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ROBOTIC RANGE CLEARANCE COMPETITION (R2C2) COMPETITION LESSONS LEARNED

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14. ABSTRACT

This presentation provides an overview of lessons learned from previous range clearance operations and how they are important factors to be considered in the Robotics Range Clearance Competition (R2C2).

15. SUBJECT TERMS

R2C2, Robotic Range Clearance Competition, lessons learned, ARTS

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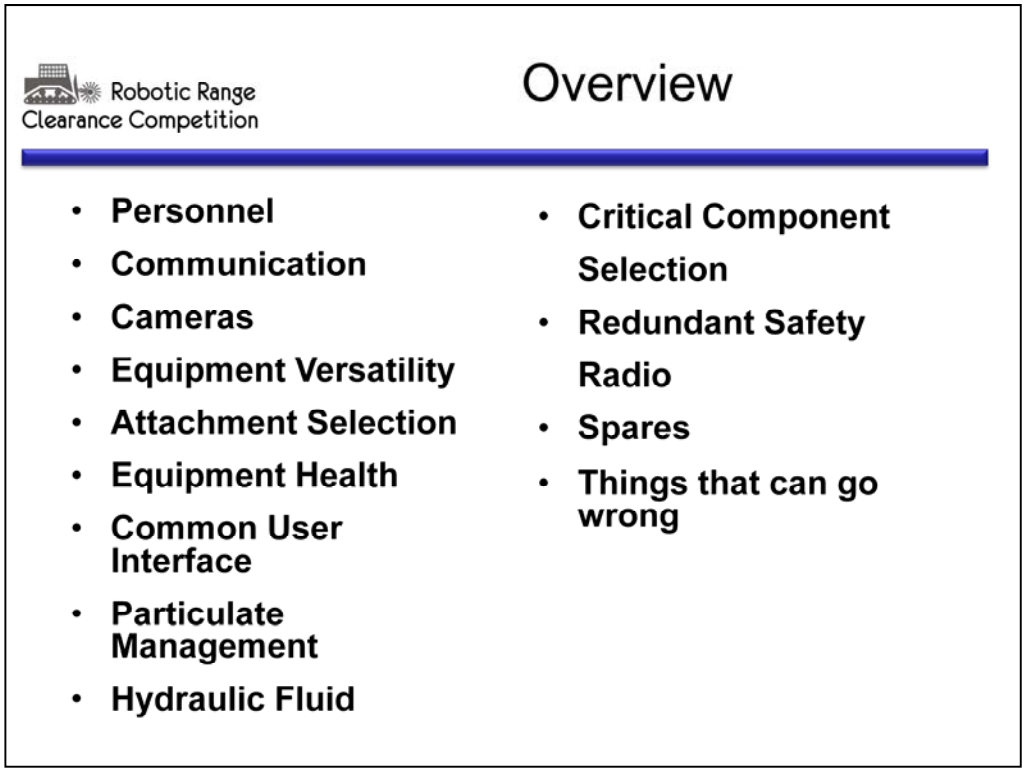
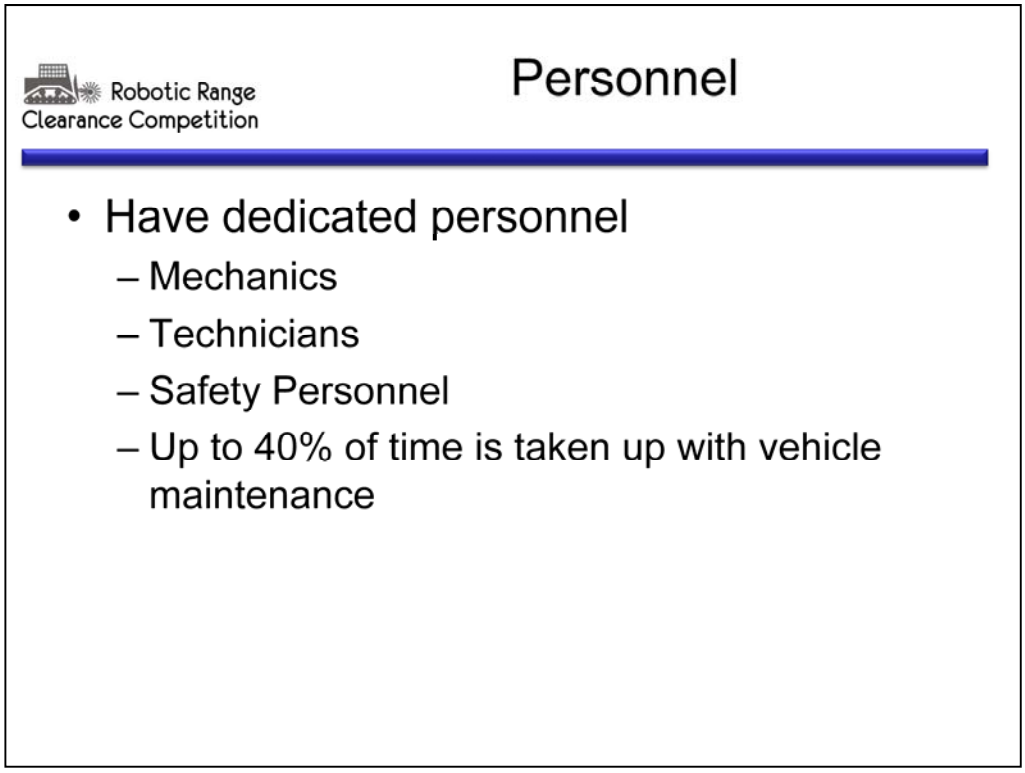
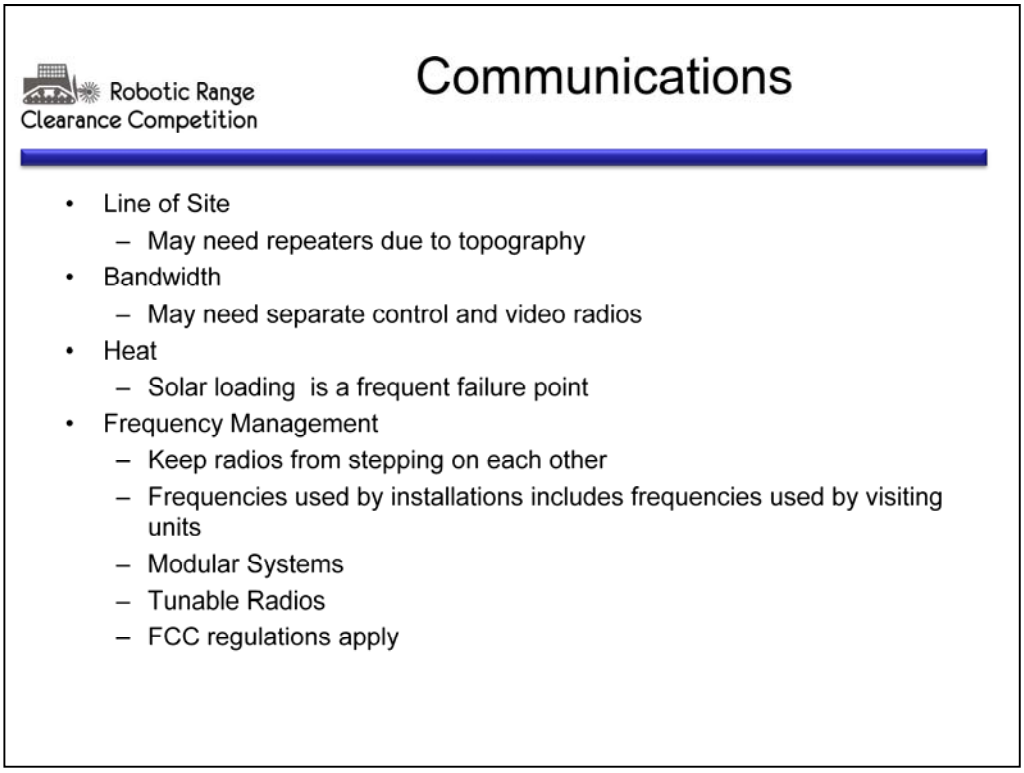


Introduce the overview of what the presentation will cover.


Robotic Range
Clearance Competition
Personnel
• Have dedicated personnel
– Mechanics
– Technicians
– Safety Personnel
– Up to 40% of time is taken up with vehicle maintenance

See slide.


Robotic Range
Clearance Competition
Communications
• Line of Site
– May need repeaters due to topography
• Bandwidth
– May need separate control and video radios
• Heat
– Solar loading is a frequent failure point
• Frequency Management
– Keep radios from stepping on each other
– Frequencies used by installations includes frequencies used by visiting units
– Modular Systems
– Tunable Radios
– FCC regulations apply

See slide.

Robotic Range Clearance Competition

Cameras

- Have auto iris and gain control
- Placement
  - Operators have limited FOV so cameras can be knocked off or damaged inadvertently
  - Protection from obstacles and debris
- Day and night operations

See slide.

Describe the ARTS, its attachments, and how they can be used to improve range clearance.

Robotic Range Clearance Competition

Attachment Selection

- Hydraulic/Electrical Power necessary to operate the attachment
  - Some may need additional power packs
  - Matching attachments to the equipment (weight / power requirements)
- Magnets are strong enough to pick up debris
- Mulchers may need teeth replacement or repair

See slide.

Robotic Range Clearance Competition

Attachment Selection

Barber Surf Rake

- Able to pick up small items comparable to a quarter and as large as a coffee can with a weight of 10lbs or less.
- Anything larger destroys tines and could jam machine
- Excellent for open areas with minimal vegetation

See slide.

Robotic Range Clearance Competition

Attachment Selection

Harley Rock Picker

- Able to pick up small items comparable to a quarter based on screen size and as large as a 155mm.
- Replaceable screens for size control cleaner scrap piles
- Excellent for open areas with minimal vegetation
- No longer in production

See slide.

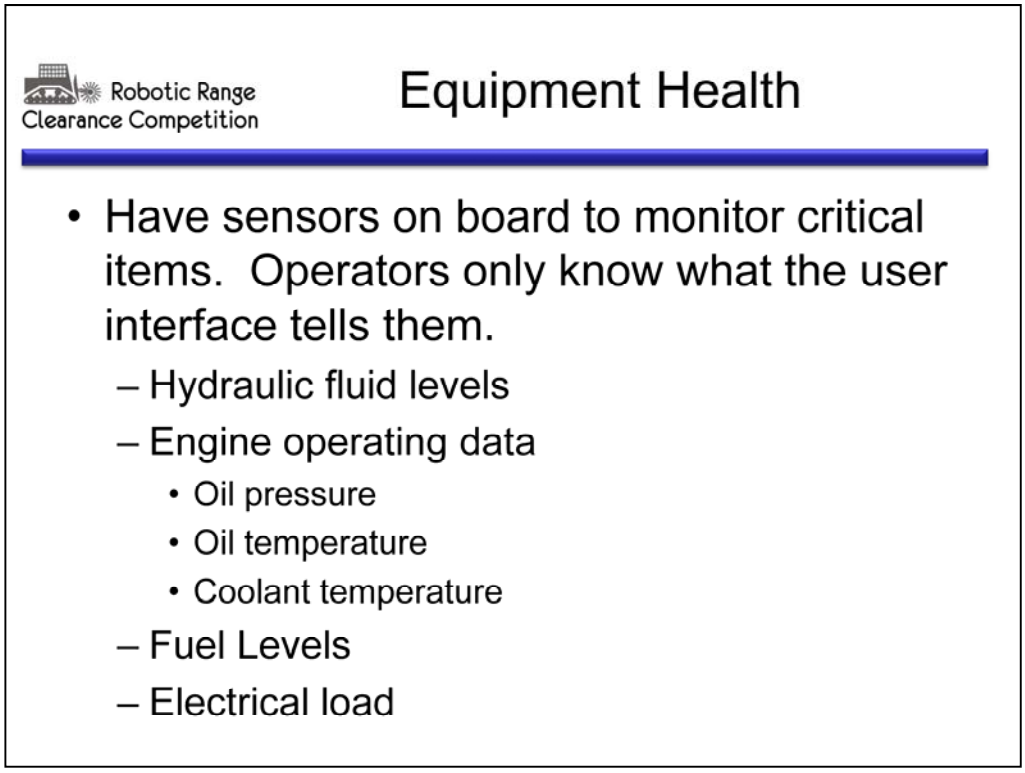
Robotic Range Clearance Competition

Attachment Selection

FAE Mulcher

- Cots system that was designed with flail hammers
- AFRL modified to have solid replaceable teeth
- Good for mulching 4" trees and under growth
- Leaves good mulch with minimal stumps and branches

See slide.


Robotic Range
Clearance Competition
Equipment Health
• Have sensors on board to monitor critical items. Operators only know what the user interface tells them.
– Hydraulic fluid levels
– Engine operating data
• Oil pressure
• Oil temperature
• Coolant temperature
– Fuel Levels
– Electrical load

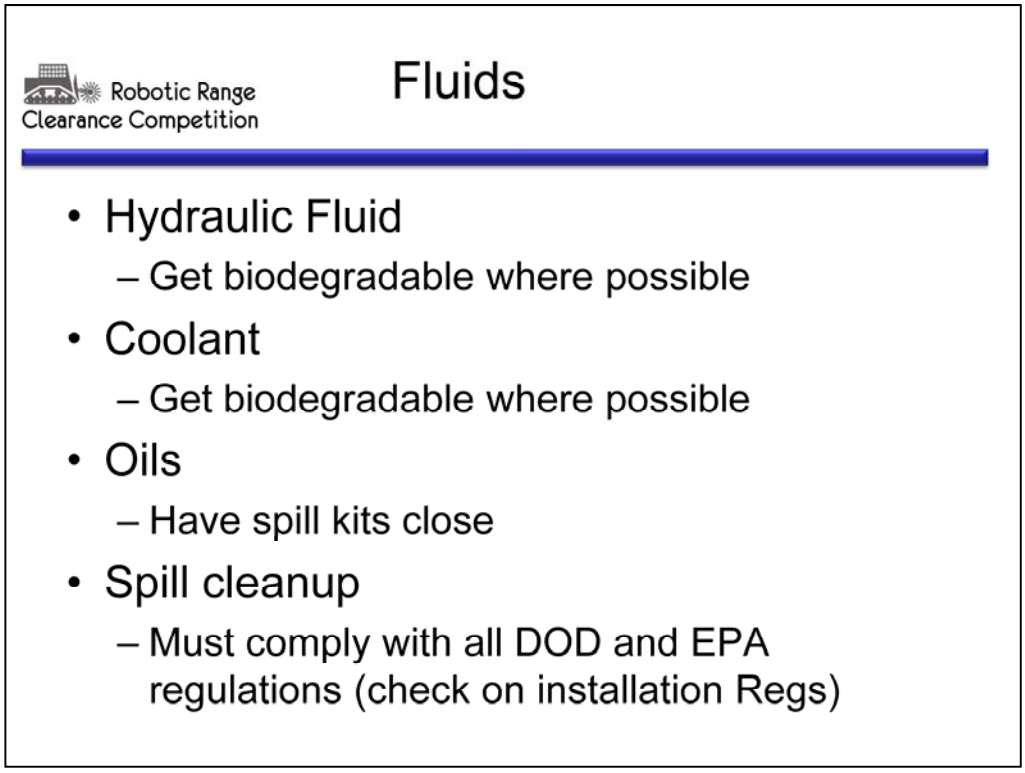
See slide.

Robotic Range Clearance Competition

Particulate Management

- Fine particle and dust will get into your gear. Add filters to inlet and outlet ports.

See slide.


Robotic Range
Clearance Competition
Fluids
• Hydraulic Fluid
– Get biodegradable where possible
• Coolant
– Get biodegradable where possible
• Oils
– Have spill kits close
• Spill cleanup
– Must comply with all DOD and EPA regulations (check on installation Regs)

See slide.

Robotic Range Clearance Competition

Critical Component Protection

Protect antennas, cameras, e-stops, and warning lights

Before

After

See slide.

Robotic Range Clearance Competition

Things that can go wrong

- Broken hydraulic hoses
- Vehicle turnovers
- Loss of communications due to antenna failures
- Brush hog blades breaking
- Mulcher Teeth breaking
- Barbed wire entanglement
- Detonation of UXO
- Unauthorized intrusion on range during operations

See slide.

Robotic Range Clearance Competition

Terrain/Soil Condition Issues

- Slopes and hills
  - Slide hazards, roll over and just plain stuck
- Type of soil
  - Sand
  - Clay
  - Rock
- Weather/rain
  - Make clay slick
  - Makes sand heavy
  - Can impact load bearing capacity

See slide.

Robotic Range Clearance Competition

Subsurface Objects

- Excavator worked best for items up to 15’ deep
- Excavators have also removed debris from shallow water

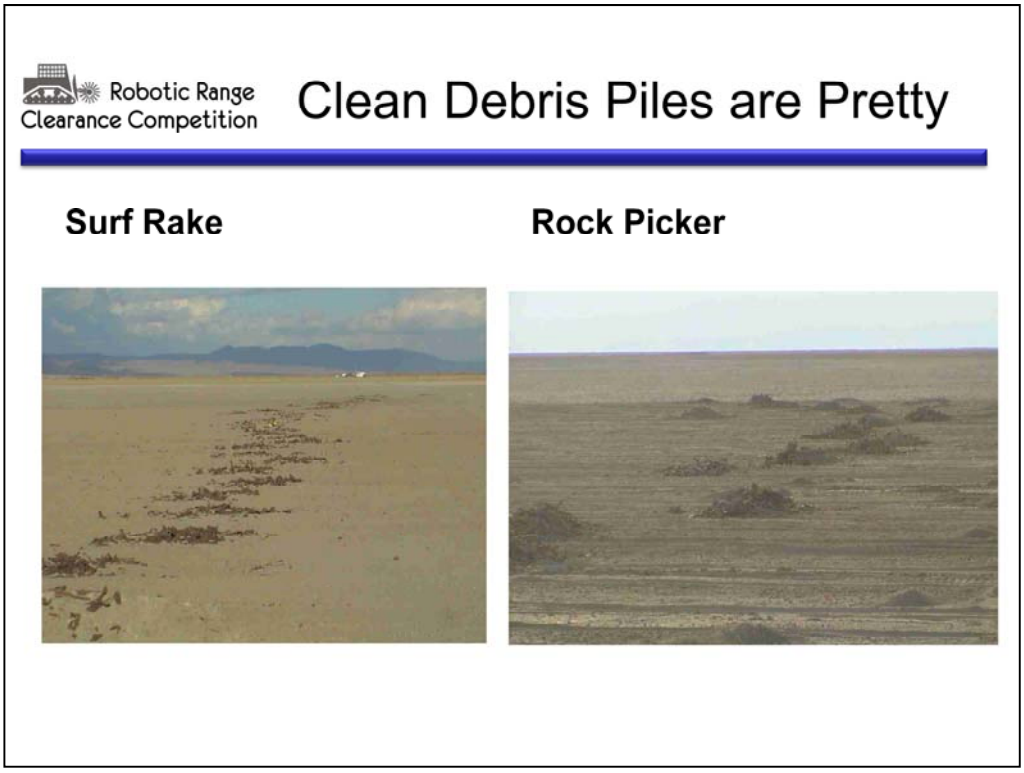
See slide.

Robotic Range Clearance Competition

Towing Sensors

- Vehicle has proper hitch or connection point
- Vehicle has proper power take-off (PTO) points if necessary
- Vehicle can match the ideal speed for the sensor

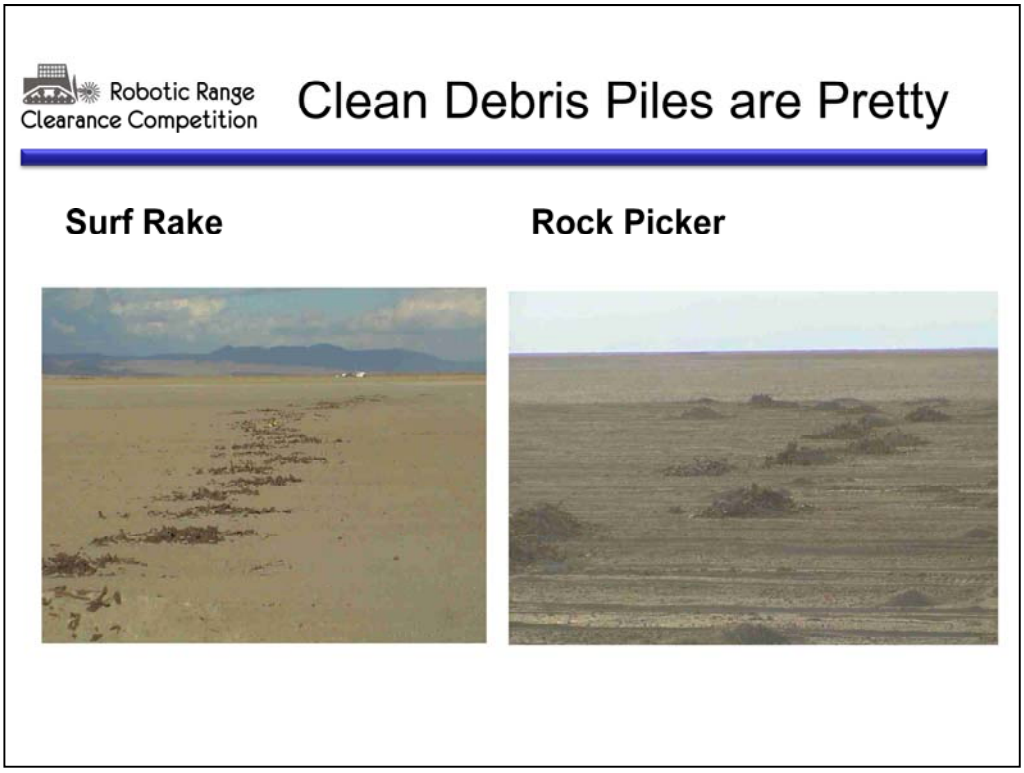
See slide.


Robotic Range
Clearance Competition
Clean Debris Piles are Pretty
Surf Rake
Rock Picker

See slide.


Robotic Range
Clearance Competition
Clean Scrap Piles are Pretty
Scrap Pile Start of Project
Surf Rake Scrap Piles
Scrap Pile End of Project
Rock Picker Scrap Piles
Starting process produced piles with a large amount of soil – Process was Optimized to minimize soil. Rock Picker produced cleaner piles than Surf Rake.

See slide.


Robotic Range
Clearance Competition
Clean Debris Piles are Pretty
Surf Rake
Rock Picker

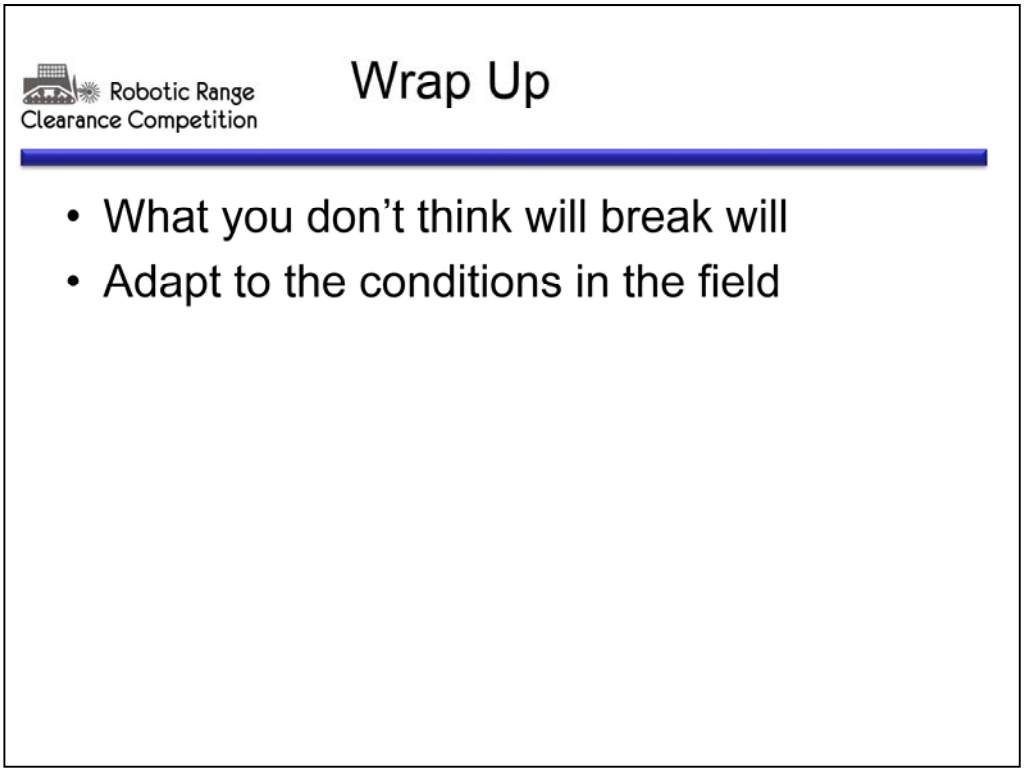
See slide.

Robotic Range Clearance Competition

Magnet Soil Interaction

- Magnets will not affect post job EM surveys
- Magnets will affect magnetometers

See slide.



Wrap up presentation.