

Applying Simulation to Study Human Performance Impacts of Evolutionary and Revolutionary Changes to Armoured Vehicle Design

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Services:

- Technical and Engineering Consulting
- System Level and Capability Level
- Government and Industrial Clients
- Defence and Homeland Defence

Clients:

- Defense R&D Centers
- Defense Concept Development & Experimentation Centers
- Defense Procurement Centers
- Defense Simulation Coordination Office
- Crisis Management Centers
- Original Equipment Manufacturers

Locations:

- Canada, US, Germany, UK, Australia



Simulation Based Professional Services

Simulation Labs study alternative designs, tactics, and procedures, at the Tactical, Operational, and Strategic levels.

Strategic Level



Operational Level



Tactical Level



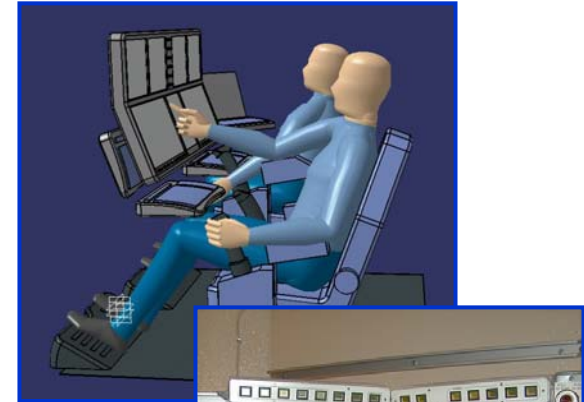
- Armoured vehicle design challenges
- Why use simulation?
- Past and current projects
- Activities related to conference themes
 - Perceptual requirements for displays
 - HCI interactions issues
 - Training approaches
 - Measurement of human performance
 - Augmented, mixed, and virtual environments
 - Future military applications
- Conclusion

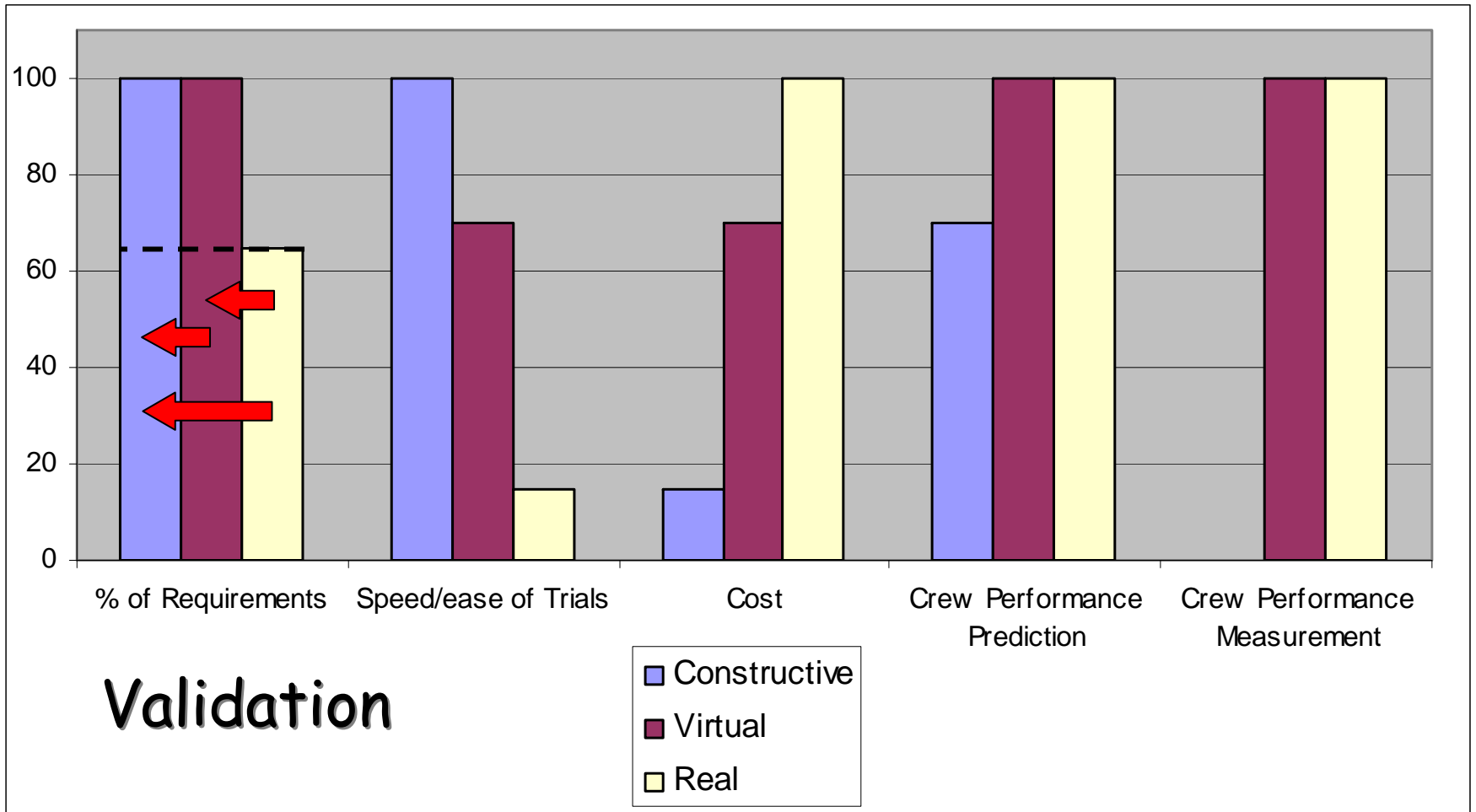
- Advanced technologies
 - Faster, lighter, more capable...but more expensive and complex
- Information & task overload
 - Net-centric info must be filtered
- Situation Awareness
 - What do crews need to know?
- Limitations on vehicle size & weight
 - Airlift, mobility characteristics
- Reduced crew size
 - Do the same tasks? Rotate crews?
- Common vehicles
 - “Special equipment vehicles”

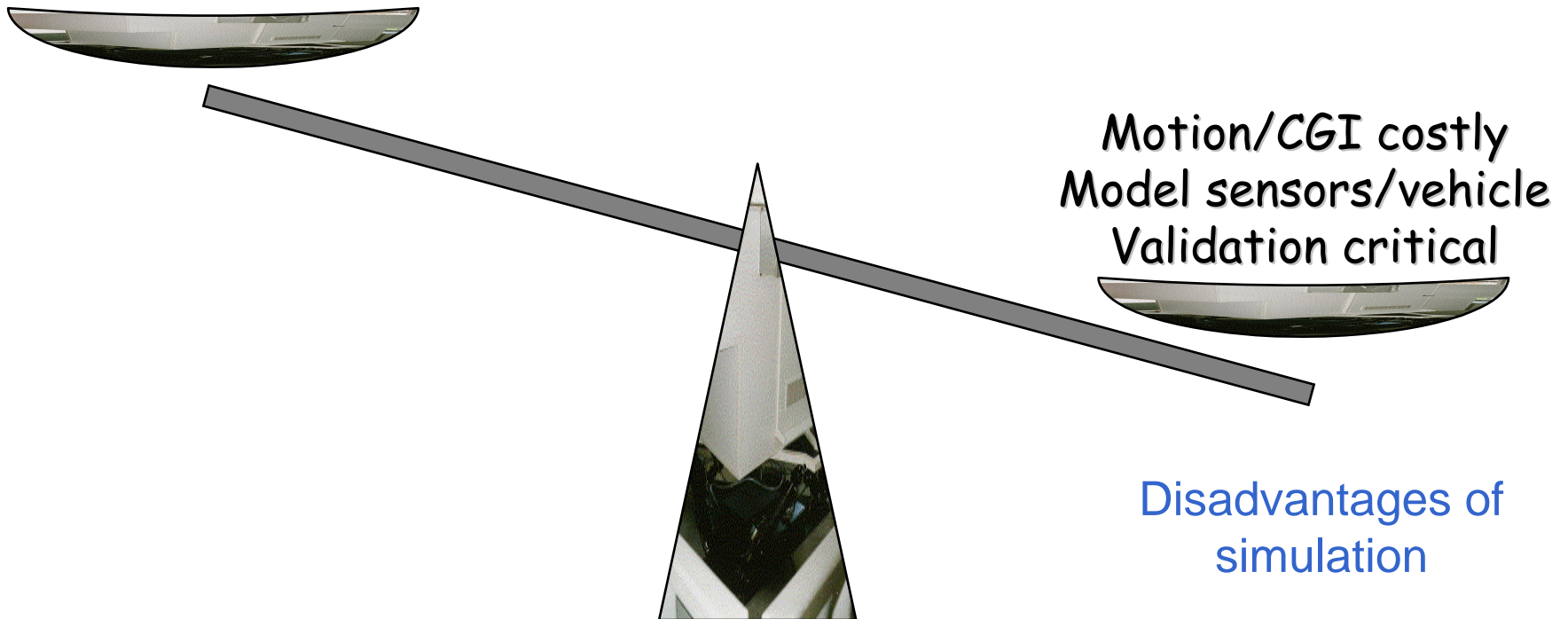


- Three kinds of simulation:
 - Live
 - Real people in real situations in real vehicles
 - Virtual
 - Real people in simulated environments
 - Constructive
 - Simulated (computer-generated) people in simulated environments

A consistent theme in our projects is the use of all three environments as best suited to the required results

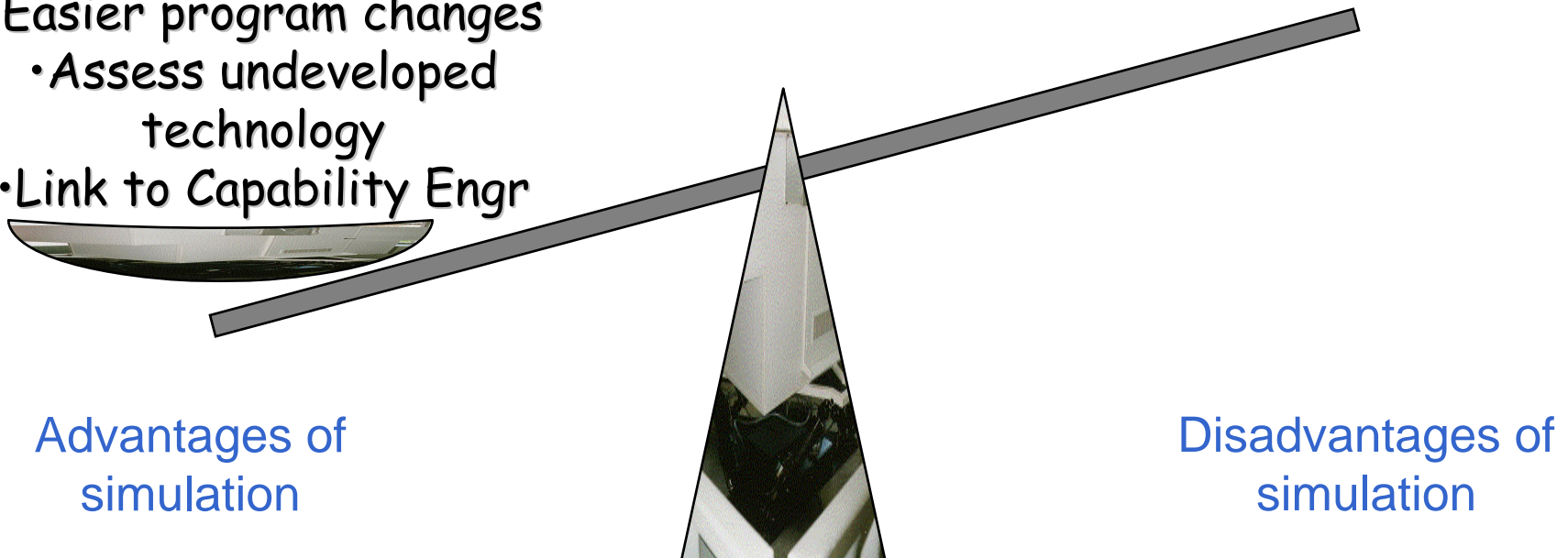




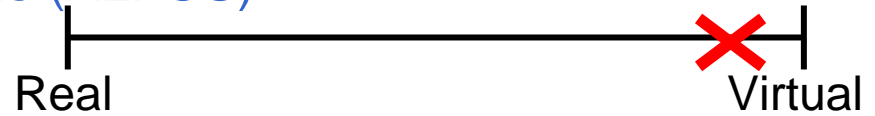


- Easier/more varied/reproducible trials
- Use commercial components and unqualified software
 - Not limited by vehicle configuration
 - Rapid SMI prototyping
- Easier/cheaper development
- Easier program changes
 - Assess undeveloped technology
- Link to Capability Engr

Motion/CGI costly
Model sensors/vehicle
Validation critical



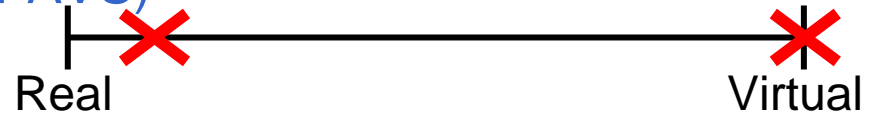
- Advanced Land Fire Control Systems (ALFCS)



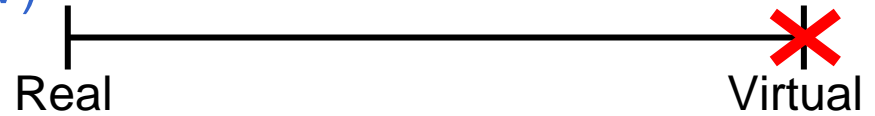
- Defensive Aides Suite Definition Study and Pronghorn Trial



- Future Armoured Vehicle Systems (FAVS)



- Multi-Mission Effects Vehicle (MMEV)

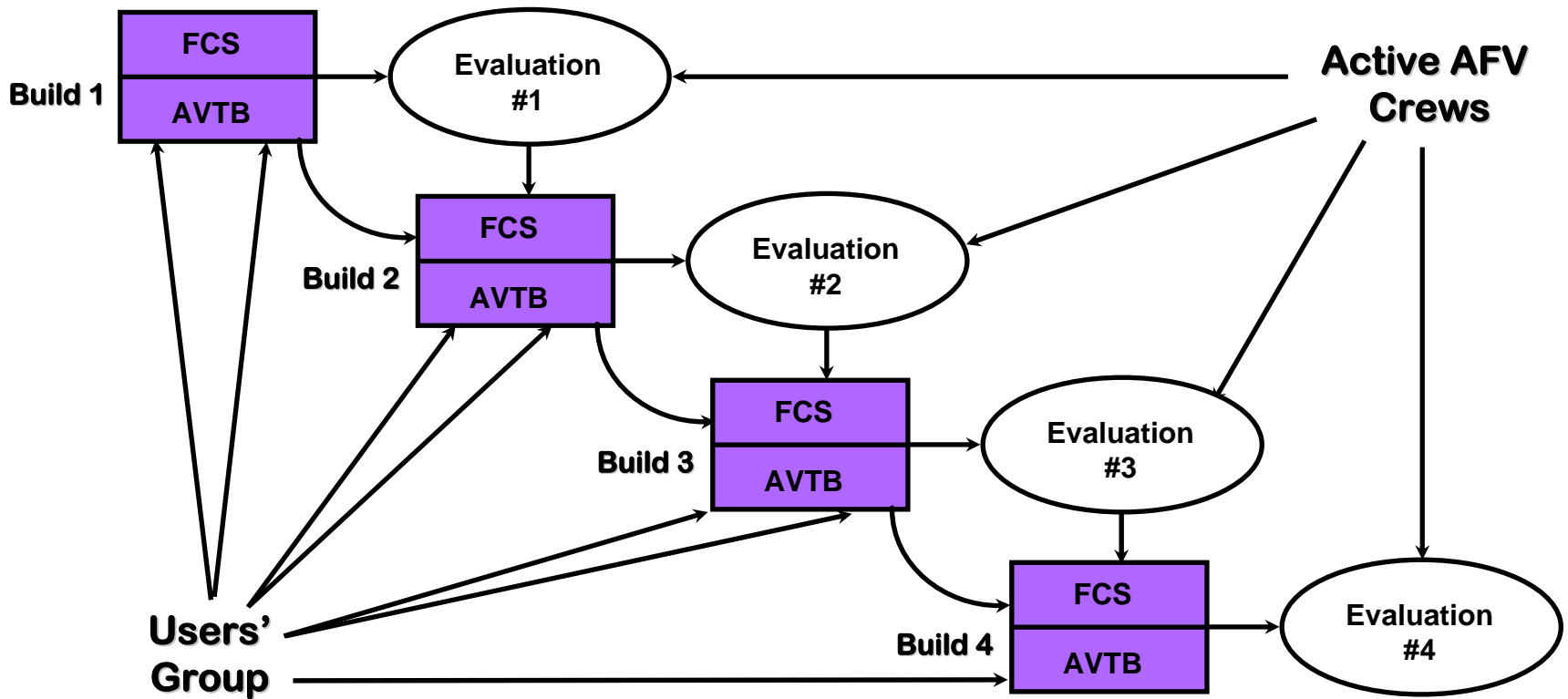


- Sponsored by Defence R&D Canada, client General Dynamics Canada

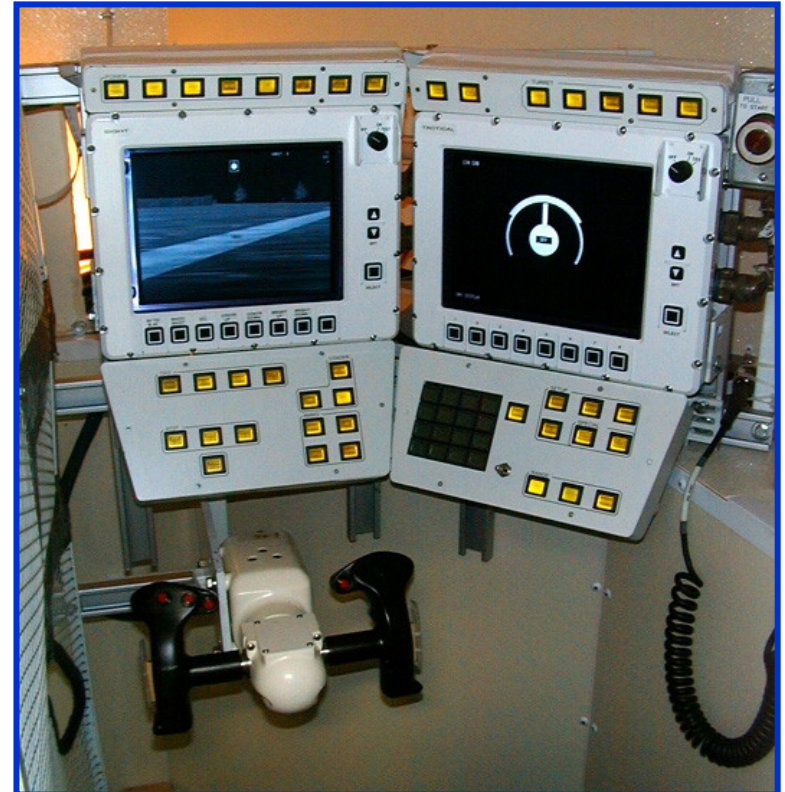


- 6 DOF motion platform
- AFV crew enclosure
- Computer-generated imagery and enemy vehicles
- Sensor and host vehicle models

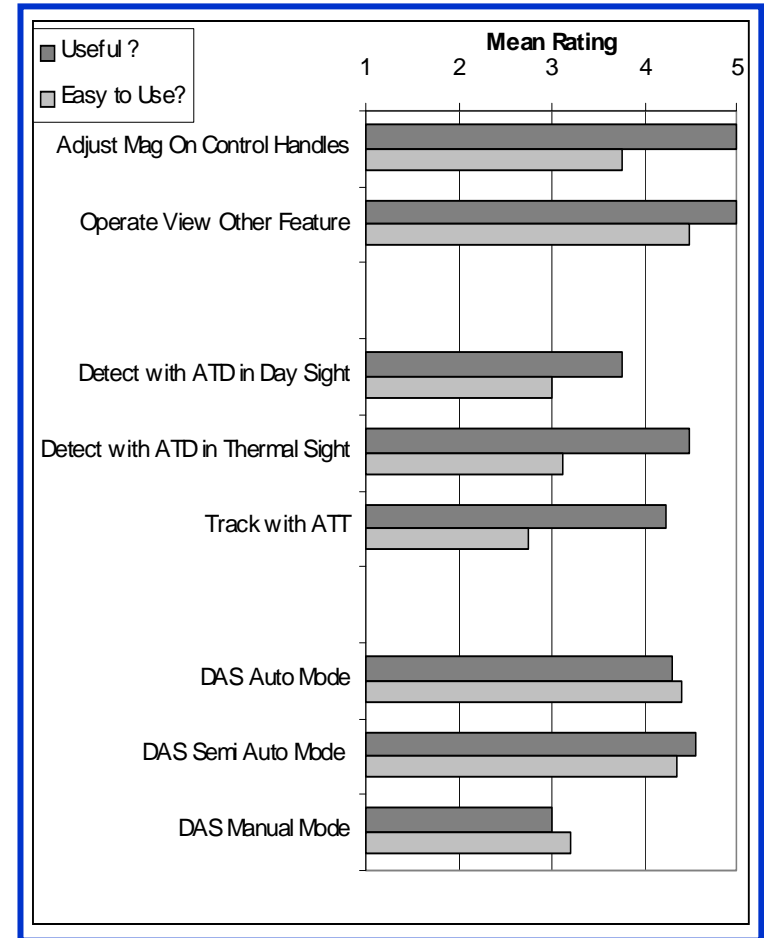
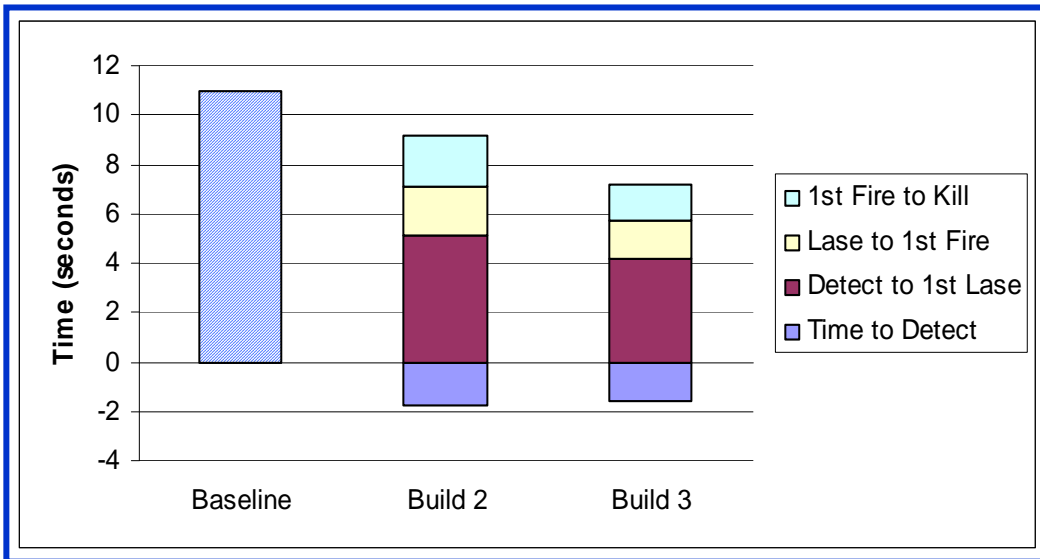




- 2-person turret with autoloader
- Relaxed-view sights/integrated control panel
- Multi-function control handles
- Basic Defensive Aides Suite
- Automatic Target Detection/Tracking
- Image enhancement
- Wide Angle Surveillance system
- Scan path/Fire points
- Integrated tactical display



- Measurement of Human Performance and subjective crew opinion
 - Increase in engagement speed and accuracy
 - Suitability of relaxed view displays
 - Improvement in survivability
 - Design of OMI and symbology
- Actual FCS used in Mobile Gun System



- DAS implementation in ALFCS virtual environment by General Dynamics Canada
- Real DAS implemented in LAV by Litton Systems
- CAE Professional Services conducted HF design of virtual DAS, and evaluation in field and lab of both systems
- Very similar evaluation results – V&V is important!



The FUTURE ARMOURED VEHICLE SYSTEMS Technology Demonstration Project

Simulate Co-operative
Air-Land Engagements

Create Virtual
Immersive Environment

Quantify Technology
Performance

Create Computer
Task Network Model

Validate Model

Performance
Data

Validate Model

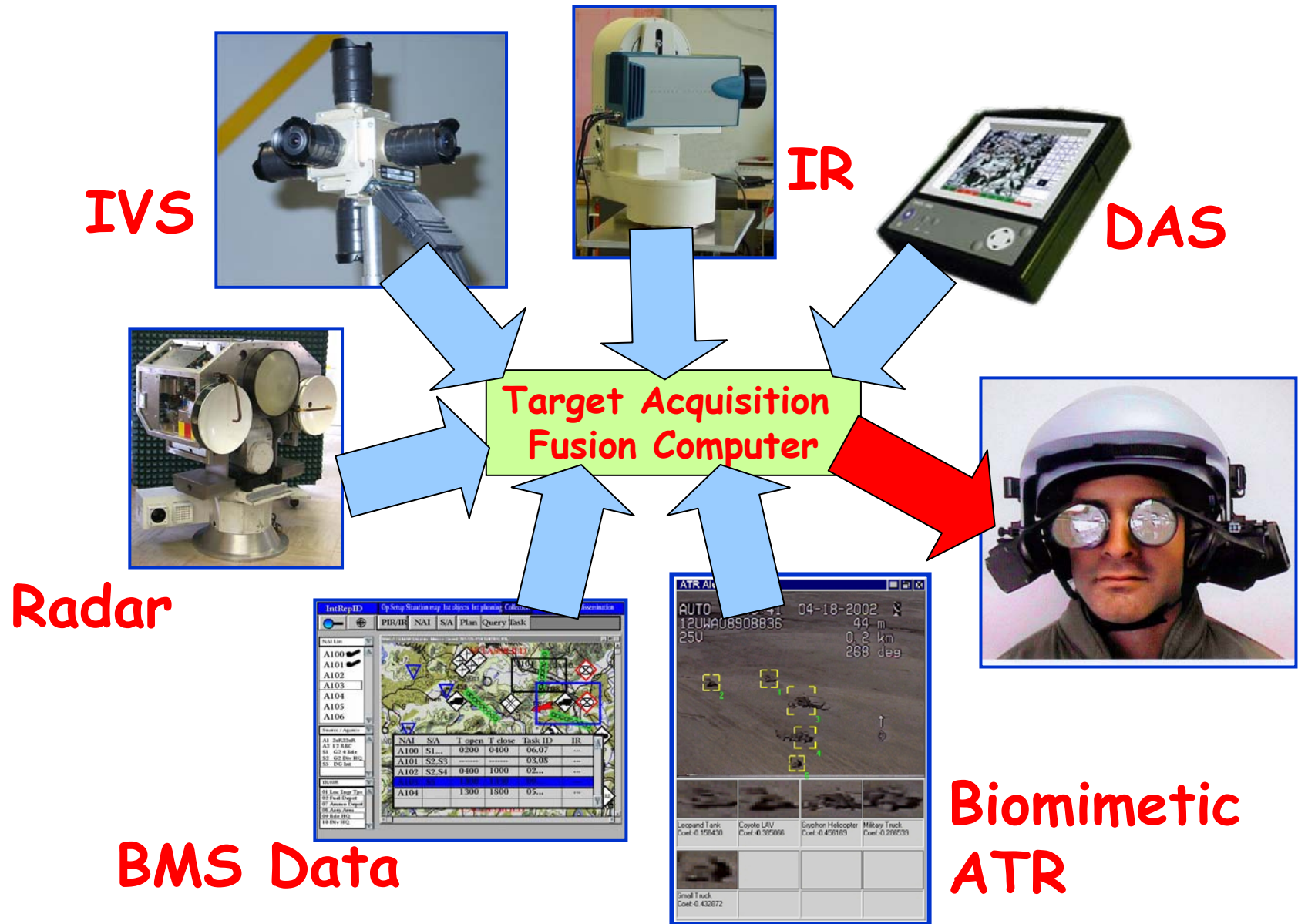
Validate Assumptions
and Performance

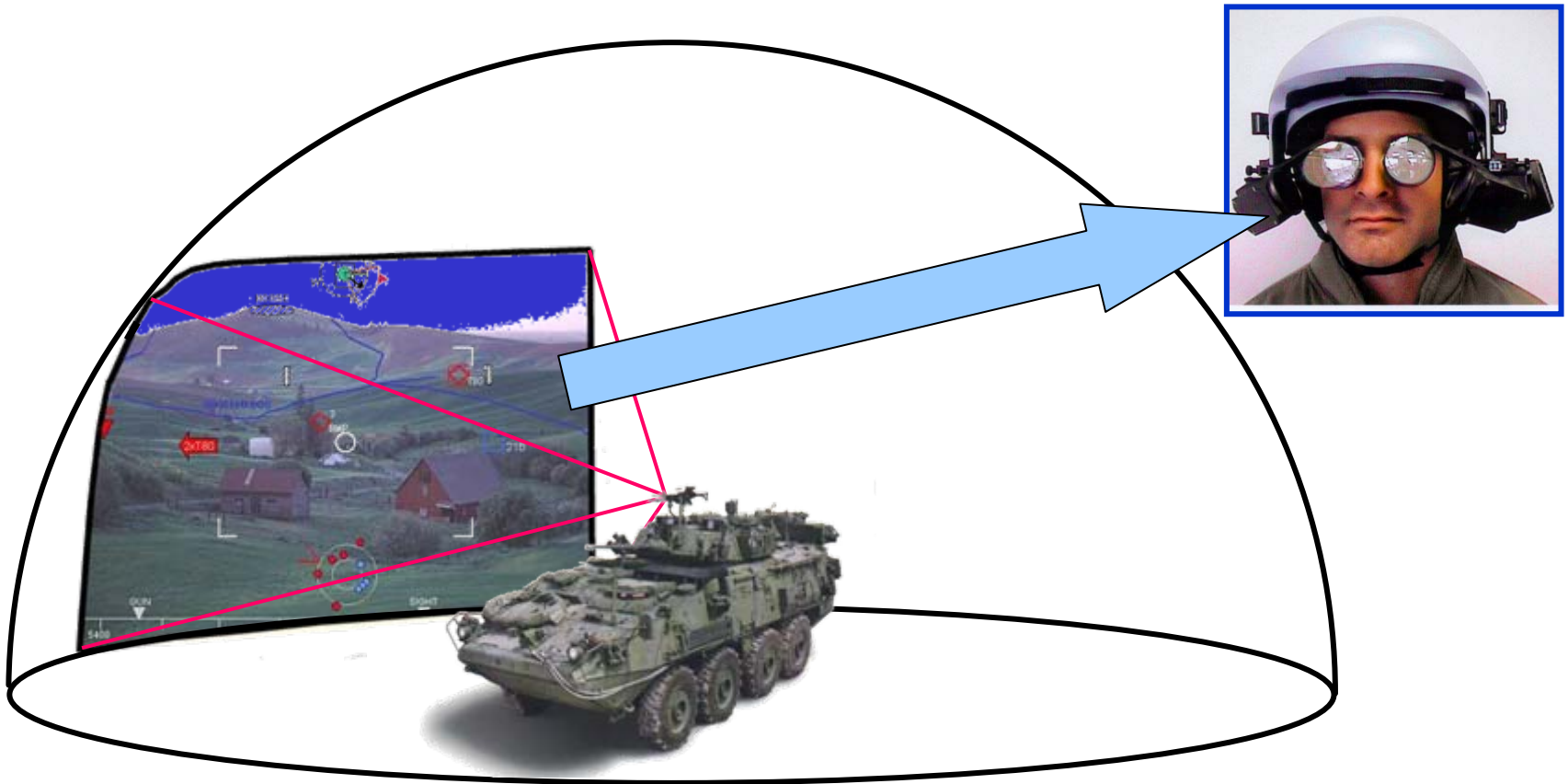
Develop Technologies

- Neural Network ATR
- Immersive Visualization
- Radar/IR Integration
- Image/Target Processing
- Image Presentation /SMI
- Multi-Function Laser DAS
- Adaptive Camouflage

Integrate in LAV









Joysticks

Two joysticks mounted on seat armrests

- Movement controls centre of view, fine aim, and 'flies' vehicle in digital terrain
- Buttons for all OMI functionality



Seat

- Full reclined backrest with armrests
- 5-point harness
- Push-to-talk for radios on armrests



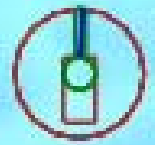
HMD

Wide-angle colour stereo immersive view

- Visual and IR imagery
- Symbology to represent tactical and navigational features
- Head-tracker
- Live mic for DVI and intercom

SENSORS:

Heading(Mils): 1089
Position: 19.1224 01629 05370
System Status: Major Failure
Sensors Mode: SCAN
DAS Mode: AUTO



T80



2200

3000



RY
1
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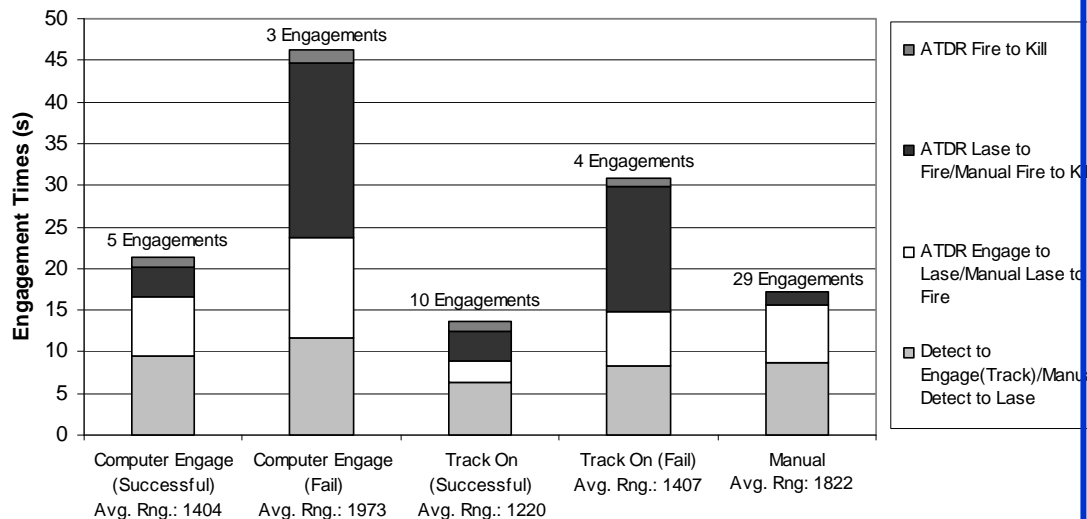
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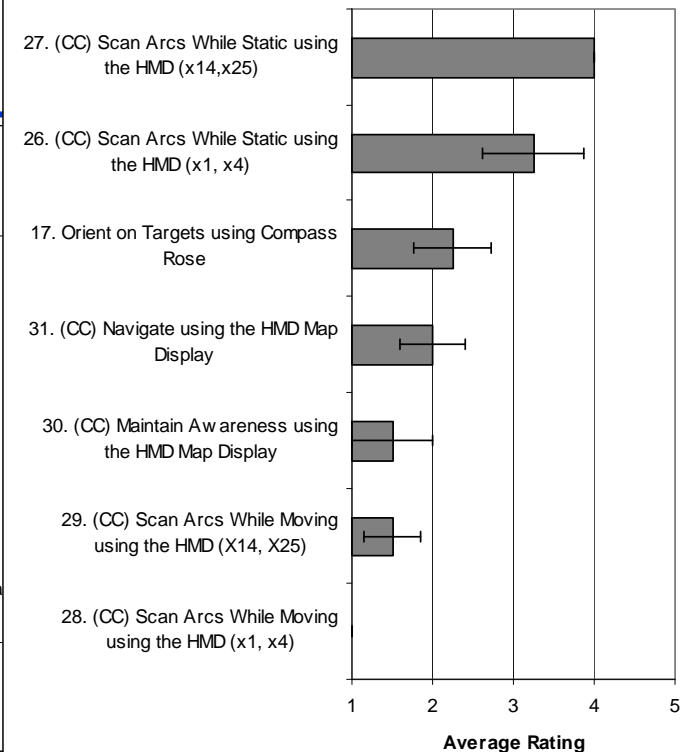


- HMDs not suitable for AFVs, but immersive visualization critical for SA
- Three-prong simulation approach successful and validated
- Technology development mostly successful
- Created new TTPs
- Distributed simulation successful

ATDR Comparison



HMD Ratings



- Multi-mission fire control:
 - Direct Fire
 - Non Line of Sight (NLOS)
 - Air Defence
- Use of unmanned vehicles (including organic to the MMEV) for Situation Awareness and target engagement
- Net-centric environment allows external target assignment and remote sensing and target engagement



Combined Arms Operational Construct

TACTICAL
LEVEL




Bde Gp
UAV




Bde Gp
HQ




Bde Gp
Tac Hel




Bde Gp
Arty




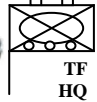

Bde Gp
Recce

Brigade
Group



Task
Force




MMEV
TCP

TF
HQ






CAT
HQ



Combined
Arms Team




MMEV

TUA

MGS




INF

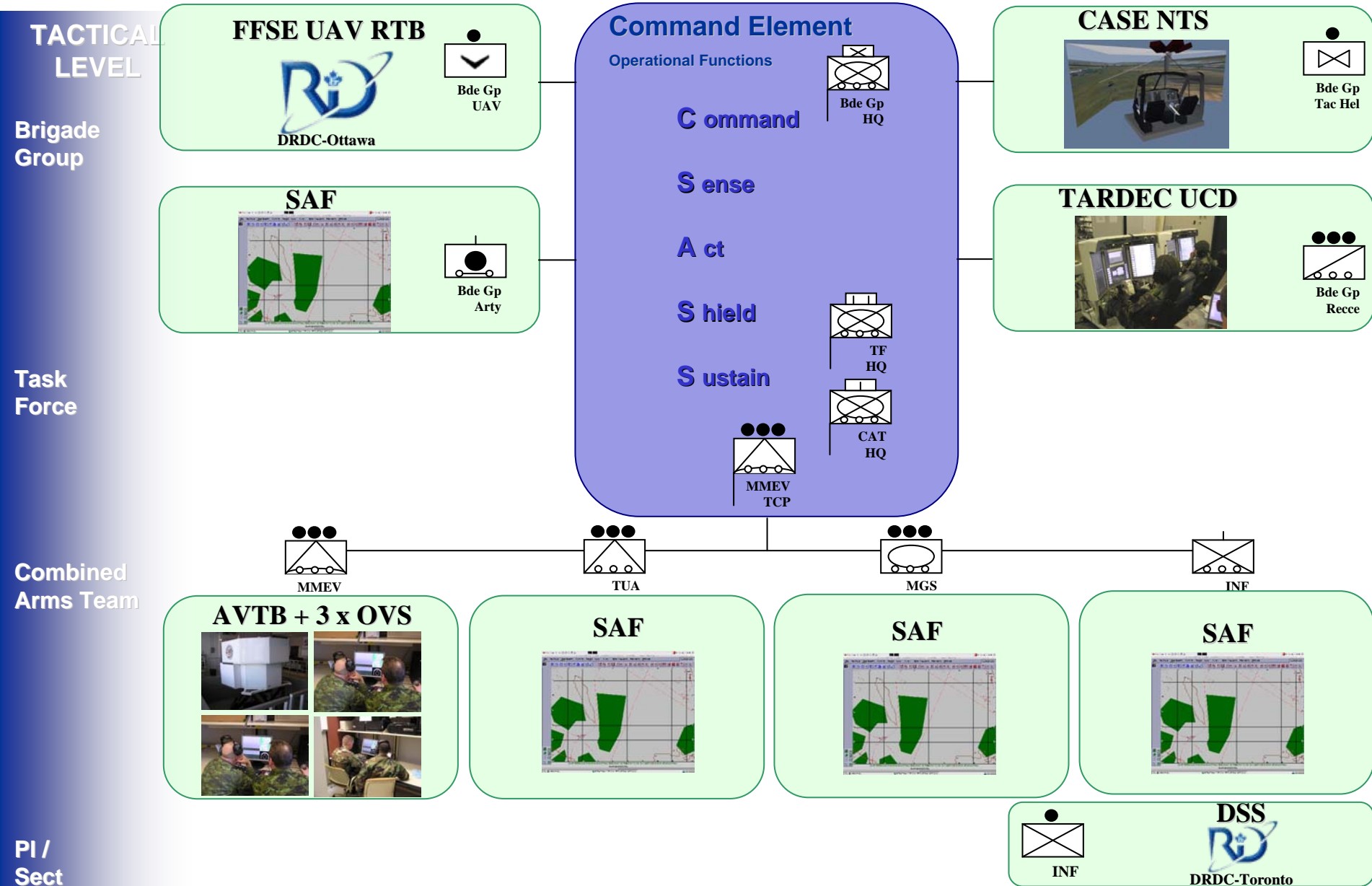




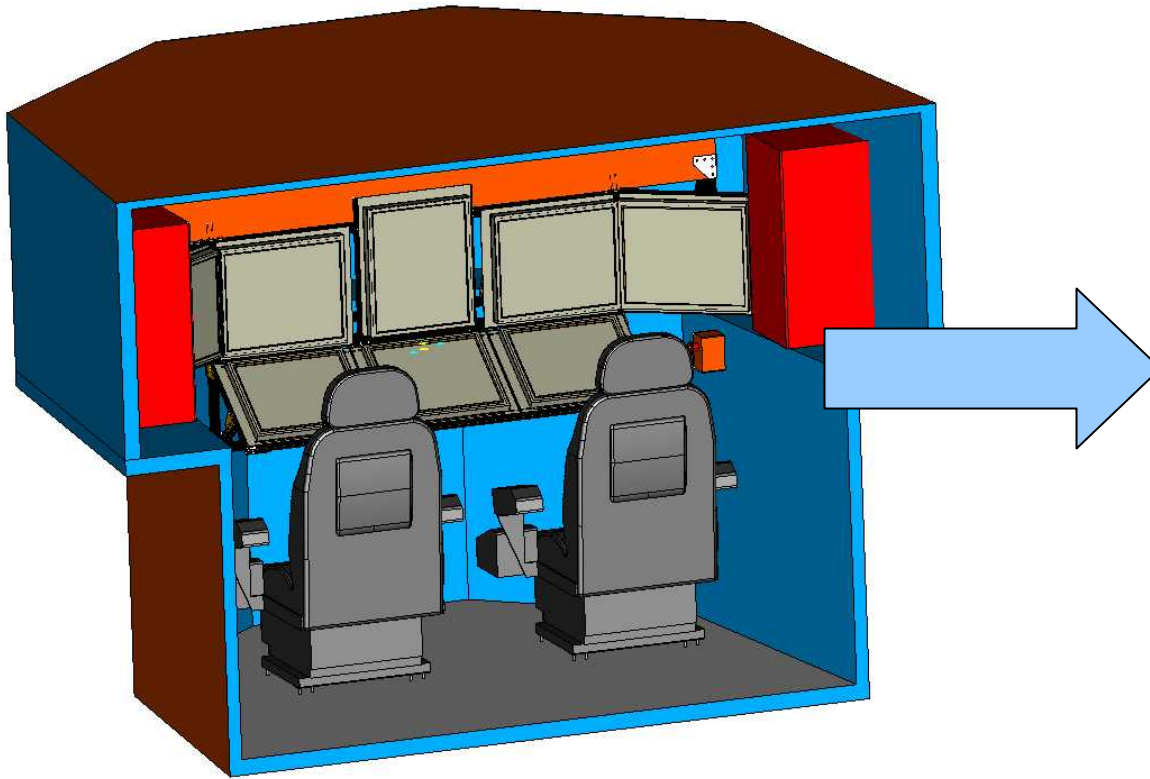

PI /
Sect




INF



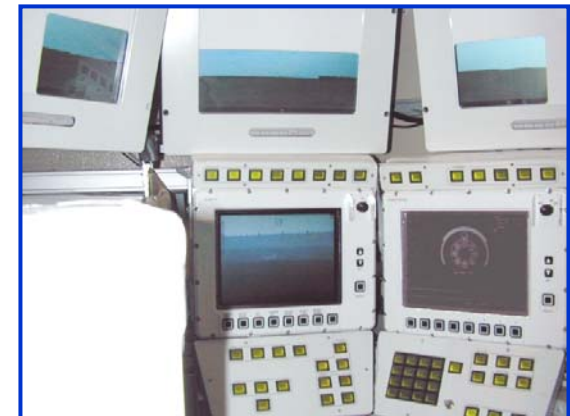
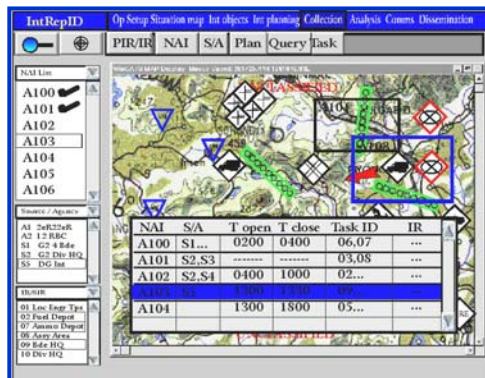
- Note use of simulation to design the simulation!



Get picture

- Improved Situation Awareness
- Benefits of OMI flexibility – roles not specific to crew position
 - Improves ability to conduct multi-role operations
- Increased crew accountability/responsibility
 - Required changes in training and career progression
- Digital vs voice commands
 - Increased speed, decreased SA
- Need direct sensor-shooter communication
- Digital waypoints and shared digital map have high utility

- Complete HMD evaluation
 - Performance impact
 - Crew integration
- Requirements for relaxed view displays
 - Screen size/orientation/number
 - Display technical requirements
 - Allocation of information
 - Display symbology – style guide
- Wide-area Situation Awareness schemes

NAI	S/A	T open	T close	Task ID	IR
A100	S1...	0200	0400	06,07	...
A101	S2,S3	03,08	...
A102	S2,S4	0400	1000	02...	...
A103	S3	1300	1700	09	...
A104		1300	1800	05...	...

- Direct Voice Input
- Multi-button joysticks/control handles
- Reconfigurable buttons
- Touch screen
- States & modes



- Cannot have too much training!
- Training flow from Powerpoint to hands-on
- Challenges with conversion of attitudes from legacy methodologies and equipment
- How to operate in Net Centric world
- Necessary changes to career progression and training

- Target engagement
- Navigation
- Command & Control
- Situation Awareness
- Fatigue, workload, sickness
- ***The limitations of HP evaluation! Must consider objective task performance...

- “Don’t go there” markings
- Way points/fire points
- Boundaries/report lines, etc
- Done in real and virtual vehicles (FAVS)

- All projects concerned future technologies
- Worked with Army strategic concepts organization
- Includes new TTPs, organizational structure

- In excess of 5000 hours of experimentation has been conducted, and more is on-going in live, virtual, and constructive environments
- Human and system performance measurements have lead to vastly increased understanding of display requirements, training approaches, human-computer interactions, and use of augmented and mixed environments.

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