GRCCE Overview

JOINT GROUND ROBOTICS ENTERPRISE

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Ground Robotics Vision/Path Forward

Workshop Methodology

Day One

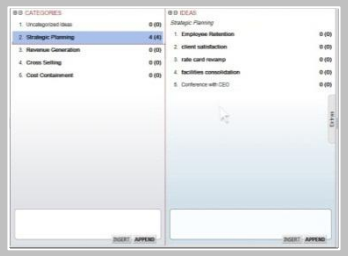
- Draft Vision Statement
- Identify Challenges
- Draft Goal Statements

Day Two

- Finalize Vision Statement
- Finalize Goal Statements
- Set Objectives

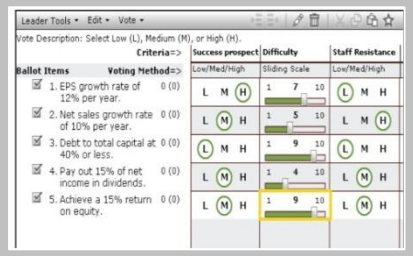
GroupSystems ThinkTank Tools

Brainstorming



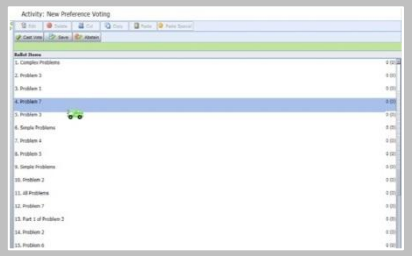
Participants entered ideas simultaneously and saw them show up in the large space at the center of the screen.

Criteria Voting



Participants selected various criteria to evaluate ideas from previous brainstorming sessions, and results were shared with the group.

Preference Voting

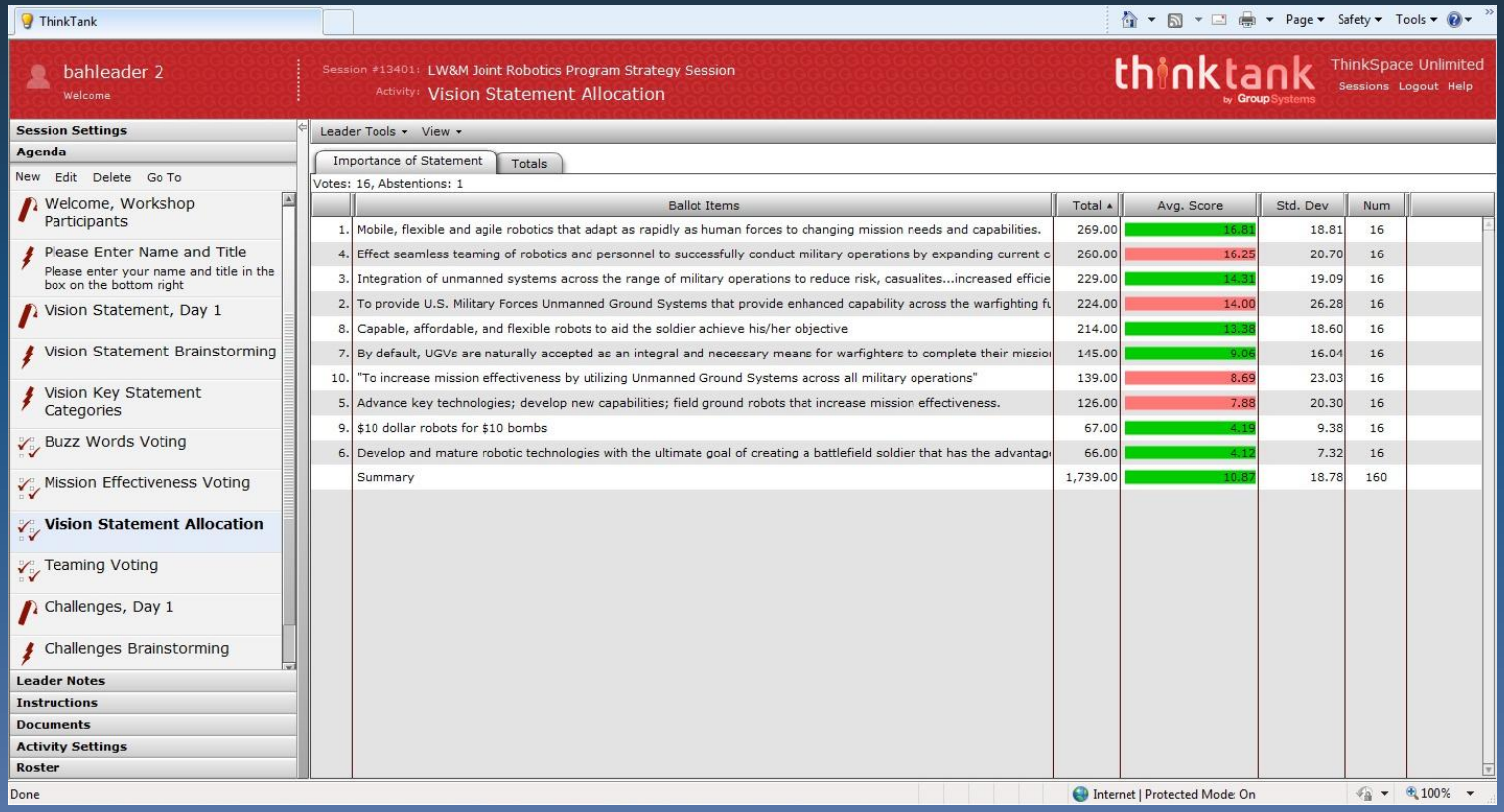


Participants dragged and dropped items into their preferred order, cast their votes, and results were shared with the group when all votes were cast.

Ground Robotics Vision/Path Forward

Key Phrases for a Vision Statement

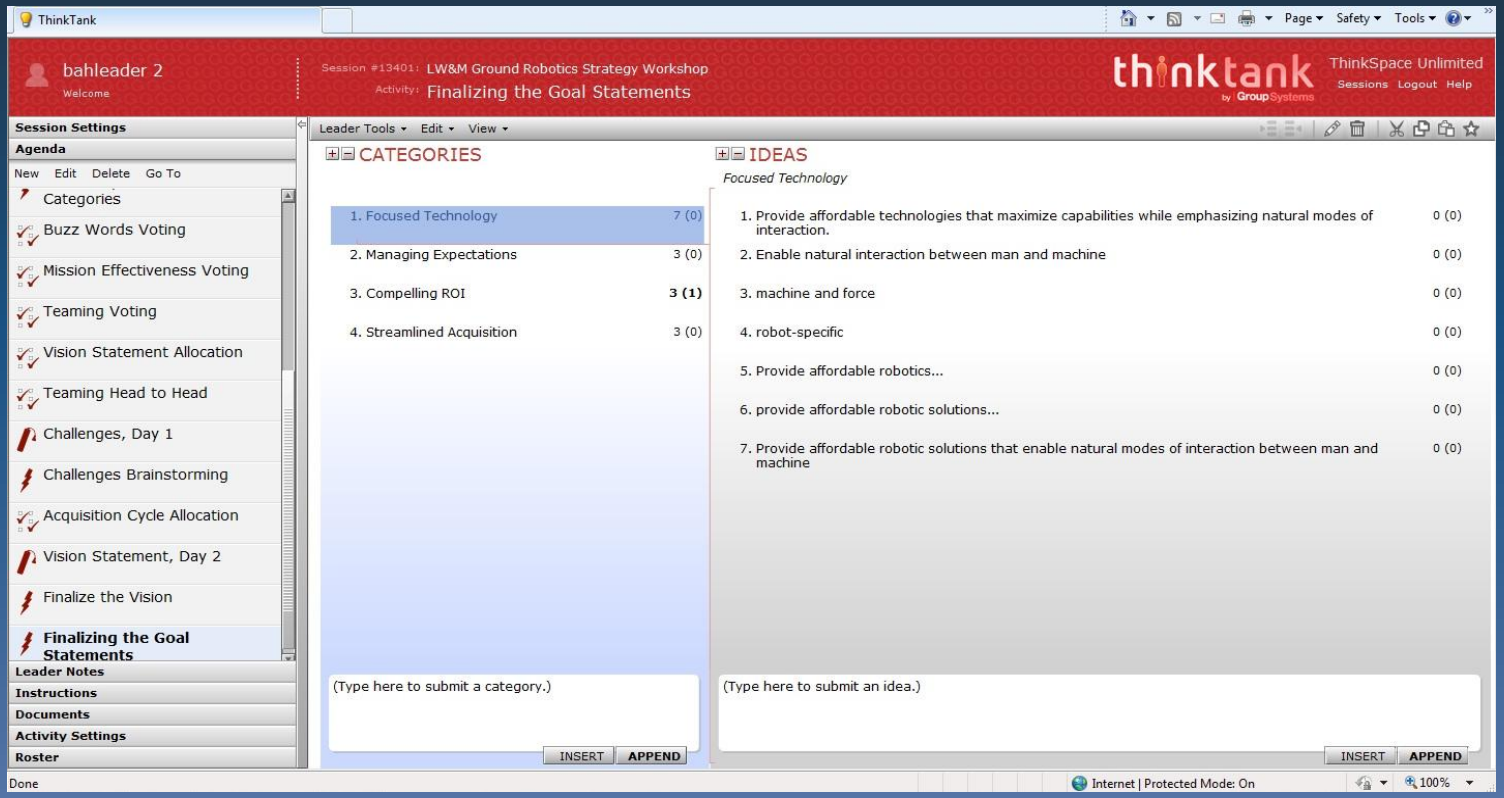
- Draft vision statements were crafted from the key components previously compiled
- Preferential voting and sorting arrived at a list of consensus statements



Ground Robotics Vision/Path Forward

Creating Goals from the Challenges – Focused Technology

- The major challenges regarding technology were grouped together and formed into the Goal “Focused Technology”
- The precise wording for the Goal was decided in small break-out sessions with 4 person working groups



DoD Ground Robotics Vision

An integrated manned/unmanned force that strengthens the United States as the world's preeminent landpower

Cultural Acceptance

Focused Technology	Balanced Requirements	Compelling Return on Investment	Streamlined Acquisition
Provide affordable robotic solutions that enable natural modes of interaction between man and machine	**Reconcile fieldable technology with prioritized and articulated requirements**	**Build the business cases necessary to justify the required investment**	**Match the acquisition strategy to the accelerated pace of robotics technology development and transition**

- Focus on intelligence, perception, human-machine interface, mobility, manipulation, and navigation technologies.
- Improve robotic performance in complex and dynamic environments.
- Support the creation of dynamic man/machine teams through increased collaboration and autonomy.
- Establish stakeholder dialogue on the current capabilities of robotic systems and identify potential applications through periodic base-lining activities and technical demonstrations
- Select key missions with the greatest chance of initial success and advocate those programs that promote social acceptance of robotics technologies.
- Define standardized metrics and tests and implement a framework for verification of technology readiness and validation of realistic requirements for robotic systems.
- Adopt a design approach that prioritizes unmanned materiel solutions and leverages opportunities for inclusion of robotics technologies into manned systems.
- Develop realistic total ownership cost benefit analysis for robotic systems:
  - In year 1, develop business cases for 1 or more dual use applications for specific domain and customers that are fieldable in 3-5 yrs.
  - In year 2, based on lesson learned define and document a repeatable process that can be adopted across the community.
  - In the out years, distill the lessons learned to continuously improve the process and promote the successes.
- Develop and enforce joint standards for open architectures and modularity to foster reduced total ownership cost, accelerated transition and increased innovation.
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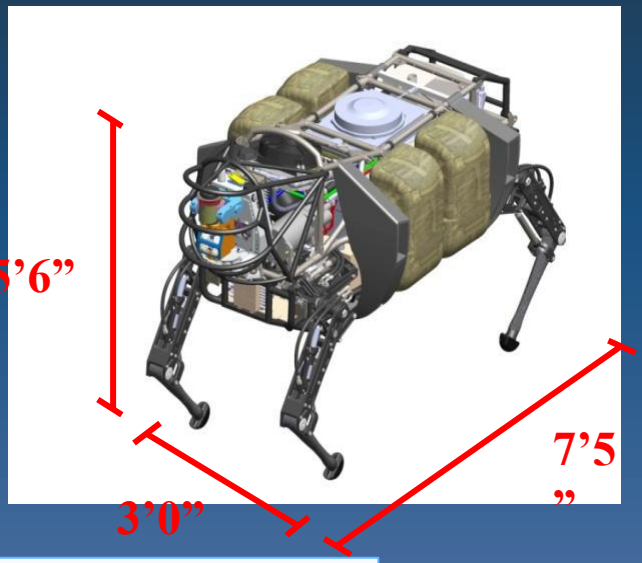
Focused Technology

Provide affordable robotic solutions that enable natural modes of interaction between man and machine

- Interface Control Standards vs Open Systems
  - Will “plug and play” help drive us to affordable solutions?
- Autonomy- How Much/How Soon/ Go Slow or Go Fast
  - Technology is still immature for many applications
  - Leadership not yet confident
  - Test community still learning
  - Demonstrate benefits in controlled environments

Legged Squad Support Systems (LS3)

- Tough dismounted terrain
- Soldier bounded autonomy:
  - Follow the leader
  - Voice command
  - Waypoint “go over there”
- Less than 70dB noise
- Mule like specs:
  - 10 mph run
  - 400 lbs. payload
  - 20 mile range
- Provide mobile electric power to Squad



Marine Corps/DARPA Partnership

GUSS/Cargo UGV

GUSS

- Evaluated the impact of multiple ground unmanned support surrogate (GUSS) vehicles
- Support Marine Corps missions:
  - Resupply
  - “Follow me“
  - Casualty Evacuation
  - Reconnaissance
- Pushing the envelope on small tactical vehicle autonomy and obstacle avoidance

Cargo UGV

- Assist in continuing to evaluate the utility of an Unmanned Ground Vehicle (UGV) to conduct supply distribution
- Require modification and integration of a robotic vehicle control kit that can be applied to current USMC cargo vehicles
- Testing and evaluation of the concept demonstrators will include technical evaluations in the form of Limited Technical Assessments (LTAs) and tactical evaluations in the form of live force Limited Objective Experiments (LOEs

Balanced Requirements

Reconcile fieldable technology with prioritized and articulated requirements

- Requirements Pull or Technology Push
  - Our role is to develop solutions to meet our customers need.
    - However, despite numerous demos, the community has had marginal success getting demonstrated autonomy into a fielded product.
    - We can (and should) inform our customers what robotic technologies can achieve, but our ability to create market demand is limited.

Army Requirements “Pull”

Ultra-Light Recon Robot

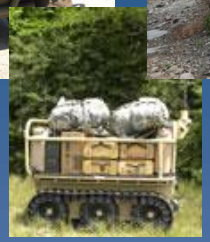
Army developing CPD for next increment of Micro UGVs

[Initial draft in 3d QTR FY 12]

Small Unmanned Ground Vehicle (SUGV)

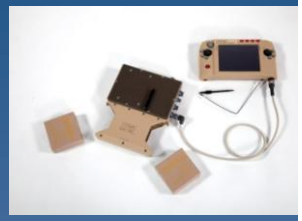
[SUGV Inc II CDD in Staffing]

Squad Multipurpose Equipment Transport (S-MET)



[CDD in Staffing]

Tactical Robotics Controller



[Joint (Marines/Army) Draft CDD]

Ultra-Light Recon Robot

Reduce the burden on dismounted Warfighter while giving them ability to inspect suspect areas for potential hazards

Compelling Return on Investment

Build the business cases necessary to justify the required investment

- Can Robots Reduce Personnel Costs?
  - Driver/Commander augmentation
  - Benign, Structured Environments
- Sustaining the U.S. Robotics Industrial Base
  - What does decreased defense spending mean for revenue opportunities?

Compelling Return on Investment

Build the business cases necessary to justify the required investment

- Key missions with greatest chance of success.
- Advocate those programs that promote social acceptance.
- Cost Benefit Analysis of civilian equivalent mission sets
  - Mining
  - Agriculture
  - Warehousing

Robotic Range Clearance Competition

- The Robotics Range Clearance Competition :
  - Advanced the state of the art in robotics range clearance technologies
  - Fosters opportunity for COTS procurement for Robotic Range Clearance
  - Provide the best balance of efficiency and innovation in robotic technology development
- Advance the state of the art in robotics thru range clearance technologies with $2 Million in cash prizes
- G3/5/7 releasing an IDIQ
- Currently there are millions of acres encumbered with spent training rounds and munitions debris
- The competition illustrated a safer, more timely, and more cost effective way to return the land to productive use

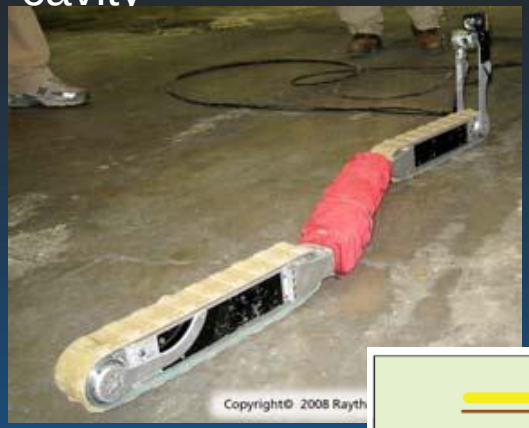
Streamlined Acquisition

Match the acquisition strategy to the accelerated pace of robotics technology development and transition, reducing the total cost of ownership

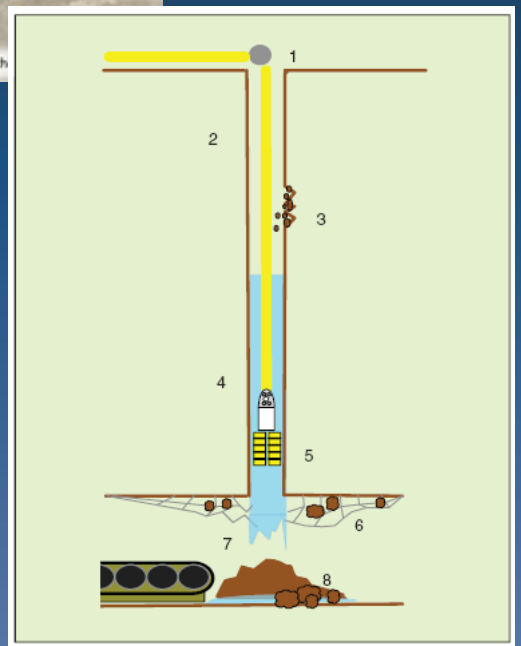
- Test and Evaluation of Autonomous Ground Systems
- Do we optimize for Technology Insertion or Logistics Efficiency?

Counter Tunnel Exploitation

- 7” maximum diameter with no constraint on length
- Must access 18” high and wide cavity



MDMR/DARWIN robot



Borehole Deployment

- Traverse out and back over 1325 ft (400m)
- Varied and rough terrain
  - heavy mud
  - loose gravel
  - areas of very limited traction
  - standing water up to 8” deep
- Climb a 12” step/wall and traverse a 12” crevice
- Provide real-time visualization capability in a no-light environment
- Provide 4” square area for sensor payload
- Provide power and communications for sensor payload

Moral of the Story

Learn from the past, push towards the future

- Leverage requirements, user experiences, and lessons learned from rapid fielding initiatives and Program of Records (AEODRS, M160, SUGV, AMDS)
- Continue R&D and push the envelope to expand robotic technology and capabilities
- Address current manned requirements and needs with unmanned systems
- Develop tactics and techniques through assessments and Warfighter experiments
- Articulate the return that unmanned systems provide (cost, lives) and explore options of adjusting force structure
- Adapt to the current pace of technology development and strive for acquisition reform to address urgent and emerging needs

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Enjoy the Demos!

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