Guideline for Scenario Development

Technical Course MSG-162

Robert Siegfried

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- NMSG
  - Vice-Chair (since 04/2018)
  - Co-Chair MSaaS (since 2013)
- SISO
  - Member of Executive Committe (EXCOM) since 2015
  - Drafting Group Editor GSD PDG

Content

- STO Overview
- Overview of standards and tools for scenario specification
- Example scenario development for distributed simulation environment

The NATO Science & Technology Organization (STO)

Overview

Compiled by NATO CSO

Briefing Outline

- S&T in NATO
- The STO
- The STO Collaborative Network, Supported by the Collaboration Support Office (CSO)
- Some Recommendations & RTG Procedures
- Your Panel Office: Role and Functions
- Back-Ups:
  - Leveraging Effect: Examples
  - Definitions of TAP, ToR and PoW
  - How CSO Can Support You
  - Check-List

Note: in this presentation, for simplicity, the word “Panel” without “Group” also refers to the NATO Modeling & Simulation Group (NMSG)

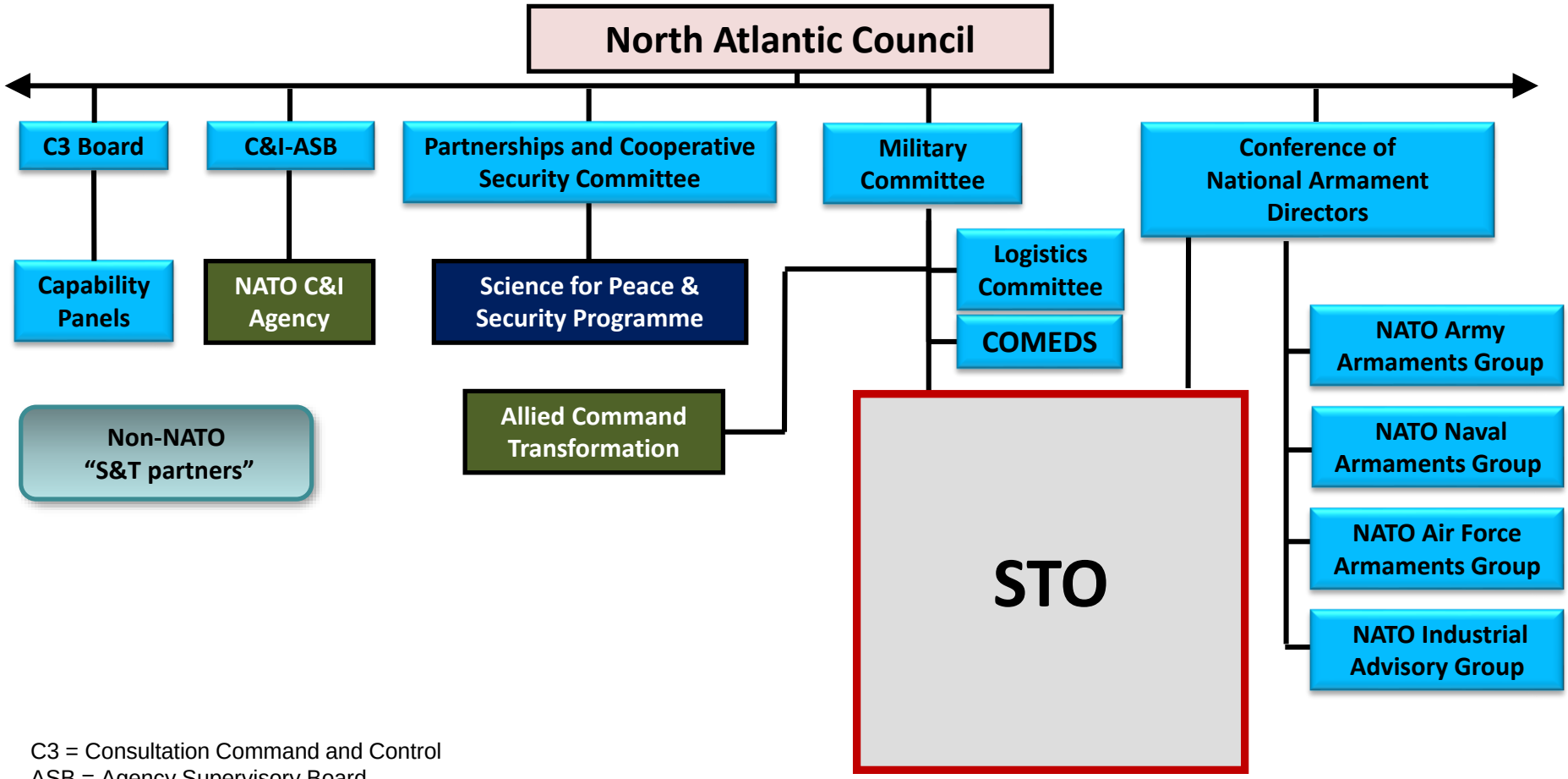
Science & Technology in NATO

"Scientific results cannot be used efficiently by soldiers who have no understanding of them, and scientists cannot produce results useful for warfare without an understanding of the operations."

Theodore von Kármán (1881-1963)

NATO has had a persistent Science presence since 1952 and delivered superior collective capability

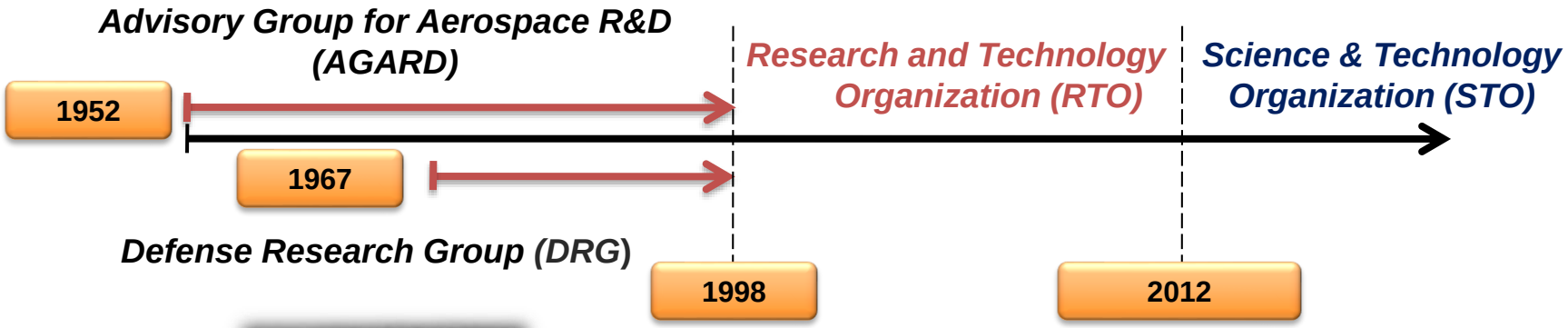
The NATO S&T Community since 1 July 2012



C3 = Consultation Command and Control
ASB = Agency Supervisory Board
C&I = Communications and Information
COMEDS = Committee of the Chiefs of Military Medical Services

The Science and Technology Organisation

The STO – Building on a Long Legacy…



Over years this “long legacy” allowed a lot of scientists to forge very profound professional relationships based on **trust and confidence**

STO Mission (Charter)

- To help position the Nations' and NATO's S&T investments as a strategic enabler of the knowledge and technology advantage for the defence and security posture of NATO Nations and partner Nations, by:
  - **Conducting and promoting S&T activities** that augment and leverage the S&T capabilities and programmes of the Alliance, of the NATO Nations and the partner Nations [...]
  - Contributing to NATO's ability to **enable and influence security- and defence-related capability development and threat mitigation** in [...]
  - **Supporting decision-making** in the NATO Nations and NATO


CHARTER
OF THE
SCIENCE AND
TECHNOLOGY ORGANIZATION
(STO)

The Science and Technology Organisation

1 Board: Science and Technology Board
2 Business Models
3 Executive Bodies

S&T organization

Military Committee

Conference of National Armaments Directors

Science and Technology Board

Collaboration Support Office

Office of the Chief Scientist

Centre for Maritime Research & Experimentation

Manages the NATO S&T Collaborative Program of Work (CPoW)

Provides NATO HQ Scientific Advice

Conducts the NATO "In-House" S&T Program

The STO Collaborative Network

Scientific and Technical Committees (Panels/Group)

"The Nations for the Nations and NATO"

Why Collaborative S&T in NATO?

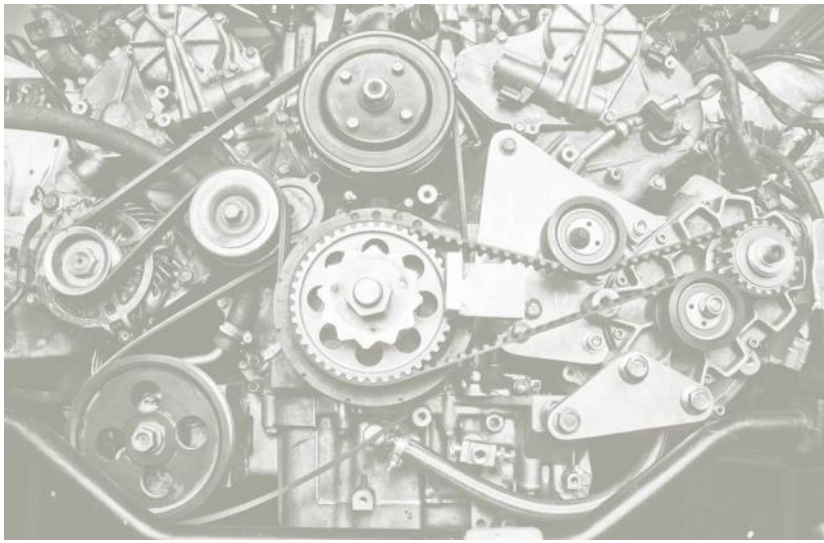
- It **federates and strengthens the Alliance** by:
  - Fostering the collective address of the common S&T needs of the Alliance and its Member Nations, demonstrating solidarity
  - Forging very profound professional relationships based on trust and confidence resulting in increased efficiencies
  - Providing commonly agreed advice to National and NATO decision makers
- It **leverages scarce resources** while providing **synergies** and **interoperability** by:
  - Enabling cost avoidance and cost sharing
  - Finding (common) solutions for increasingly complex problems
  - Benefiting from the best (specialised) resources in the Nations
  - Allowing shorter delays in reaching conclusions

Specialisation is a reality: no one has it all

The CSO

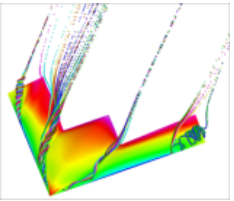
"The Collaborative Production Engine of the STO"

- ***Maintain Active Network of > 5,000(+) Scientists***
- ***Support 7 Technical Panels & Group***
- ***Manage > 250 Collaborative S&T Activities per year***
- ***Manage Outreach to > 500,000 Scientists***

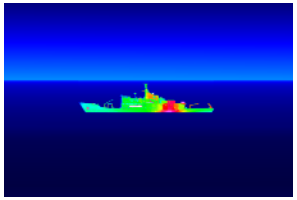


Technical Panels and Group

- Applied Vehicle Technology (AVT)
- Human Factors and Medicine (HFM)
- Information Sciences Technology (IST)
- Modeling and Simulation Group (MSG)
- System Analysis and Studies (SAS)
- System Concepts and Integration (SCI)
- Sensors and Electronics Technology (SET)





Collaborative S&T Tools

Activities

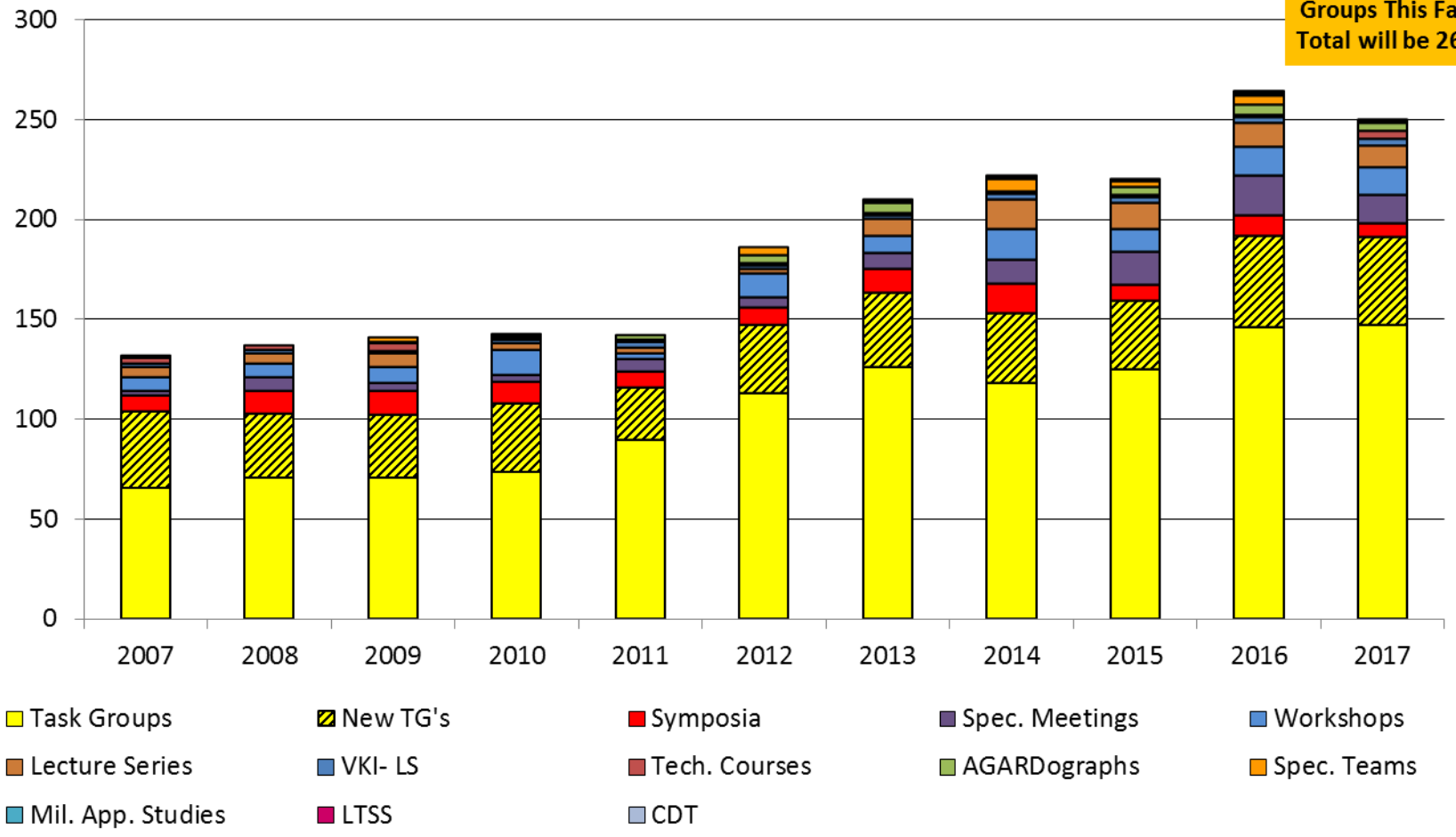
You Are Here

- **Task Group**
  (study group, 3 years max.)
- **Specialists' Team**
  (quick reaction)
- **Workshop**
  (selected participation, 2-3 days)
- **Symposia**
  (>100 people, 3-4 days)
- **Specialists' Meeting**
  (<100 people, 2-3 days)
- **Lecture Series**
  (junior and mid-level scientists)
- **Technical Course**
- **Exploratory Team**

Total Number of Activities per Year

All Panels/Group Combined

14 New Task Groups This Fall Total will be 264



NATO Nations in STO CPoW

- ALBANIA
- BELGIUM
- BULGARIA
- CANADA
- CROATIA
- CZECH REPUBLIC
- DENMARK
- ESTONIA
- FRANCE
- GERMANY
- GREECE
- HUNGARY
- ITALY

ESTIMATED SIZE OF MILITARY R&D IN NATIONS

70,000 (+) scientists

From 100 (+) laboratories

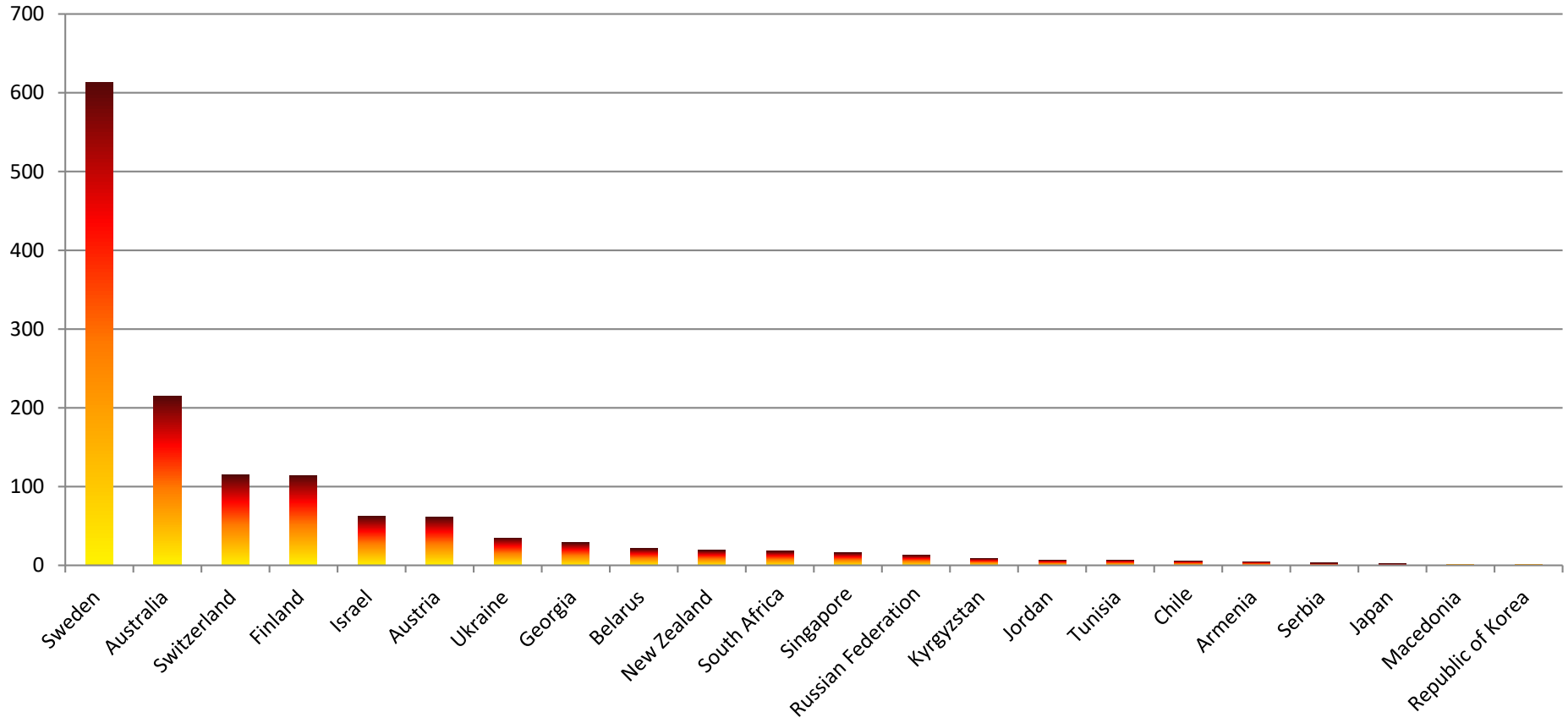
Investing 25B€ (+) yearly

Montenegro?

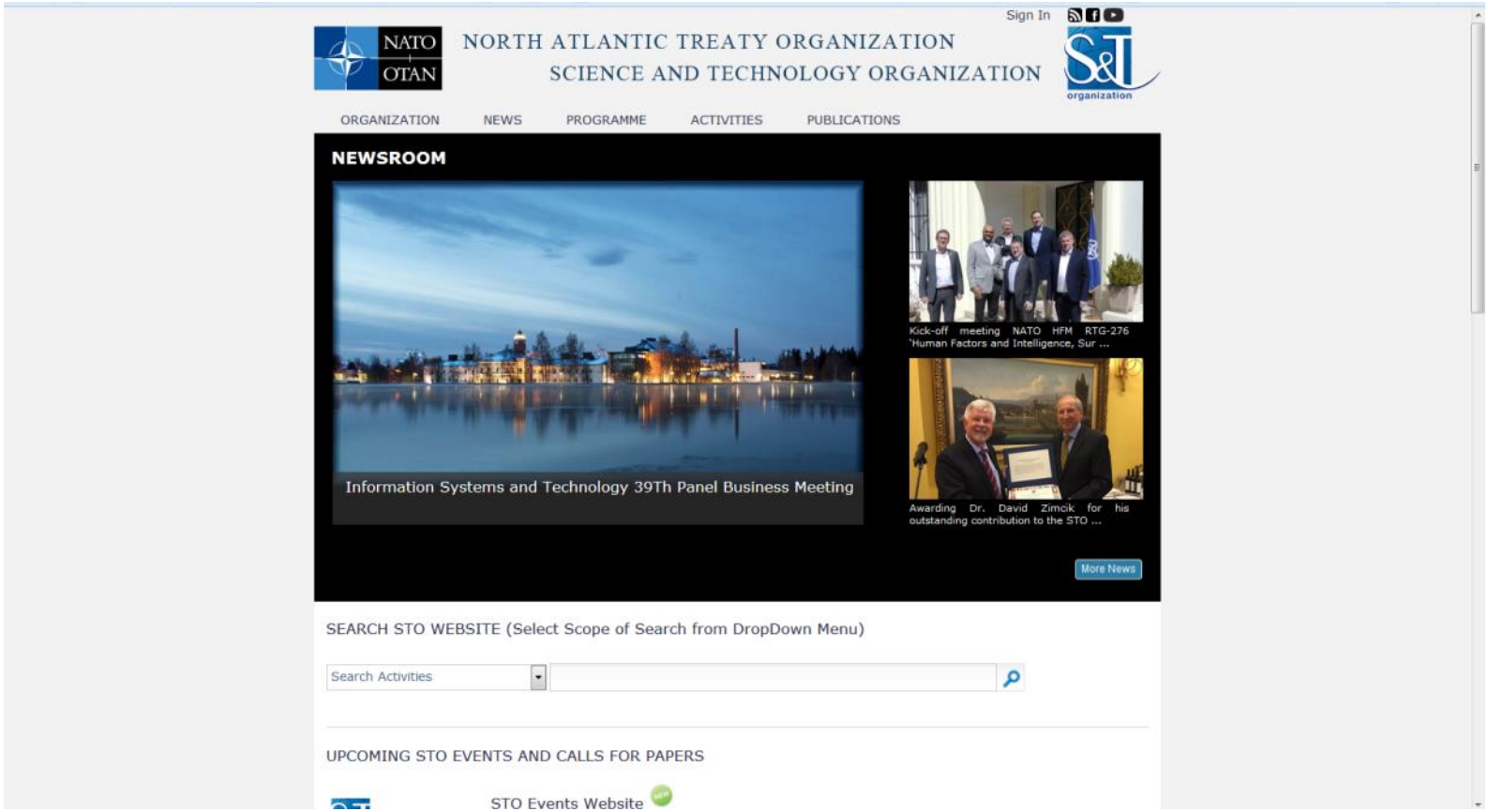
- LATVIA
- LITHUANIA
- NORWAY
- POLAND
- PORTUGAL
- ROMANIA
- SLOVAKIA
- SLOVENIA
- SPAIN
- THE NETHERLANDS
- TURKEY
- UNITED KINGDOM
- UNITED STATES

Most Active Partner Nations 2006-2016

In Long-Lasting Activities (RTGs, STs, AGs & MASs)



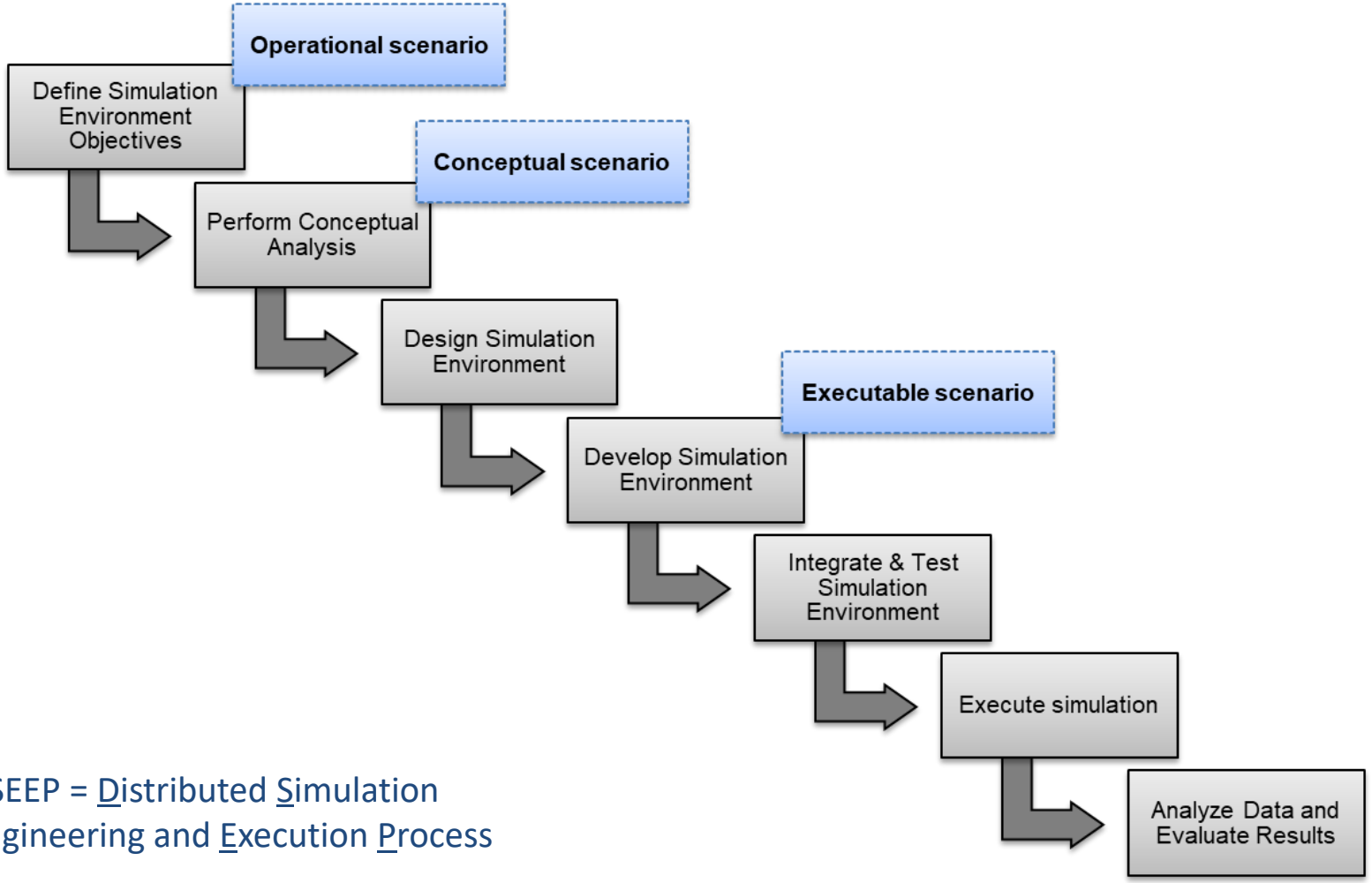
www.sto.nato.int



Content

- STO Overview
- **Overview of standards and tools for scenario specification**
- Example scenario development for distributed simulation environment

Scenario Development Process



DSEEP = Distributed Simulation Engineering and Execution Process

Maturity Levels

Maturity level of scenario description	Representation of the scenario description
0 – No written scenario description	Thoughts and ideas within the mind of the military user/SME; oral explanation.
1 – Non-standardized scenario description	Free text.
2 – Standardized scenario description	Documentation which is structured according to a standard or agreed guideline or template.
3 – Formal scenario description	Formal specification of a scenario.

Operational Scenarios

1 - Non-standardized scenario description

- "Everybody uses his own standard."
- DSEEP
- General purpose software (Word etc)

2 - Standardized scenario description

- NATO Comprehensive Operations Planning Directive (COPD)
- General purpose software

3 - Formal scenario description

- C-BML (in future: C2SIM-Tasking Reporting)
- JC3IEDM
- ADatP-3

Conceptual Scenarios

1 - Non-standardized scenario description

- Unified Modelling Language (UML)
- Systems Modelling Language (SysML)
- General purpose software (Word etc), UML Editors

2 - Standardized scenario description

- NATO Architecture Framework (NAF)
- VEVA documentation guidelines (in Germany)

3 - Formal scenario description

- Base Object Models (BOM)
- Joint Exercise Management Module (JEMM)

Executable Scenarios

1 - Non-standardized scenario description

- Individual documentation (e.g., MEL/MIL, story books)
- General purpose software (Word etc)

2 - Standardized scenario description

- Proprietary (vendor-specific) data exchange formats

3 - Formal scenario description

- MSDL (in future: C2SIM-Initialize)
- JTDS Order of Battle Service
- C-BML (in future: C2SIM-Tasking Reporting)
- C2IEDM/JC3IEDM
- XML editors

Guidance

- GSD provides initial support which standards and tools may be used to specify scenarios
  - Short description of each standard/tool
- Keep in mind: List is not exhaustive
  - Expect changes (new standards/tools, etc)
- Actual selection of standards/tools depends on individual constraints and available knowledge

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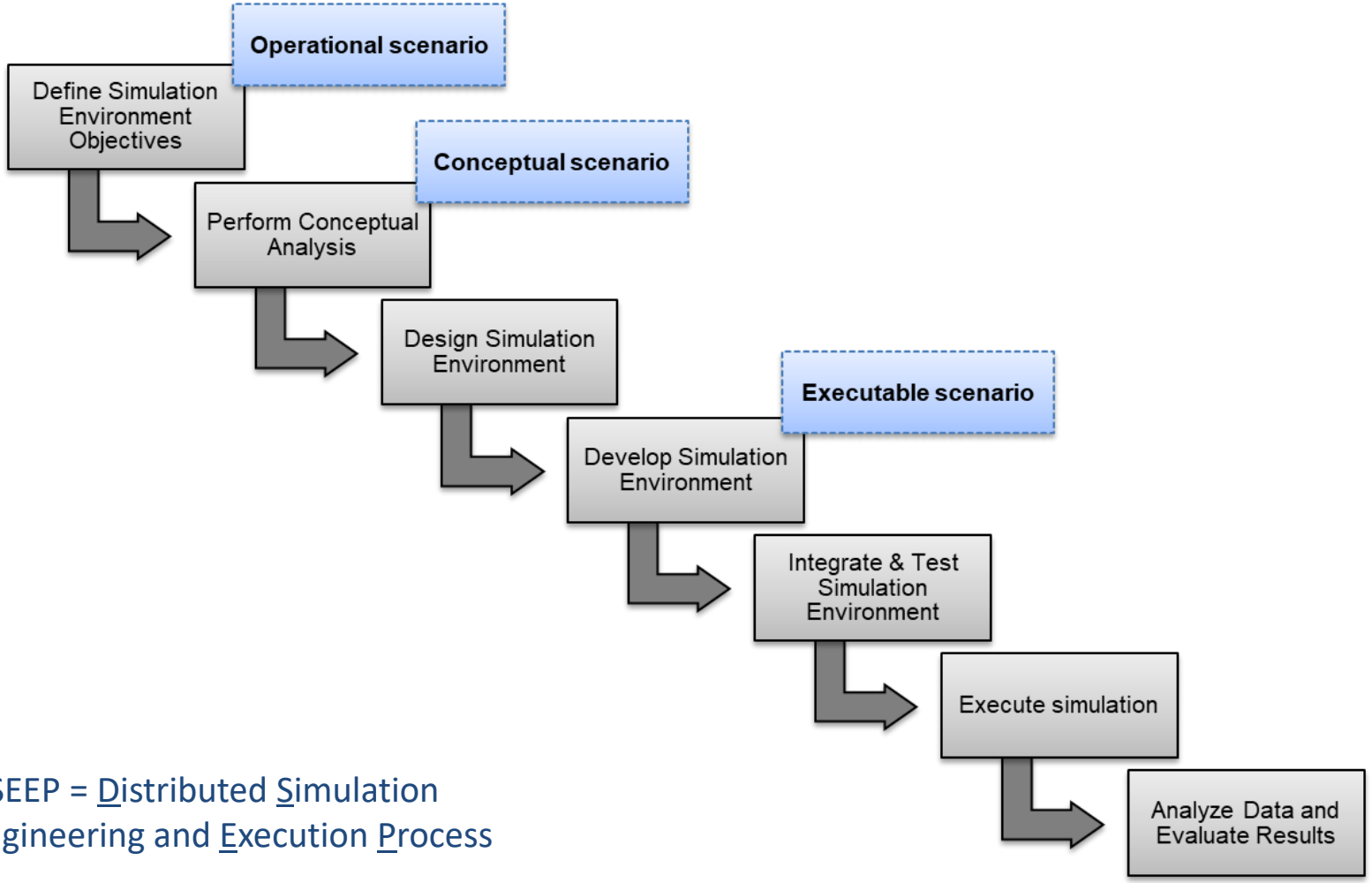
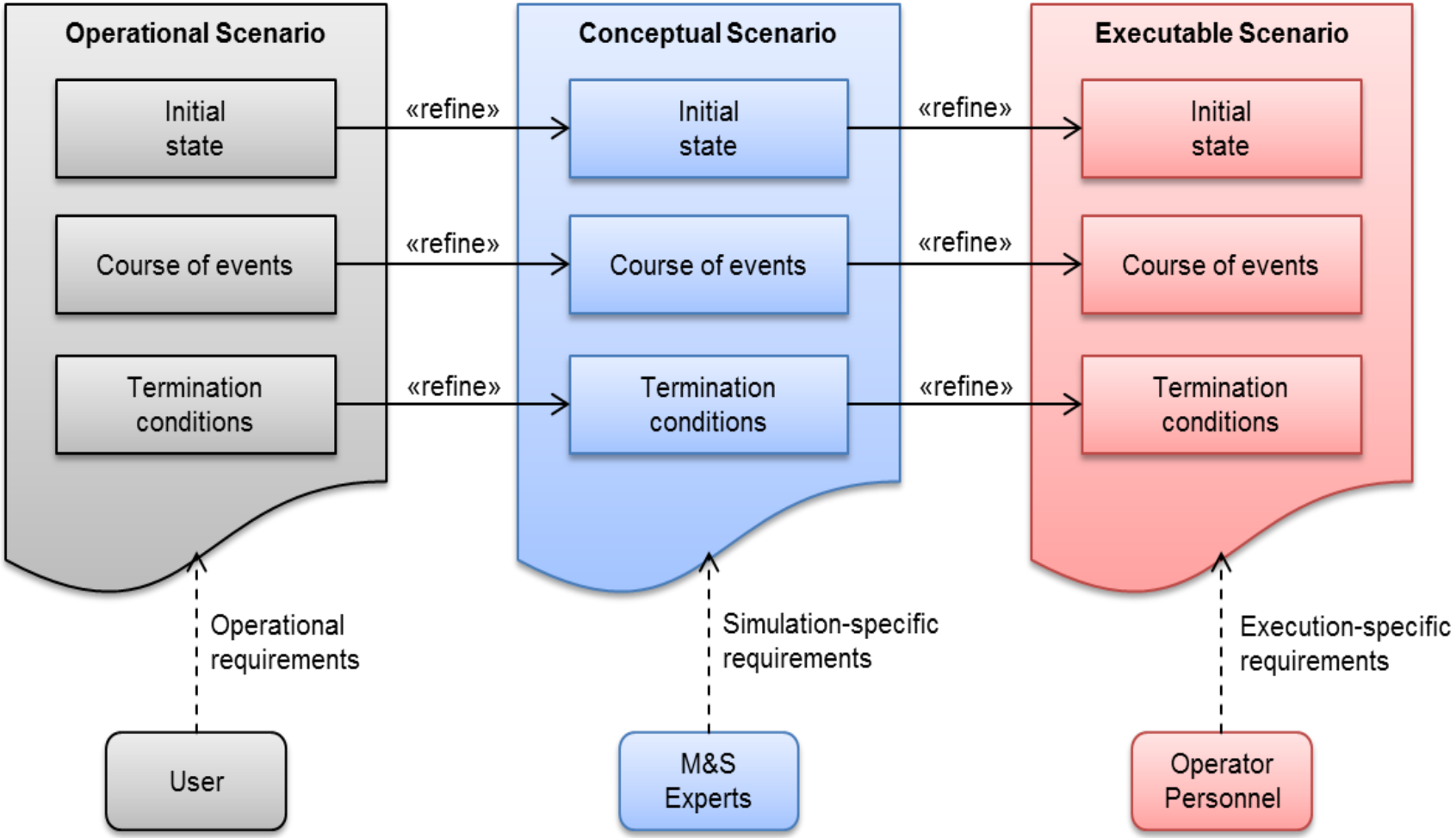
- **Example scenario development for distributed simulation environment**

Scenario Development Process



DSEEP = Distributed Simulation Engineering and Execution Process

Content of a Scenario

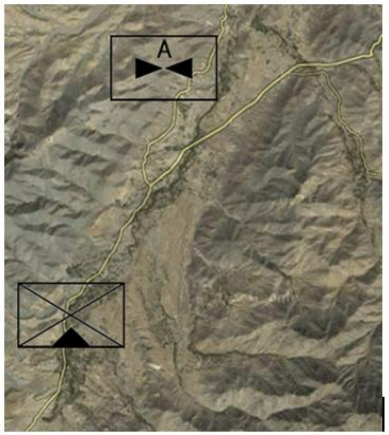


Operational scenarios

1 Define simulation environment objectives

- Have to be provided by military user or sponsor
  - possibly assisted by SMEs
- They provide a military description of a real or fictitious „piece of the world“ of interest
  - Authoritative sources of requirements
- Described in terms the user is familiar with
  - Often a combination of graphical and textual description

Example: Operational scenario



Initial State

A ManPAD team consisting of a commander, an observer and a gunner, is supporting a maneuvering unit. The ManPAD team is deployed around 400 meters behind the maneuvering unit on high ground. At the instant when the ManPAD commander receives an early warning with the assumed target location, the maneuvering unit is heading north and the ManPAD team is behind the unit. The ManPAD observer starts searching the sector from which the aircraft is approaching.

Course of Events

The ManPAD observer catches a glimpse of a blade flash from rotating helicopter blades approaching from North. Since the ManPAD team is in Weapons Free status, the ManPAD gunner starts an interrogation procedure. As soon as the target is in range ring, he triggers an IFF (identification friend or foe) operation. As the target is identified as hostile, the ManPAD Commander orders a Fire Command. At the instant of fire, the enemy helicopter is at 500 meters altitude and has a speed of 45 meters per second with straight flight. The ManPAD gunner launches the missile from 80% of range ring, and the missile approaches the target from the front. As soon as the helicopter detects the engagement, it throws a dozen flares to protect against the missile when it is within the last kilometer. The ManPAD observer then evaluates the first missile and reports the result to the MANPAD commander for consecutive action.

Termination Conditions: Not explicitly specified in this example.

Conceptional scenario

2 Perform conceptual analysis

- Refinement of the operational scenarios
  - Closely related to the conceptual model
- Developed by M&S experts
  - Possibly assisted by sponsor, user, SMEs
- Described in more technical and specific terms
  - Reflects transfer of responsibility
  - More structured scenario specification, more precise use of terms, possibly use of specialized tools

Example: Conceptual scenario

- Initial State: Units

Unit	Attribute	Value
Maneuvering unit	Initial position	400, 0, 0 in Local NED
ManPAD Team	Initial Position	0, 0, 0 (Local NED origin)
	Sub Units	ManPAD Commander, ManPAD Observer, ManPAD Gunner
	Equipment and Weapons	IFF and ManPAD-X
	Status	Weapons Free
Target	Type	AH-1 similar helicopter
	Altitude	500 meters
	Speed	45 m\s to South (-45, 0, 0)
	Maneuver	Straight flight
	Position	5500, 0, -500 in Local NED
	Engagement Ring	2500m

Example: Conceptual scenario

- Initial State: Forces and Force Structure
  - ***ManPAD Team***
    - Composed of: ManPAD commander, ManPAD observer, ManPAD gunner.
    - Command structure: ManPAD observer and ManPAD gunner are under the command of ManPAD commander.
    - Spatial position: All three persons are located in the same area next to each other.
    - Command and Control requirements: Ability to receive voice messages and commands over radio.

Example: Conceptual scenario

- Initial State: Geography

Attribute	Value
Area	Hypothetical area
Terrain	Flat earth
Atmosphere	ICAO Standard
Wind	5 m/s from East

- Initial State: ROE
  - ***ManPAD Team:***
    - If any approaching object is identified and the status is Weapons Free then IFF operation will be triggered as soon as object heads into the range ring.
    - If object is identified as hostile and the object is in 80% of range ring, weapon is fired.
  - ***Helicopter:***
    - Apply any means of soft kill (flares, maneuver etc.) as soon as a missile attack is detected.
    - Attack any maneuvering target within engagement ring.

Example: Conceptual scenario

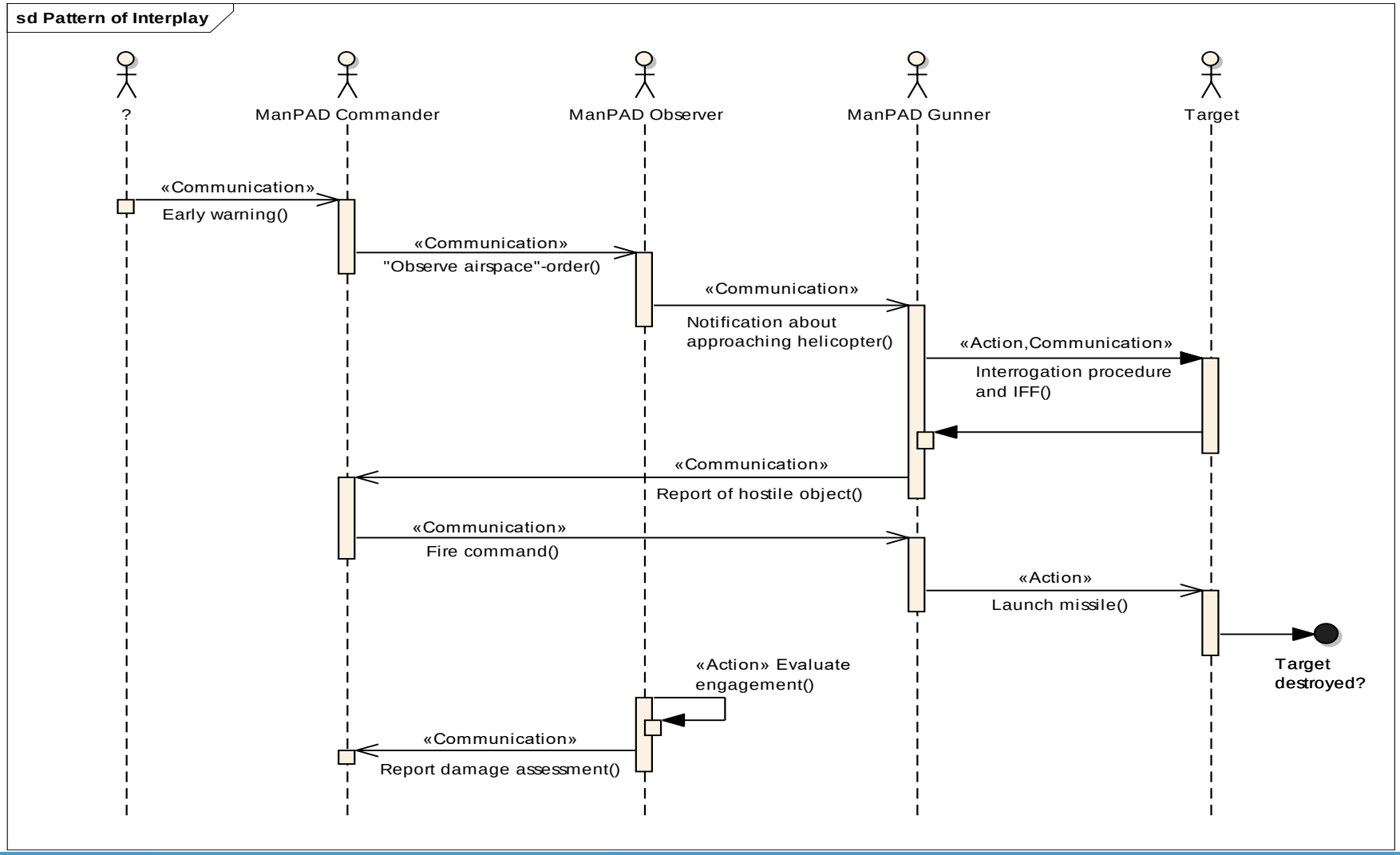
- Communication Events

Time	Event
00:00	ManPAD commander receives a voice message with early warning information for a target at a specific position.

- Interaction Events

Event type	Attribute(s)	Trigger/condition
Target Identification	Target Position	Within 5km of ManPAD team
IFF Operation	Target Position	In the range ring of ManPAD missile
Missile Fire	IFF Status	Foe
	Target Position	In 80% of range ring
Missile Detection	Missile Position	Within 1.5km of helicopter
Flare Dispense	Missile Slant Range	1400 m
	Dispense Number	12
	Initial Dispense Time	0.6 s
	Dispense Interval Time	0.1 s

Example: Conceptual Scenario (BOM)



Example: Conceptual Scenario (BOM)

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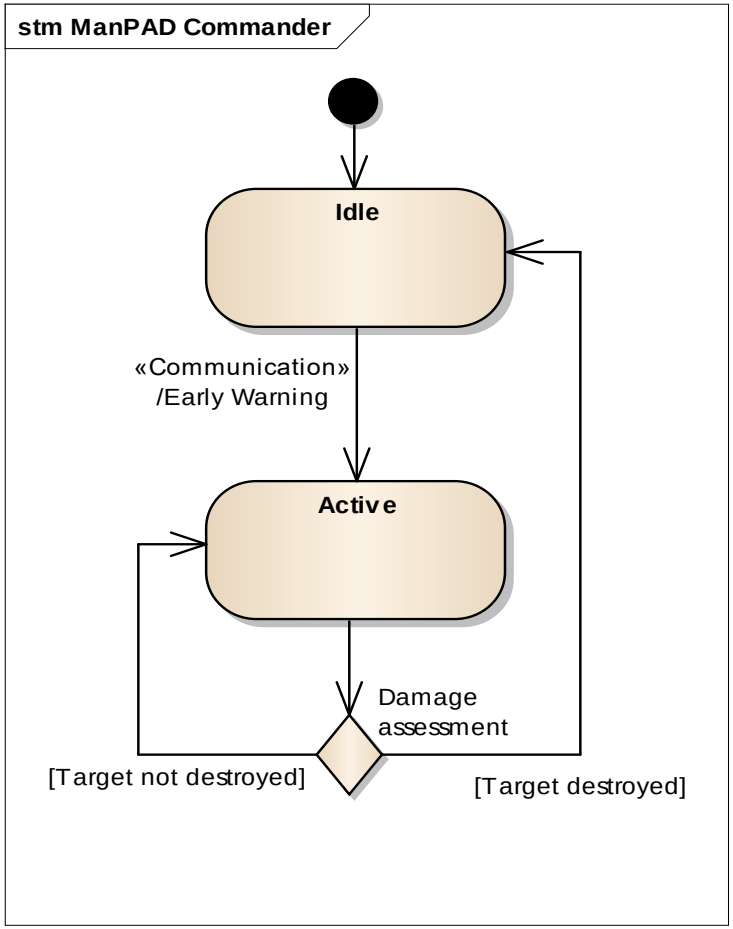

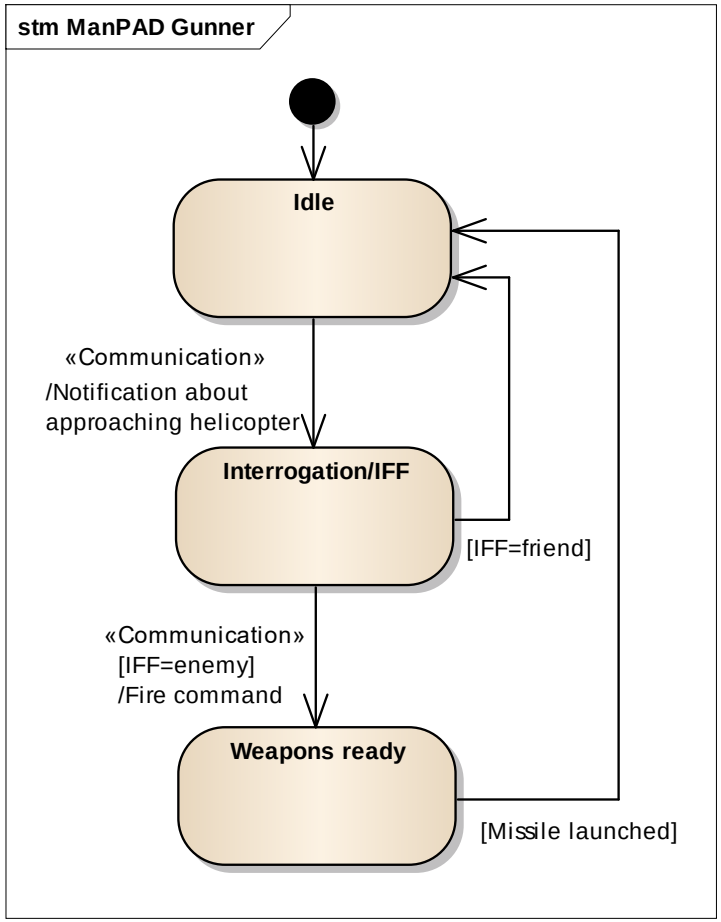

Executable scenario

4 Develop simulation environment

- Most detailed specification of a scenario
  - Subset of the conceptual scenarios
  - Contains all information necessary for preparation, initialization and execution of the simulation environment
- Developed by M&S experts and system operators
  - Assistance of sponsor, user, SMEs should not be necessary
- Ideally directly available to simulation systems
  - File, Web service, …

Example: Executable scenario

```
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        <blue_forces>
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        <red_forces>
        <manpad_troop>Red Manpad Troop</manpad_troop>
        </red_forces>
    </participants>

    <intial_conditions>
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    </intitial_conditions>
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            <launch_time> 0 </launch_time>
            <launch_position> -1060, -1060,0 </launch_position>
```

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