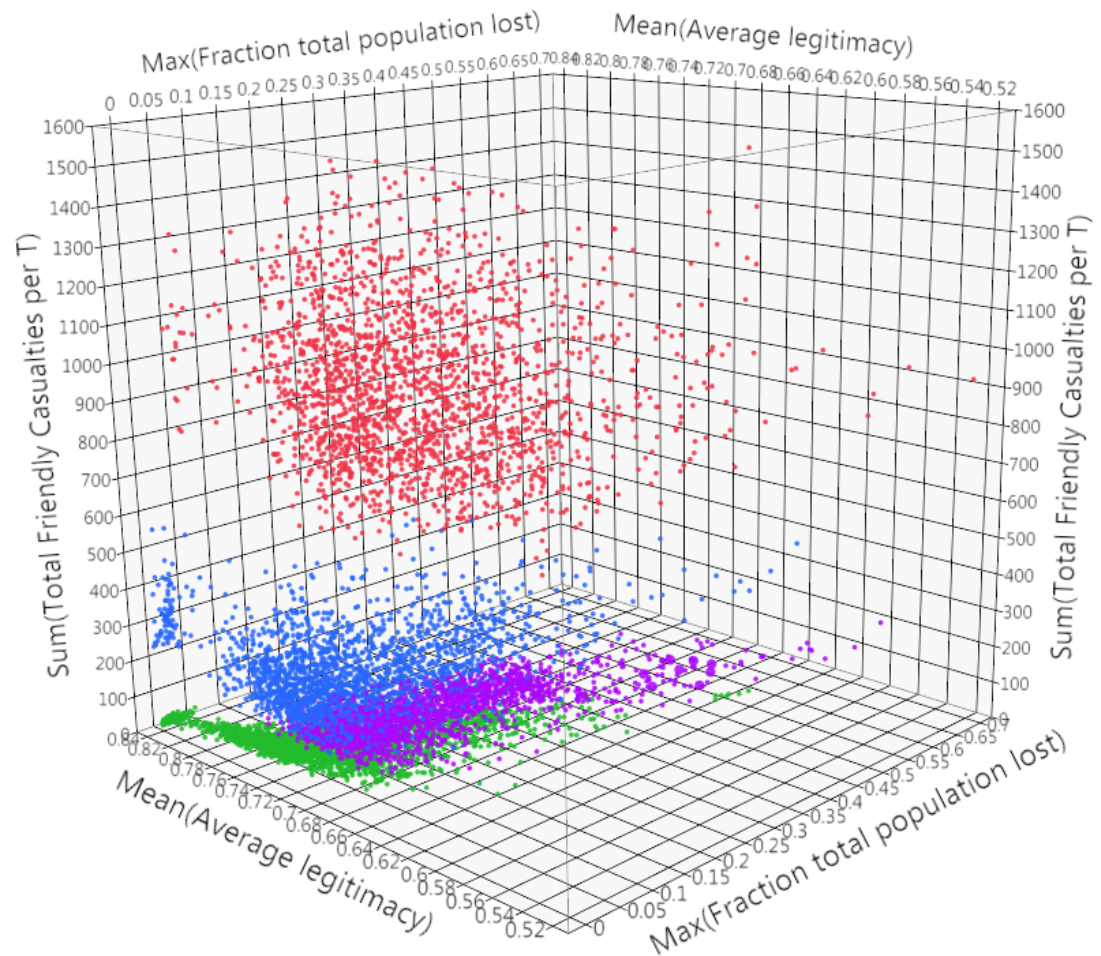
Courses of action

- ▶ Base case: 'None'
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POLICY ANALYSIS

Policies

- › Base case: 'None'
- › 'Combat'
- › 'Policing and PRT'
- › 'All with balanced focus'



SOME ADVANTAGES OF EMA BEYOND POLICY ANALYSIS*

*IN ADDITION TO OTHER SD / M&S BENEFITS

› **Insight**

- › Clustering for scenario identification

› **Force structuring, commitment of resources**

- › Which events (e.g. threat) can always/never be countered with a given set of capabilities?
- › Which uncertainties should be reduced (by for example tasking intelligence units) for a maximum decrease in outcome uncertainty?

› **Course of action**

- › Which COA's are most effective under deep uncertainty?
- › Which assumptions must hold true for a policy to be effective?

EVALUATION & WAY AHEAD

- › Very positive reception by project stakeholders
 - › OA & Intel analysts: “This is the future”

- › Extension
 - › Develop ‘building block’ approach to modelling
 - › Extend modelling methodology: ABM, Hybrid, GIS
 - › Process: Integration in operational process, multi-layered communication of insights, operational requirements (DOTMLPFI)?

- › Way-ahead
 - › November 2016: Operational test during NLD Vigorous Vector wargame focus on hybrid warfare scenario (new model)

- › Research and concepts aside, where are we now in the ‘real world’?
 - › December 2016: Qualitative system modelling tool ‘MARVEL’ delivered to Intel unit together with modelling training





› THANK YOU FOR YOUR ATTENTION

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for life

GUIDO.VELDHUIS@TNO.NL

SIMILAR IDEAS: PLANNING FRAMEWORKS

› **COMPOEX: CONflict Modeling, Planning, and O** **Experimentation; DARPA**

includes

- › Model building tool, Model library, Data tool,
Option Exploration tool, Campaign planning tool

› **NOEM: National Operational Environment Model; ARL**

includes

- › Adaptable models for analysis and assessment of interventions

› **NATO TOPFAS: Tool for Operational Planning, Force Activation and Simulation**

- › Operational planning support tool

› **Others frameworks and models exist**

