



Technology for Combat Identification

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Fratricide and Combat ID

*Reducing 'blue-on-blue'
in the complex modern battlespace*



Fratricide Definition

‘...the employment of friendly weapons and munitions with the intent to kill the enemy ... that results in unforeseen and unintentional death or injury to friendly personnel.’



The Australian Experience

- Fratricide, and 'near misses', part of our Vietnam War experience
- Since Vietnam, no fratricide reported
 - But 'near misses' on operations
 - And 'would be' fratricide in training
- Risk considered to be increasing
 - Beyond-line-of-sight weapons
 - Complex warfighting environment
 - *Ad hoc* coalitions



Human Dimension

- Incorrect ID, and fratricide, rarely occurs as a result of technology failure
- Investigation of accidents and safety incidents usually identifies a human factor
- Must be careful that CID technology doesn't make problem worse
 - Soldiers treat outputs as 'friend / enemy' rather than 'friend / unknown'



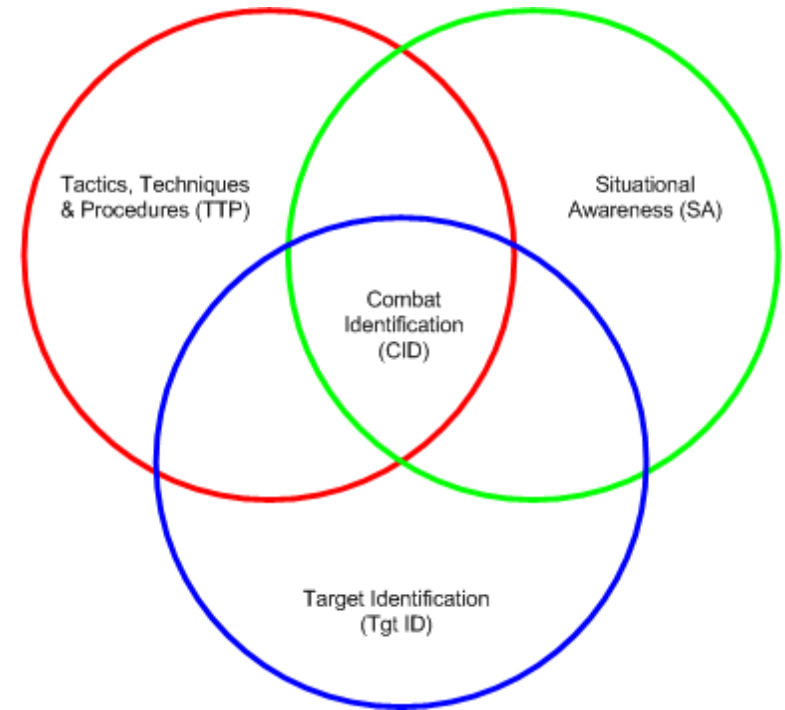
Characterising Combat ID Technology

What are we interested in knowing?



Combat ID Elements

- Tactics, Techniques and Procedures (TTPs)
- Situational Awareness (SA)
- Target Identification (Tgt ID)





Characteristics of Interest

- CID element (TTP, SA, Tgt ID)
- Role (air-to-ground, etc)
- Applicable platforms
- Operating spectrum
- Effective range
- Power consumption
- Life-span
- Target cooperation
- Warning method
- Environmental constraints
- Cost
- Technology maturity
- Human systems integration
- Implementation into service
- Suitability for complex warfighting



Characteristics in Detail (1)

Technical characteristics	
<i>CID element addressed</i>	Which of the three elements of CID (Tactics, Techniques, and Procedures, Situational Awareness, and Target Identification) the technology addresses.
<i>Role</i>	Employment role - Ground-to-air / Air-to-ground / Ground-to-ground.
<i>Applicable platforms</i>	Applicable platforms for the technology, such as aircraft, armoured vehicles, soldiers, etc.
<i>Effective range</i>	Effective range of the technology in metres or kilometres.
<i>Operating spectrum</i>	Operating spectrum of the technology, such as RF, laser, visible, infrared, audible, etc. Where available, operating frequencies or wavelengths have been noted.
<i>Power consumption</i>	Power consumption of the technology.
<i>Life-span</i>	Life-span of the technology in terms of material degradation, battery life or other limits on life-span.
<i>Target cooperation</i>	Whether or not operation depends on active cooperation by the would-be target, such as retransmitting a signal, to support identification as a 'friendly'. Characteristic is either 'cooperative' or 'non-cooperative'.
<i>Warning method</i>	Method by which the CID information is communicated to the technology operator or user.
<i>Environmental constraints</i>	Environmental constraints, such as bad weather, daylight or humidity.
<i>Costing data</i>	Known costing data related to the technology.
Technology readiness	
<i>Assessed technology TRL</i>	Assessed 'standalone' TRL for the technology
<i>Rationale for technology TRL</i>	Rationale for the assessed 'standalone' TRL.
<i>Assessed system TRL</i>	Assessed TRL for a CID system based on the technology
<i>Rationale for system TRL</i>	Rationale for the assessed system TRL.



Characteristics in Detail (2)

Human Systems Integration	
HSI advantages	HSI advantages of the technology.
HSI disadvantages	HSI disadvantages of the technology.
Endsley SA Level	Endsley SA level – perception / comprehension / projection
Relevance to current Australian capabilities	
Implementation advantages	Advantages of implementing the technology into the military, such as simplicity, low cost, robustness or easy integration.
Implementation disadvantages	Disadvantages of implementing the technology into to the military, such as cost or platform integration difficulties.
Complex Warfighting suitability	
Integration flexibility	The capability to be operated separately of other battlespace systems and, also, the capability to expand and integrate with other systems as necessary. Assessed as one of five levels (poor / fair / good / very good / excellent) supported by a short word picture.
Useability	Useability defined from the soldier-operator perspective. Assessed as one of five levels (poor / fair / good / very good / excellent) supported by a short word picture.
Mobility & robustness	Mobility and physical robustness to support the demands of light, fast force elements. Assessed as one of five levels (poor / fair / good / very good / excellent) supported by a short word picture.
C2 supportiveness	The degree of support to commander's situational awareness, control and decision making, allowing commanders at all levels to scale control as required by the circumstances. Assessed as one of five levels (poor / fair / good / very good / excellent) supported by a short word picture.
Discrimination	The capability to define, identify, track and/or target diverse elements in complex human environments. Assessed as of one five levels (poor / fair / good / very good / excellent) supported by a short word picture.

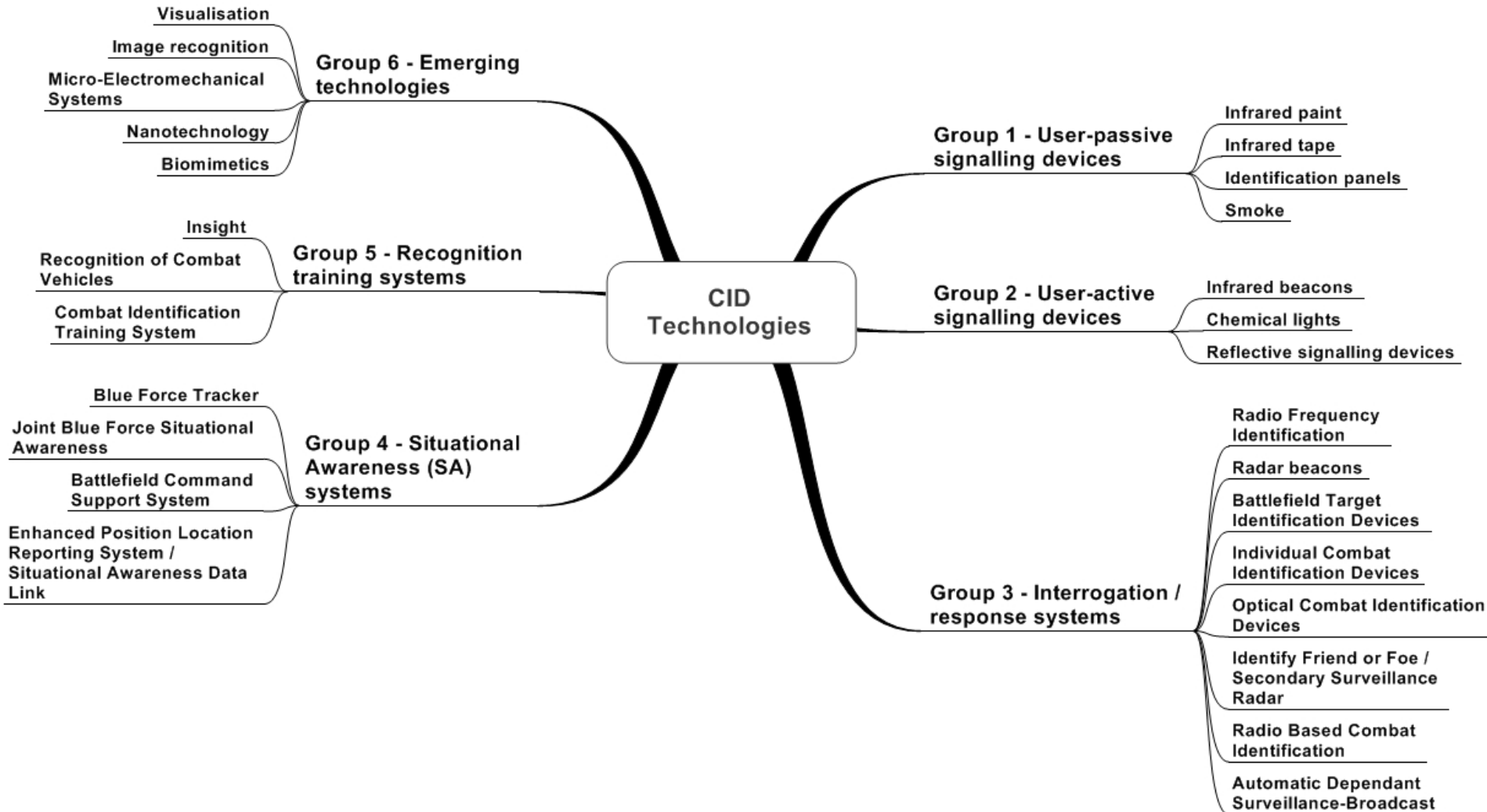


Combat ID Technology

Identifying what's out there



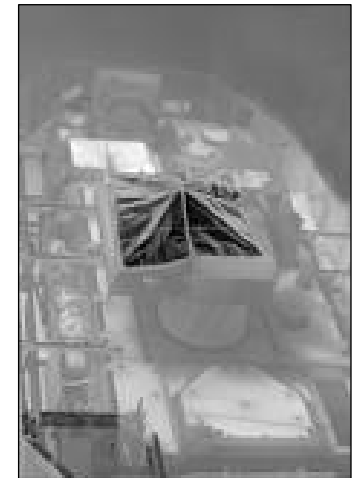
Technology Groupings





User-passive Signalling

- Infrared paint and tape
 - Visible through Image Intensification (II) and Thermal Imaging (TI) equipment
 - Currently in use for CID
- Identification panels
 - Combat identification panel (CIP) – primarily used for ground-to-ground identification
 - Thermal identification panel (TIP) – primarily used for air-to-ground identification
 - Currently in use for CID
- Smoke markers
 - Variety of colours
 - Range of a few kilometres





User-active Signalling

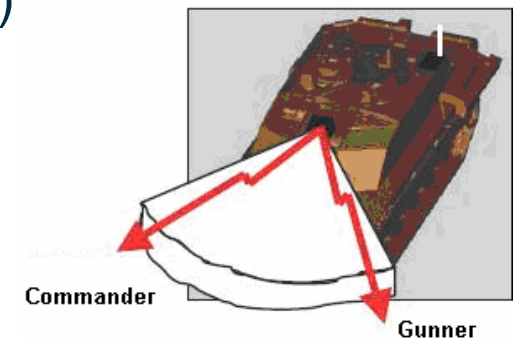
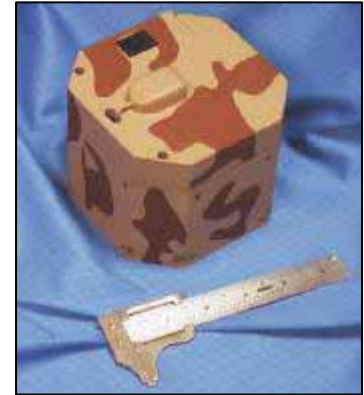
- Infrared beacons
 - Infrared strobes or infrared-encoded spectrum flashers
 - Viewed through night vision equipment at ranges of 10 kilometres
 - Some emit a flash at a constant rate while others can be coded in the field
 - Currently in use for CID
- Chemical lights
 - Infrared and visible spectrum
 - Infrared chemical lights visible through night vision equipment
- Reflective signalling devices
 - Third-party source of energy (the Sun)
 - Can be seen further than 20 kilometres
 - Daytime use only





Interrogation / Response

- Radio Frequency identification tags (RF tags)
 - Wireless radio comms to auto-identify objects
 - Information can be written to some tags
 - Embedded in 'dog tags' for medical information
 - Active, semi-active, and passive 'flavours'
- Radar Beacons (RACONs)
 - Typically operate at X-Band (I/J-Band), some S-Band
 - Beacon is the transponder
 - Radar is the interrogator ... displays on radar
- Battlefield Target Identification Devices (BTIDs)
 - mmW CID systems conforming to NATO STANAG 4579
 - Can identify a friendly vehicle within 5 km
 - Operates in Ka-Band





Interrogation / Response

- Individual CID Devices (ICIDs)
 - Directional laser interrogation query (in weapon)
 - Secure omni-directional transponder (in helmet)
- Optical CID Devices (O-CIDS)
 - O-CIDS uses pulse code modulated eye-safe laser to interrogate
 - Response is retro-reflected portion of interrogating laser pulses





Interrogation / Response

- Identify Friend or Foe (IFF) / Secondary Surveillance Radar (SSR) systems
 - Uses 1030 MHz for interrogation and 1090 MHz for reply
 - Variety of modes for both civilian and military uses
- Radio Based Combat Identification (RBCI)
 - Implemented as software package applied to software-defined radios such as JTRS
- Automatic Dependant Surveillance-Broadcast (ADS-B)
 - Aircraft and vehicles transmit their positions in a standard navigational format
 - Provide low-altitude & ground SA where conventional radar is hampered
 - Additional data can be included in the automatic broadcast



Situational Awareness (SA)



- Blue Force Tracking (BFT)
 - Satellite-based tracking & comms
 - BFT users can track other BFT-enabled platforms on a computer screen
- Joint Blue Force Situational Awareness (JBFSA) program
 - Advanced Concept Technology Demonstration (ACTD)
 - Use current SA systems and technologies to enhance own-force SA
- Battlefield Command Support System (BCSS)
 - Australian Army system to support brigade and below C2
 - Commercial hardware ('industrialised' not 'ruggedised')
 - Integrated community-specific applications (e.g. combat engineers) underpinned by common SA & messaging



Situational Awareness (SA)

- Enhanced Position Location Reporting System (EPLRS)
 - Digital mobile wireless network
 - Operates over 240-420 MHz
 - Automatic relay over 3-10 km range
- Situational Awareness Data Link (SADL)
 - Built on EPLRS + 1553B chipset (MIL-STD-1553B)
 - Customised for US Air Force SA and C2
 - Enables two-way SA and C2 messaging
 - SADL gateway enables access to Link 16 (air or ground-based)





Recognition Training

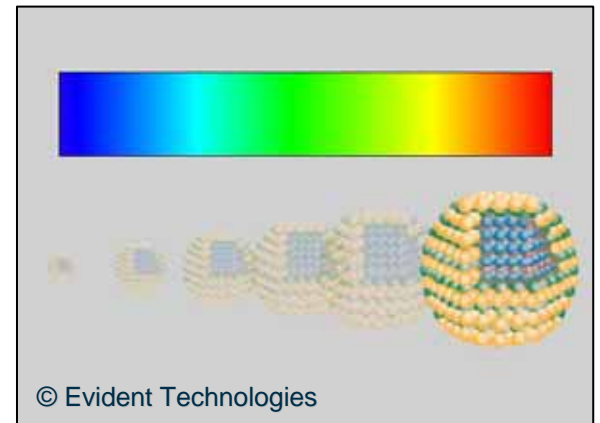
- UK 'Insight'
 - software tools and relational DBs to train personnel in identification of air, land, & sea platforms
 - may be linked to a range of additional databases to provide additional visual training
- Recognition of Combat Vehicles (ROC-V)
 - Trains personnel in the identification of US and allied combat vehicles
 - Vehicle signatures through a range of visual and thermal weapon sights
- Combat ID Training System (CITS)
 - NATO-sponsored
 - Web-based vehicle recognition
 - Standard image formats of vehicles for inclusion





Emerging Technologies

- Visualisation technologies
- Image recognition techniques & technologies
- Micro-electromechanical systems (MEMS)
- Nanotechnology
 - Wavelength-tunable quantum dots
- Biomimetics
 - Applying methods and systems found in nature to technology





Conclusions

What does this all mean?



Adversary Threat (1)

- Threat posed by adversary technology varies across potential future operational theatres
- Increased adversary technology increases likelihood of detection, interception & 'spoofing' (mimicking) of CID signals



Adversary Threat (2)

- Low-technology adversary would find detection & interception of interrogation / response systems difficult
- Same systems may be seriously disrupted / ineffective with high-technology adversary and dense EW environment
- Low-technology CID solutions may enable adversary to mimic friendly CID patterns



Environmental Constraints

- Foliage, dust, humidity & battlefield obscurants to be considered
- May have detrimental technical and operational effects
- May impact interpretation of result or systems used for displaying



Endsley's SA Levels

- **Level 1**
 - Perception of elements in environment
- **Level 2**
 - Comprehension of current situation based on synthesis of disjointed Level 1 elements
- **Level 3**
 - Projection of future status through knowledge of status & dynamics of elements (Level 1) & comprehension of situation (Level 2)
- Present CID technology contributes almost exclusively to Level 1 & Level 2 SA



Power Requirements

- Major constraint in deploying CID technologies to soldiers
 - Weight
 - Logistics (batteries)
- Signalling devices do not require power for operation (except IR beacons)
- In all other cases, power is required



Platform Applicability

- Soldiers, vehicles, aircraft, ships & boats
- Very few technologies claim to cover scope of platforms required
- Those few that do (RF tags and RBCI) subject of ongoing development programs



Technology Incompatibility (1)

- Technologies within groups potentially interfere with each other
 - IR chemical lights could resemble IR spectrum flashers, especially if placed on moving antenna
- Generally, technologies across groups do not pose much risk of interference
 - Combat ID panels won't interfere with Blue Force Tracking
 - BTIDs won't interfere with IR flashers



Technology Incompatibility (2)

- Several of the RF technologies may be found to be incompatible – further analysis is required
 - Active RF tags, RBCI, and ICIDs could interfere with each other
 - Additionally, operational EW could interfere with radio frequencies used by radio-based CID technologies



Warfighting Suitability

Where the rubber hits the road



Complex Combat Environment

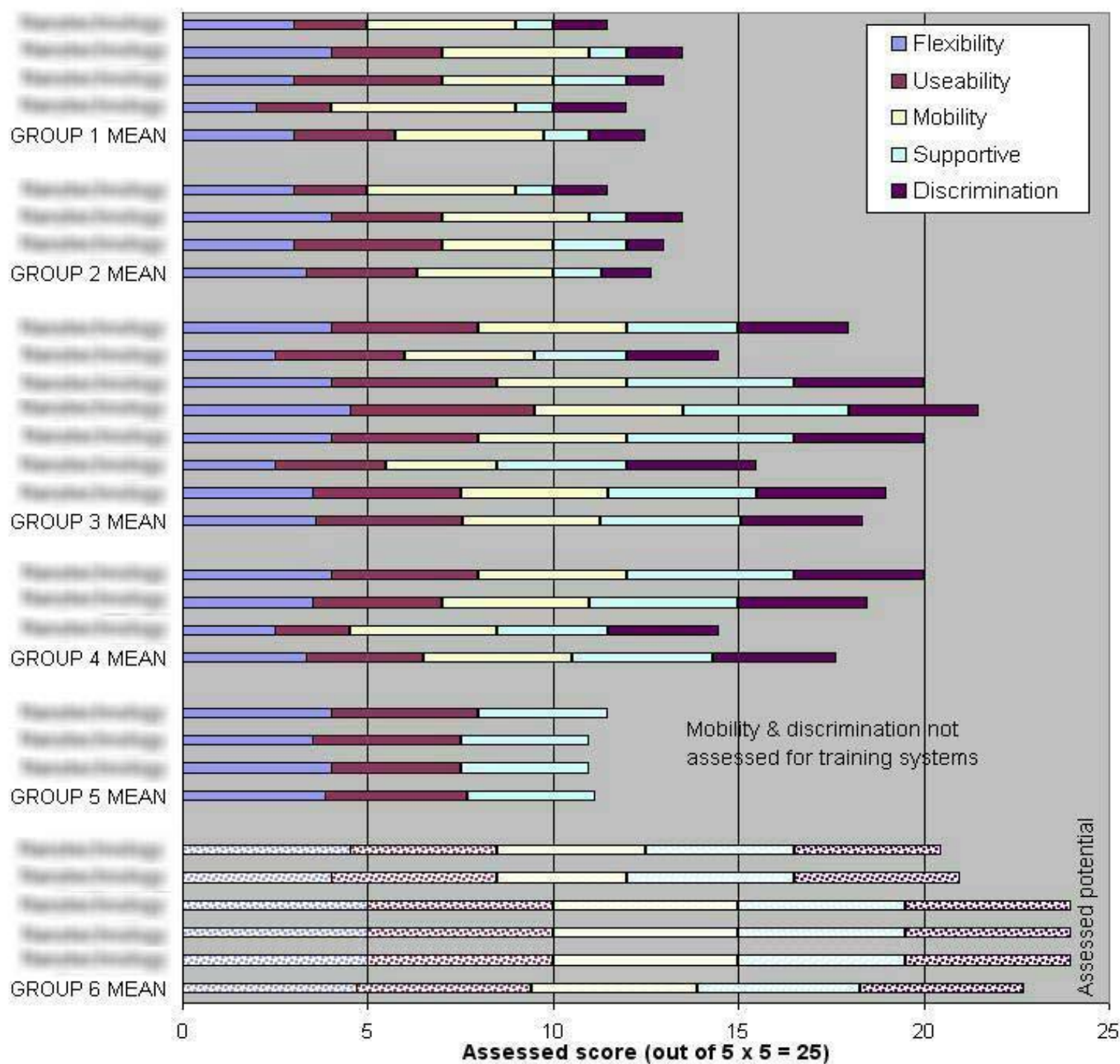
- Complex terrain
 - Physical
 - Informational
 - Human
- Diversity
 - Of enemy
 - Of partners, incl civil & NGO
 - Differing tactical & strategic defeat thresholds
- Diffusion
 - Blurring between peace & war
 - Looser geographical bounds (what defines a 'theatre'?)
- Lethality
 - Low-level ops \neq low intensity or lethality
 - 'Power to the edge'
[mis-quote Alberts & Hayes]



CID Technology Attributes

- Integration flexibility
 - Capable of being operated separately from other battlespace systems but, also, of expanding and integrating with other systems as necessary
- Useability
 - Simple to use
- Mobility and robustness
 - Support light, fast force elements
- C2 supportiveness
 - Improve commanders' situational awareness, control and decision making, allowing commanders at all levels to scale control as required
- Discrimination
 - Capable of identifying, tracking and/or targeting diverse elements in complex human environments

Technology by group





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Questions and comments invited