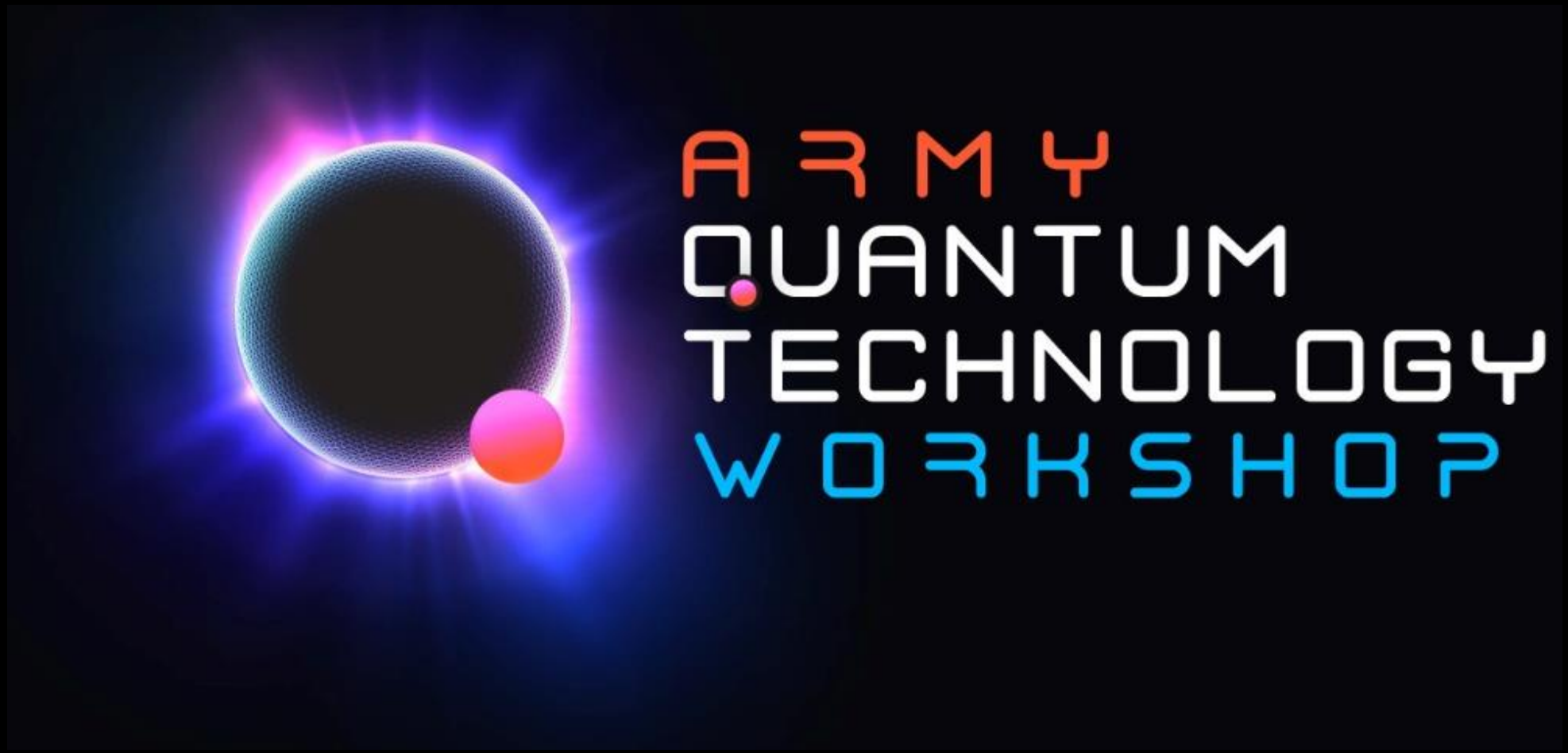
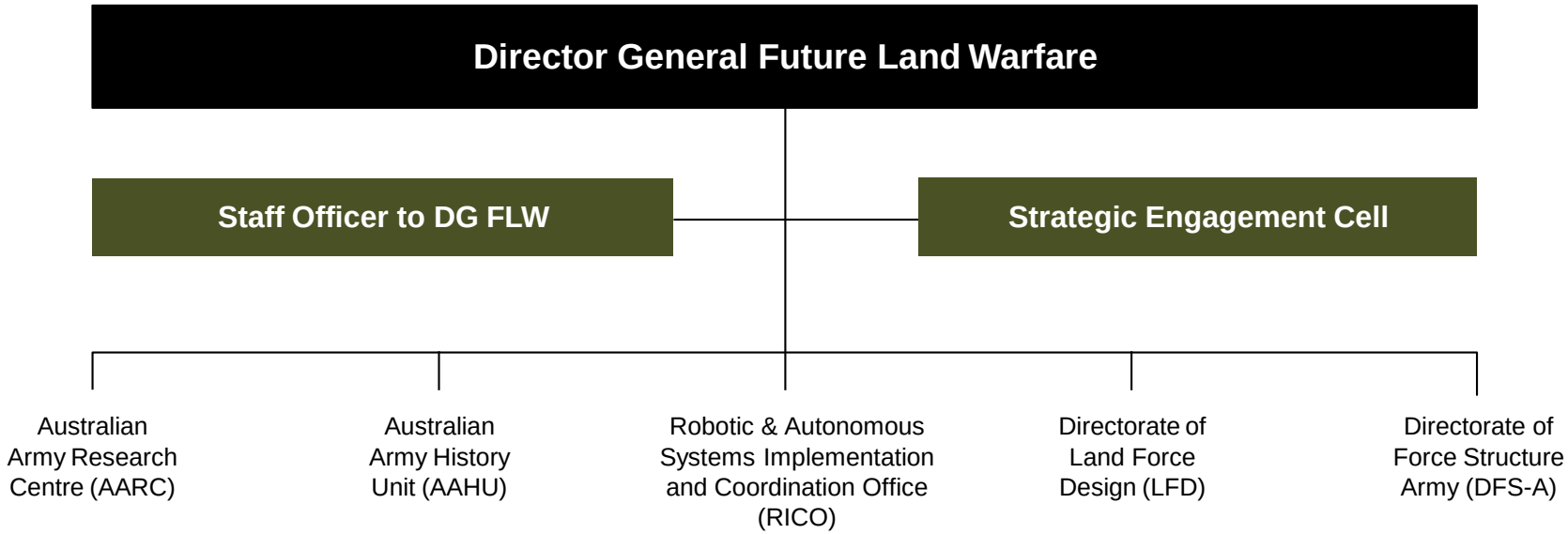
Army



Future Land Warfare Branch



Understand **Advocate** **Design** **Implement**

Vision: Understand the opportunities and challenges of the future and ensure that Army is ready to appropriately respond.

RICO ROBOTIC & AUTONOMOUS SYSTEMS IMPLEMENTATION & COORDINATION OFFICE

Army

Emerging and Disruptive Technology

RICO ROBOTIC & AUTONOMOUS SYSTEMS IMPLEMENTATION & COORDINATION OFFICE

Emerging and Disruptive Technology

Robotics and Autonomous Systems

Small Robots
Issuing systems to Engineer & Infantry units

Legged Robots
continue user evaluation

Brain Interface
Demo with legged robot in Majura in May 22 – Ph 3 DIH proposal in draft

OCCV
Trials continue with 7RAR

Autonomous Leader Follower
Road trials & regulation (Vic & NSW)

Autonomous Artillery Ammunition Handling

Consumable UGV
Demo/ground swarming

RAS Strategy V2.0

RAS Strategy Revision

Energy and Power

ePMV
Unveiled at ARX 2022
Rapid Prototype initiative
eM113 – 12 months
PMV-M Solar Bonnet

Quantum Technology

QTC 2021
Exploit contracting development of systems

Q Camo
1 x Contract team
1 x Defence team (10LHR)

QTC 2022
6 x entities under contract

Engagement

- Chief of Army Symposium
- Army Robotics Expo
- Quantum Technology Challenge
- Army Innovation Day

Collaboration

C3 Process Optimisation Phase 2 "Understanding the Battle"

Microsoft

Hyperteaming (Machine teaming) x 12 ongoing

TRUSTED AUTONOMOUS SYSTEMS

Autonomous support to mounted combatants prototype

BOEING

RICO ROBOTIC & AUTONOMOUS SYSTEMS IMPLEMENTATION & COORDINATION OFFICE

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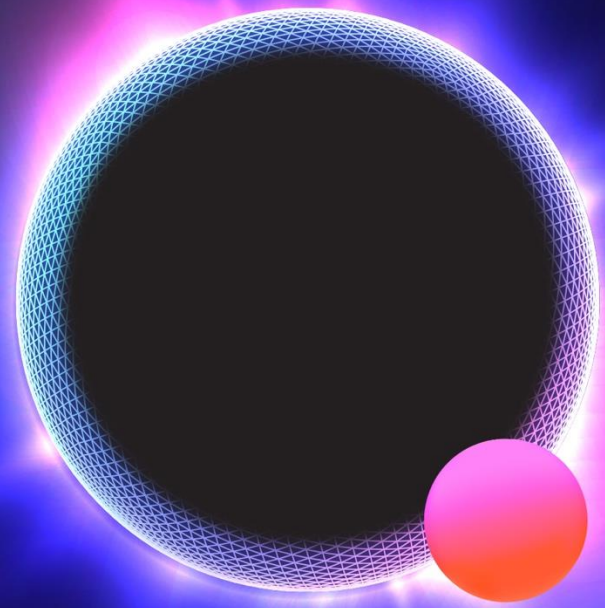


Army Quantum Technology Roadmap

Roadmap Execution Report 2022

Lieutenant Colonel Marcus Doherty

SO1 Quantum Technologies

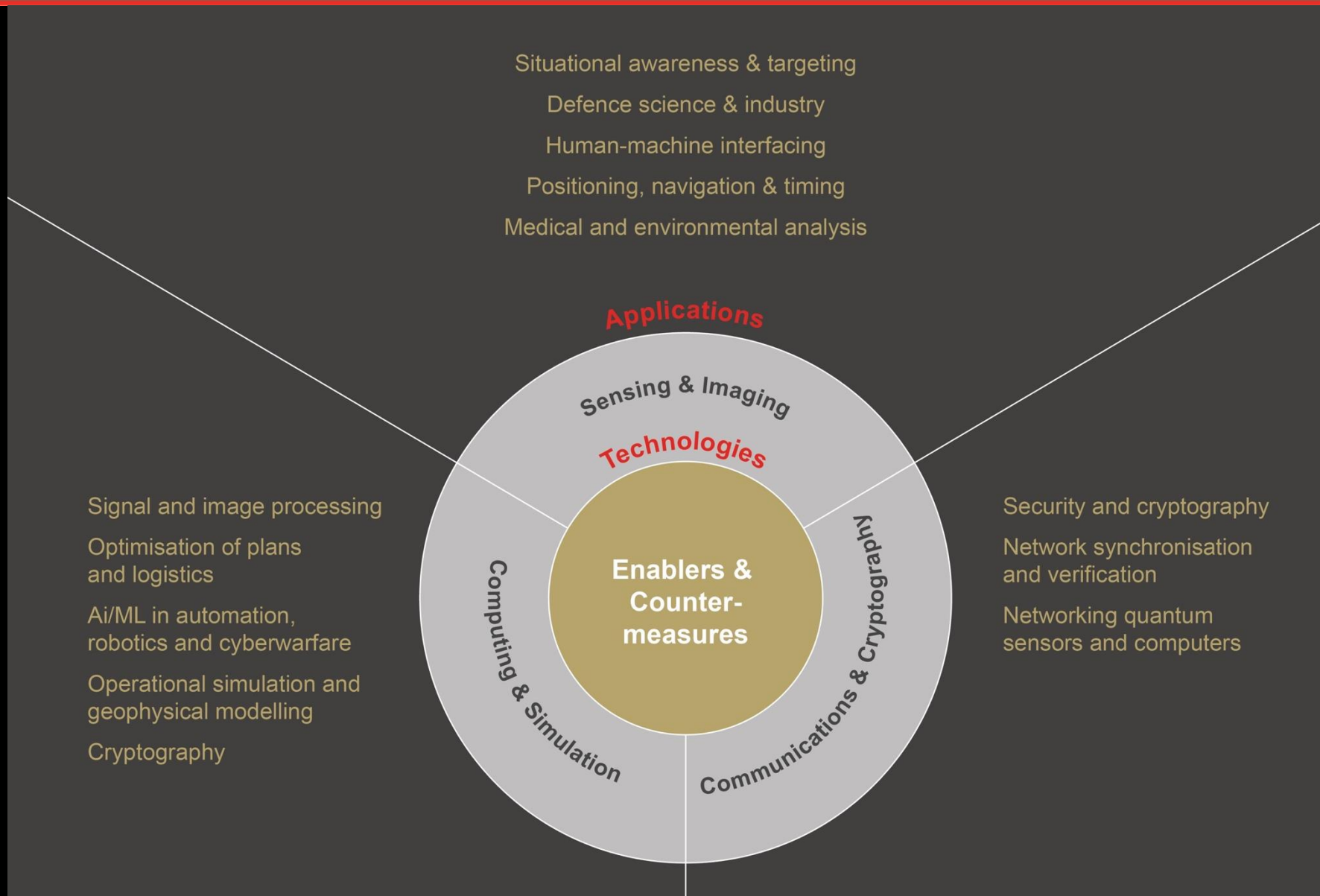
RICO

Future Land Warfare Branch

Serving our Nation

Quantum Technologies

Harnessing the fundamental laws of nature to offer unprecedented capabilities



Army's Roadmap

Mission: Gain and retain an early quantum advantage in the land domain

Current state

- High potential
- Complex
- Diverse
- Ambiguous
- Low TRL
- National strength
- Global competition

Thesis

The most disruptive & advantageous applications are yet to be discovered

Lines of Effort

Collaborate. Growth of an Army Chapter of a Defence Quantum Innovation Community.

Explore. Implementation of a rapid quantum application discovery and testing cycle via regular Quantum Technology Challenges.

Exploit. Development of select quantum technologies, applications and associated operating concepts and force designs.

Refine. Curation of Army's quantum technology understanding, landscaping, assessment and strategy.

Objectives

Establish a quantum innovation ecosystem focused on land domain.

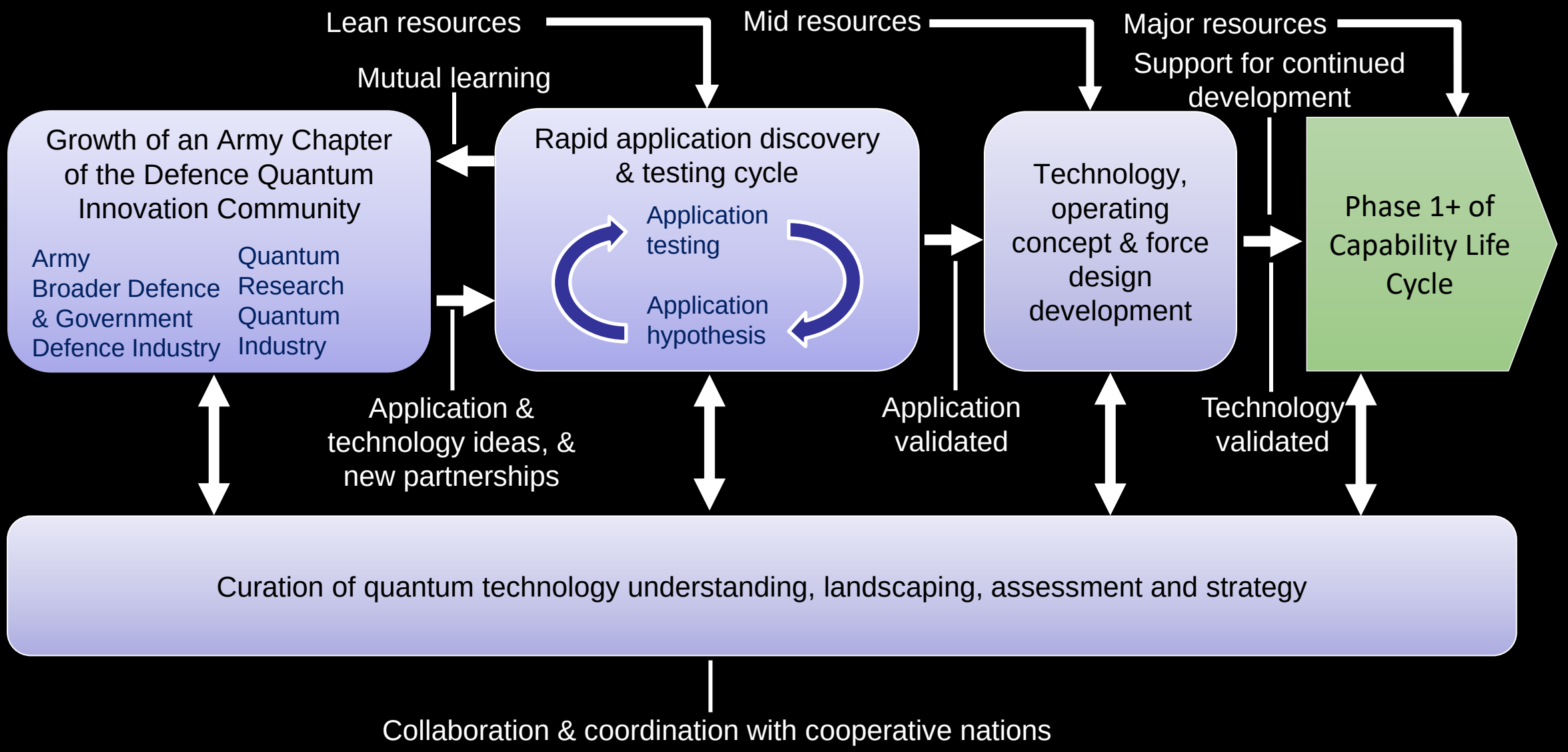
Identify the most advantageous applications for the land domain.

Develop the related technology, operating concepts and modified force designs.

Support Defence's quantum technology strategy.

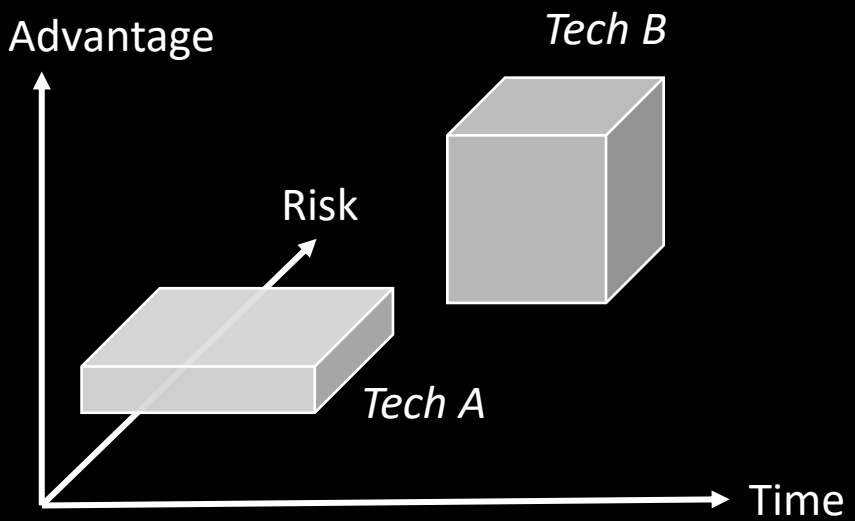
Army

Army's Method



Army's Portfolio

Seeking to maximize advantage in each time horizon, whilst minimizing risk



Technology type	Priority 1	Priority 2	Priority 3
Sensing & imaging	• Positioning, navigation & timing • Gravity and magnetic anomaly detection	• Electromagnetic detection & ranging • Medical & environmental sensing	• Human-machine interfacing • Material and device characterisation
Communications & cryptography	• Point-to-point Quantum Key Distribution • Network clock synchronisation	• Multi-point Quantum Key Distribution • Long-lived encrypted quantum memories	• Networking quantum sensors and computers • Integrated quantum-classical networks
Computing & simulation	• Image/ signal processing • Optimisation of logistics and planning	• AI/ ML and robotics • Cyberwarfare tools • Cryptography • Operational simulation	• Geo/physical modelling • Materials, biotechnology and nanotechnology simulation
Enablers & countermeasures	• Post-quantum cryptography • Disrupting Quantum Key Distribution	• Characterisation, benchmarking and optimisation tools • Spoofing quantum sensors	• Scalable manufacturing • Disabling quantum computers

Army's Role

Army's role is to:

- Focus on application and technology assessment and validation in order to identify implications for future force design and operating concepts

- Whilst catalysing the growth of sovereign industry and capability through leadership, partnerships and communication

Army's First Step

Army Roadmap Launch and QTC Demonstrations

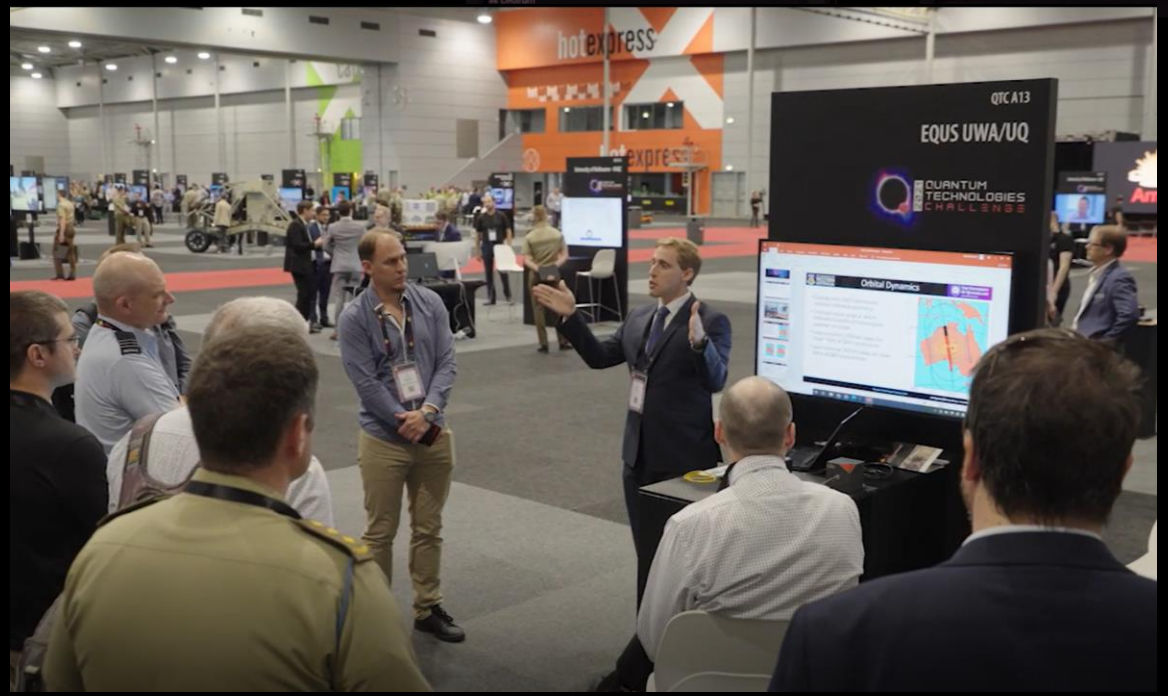
Keynote Speakers

Australia's Chief Scientist

Chief Defence Scientist

Head of Land Capability

Challenge Demonstrations



Challenge Teams

MONASH University

Q-CTRL

THE UNIVERSITY OF MELBOURNE

NEC

D-Wave The Quantum Computing Company™

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

DEFENDTEX

RMIT UNIVERSITY

QUANTX LABS

THE UNIVERSITY OF WESTERN AUSTRALIA

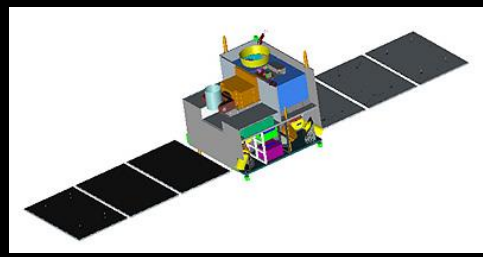
EQUS Australian Research Council Centre of Excellence for Engineered Quantum Systems

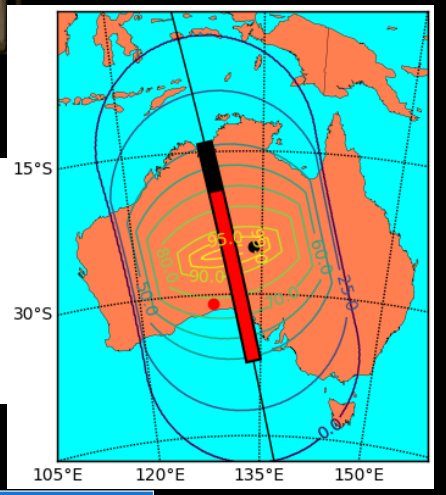
Army

Quantum Technology Challenges 2021

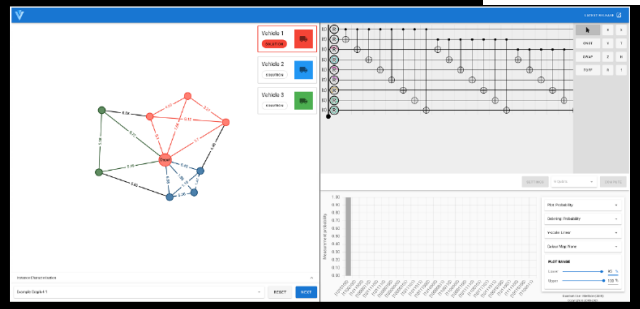
Making the ground transparent. Using quantum sensors to detect subterranean structures and track the movements of weapons, munitions and materiél through tunnels and sewers.

Denying the enemy secure communications. Disrupting our adversaries' use of space-based quantum communications to enhance the security of their information networks.





Resupplying troops in battle quickly, safely and efficiently. Using quantum computers to optimise the resupply of our soldiers in battle by future autonomous resupply systems.



QTC21 Outcomes & Exploit Projects

Intangible:

- Profound uplift of quantum awareness in Defence and industry:
  Quantum technologies have arrived, we need to take action
- Various new research-industry and industry-industry partnerships
- Identification of immediate threats and opportunities

Tangible:

- >$350k in QTC21 demonstration contracts awarded to 7 teams
  - Of which:
    - Army identified 4 teams for Exploit Projects
    - RAAF identified 1 team for a Project
    - BHP identified 2 teams for Projects
- >$1.4M of Exploit Project contracts awarded by Army thus far

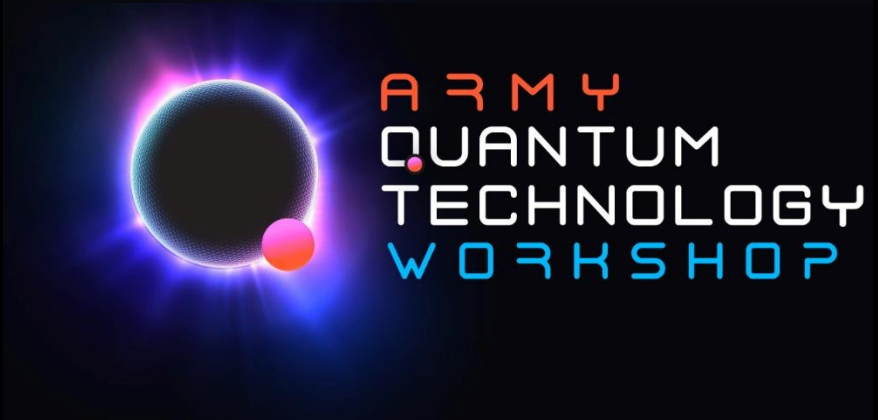
Army

Army's Second Step

Catalysing a sovereign quantum industry by challenging the next generation of scientists, engineers and entrepreneurs.

Generating awareness and leveraging practitioner expertise by challenging Army teams.

Inventing countermeasures to the threat of detection by quantum sensors to protect our soldiers and harden our quantum sensors.

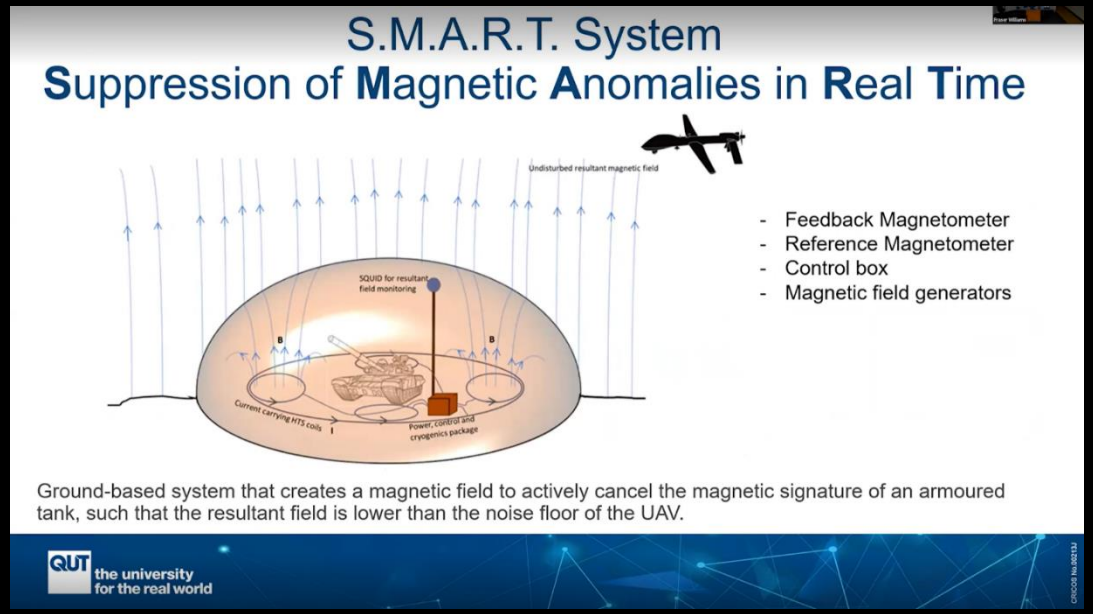


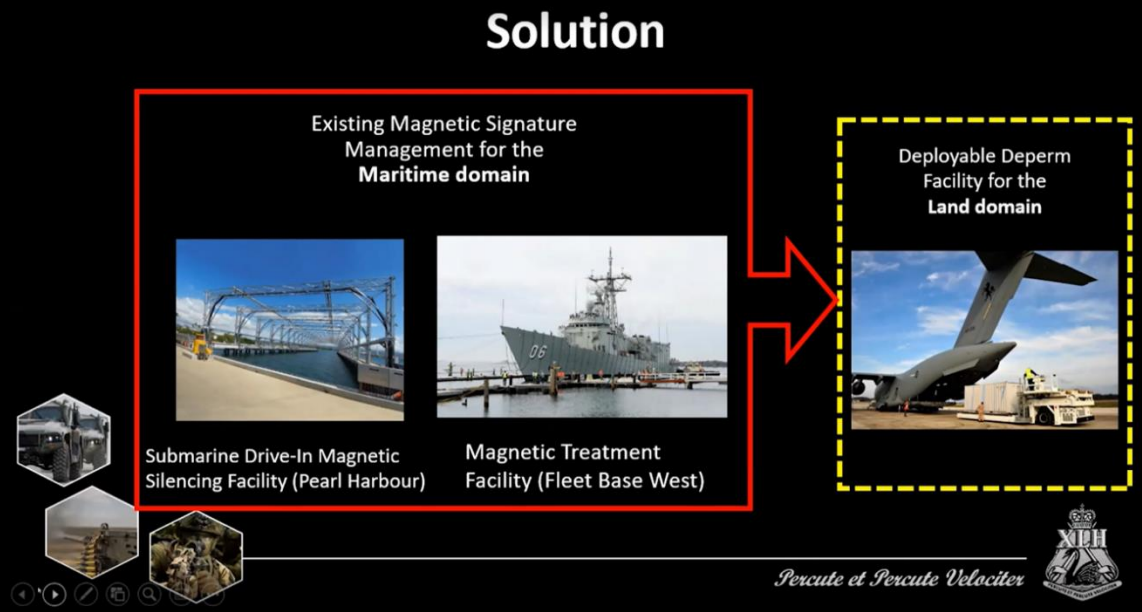
Growing the quantum innovation ecosystem by meeting with the quantum technology community, communicating Army's Roadmap, workshopping technology and application ideas, and building networks with industry and research.

QNG21 & QCamo21 Outcomes

Joint QNG21 & QCamo21 Pitchfest:

- 2 x Student teams and 4 x Defence teams
- Top-ranked teams:
  - QNG21 – Queensland University of Technology
  - QCamo21 – 10 Light Horse Regiment
- Invited to QTC22 and awarded $50k or equivalent value





Army

Army's Third Step

Keynotes, Workshops & Demonstrations

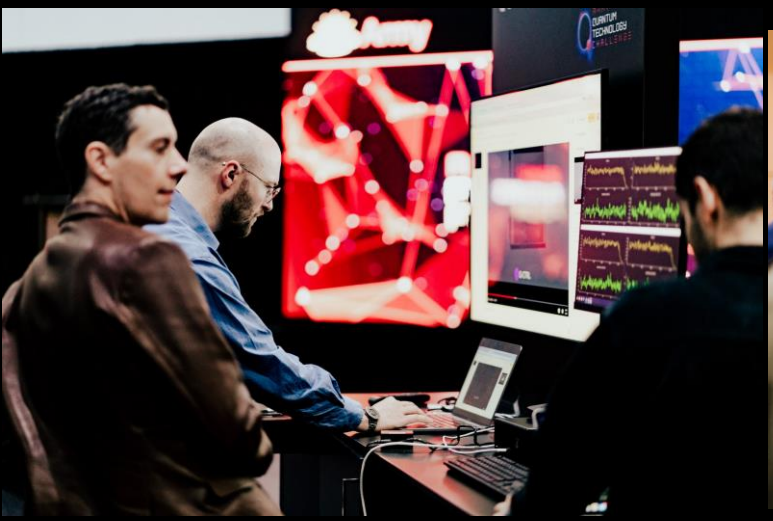
Keynote Speakers

Australia's Chief Scientist

Mr Albert Chan, Defence Research & Development Canada

Dr Fredrik Fatemi, US Army Research Laboratories

Demonstrations



Challenge Teams

MONASH University

Q-CTRL

Silicon Quantum Computing

THE UNIVERSITY OF MELBOURNE

Quintessence Labs

Outlander Solutions

XIII

QUT

QTC21 Exploit Project Exhibitors

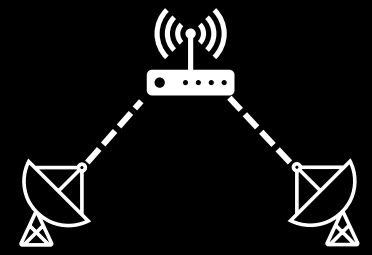
THE UNIVERSITY OF MELBOURNE

QUANTX LABS

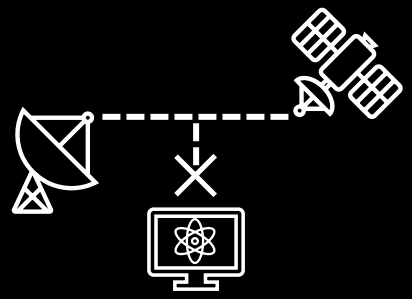
RMIT UNIVERSITY

Q-CTRL

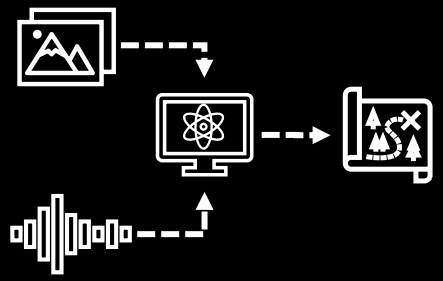
Quantum Technology Challenges 2022



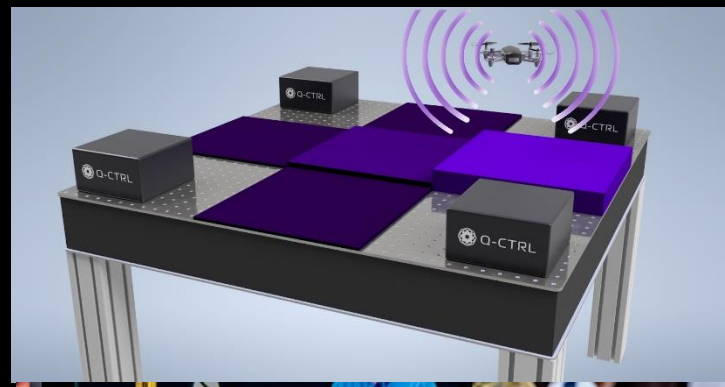
Locating enemy electromagnetic emitters on the battlefield. Using quantum sensors to detect, locate and identify electromagnetic emitters with greater precision, range and bandwidth, whilst reducing detector SWaP.



Securing our communications against quantum computers. Employing post-quantum cryptography methods to protect existing classical communications systems from decryption by enemy quantum computers.



Identifying threats and critical information in complex signals and images. Using quantum computers to identify and classify features in complex ISREW signals and images more precisely and efficiently.



QTC22 Outcomes & Exploit Projects

Intangible:

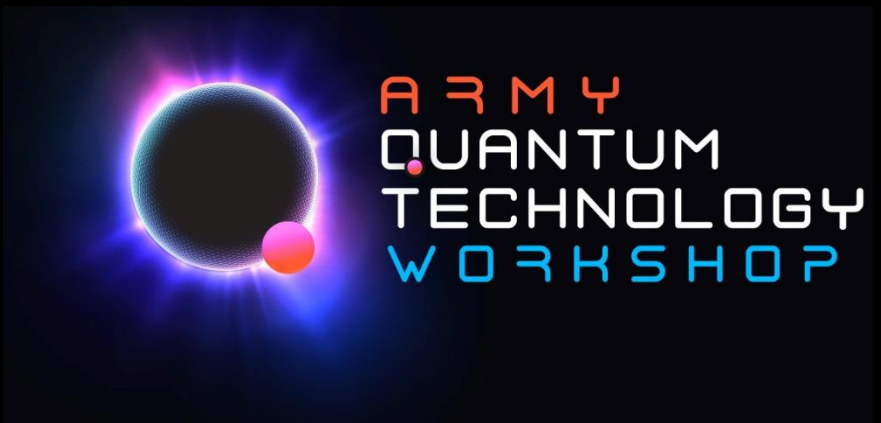
- Confirmed broad quantum awareness in Defence and industry:
  We want to know more about quantum technology
- Networking across Whole-of-Government and Whole-of-Defence
- Unexpected discoveries of threats and opportunities
- Exhibition by an Army team: discovery of internal capability

Tangible:

- >$350k in QTC22 demonstration contracts awarded to 8 teams
  - Of which, Army identified
    - 5 teams for Exploit Projects
    - Referred 2 teams to Capability Programs
- >$1.4M budget for Exploit Project contracts

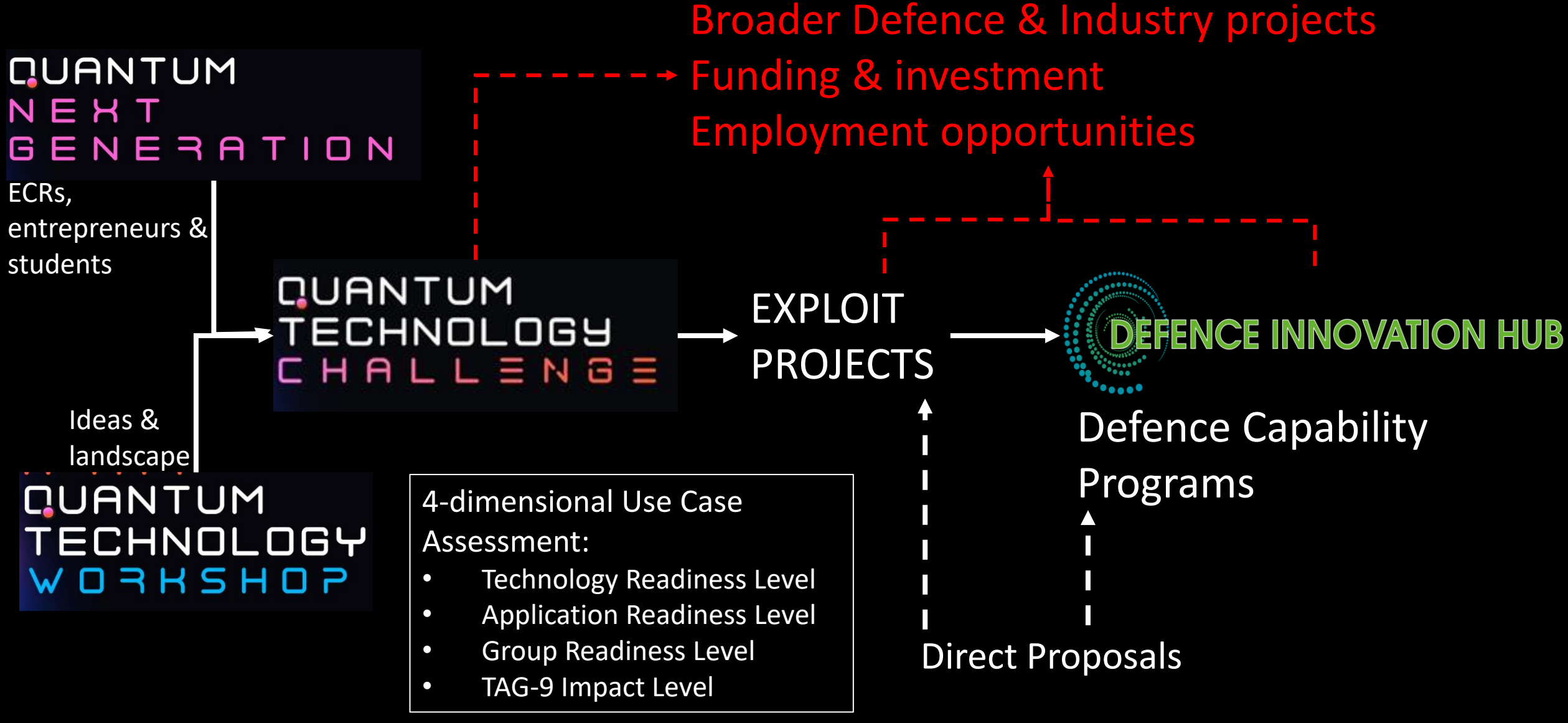
Army's Fourth Step

Optimising the employment of quantum sensors in radar in order to benchmark the potential of quantum sensors in electronic warfare, whilst developing the next generation of technologist in industry and Defence.



Growing the quantum innovation ecosystem by meeting with the quantum technology community, communicating Army's Roadmap, workshopping technology and application ideas, and building networks with industry and research.

Army's Future: Emerging Pathways



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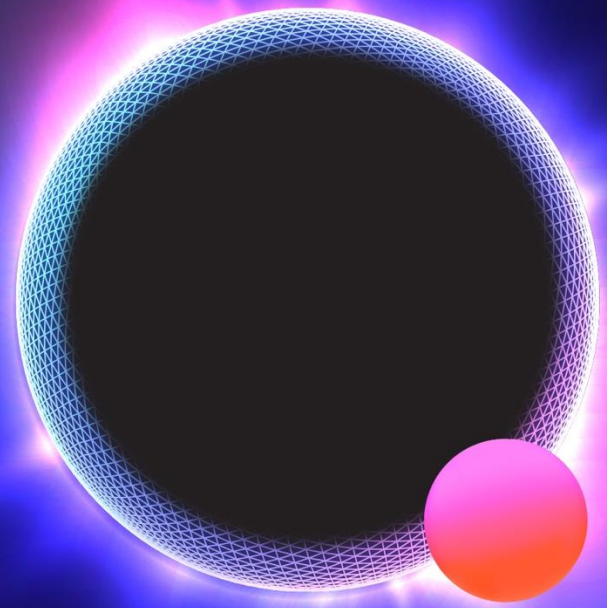


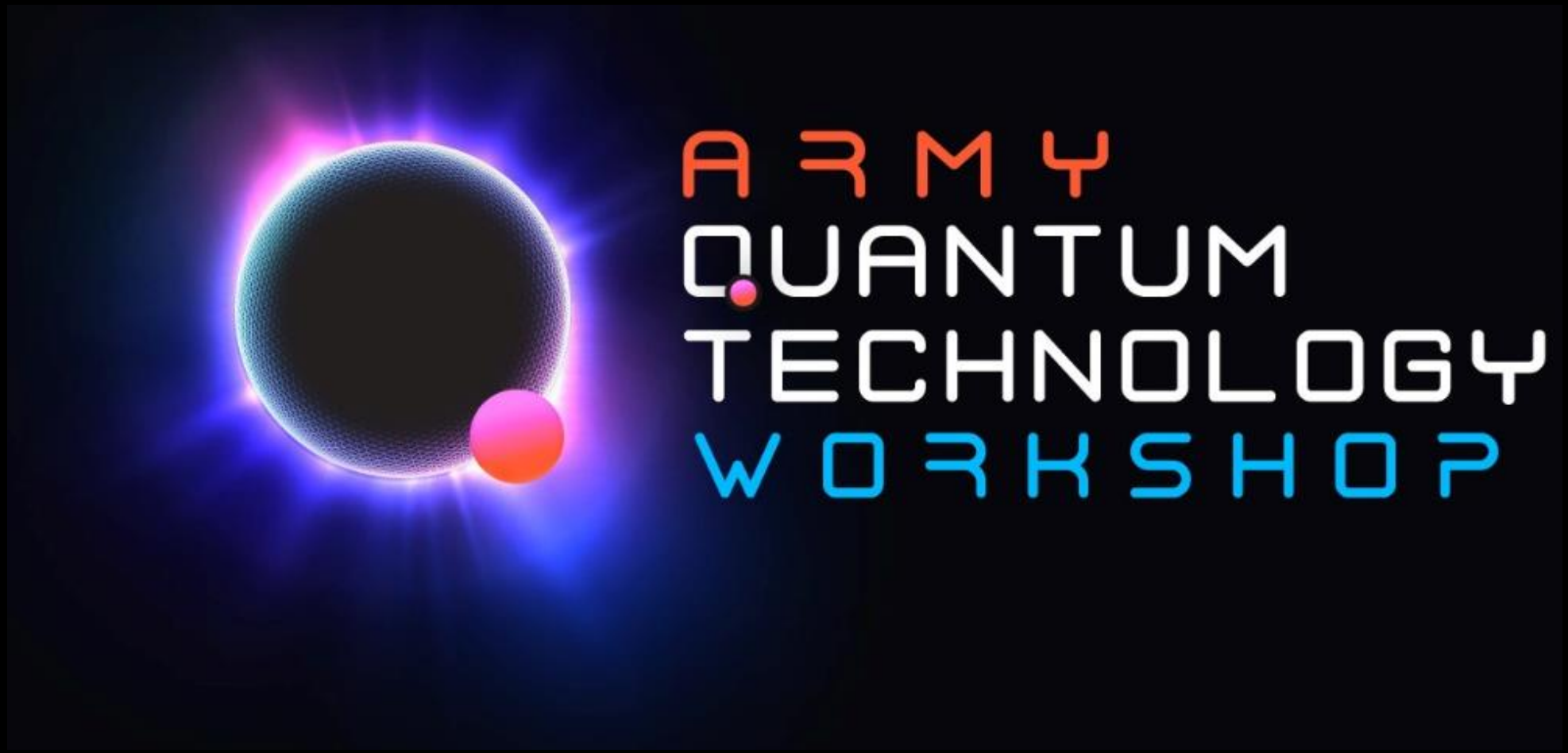
Questions?

For more information:

researchcentre.army.gov.au

Serving our Nation

Army



Small Group Meetings

- Discussion Activity 1:
  - Potential use cases of quantum technology for Army (*Focus on your own research and technology*)
    - The existing classical benchmark/ solution?
    - The comparable benefits/ advantages of the quantum technology?
    - The comparable constraints and limitations?
    - The time to demo (simulation or prototype) and time to develop?
    - What key questions must be addressed first when assessing this use case?

Small Group Meetings

- Discussion Activity 2:
  - Thoughts on some of Army's next targets:
    - Quantum sensing for maintenance, monitoring, compliance and performance enhancement
    - Vulnerabilities of quantum computers and defences
    - Quantum networking of quantum sensors for enhanced sensitivity, wide area sensing and additional functionality