



# Transforming Command & Staff Training for Multi-Domain Operations

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# MAK ONE & HIVE Simulation Solution...

## Provide Cost-Effective Tools Directly to End Users

### Put the training tools in your hands

- Train whenever, wherever you want
- Train specific missions and key processes

### Make them simple and effective

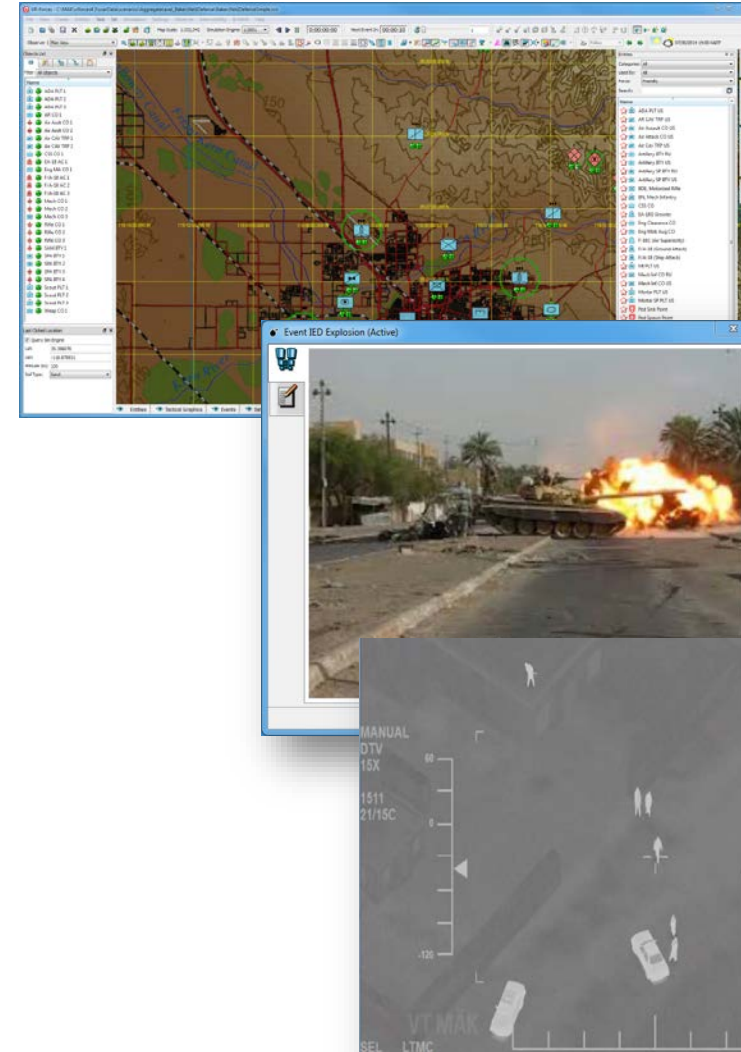
- Easy to learn and operate - Simple terrain & scenario generation
- Unit personnel can develop & run exercises without outside assistance

### Provide a cohesive and integrated Constructive and Virtual Environment

- Based on a common software platform with common terrains, models, and scenarios

### Comprehensive measurement and evaluation

- Course of Action analysis
- Realtime assessment
- After Action Review



# MAK ONE

A single comprehensive constructive environment for wargaming, training & experimentation

## PLAN / PREPARE

- Modify the ORBAT & Parameters
- Modify Terrain and build complex plans (scenarios)
- Launch Exercises



## EXECUTE

- Hybrid Cloud / Site Deployment
- Scalable exercises
- Realtime control
- C2SIM



## ASSESS

- Dashboards
- Performance Assessment
- COA Scoring



# Hive

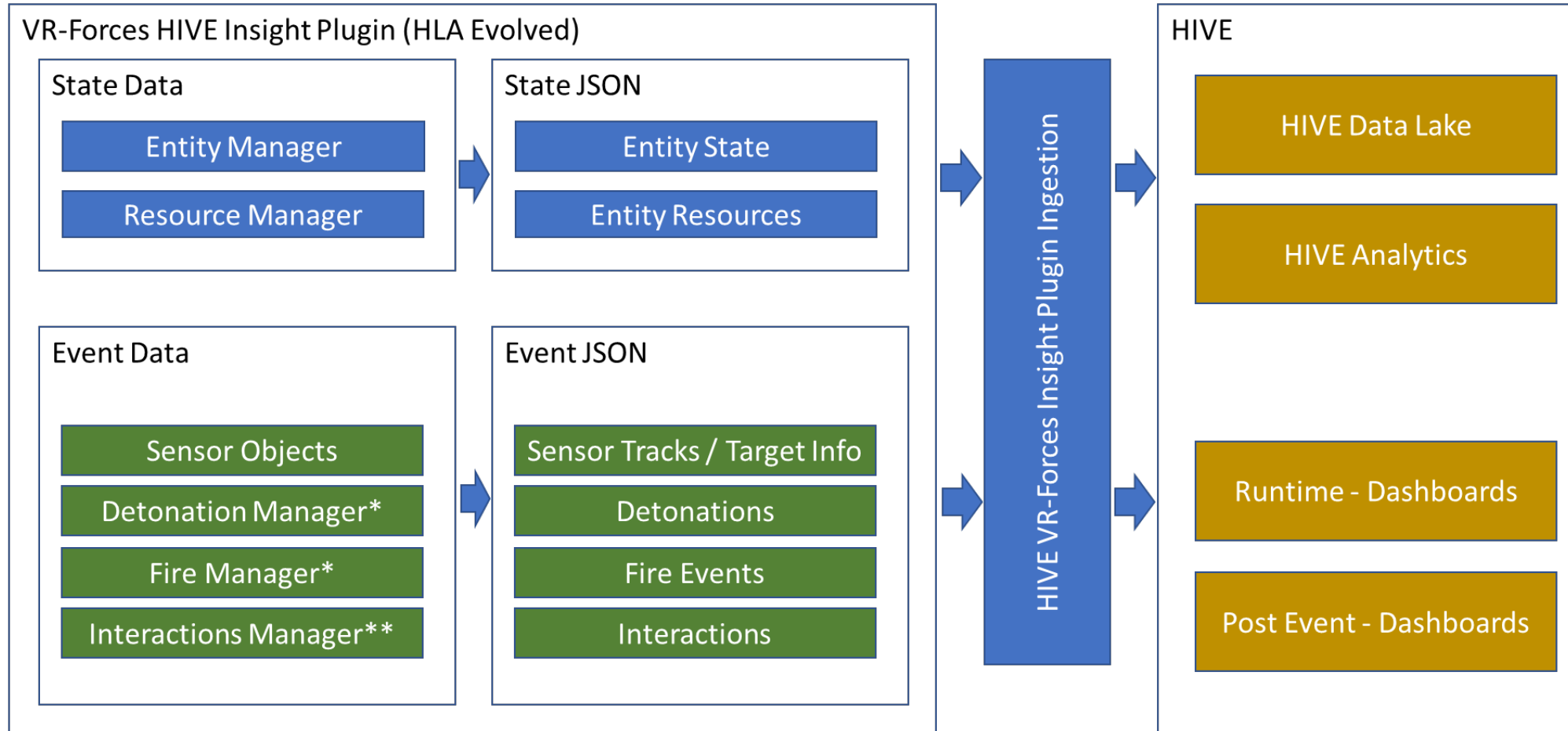
HIVE enhances MAK One with data analytics meeting Training Audience, Training System and Wider Defence user needs.

It can provide in-flight feedback via mentors in realtime and to support AARs, as well as provide post event access to performance data.

It also:

- Illuminates in-flight exercise complexity and challenge management
- Provides evidence to support readiness assessment.
- Will provide evidence to support doctrine validation, lessons processes, experimentation, and evidence-based Force Development decision making.

# VR Forces integration with Hive



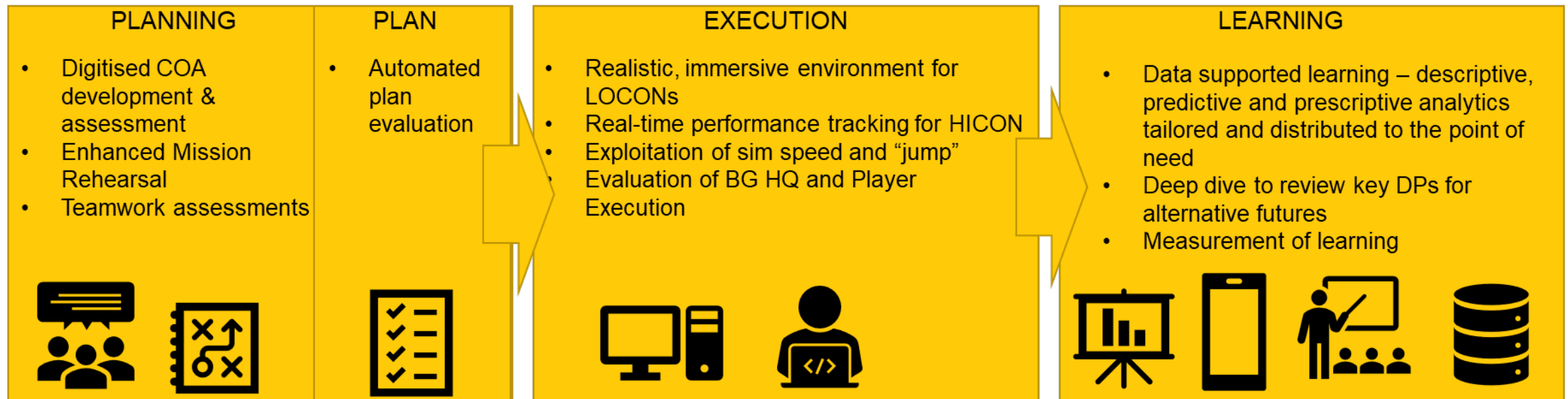
\*Entity Level simulations

\*\* Aggregate level simulations

# MAK ONE + HIVE

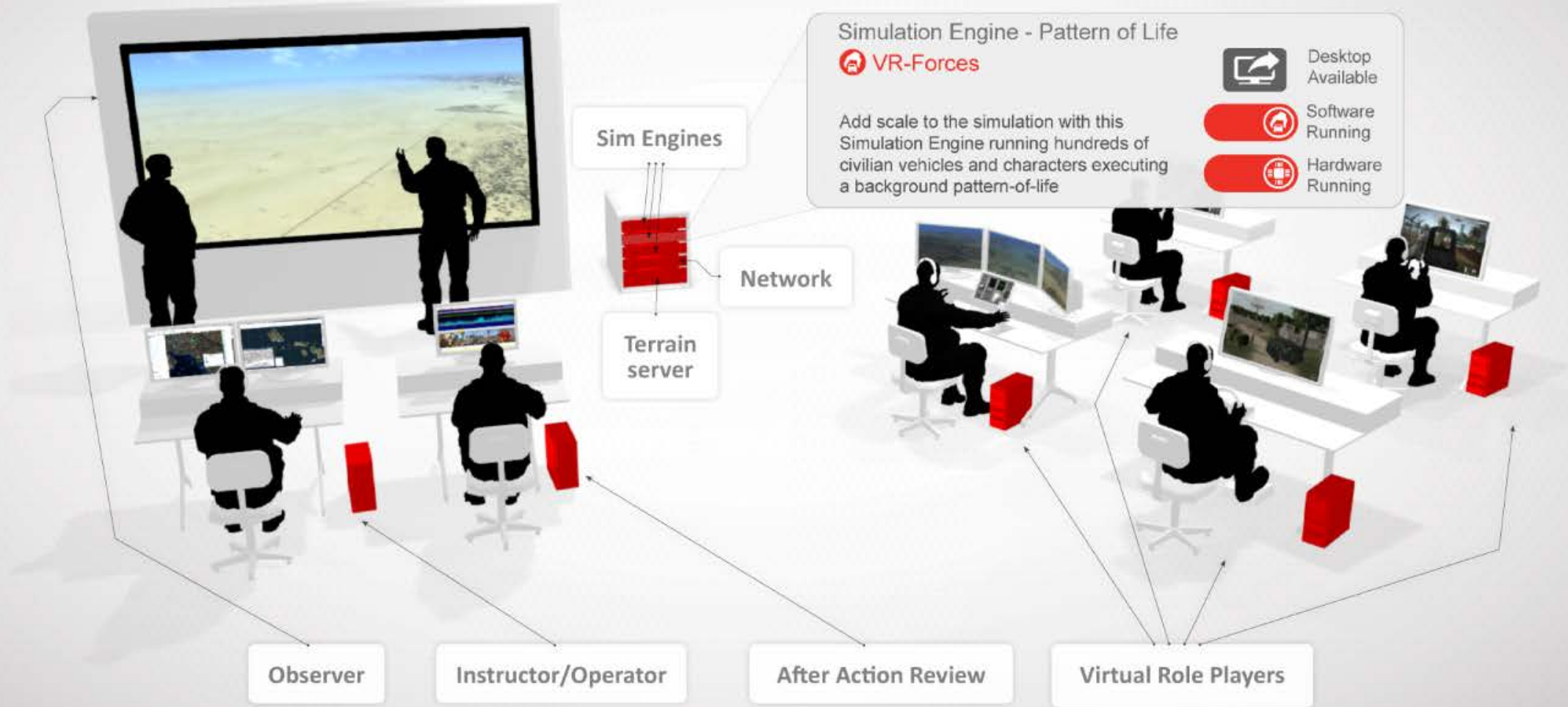
- Simulated with scale, high fidelity and multi-domain representation
- Enhanced evaluation of planning;
- Automated evaluation of the Plan;
- Full evaluation of Execution;
- Enhanced support to Learning

	"As is"	"To be"
Subjective Evaluation of planning	✓	✓
Objective evaluation of planning	✗	✓
Assessment of Plan	✗	✓
Subjective Evaluation of execution	✓	✓
Objective evaluation of execution	✗	✓
Comparing planning performance with plan potential with execution outcome	✗	✓



**MAK ONE ARCHITECTURE:**  
*Combines Virtual & Constructive Simulations*

MAK ONE can be deployed locally in classrooms and labs, in a portable environment on laptops, in a distributed simulation network, on virtual machines, or in the cloud.



# Scalability & Interoperability

## Supporting Brigade Level Exercises

### Scalability

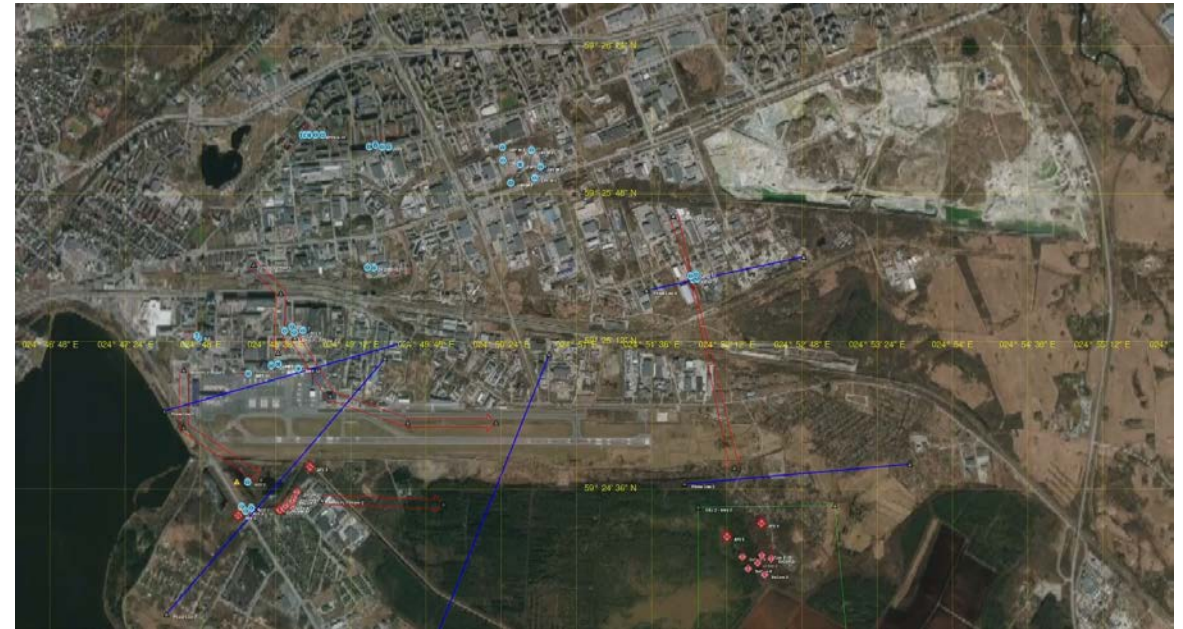
- From single laptop to large scale multi-user exercise
- From Squad vignette to Brigade-on-Brigade exercises
- From local exercise on a LAN to distributed Exercise in the Cloud
- From Single User to Multi-User

### Realtime Scaling

- Add spare capacity
- Automated load balancing

### Open Standards

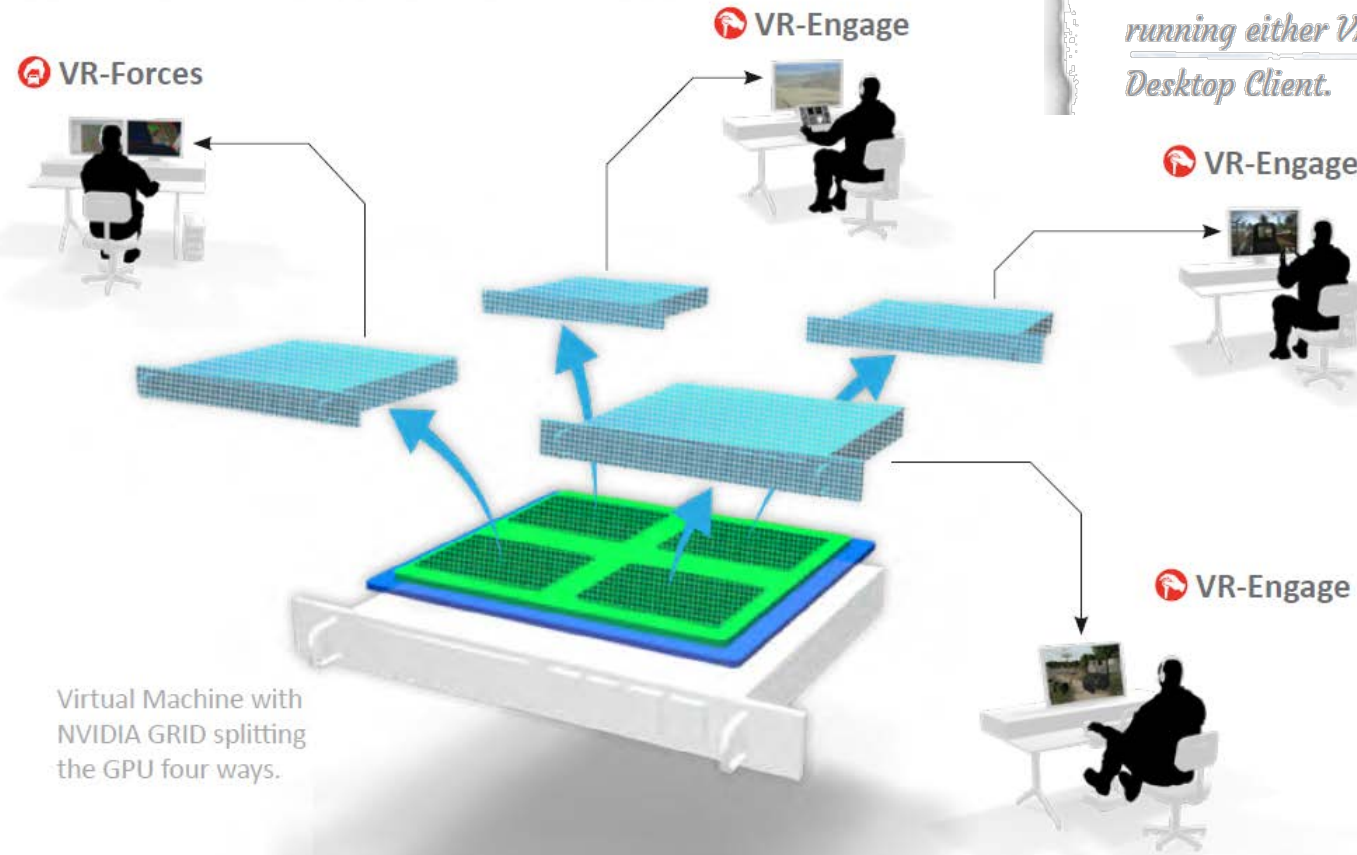
- GIS Data
- HLA & WebLVC
- C2SIM





# MAK Use Case

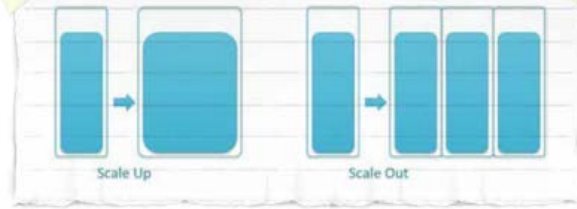
*MAK Use Case:  
Virtual Machine w/ NVIDIA GRID*



Virtual Machine with NVIDIA GRID splitting the GPU four ways.

To help our customers plan for a simulation project, we configured and tested an Intel server with 48 Intel(R) Xeon(R) Platinum 8160 CPU @ 2.10GHz processors and two Tesla P40 GRID card running VMware ESXi, 6.7.0 hypervisor, with NVIDIA vGPU Manager. We configured the GRID-based system to support three vGPU per Telsa P40 using the P40-8Q Virtual GPU profile. Each vGPU presents a virtual desktop running either VR-Forces or VR-Engage to clients running VMWare Horizon Virtual Desktop Client.

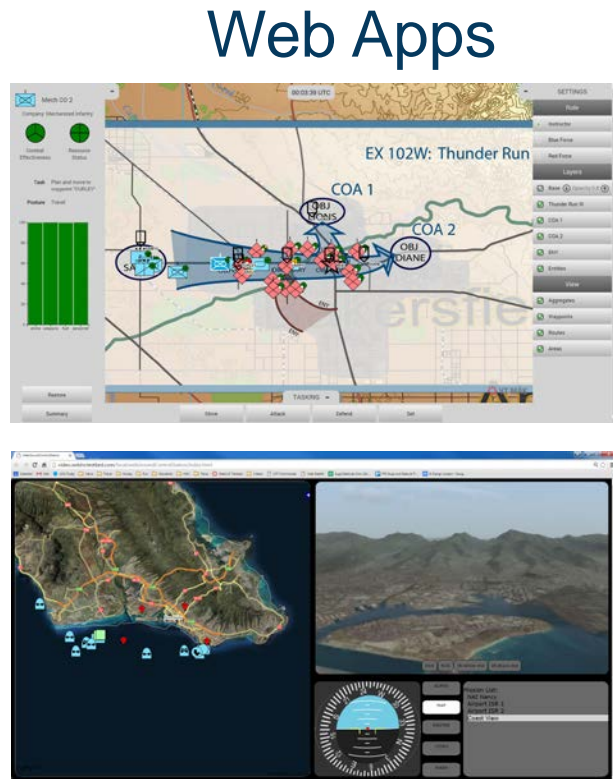
Cloud architectures take advantage of elasticity to facilitate greater scalability. Scalability can be thought of two ways.



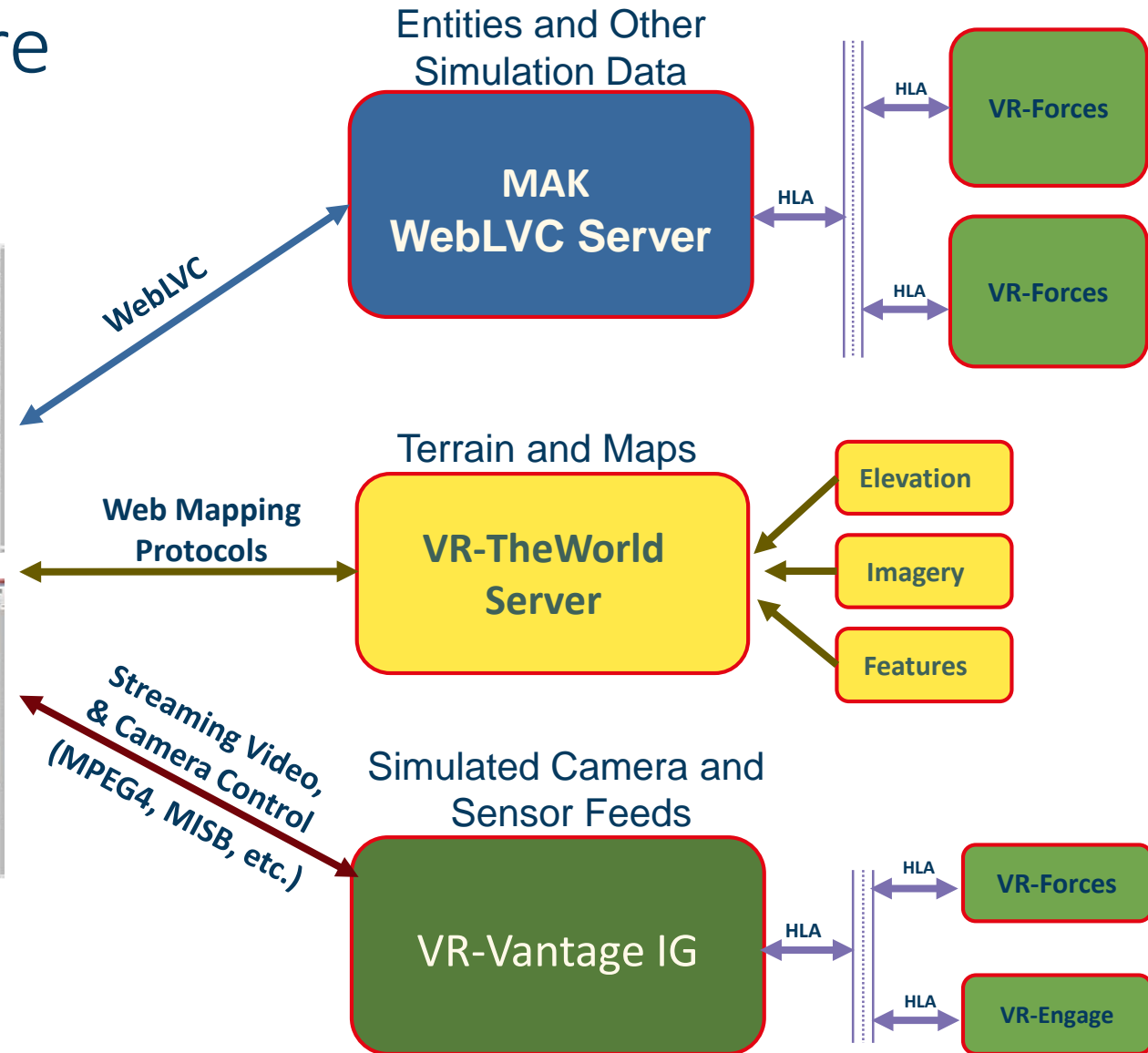
Scale Vertically or Scale-Up – this type of scalability can work with any application by moving to a more powerful (more compute, memory, storage resources) virtual machine or resizing the current VM.

Scale Horizontally or Scale-Out is the provisioning of instances of the application on additional virtual machines and then dividing the load between them. Elasticity allows the redistribution of resources between applications by provisioning, or by claiming back virtual machines as the need occurs. Horizontal scaling uses the infrastructure elasticity, but the application needs to be able to scale by adding more nodes and by distributing the load.

# Web Apps: The Bigger Picture



## Web Apps



# Plan Customize & Add Your Content

## Create ORBATs

- Multi-sided
- Import from C2/Planning Systems
- Experiment with different force structures

## Customize Parameters

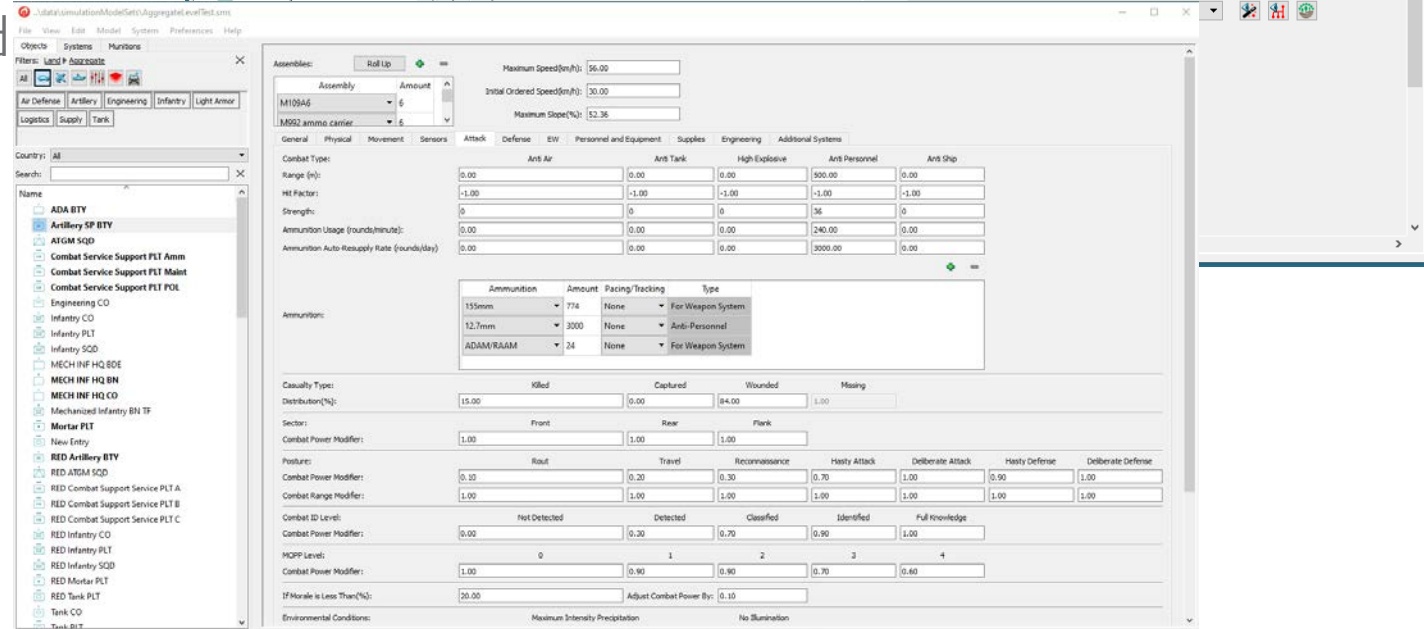
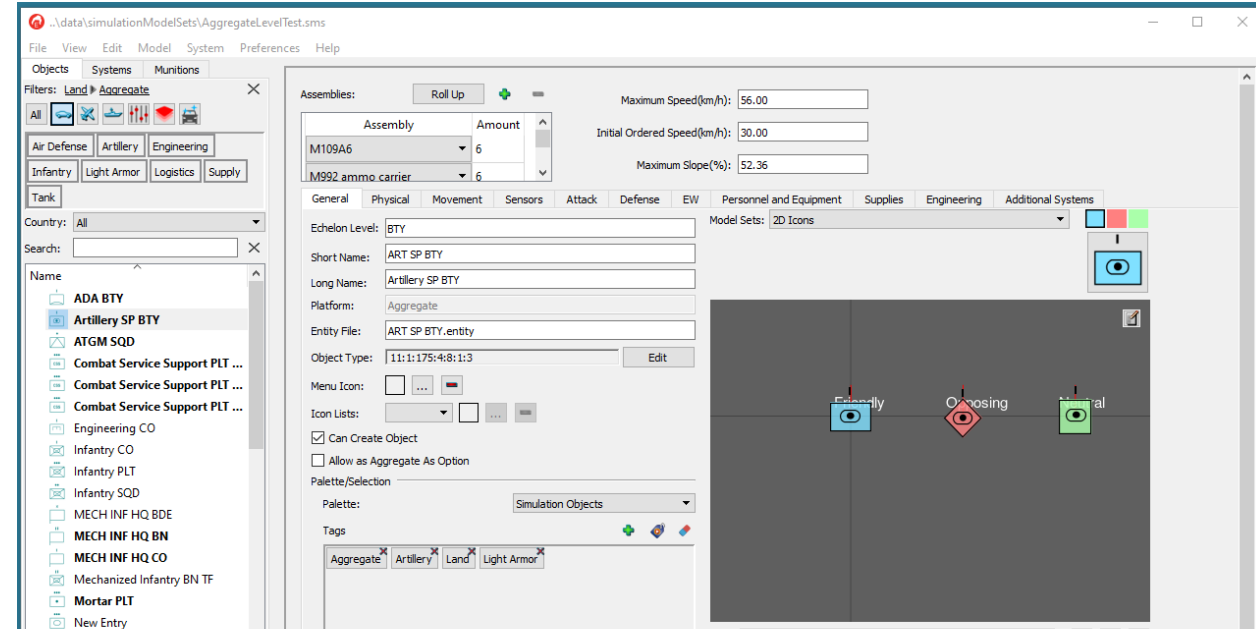
- Change performance / capabilities of units, sensors and weapons

## Add Content

- Easily edit and add new units, weapons, munitions and sensors

## Combine into

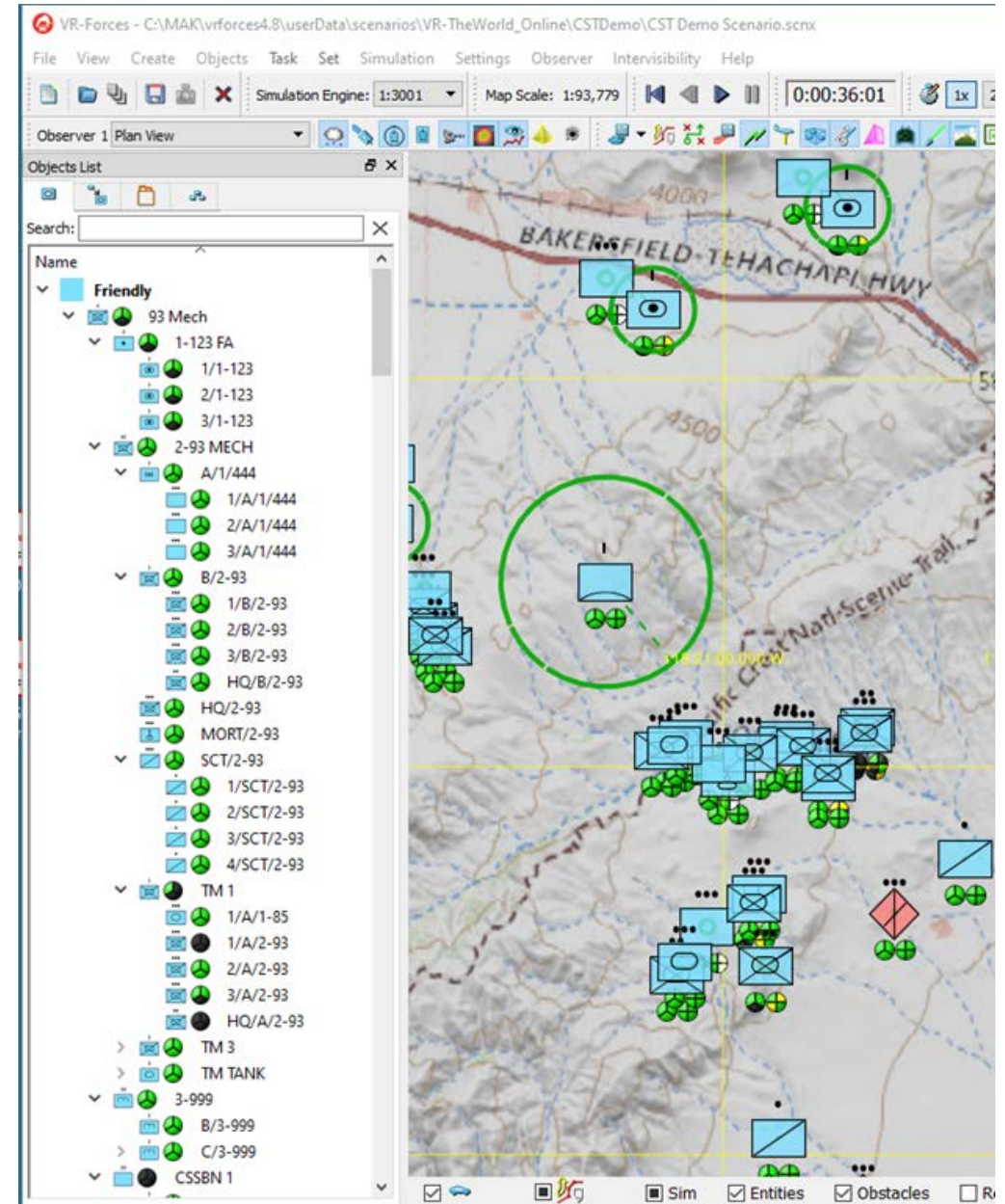
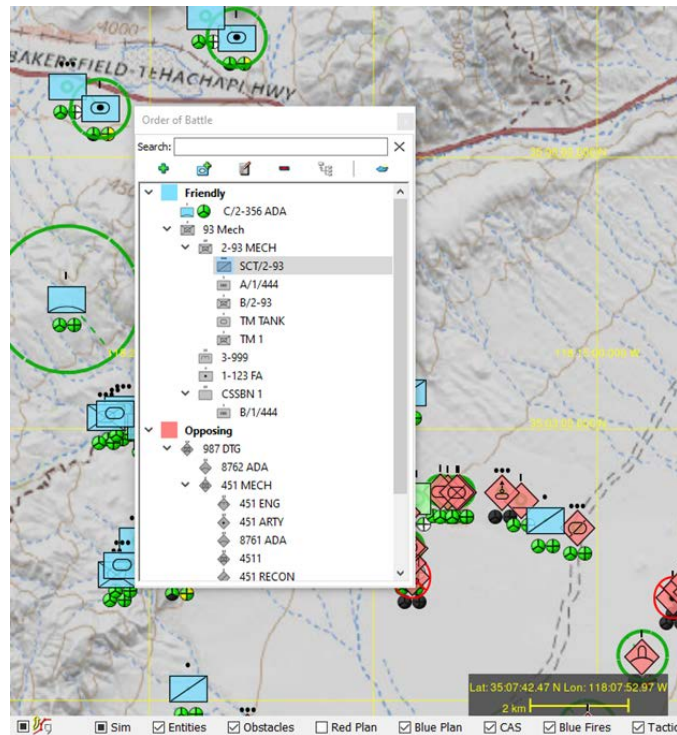
- Units & Formations
- Pre-Configured Groups



# Plan C2SIM

VR-Forces Supports C2SIM for:

- ORBAT Laydown
- Tactical Graphics



# Plan

## Fast and Simple Scenario Creation

### World-Wide Terrain

- Create scenarios anywhere in the world

### Dynamic Environment

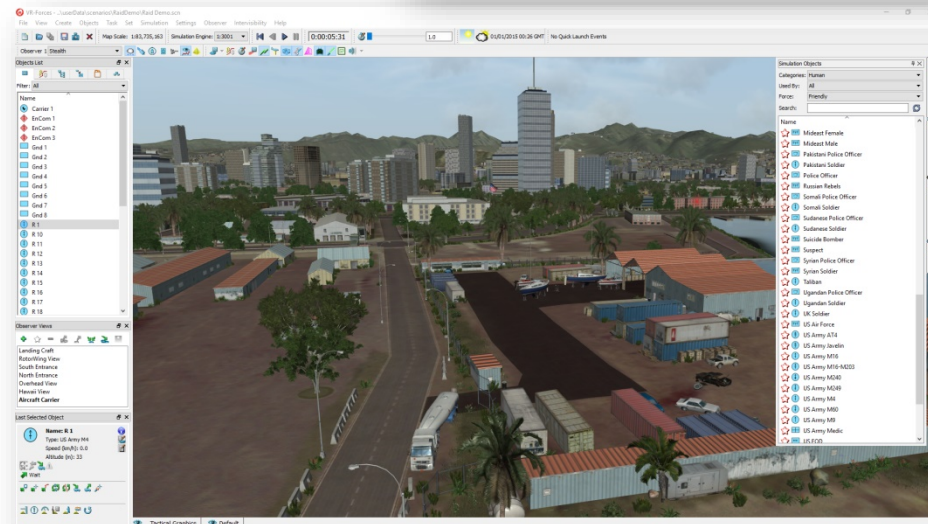
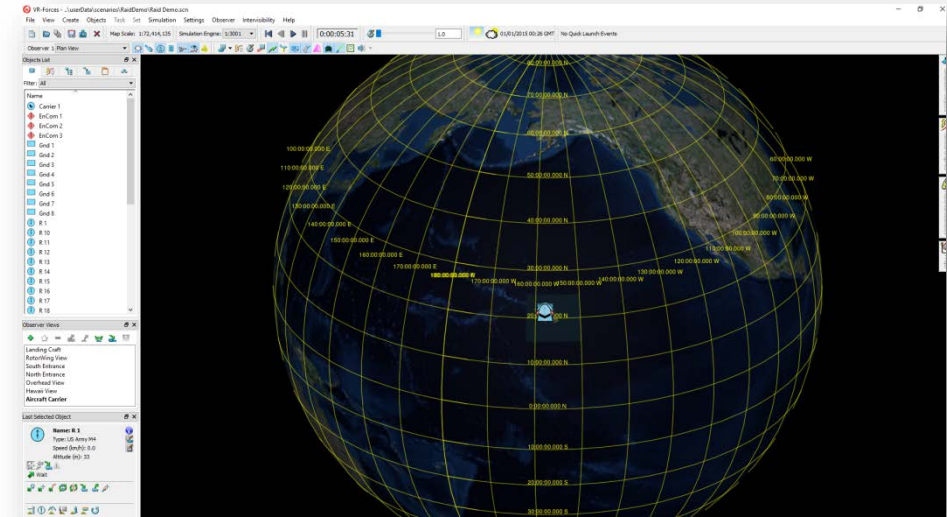
- Date and Time of day
- Weather
- Dynamic Terrain

### Quickly add entities to simulation

- Drag and Drop Units from ORBAT
- Pattern of Life
- Pre-Configured Groups

### Easy and Intuitive Scenario UI

- Tactical Graphics
- Line of Sight Calculations
- 2D, 3D and Simulated Sensor Views



# Plan and Execute

## Dynamic Synthetic Environment

- Terrain

- Support for whole earth tiled terrains generated from imagery and elevation data
  - Rural, urban, coastal, maritime, space, .....
- Procedurally generate 3D content from feature data
  - Land use data
  - Buildings
  - Road Networks
- Dynamic user modifiable terrain
  - Ridgelines & Engineering Objects
  - Features & Props

- Weather

- Specifiable in zones or globally
- Affects mobility, sensors

# Plan Sync Matrix

- Make Phased Unit (and Entity) Coordination easy. Currently each entity needs to be planned independently.
- Offer single dialog to allow coordinated plans based on Phase/Time/Events or other conditions
- Represent your scenario or battle plan as a series of phases over time.

Sync Matrix

Add Unit

Add Phase

Unit/Object	Sub Unit	Phase 1		Phase 2	Phase 3	Phase 4	Phase 5
A CO		Move to PL Sunrise		Collect Wounded	Move to Evac Area	Load Wounded	EVAC
B CO							
	A PLT	Move to South Evac Area	Defend Evac Area	Defend Evac Area	Defend Evac Area	Defend Evac Area	EVAC
	B PLT	Defend Evac Area	Move to North Evac Area	Defend Evac Area	Defend Evac Area	Defend Evac Area	EVAC
FtrFW 5		Loiter		CAS	Exfil		

OK Cancel

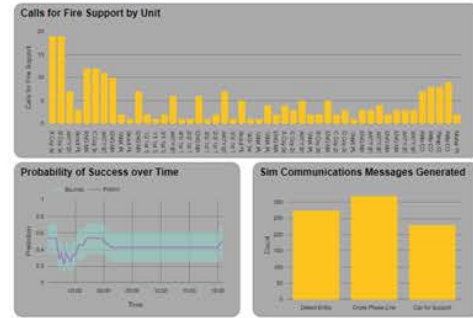
Common triggers include:

- Crossing a Phase Line
- Entering an Area
- Behavior Completion
- Stop Time
- Event
- Any VR-Forces condition

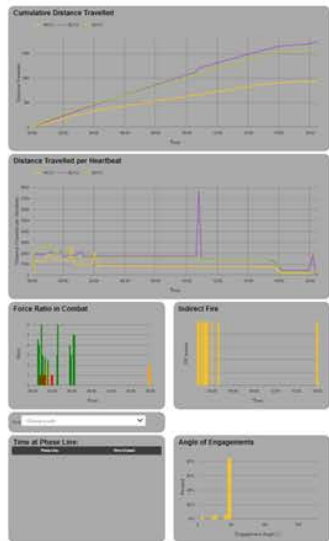
Each block represents a specific plan. Plans are issued to units based on phase progression

# HIVE FUNCTIONAL EVALUATION OF COAs & SELECTED PLAN

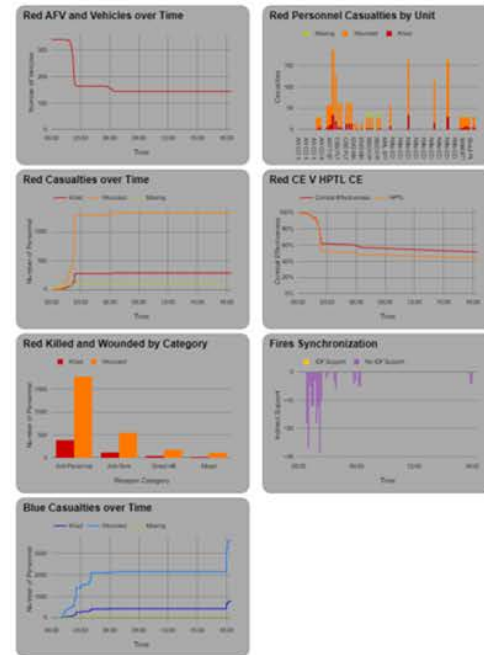
## COMMAND & CONTROL



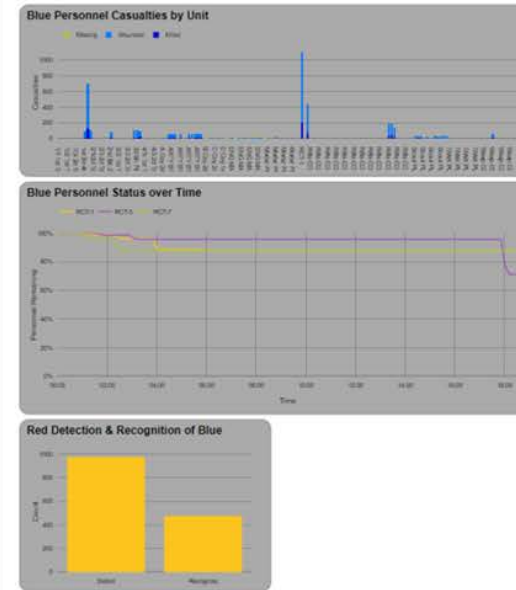
## MANEUVER



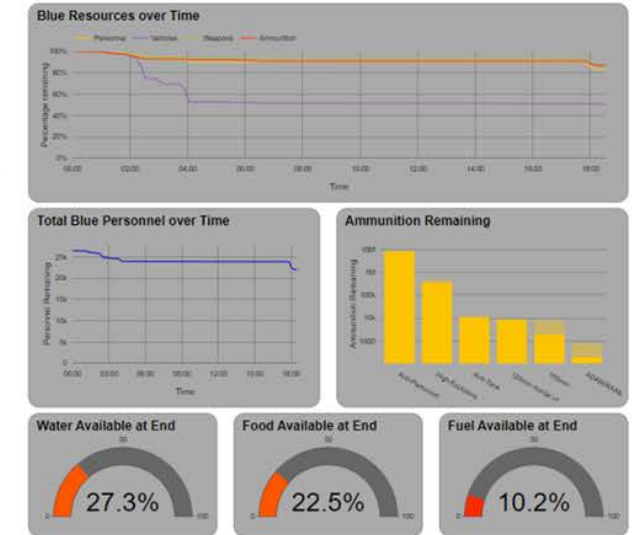
## FIRES



## FORCE PROTECTION



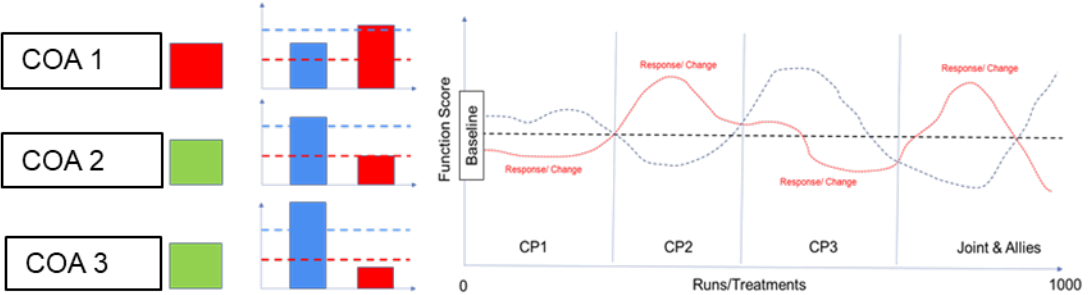
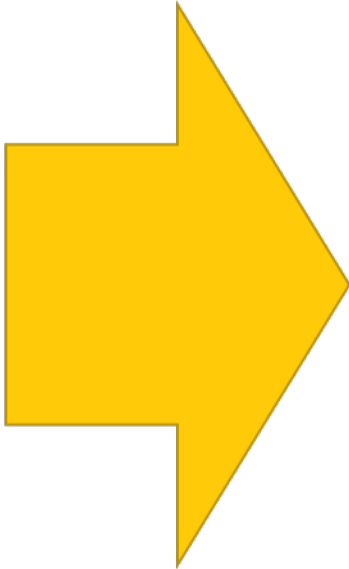
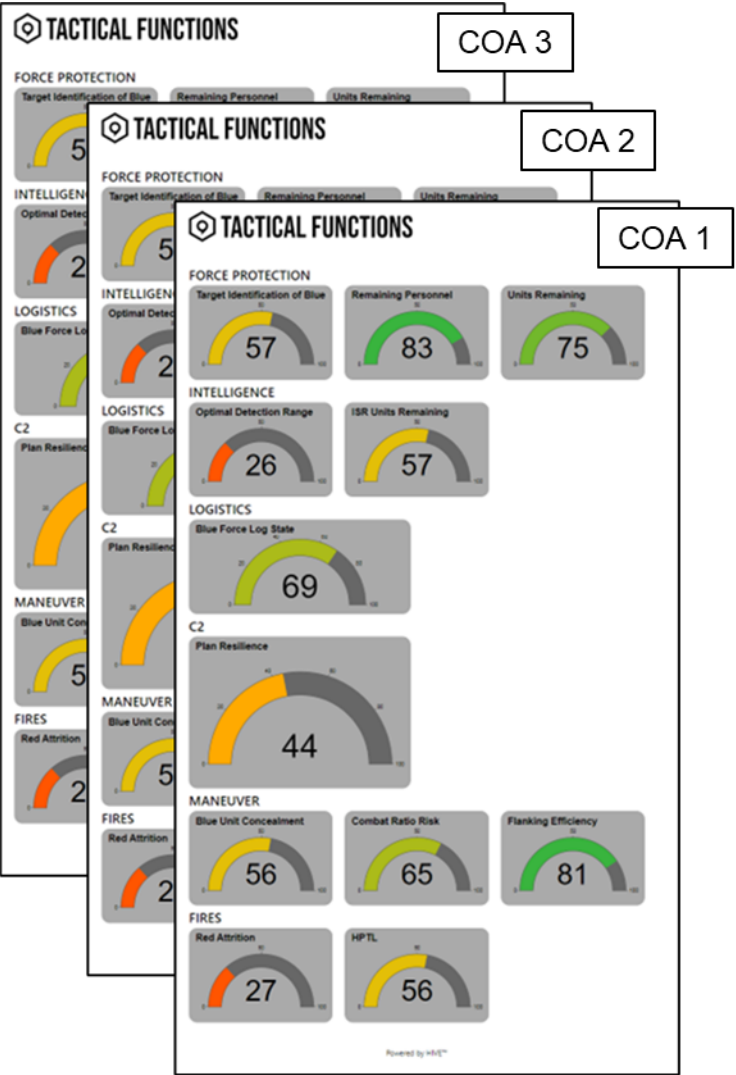
## LOGISTICS



- Pre-execution evaluation of plan
- Plan is re-run/tested against much wider RED assumptions and capability variations for robustness
- Delta is later measured between strength of plan and ability to execute plan.



# HIVE COA MEASUREMENT & EVALUATION



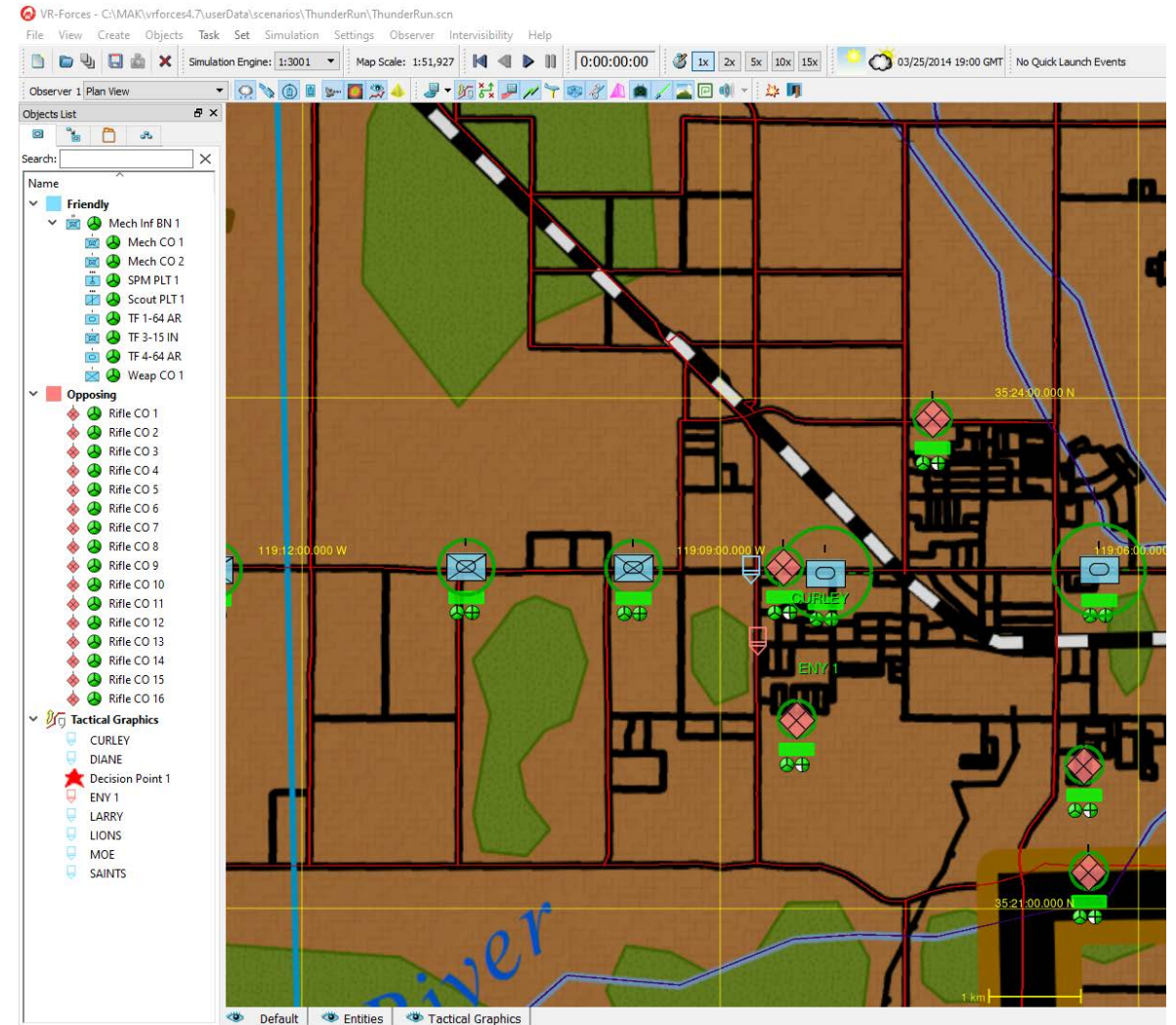
		COA 1	COA 2	COA 3
Mission Outcome		Fail	Succeed	Succeed
Identify the scale and scope of risk to force and mission	Can we execute the plan without incurring unacceptable damage to critical assets?	No	Yes	Yes
	Can we protect critical assets in specific battlespace?	No	No	Yes
Identify ways of employing concepts and capabilities to win	Function Score	45	56	98
	Planning and Execution	Below	Below	Above
	Fires	Below	Above	Above
	Intelligence	Below	Above	Above
	Protect	Above	Below	Above
	Sustain	Above	Above	Above
	Enable C2	Below	Below	Above
	Cost	Affordability	Below	Below

# Execute Multi-Domain Support

Multi-domain support for the different  
Battlefield Operating Systems

- Intelligence
- Maneuver
- Fire Support
- Air Defense
- Mobility & Survivability
- Combat Service Support
- Command and Control

Disaster Response



# Execute Roles and User Interfaces

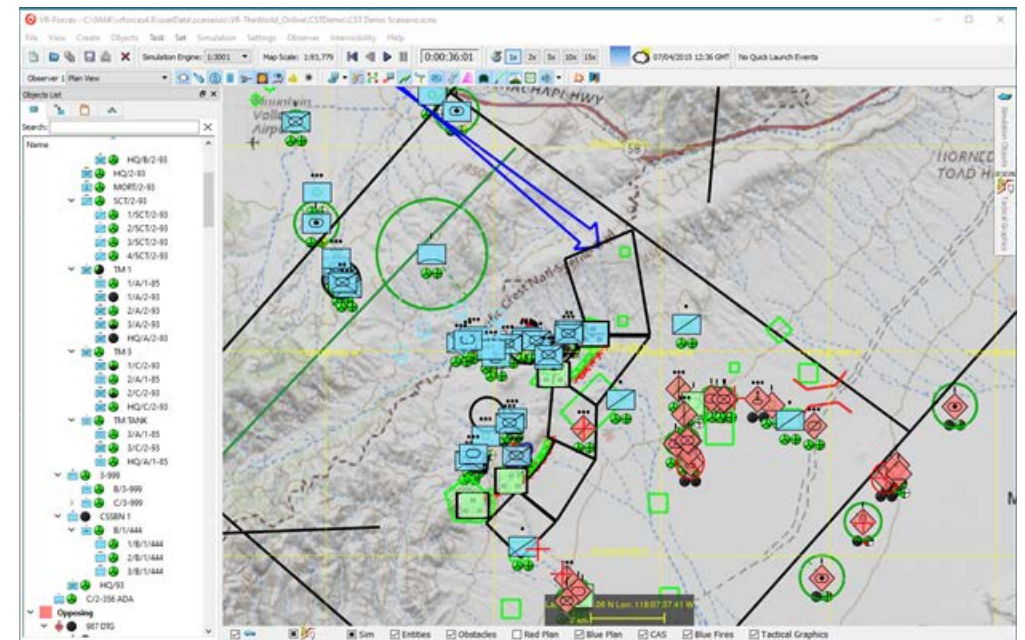
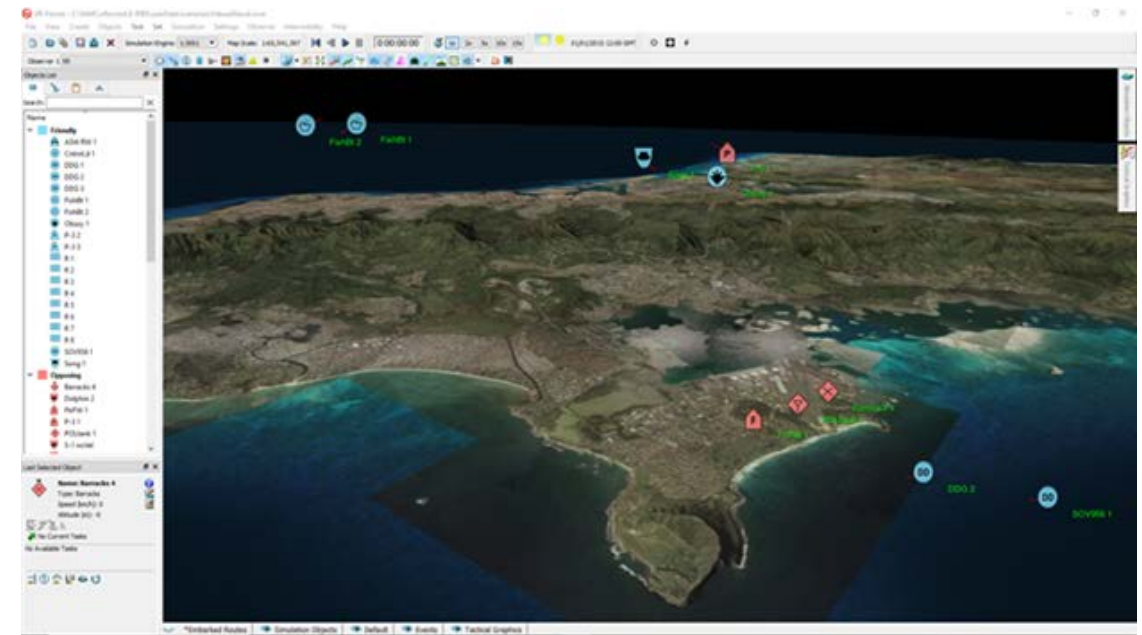
UI specific to role

Quick Menus/controls specific to role

User Reconfigurable and saved per user

Fog of War

Instructor assigns BOS, Role and Units to a  
station



# Execute VR-Forces Entities

## Manned

- Ground, rotary-wing, fixed-wing, surface, sub-surface, and dismounted entities

## Unmanned

- Air, Ground, Surface, Subsurface

## Aggregate entities into multi-force hierarchies

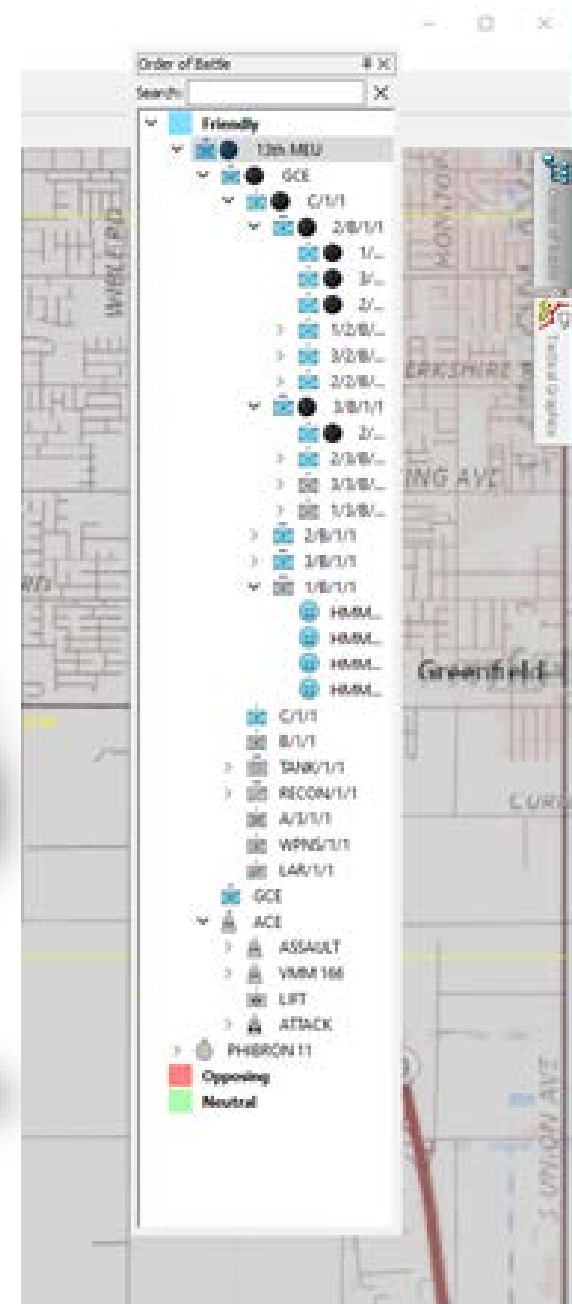
## Embark entities onto one another

## Tasking

- Automated path planning
- Mission Plans
- Dynamic assignment of tasks and set data requests
- Via communications
- Using tactical objects – waypoints, routes, areas

## Semi-automated behaviors

- Individuals and Units





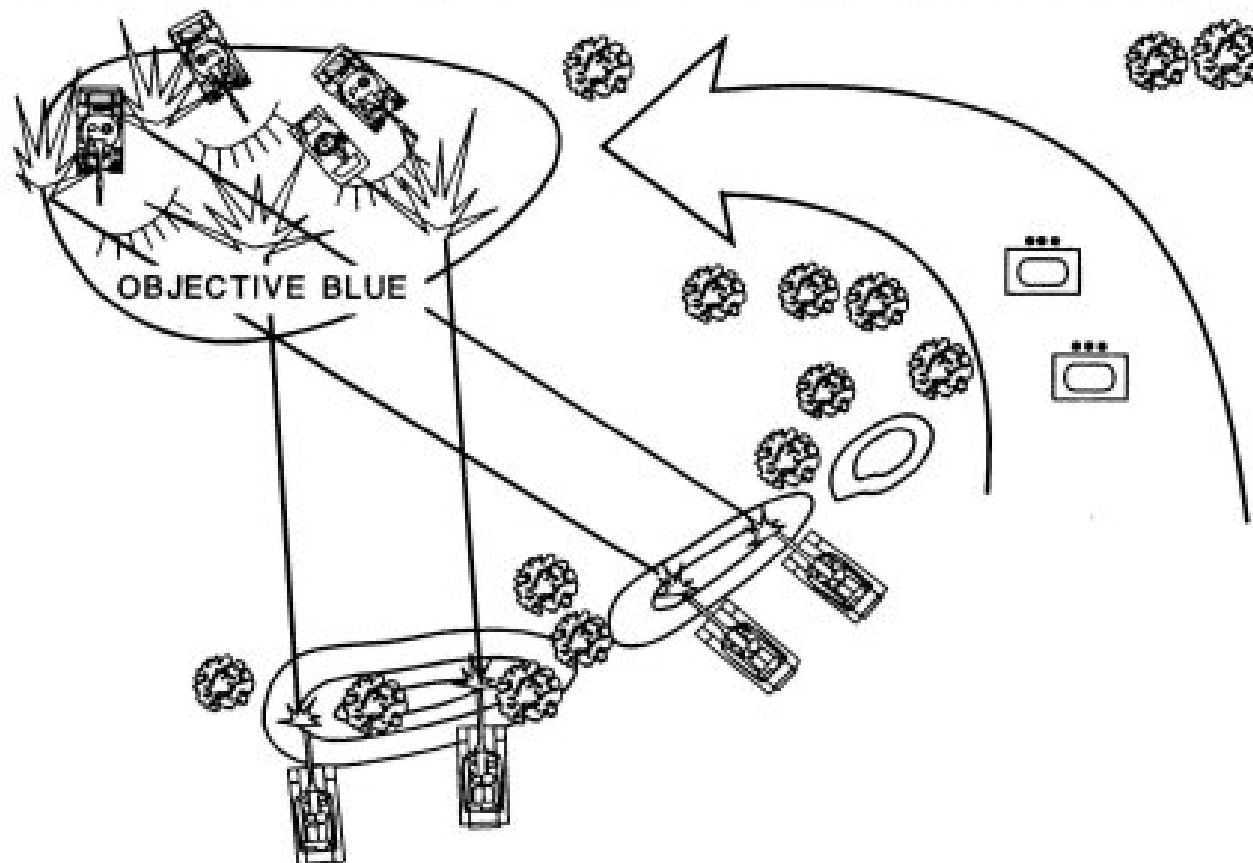
# Execute Unit Behaviors



5.0

MAK is significantly modifying VR-Forces to facilitate small unit formation, movement, and coordinated behaviors.

- Improvements to primitive behaviors
- Increased aggregate primitive state
- Improvements to the Behavior Language (LUA)
- A GUI for rapid behavior composition and understanding



2D View Layer: default Observer 1 Plan View

Objects List

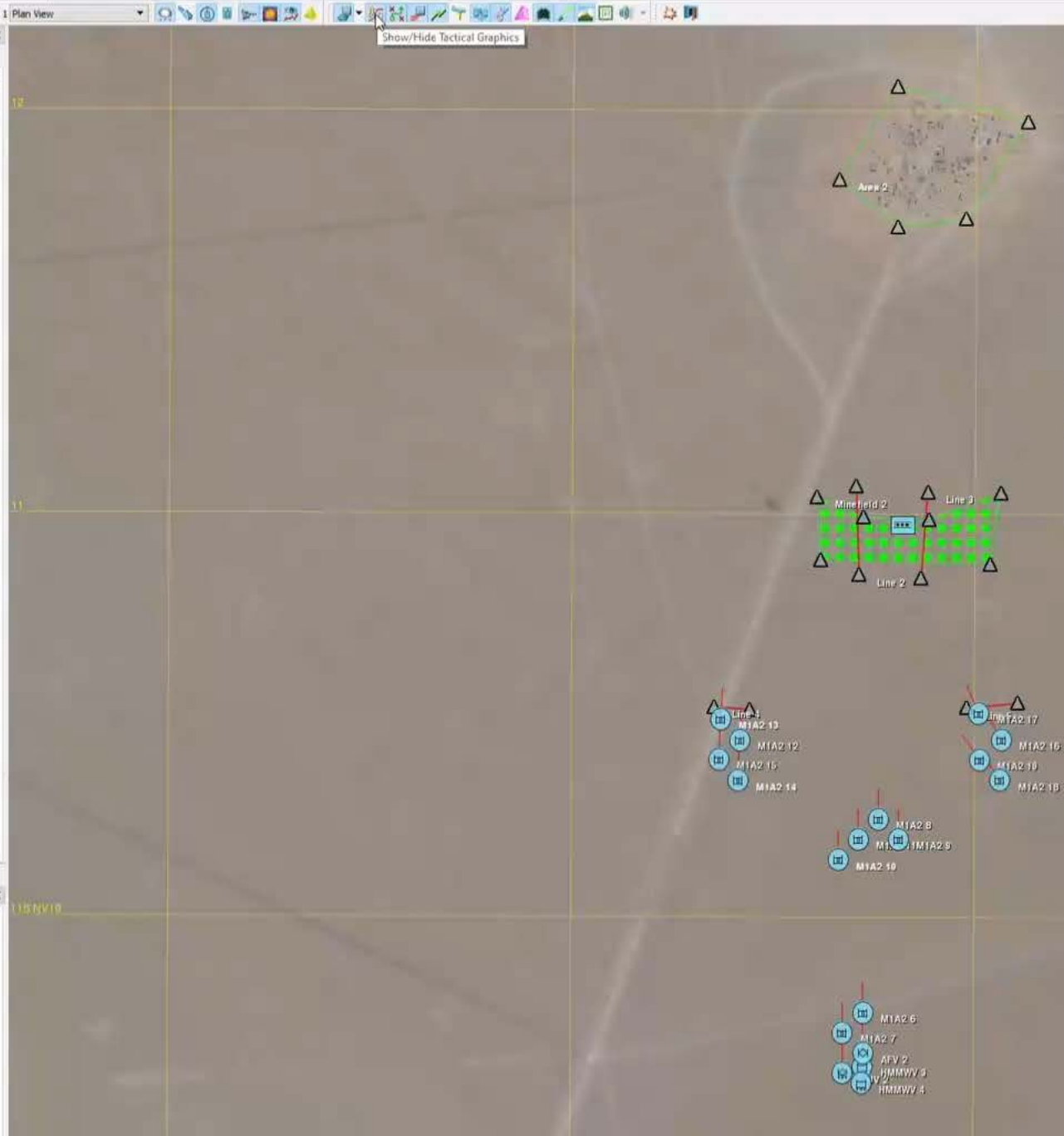
Search:

- Name
- Friendly
    - AR Co 1
      - AR HQ Sec 2
        - AFV 2
        - AUV 2
        - HMMWV 3
        - HMMWV 4
        - M1A2 6
        - M1A2 7
      - AR Plt 1
        - M1A2 8
        - M1A2 9
        - M1A2 10
        - M1A2 11
      - AR Plt 2
        - M1A2 12
        - M1A2 13
        - M1A2 14
        - M1A2 15
      - AR Plt 3
        - M1A2 16
        - M1A2 17
        - M1A2 18
        - M1A2 19

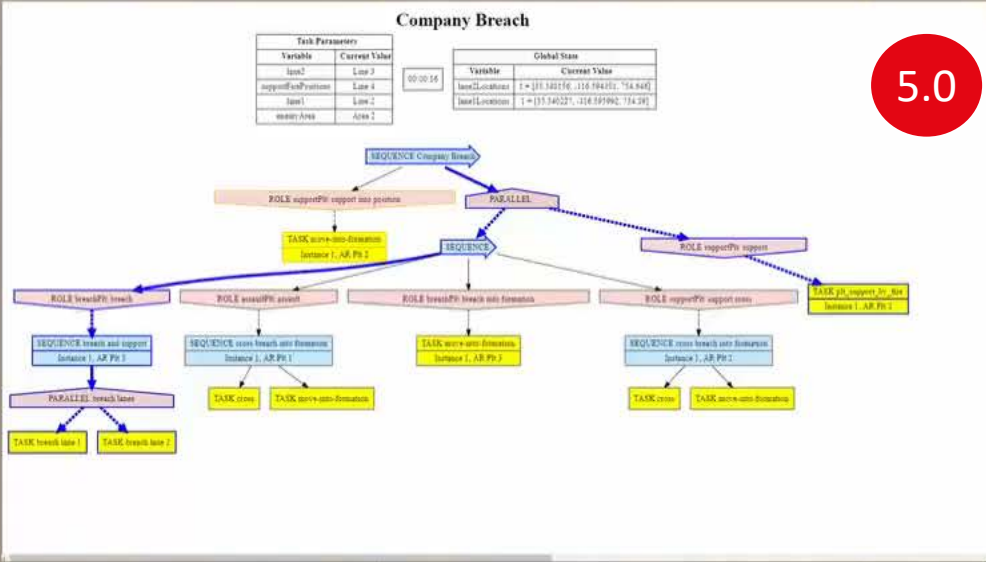
- Tactical Graphics
- Area 2
  - Line 2
  - Line 3
  - Line 4
  - Line 5
  - Minefield 2

Objects List Observer Views

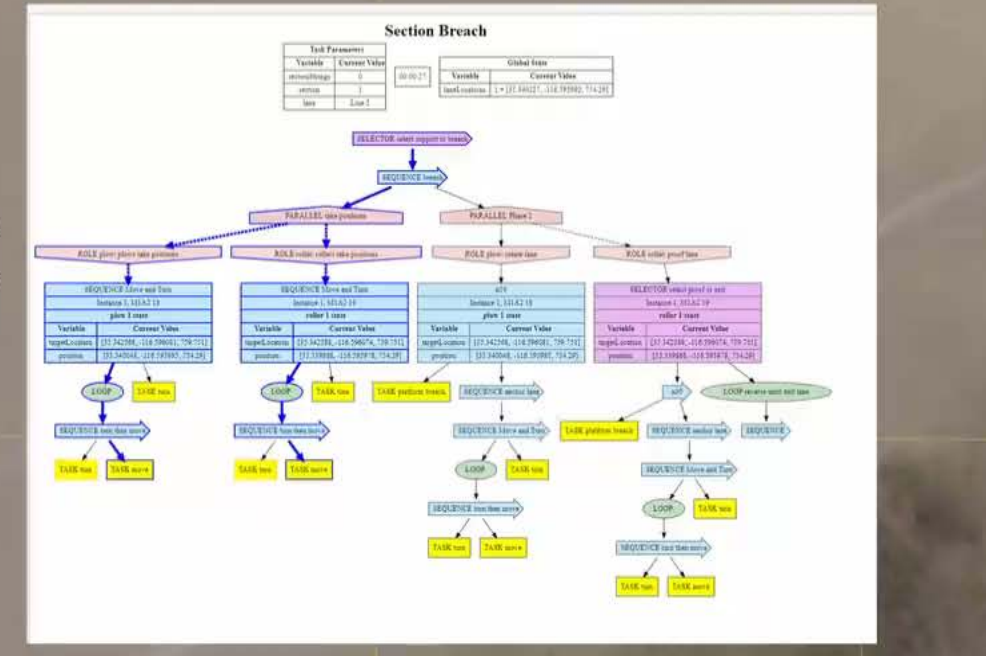
Last Selected Object



Show/Hide Tactical Graphics



5.0



# Behavior Improvements



5.0

- **Spot Reports for Units**
- Subordinate Functions/Roles
- Sensor Improvements
- Artillery Chanel
- Coordinated Turns

Spot Reports

Spot Reports Enabled: On

Only to Front-End

Broadcast

Send to Specific Entities

Superior and Peers

Filter: All

Name: AFV 1

Name
AFV 1
AR Co 1

Units can send spot reports to superiors and peers now. This is away that individual sensors can be “rolled up” to the aggregate level for processing at the unit level.



# Hive - Assess

## Realtime assessment

- Dashboards to monitor progress & facilitate dynamic challenge level adjustment

## Recording

- HLA data, CNR & BMS data

## Bookmarks, notes

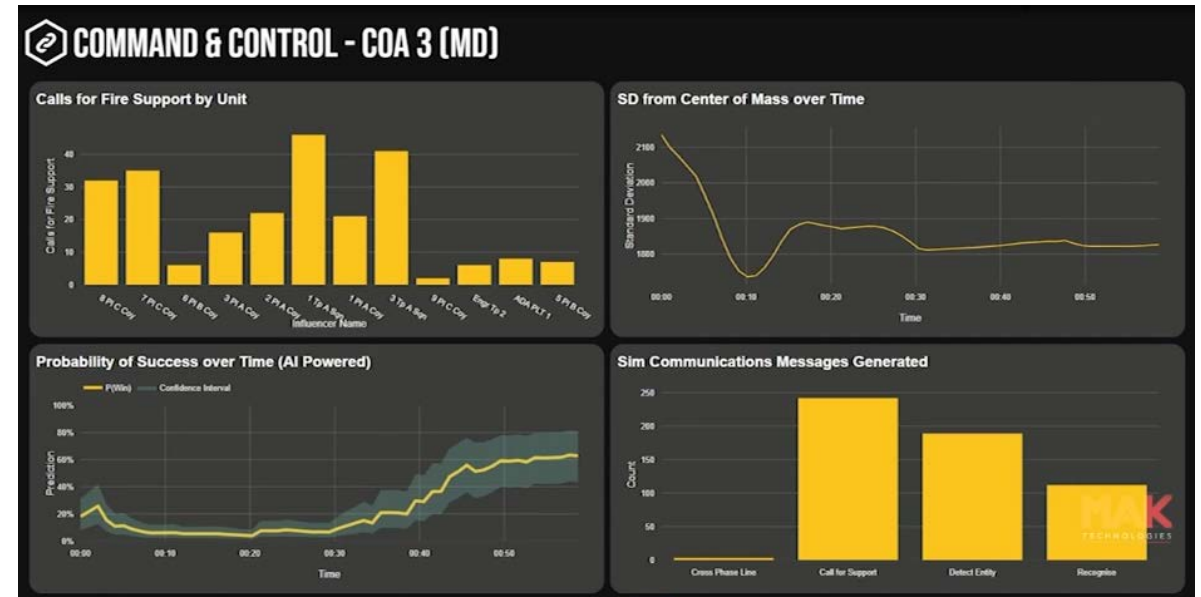
- Instructor interface to mark up recording

## Scoring

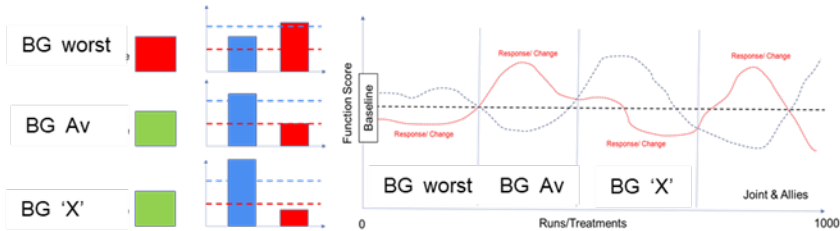
- Detailed assessment of performance
- Immersive LOCON play creates opportunity for meaningful C2 Effectiveness measurement

## Replay

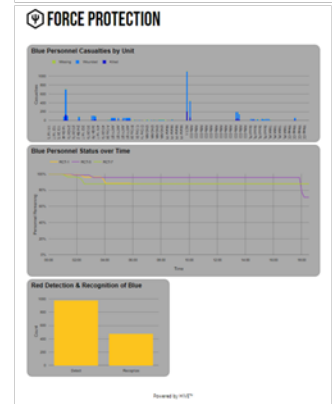
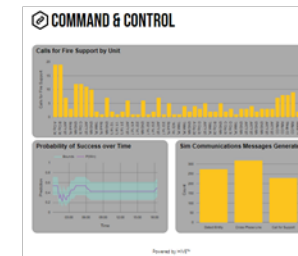
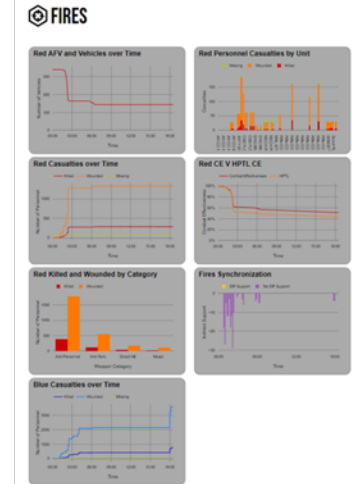
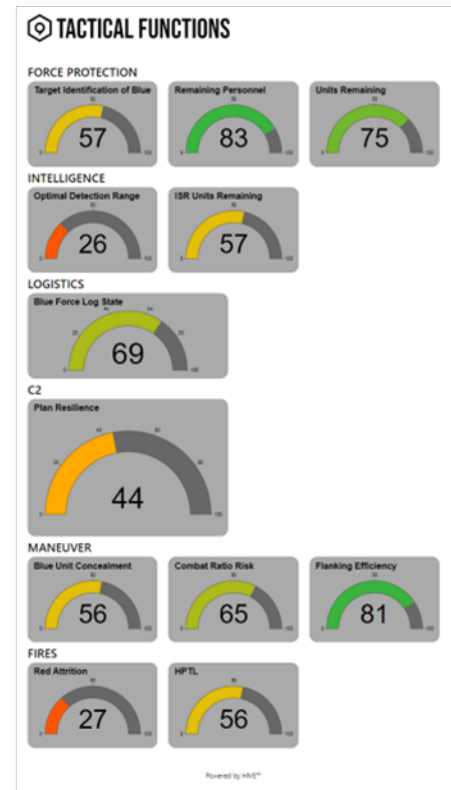
- Replay for AAR



# HIVE EXECUTION MEASUREMENT & EVALUATION



		CP3
Mission Outcome		Succeed
Identify the scale and scope of risk to force and mission	Can we execute the plan without incurring unacceptable damage to critical assets?	Yes
	Can we protect critical assets in specific battlespace?	Yes
Identify ways of employing concepts and capabilities to win	Function Score	98
	Planning and Execution	Above
	Fires	Above
	Intelligence	Above
	Protect	Above
	Sustain	Above
	Enable C2	Above
Cost	Affordability	Above



- High fidelity Measurement & Performance
  - Battalion performance - ability to execute plan
  - Coy/PI performance drill down
  - Functional performance drill down
  - Comparisons to Battalion-level Rolling Average Baselines



# Future/Next Steps

- Decision Support Assistance

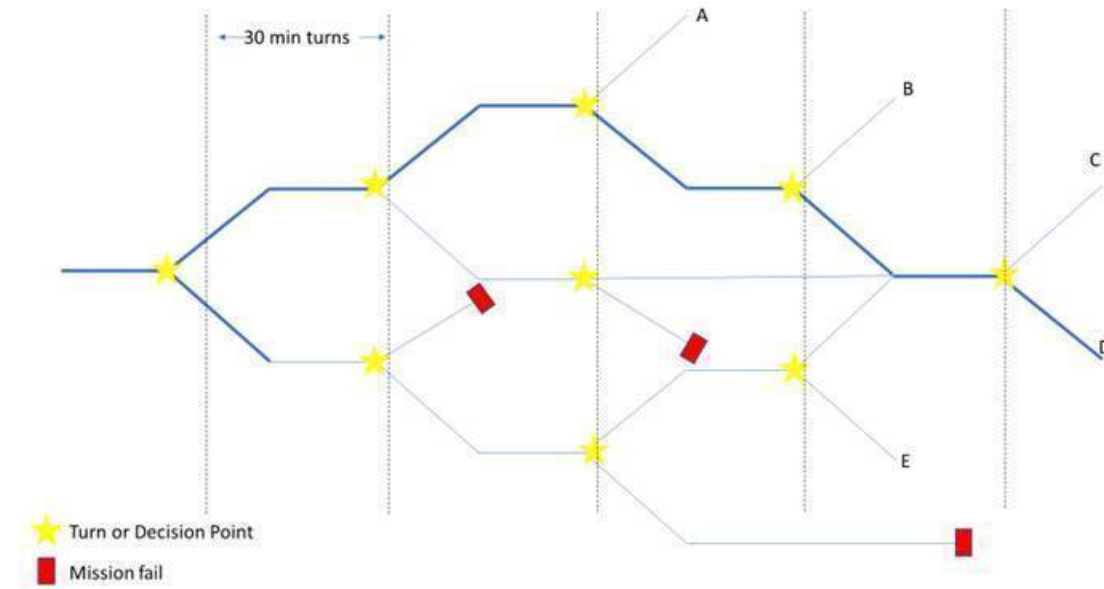
- Running VR Forces instances at H + 15, H + 30 and H + 60 intervals to anticipate operational eventualities

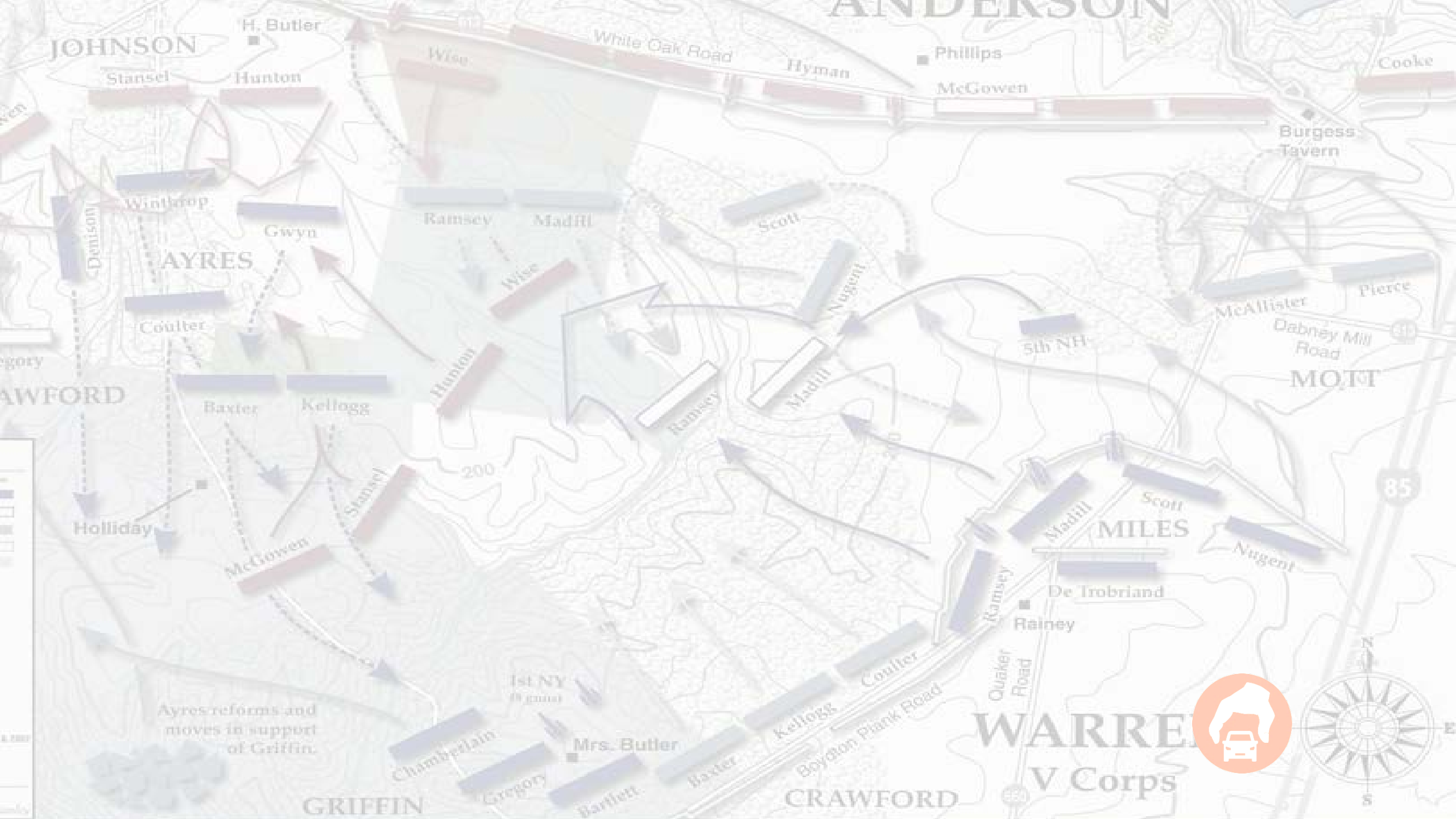
- Consequential Learning:

- We believe that a very powerful aspect of future CAST is the ability to test and explore every Decision Point made during Execution for the consequences of choosing different alternatives. VR Forces with its snapshot function already has some capability to support this, assuming clever management by Game Controllers/HICDN/White Cell etc and the ability to launch additional back ends.
- Combined with Hive analytics this offers powerful new ways of experiential learning.

- New AAR Paradigms

- Advanced simulation replay combined with or even lead by advanced analytics will likely evolve new AAR paradigms to best exploit these new forms.





JOHNSON

ANDERSON

AYRES

CRAWFORD

WARREN

MOORE

1 MILE

V Corps

Ayres reforms and moves in support of Griffin.

