



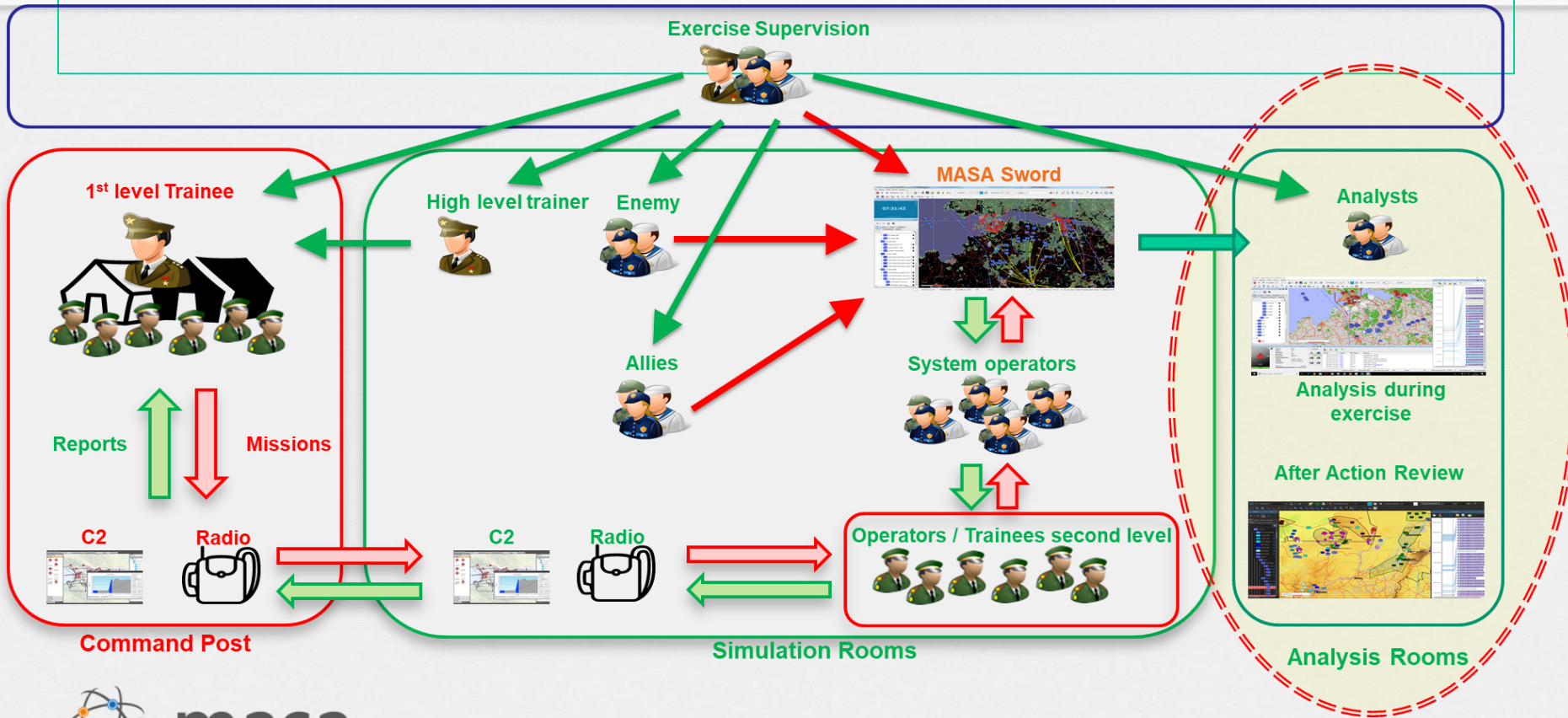
# Innovative automated analysis tools for After Action Review (AAR) using Artificial Intelligence and Modeling & Simulation

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In cooperation with:

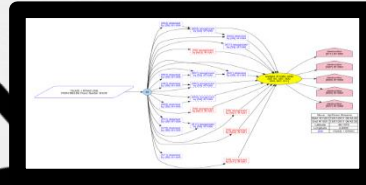


# After Action Review and Command Post Training

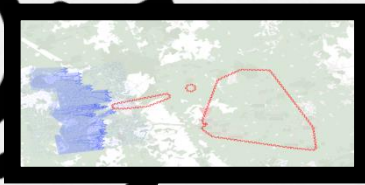


# The context of analyzing a situation

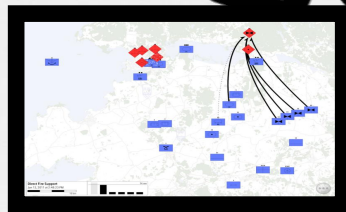
**MASA SWORD AAR** gives access to the tactical situation on a global and detailed level showing the Timeline of events and the Scores



**A narrative graph** to understand the dynamics and the evolution of the tactical situation



**Synthesis Vignettes** to observe and understand the global tactical context



**Interactive Vignettes** to do 'What if' analysis

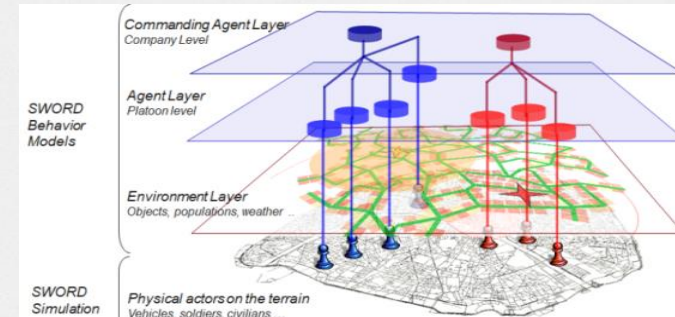
# WHY MASA SWORD?

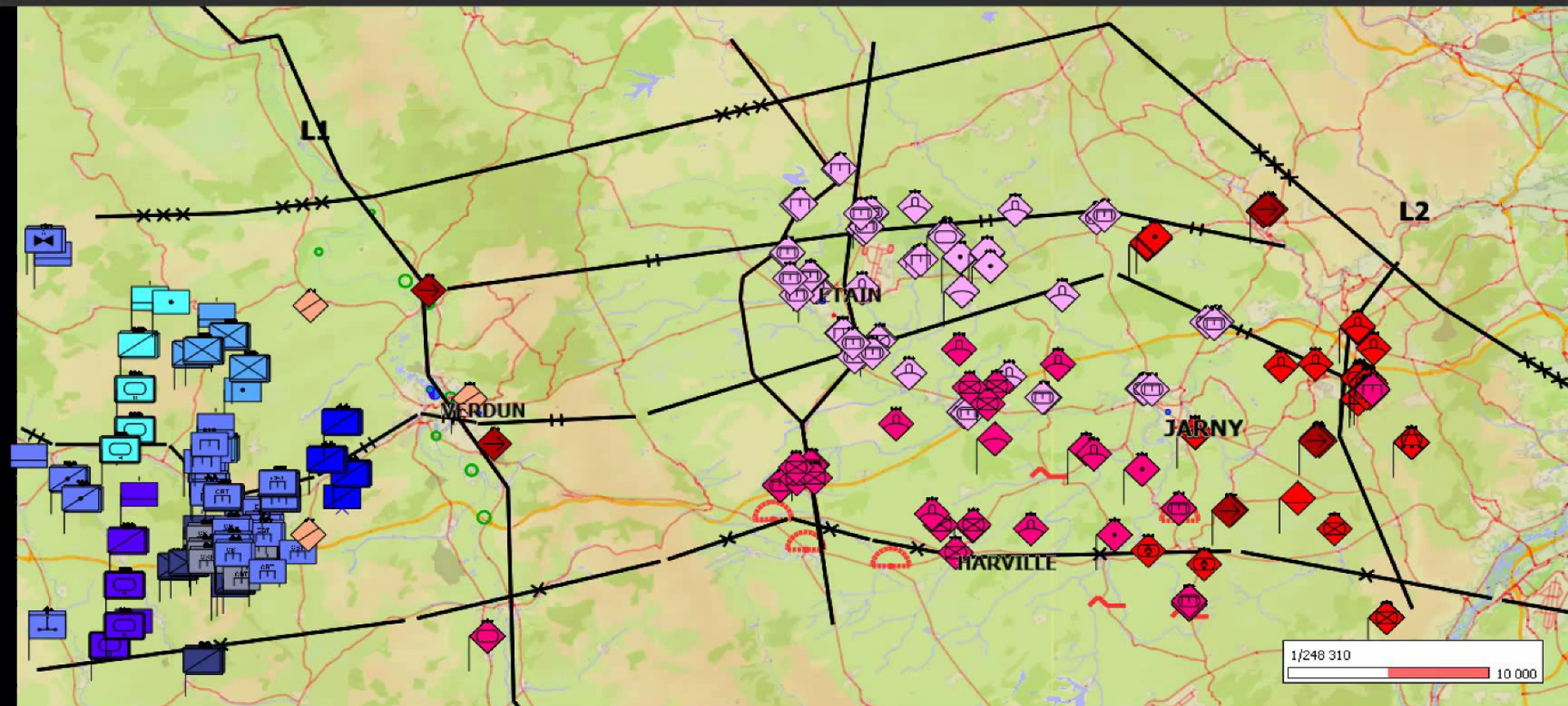
## Why was MASA SWORD used for this new approach of AAR?

**Artificial Intelligence:** The simulated units are equipped with 'credible' behavior consistent with military doctrine. They are autonomous once received a mission. The units operate in a simulated operational environment and automatically report back to their Command Post.

**Widely Used:** MASA SWORD is used all around the world for Command Post Training and for Operational Analysis and Decision Support

**Use cases:** MASA SWORD is used for complex scenarios in a big variety of contexts such as Tactical Command Post Training, Logistic Command Post Training, Decision Support, Operational Analysis, Conventional warfare, Asymmetric warfare, RAS, CD&E, Urban conflicts, CIMIC, Disaster Response & Crisis Management, Multiple factions.....



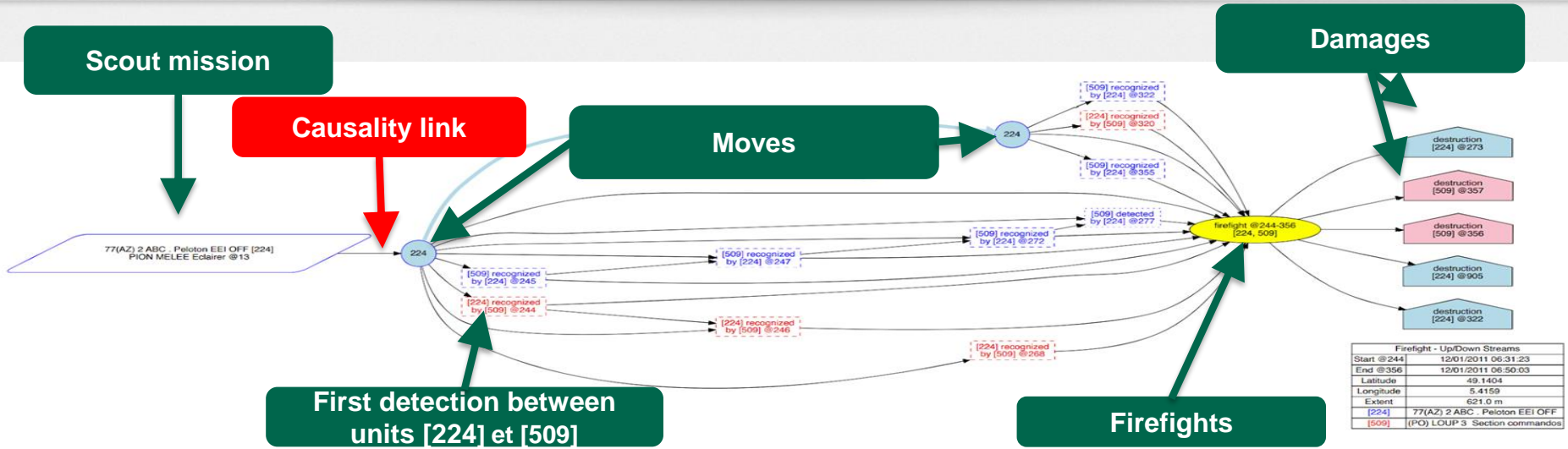


# What is a narrative graph?

ONE THING LEADS TO ANOTHER

- Causal relationship of events coming from the simulation (Missions, Fires, Movements, Damage, Detection)
- Examples: damage is caused by direct or indirect fire (or mined areas); a move is the consequence of a mission; a detection is caused by a move, ...
- Goal: To provide support for the narration of a set of events. Causal relationship of events coming from the simulation such as Missions, Fires, Moves, Damage, Detection,.....

# To understand a narrative graph: Unity [224]



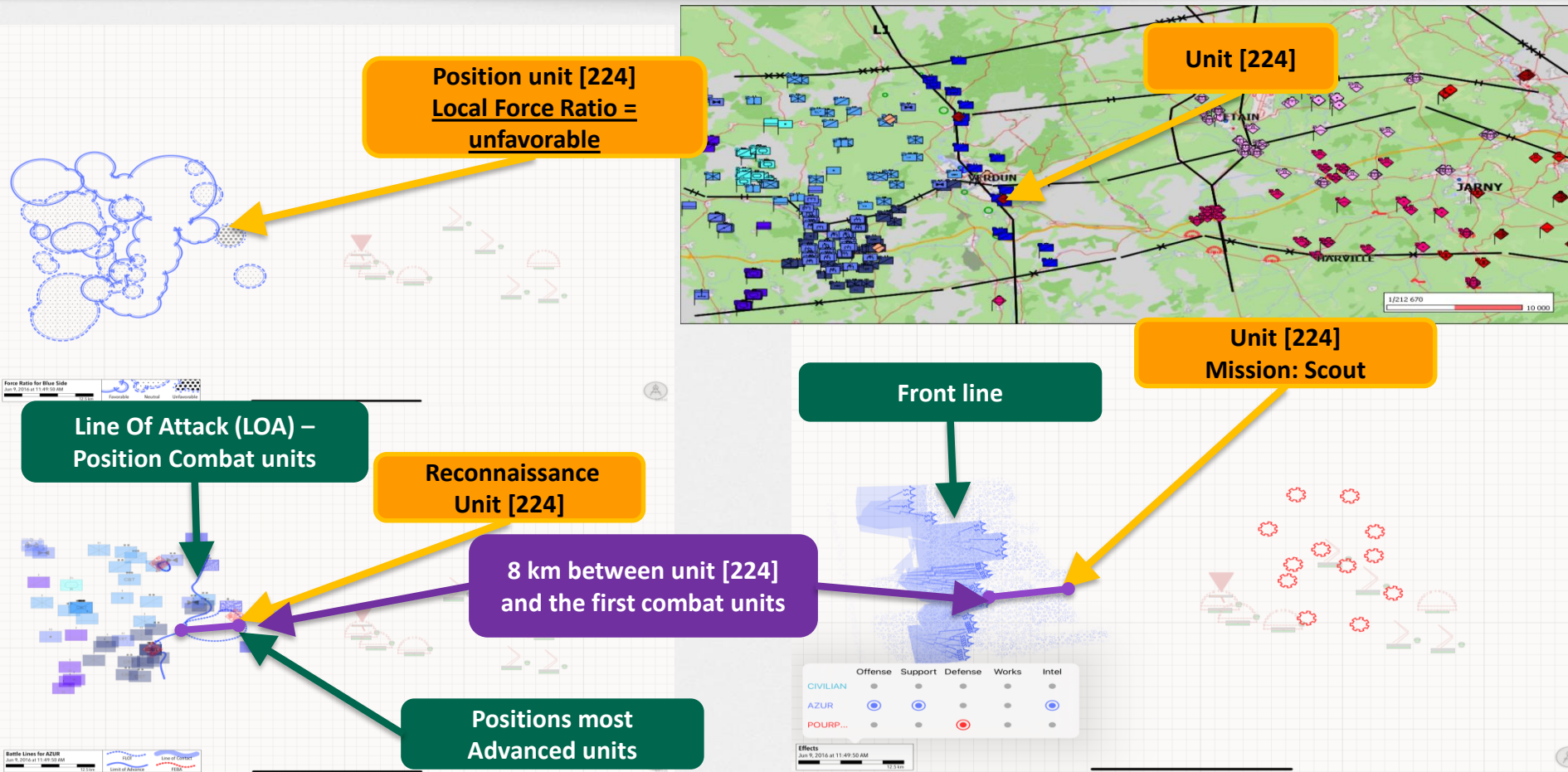
The AT4CS Reconnaissance unit **AT4CS [224]** has received the mission « scout » at 11:35 hours (tick 224), starts moving and then two minutes later (tick 245) encounters **the enemy unit [509]**. The two units detect each other, exchange fire and inflict damage on each other between 11:43 (tick 273) and 12:21 (tick 500)

However, it appears that **unit [224]** was not destroyed until an hour later (tick 905) in a fire exchange not involving **unit [509]**.

**? What is a tick? A tick is a simulation time step. In this scenario 1 tick = 10 seconds of simulated time (100 ticks ~15 min simulated)**



# VIGNETTES: Tactical Context Unit [224] at 11:49 hours (tic 310)



# Sensor capabilities of the units

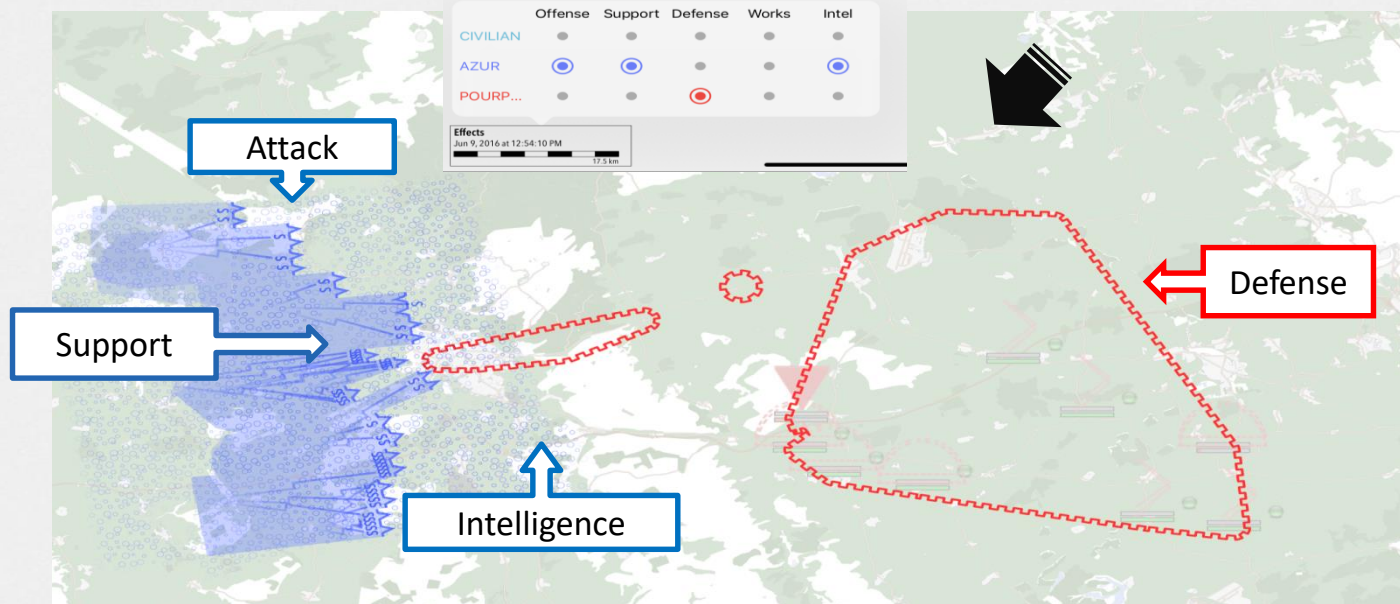
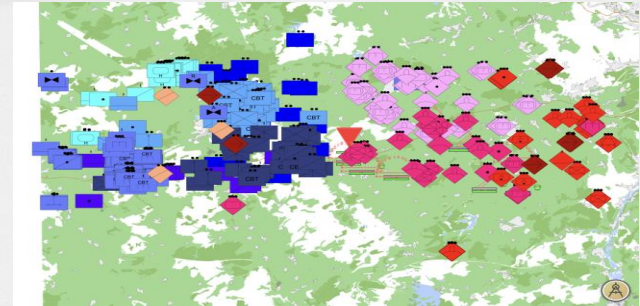
- The sensor capabilities depend on the tactical context and geography:
  - The terrain
  - Speed of the unit
  - Mission of the units
  - The posture of the unit
  - The main direction of the sensors
- There are three sensor 'states' : Detection (dark blue), Recognition (light blue), Identification (white)



✓ Here we can clearly see the reconnaissance capabilities of the helicopters

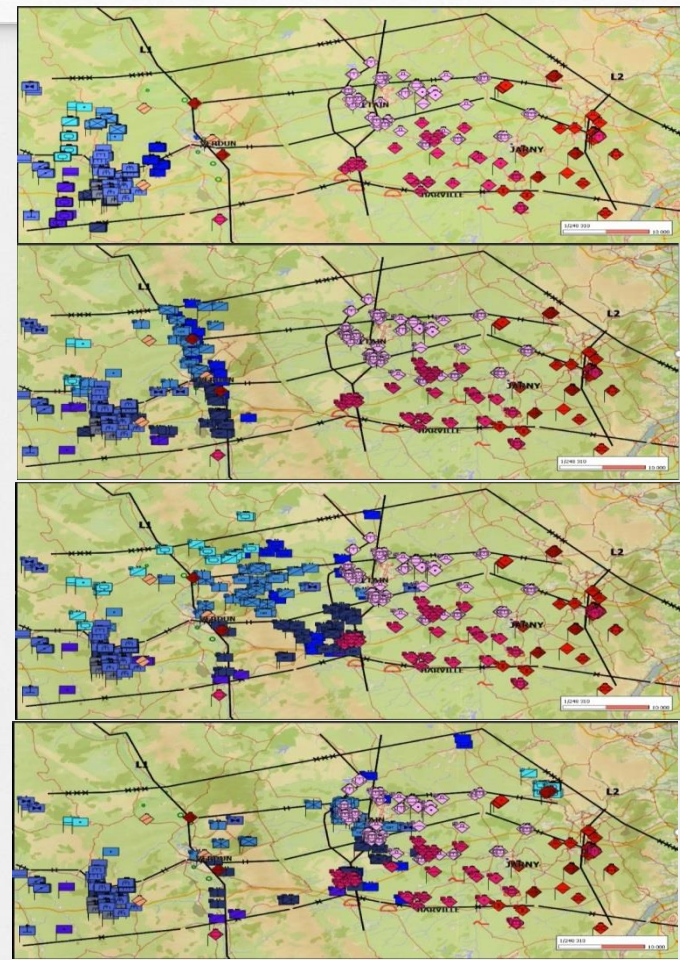
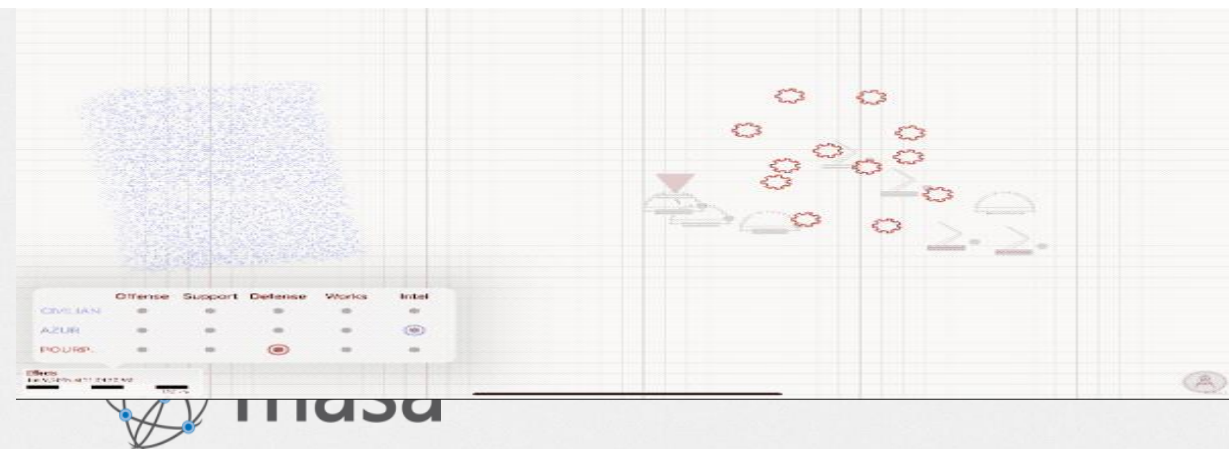
# Effect of the missions per mission type

- ✓ The impact of a mission varies per mission type. We have classified the missions along this axis.
- ✓ We can therefore now generate a view on the tactical situation based on the type of mission
- ✓ For this vignette, we have selected all the units and all of their known missions.



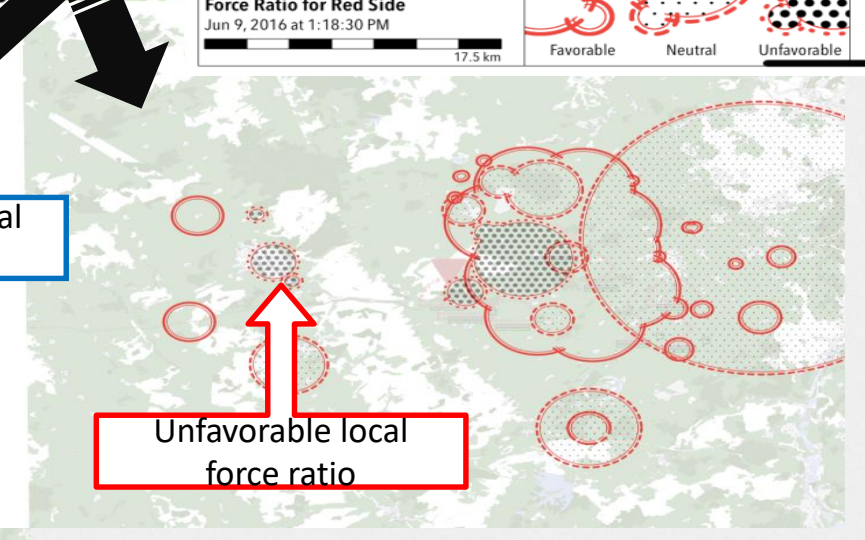
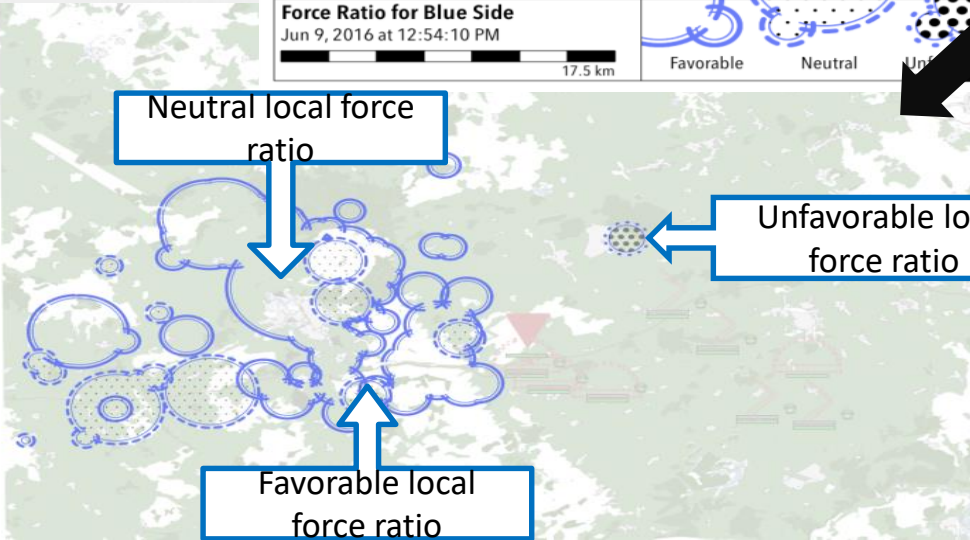
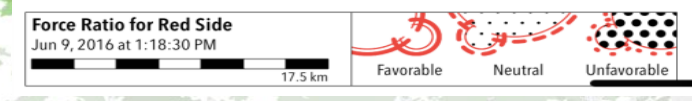
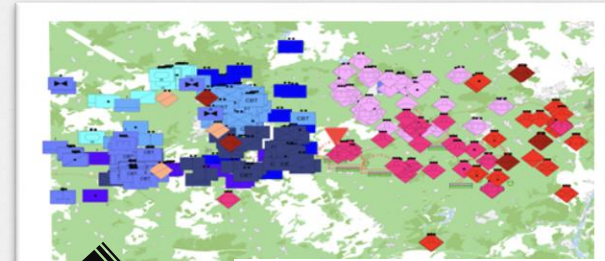
# Effect applied on the terrain

- ✓ Evolution of the tactical situation as a consequence of the type of mission
- ✓ Each mission has a main expected effect on the terrain or on the enemy
- ✓ The vignette makes it easier to analyse the moves that were made and the new positions that are taken



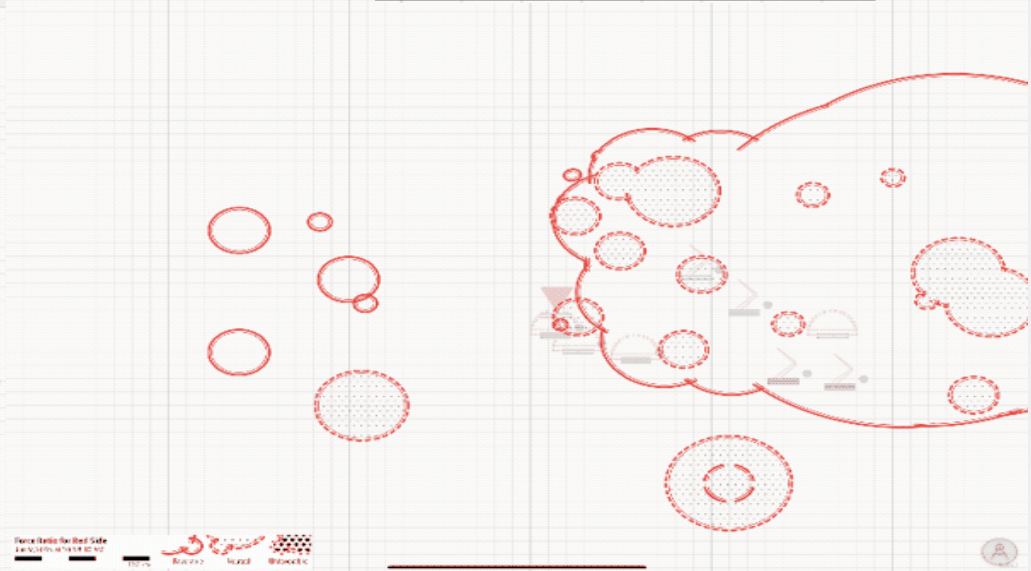
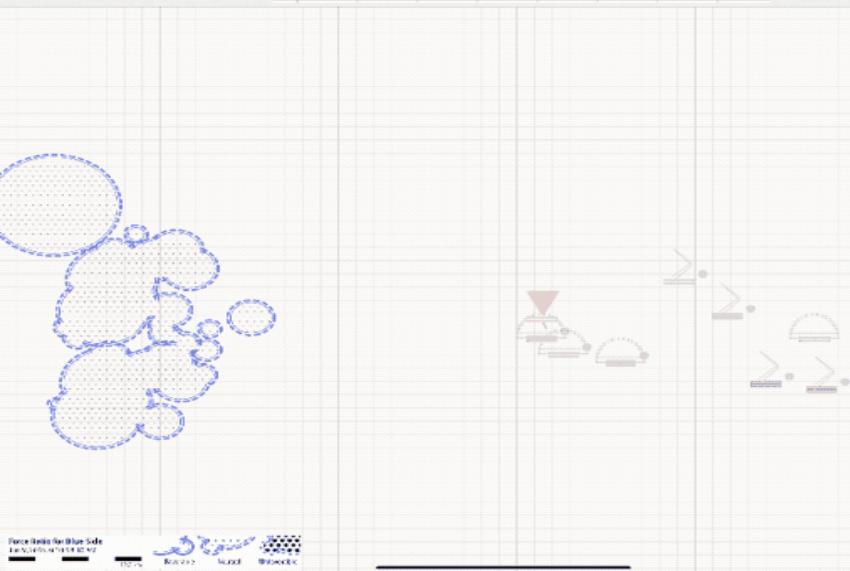
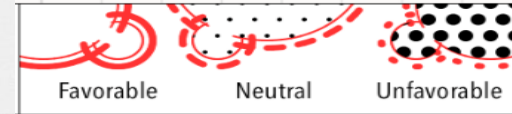
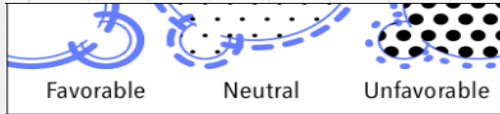
# Estimation of the local force ratios

- The simulation calculates, for each unit, an estimation of the local force ratio, depending on its knowledge of the enemy.
- An unfavorable force ratio (inferior to 3 against 1) indicates a high risk to accomplishing the mission of the unit. As opposed to a favorable local force ratio that indicates a high probability of success.



# Local Force Ratio

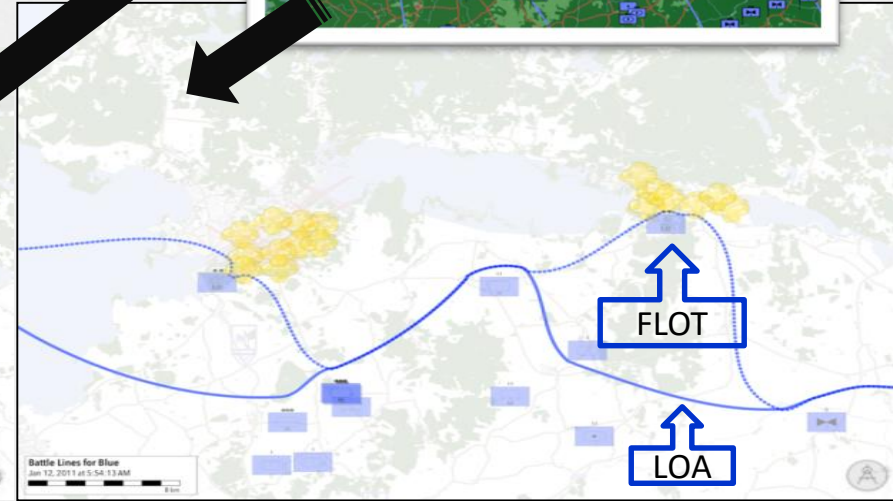
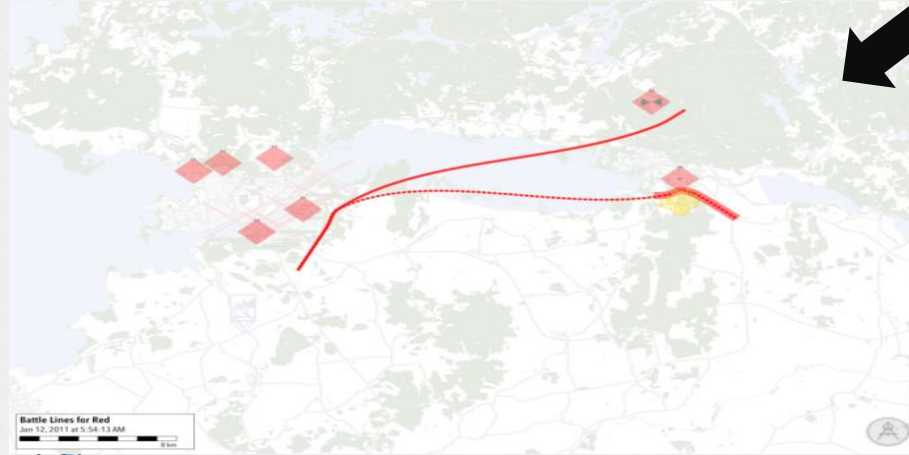
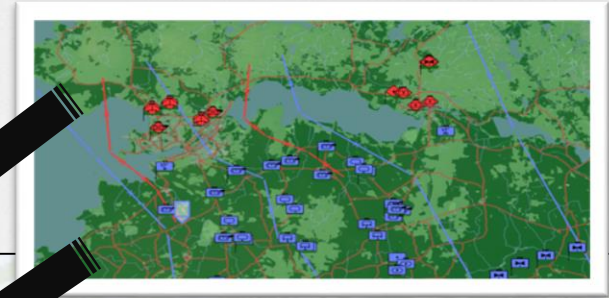
- ✓ Evolution of the local force ratios for Blue and Red
- ✓ Thanks to these vignettes we can now visualize :
  - ✓ When the enemy is detected
  - ✓ The evolution of the local maneuver
  - ✓ The main combat areas



# Automatic generation of battle lines

→ Synthesis of the blue and red positions:

- ✓ FLOT (Forward Lines of own troops) : BLUE most forward position
- ✓ LOA (Lines of attack, non-recon) : Most forward position non-recon
- ✓ LC (Lines of Contact) : Lines of Contact
- ✓ Forward Lines of OPFOR : RED most forward position



# Automatic generation of tactical lines

From the generated battlelines vignettes we can create the history of the Battle Lines

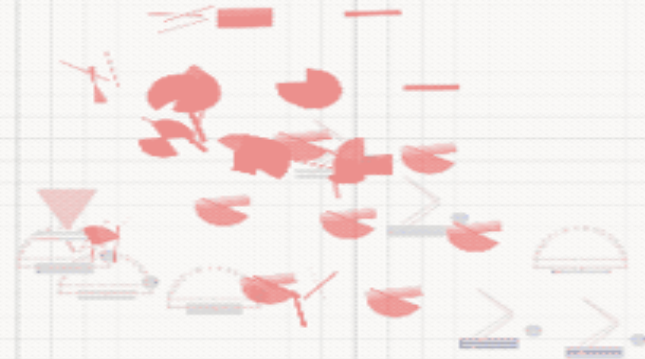
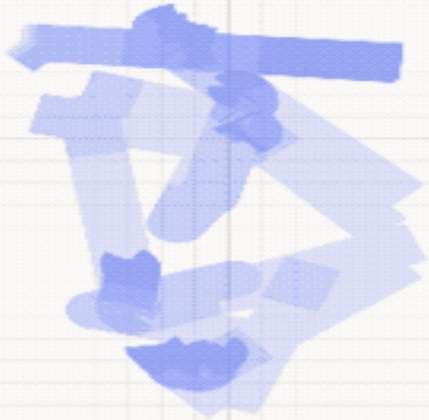


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# Snail trail: a view on movement and terrain occupation

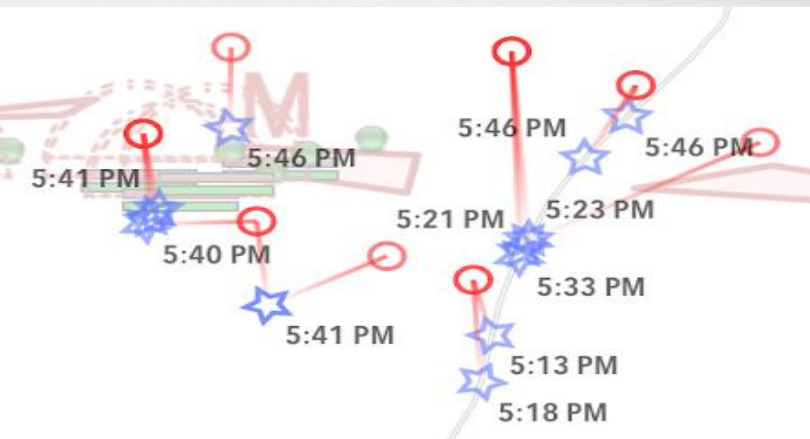
- ✓ Another vignette: Snail trail, representing the terrain occupied by the units
- ✓ This vignette can serve to find out which parts of the terrain have been neglected by the units
- ✓ The darker the color the more recent this part of the terrain was occupied



- ✓ In this case it is easy to conclude that the blue units had to make a lot of moves as where the enemy units hardly have moved at all



# History of direct fires



**Enemy fires on blue units**



This vignette shows :

- The origin of the fires
- The targets of the fires
- The timing of the fires

Thanks to this vignette, it is easy to identify the main areas of confrontation and the timing of it.

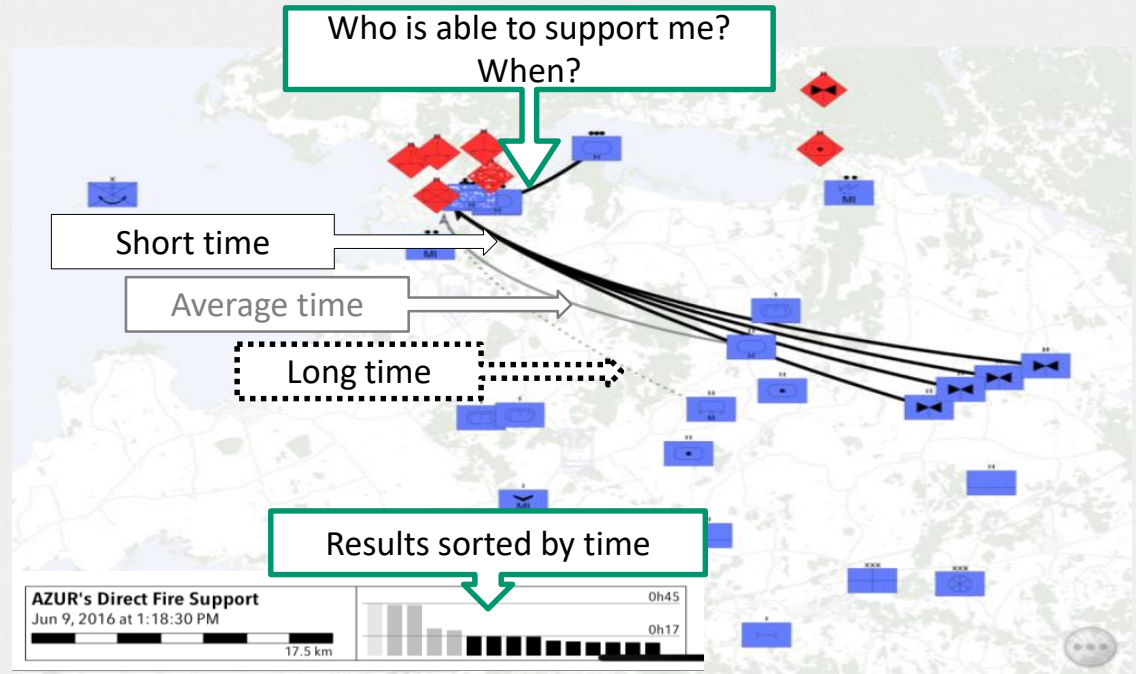
It also allows to illustrate the narrative graph when it comes to fire exchanges and their impact

**Blue fires on enemy units**



# What if unit [XXX] would have been supported?

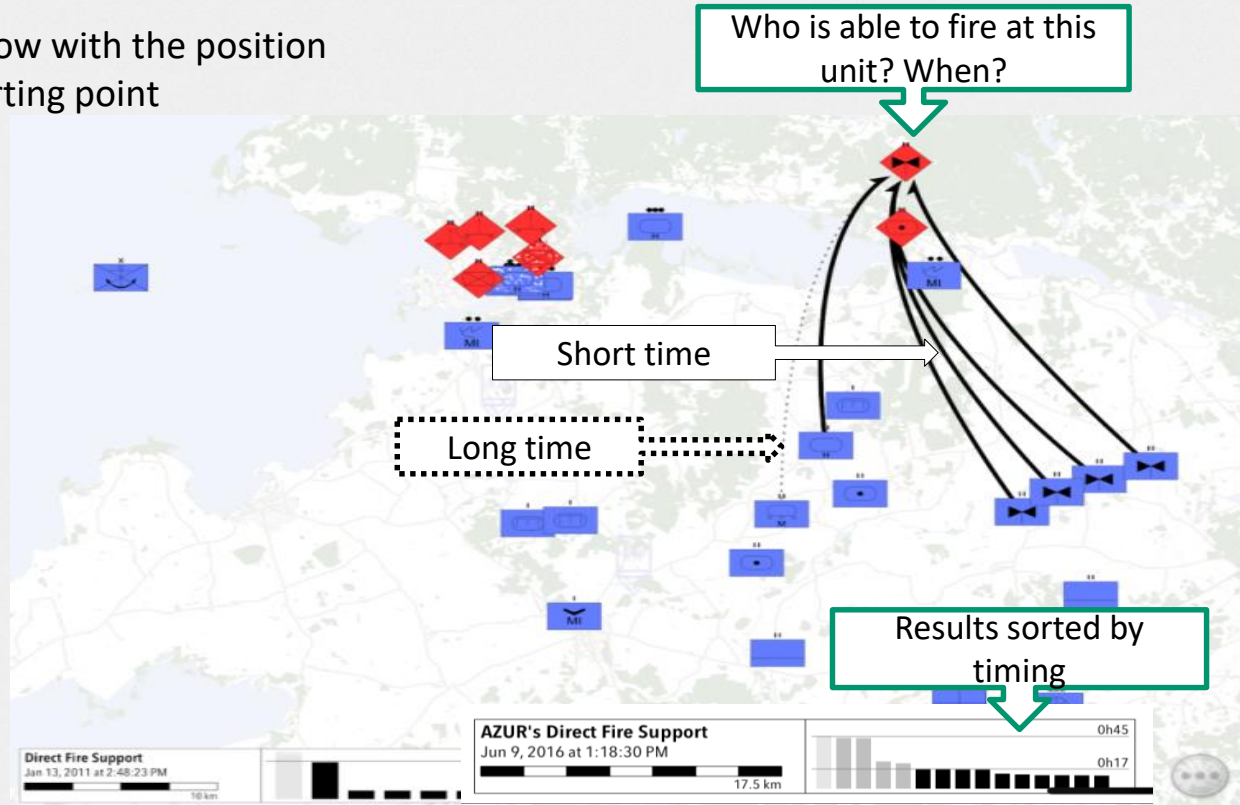
- This vignette shows which units would have been available to support our unit under fire including the timing of the available support
- This calculation is based on the fire range of the units but also on the terrain type and elevation and the tactical environment :
  - ✓ Condition of bridges and roads
  - ✓ Mined areas
  - ✓ Detection of enemies, ...



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# What if unit [XXX] would have been destroyed?

→ Same calculation, but now with the position of an enemy unit as starting point



# Even further with vignettes: Decision support

## ❑ Automatically put the information coming from the terrain in a certain context

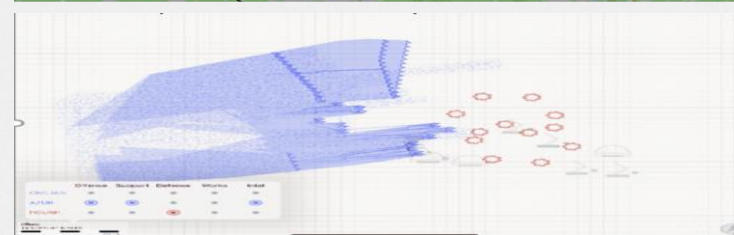
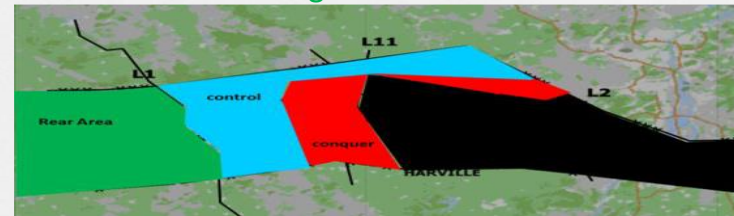
Prioritization of information and sending of alerts through intelligent information processing. Depending on the context information will not have the same meaning. This will result in different decision making.

Example : Report : « New enemy detected at position XXX »

- ❑ **Black area:** Reconnoiter area. Enemies to be expected
- ❑ **Red area:** Area to be conquered. Increase of the number of enemy units could mean the arrival of reinforcements and therefore a force ration switchover
- ❑ **Blue area:** Area to be secured. No enemies should remain in this area. Meaning that remaining enemy forces were not all evaluated.
- ❑ **Green area :** Secured area. Enemies in this area should result in a serious alert being sent.

## ❑ Operational consequence of this type of information:

Automatic alert if the current mission is jeopardized by the evolution of the tactical situation

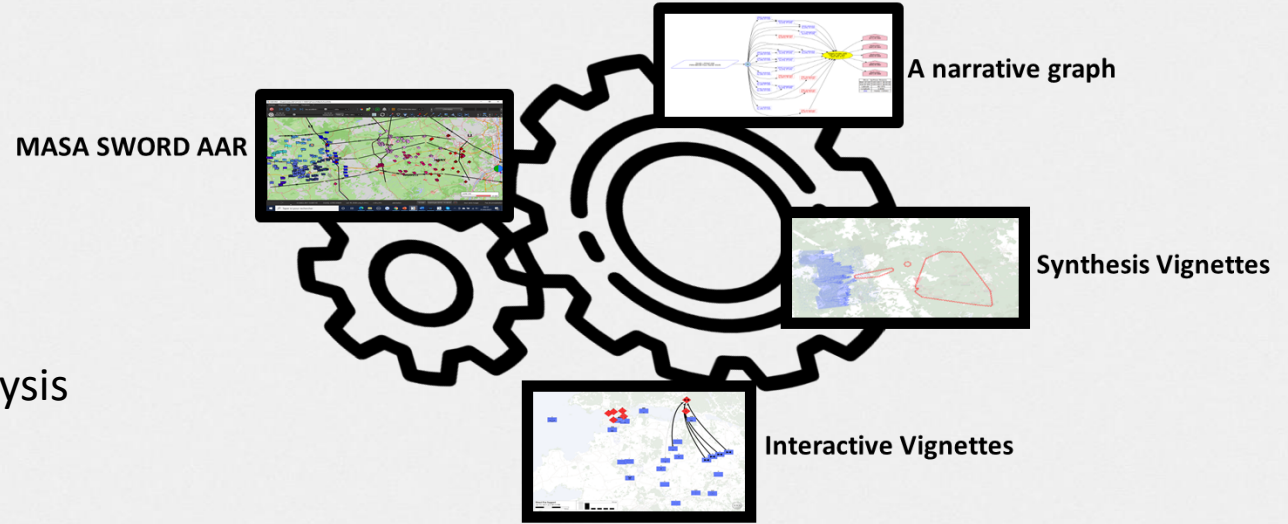


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# Conclusion and more use cases

## OTHER USE CASES:

- Decision Support
- Course of Action Analysis
- Operational Use
- Operational Analysis
- Concept Development & Experimentation





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