Innovation within 3D Space and its Effect on Military Engineering Capability

Royal Engineer Museum

10 February 2020

www.instre.org

The Galleries

1 Early Engineers

These three rooms focus on the origins of the Royal Engineers. Their early history has an emphasis on building and destroying fortifications and this is reflected in the first room. The second room focuses on the defence of Gibraltar and the birth of the soldier engineer. The final room houses relics from the Napoleonic Wars, including the map that the Duke of Wellington used prior to the Battle of Waterloo.

2 The Victorian Galleries

This winding gallery displays how the Royal Engineers helped build and defend the British Empire using innovative new technologies like steam power and guided torpedoes. You can also see some of the things that they brought back from around the world. These range from rare Chinese silks to Zulu jewellery.

3 First World War Gallery

Here you can step into a trench and discover how the Engineers helped win the Western Front by supporting the Army. The artefacts on show demonstrate how varied their duties were: from running the Army Postal Service to experimenting with weapons like gas and flamethrowers.

4 Second World War Gallery

This section focuses on what the Royal Engineers did at home and away during the Second World War. You can see how they disposed of bombs during the Blitz, the role of Airborne Engineers in special operations, and how the tanks of the Armoured Engineers smashed Hitler's Atlantic Wall defences on D Day.

5a The Open Gallery

The Open Gallery can be accessed via the Foyer. It features a regularly changing programme of exhibitions from local artists.

5b The Temporary Exhibitions Gallery

This can be accessed via the Second World War Gallery. It features popular touring exhibitions as well as those curated by the Museum itself. Details of forthcoming exhibitions can be found on our website.

6 The Courtyard

The large inner part of the building looks at the Royal Engineers during the time of the Cold War and a declining British Empire. Here we have our large objects which include a Harrier Jump Jet, a V2 Rocket and a section of the Berlin Wall.

7 The Corps Today

On the mezzanine floor, you will find our display on the recent wars in Iraq and Afghanistan. You can see some of the equipment used by the Royal Engineers today and learn about how Camp Bastion was built.

8 The Medal Rooms

These rooms feature medals from nearly every campaign the British Army has fought in. You can also see our Victoria Cross displays and the regalia of four of the Royal Engineers who attained the rank of Field Marshal.

9 Museum Grounds

There is a lot to see outside the museum, including tanks, combat engineering machines and other military vehicles used by the Royal Engineers. There is also a First World War play tank and picnic facilities available for visitors to enjoy. Please note: the grounds are locked at 5.30pm.

10 Courtyard Café and Indoor Play Area

For those looking for a drink and a bite to eat, there's the Courtyard Café situated upstairs on the mezzanine viewing area at the heart of the Museum. The café has an children's play area, and is an ideal place to relax and refuel before exploring more of the galleries and exhibits.

WHO WE ARE

The Institution of Royal Engineers (InstRE)

The Institution was established in 1875 and in 1923 it was granted its Royal Charter by King George V. The Institution is co-located with the Royal Engineers Museum at Chatham, Kent.

The present Objects of the Institution are to promote and advance the science of military engineering and to promote the military efficiency of the Corps of Royal Engineers. In pursuit of these Objects the Institution provides a forum for debate through its sponsorship of Joint Professional Meetings; the publication of articles in its Journal; the maintenance of a Museum and Library for the Corps' heritage and archive collection; and the administration of prize funds and a memorial fund. The Institution is a Licensed Member of the Engineering Council and can currently award Engineering Technician (EngTech), Incorporated Engineer (IEng) and Chartered Engineer (CEng).

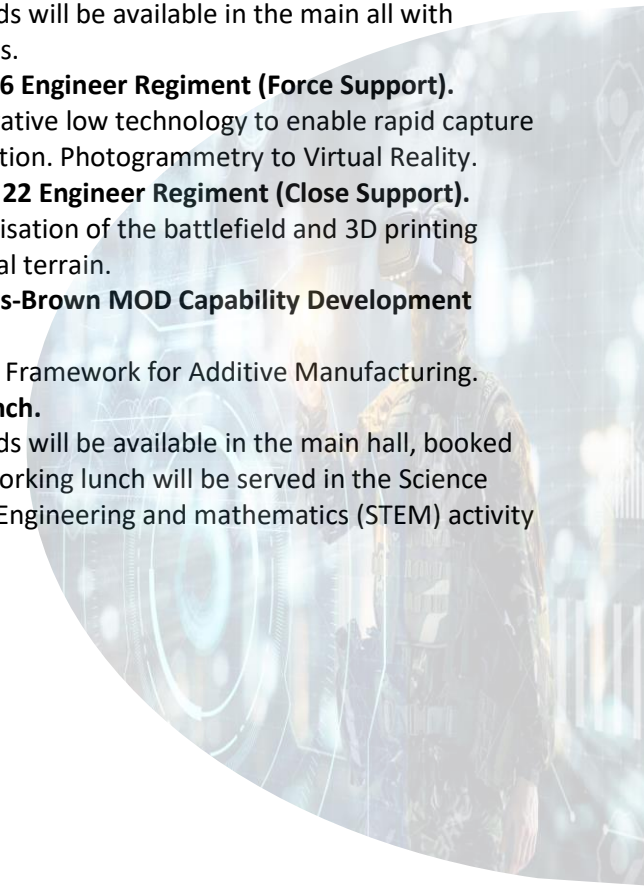
WHAT IS THE 3D ENVIRONMENT?

What is the 3D Environment? 3D Interactive environments are often referred to as virtual reality or interactive 3D and have a figurative appearance allowing interaction with other environments and physical dimensions. These can include areas such as:

1. **3D Printing** • Also known as additive manufacturing (AM). Refers to processes used to synthesise a three-dimensional object in which successive layers are formed under computer control to create an object. Objects can be of almost any shape or geometry, and are produced from digital mobile or another electronic data source.
2. **Virtual Reality** (**VR**) • Is the use of computer technology to create a simulated environment. Unlike traditional user interfaces, **VR** places the user inside an experience. Instead of viewing a screen in front of them, users are immersed and able to interact with **3D worlds**.
3. **Augmented Reality** • Is the inclusion of the real-world environment into the virtual reality environment.
4. **3D Scanning** • Is the process of analysing a real-world object or environment to collect data on its shape and possibly its appearance (e.g. colour). The collected data can then be used to construct digital 3D models.
5. **Photogrammetry** • Is the art, of obtaining information about physical objects and the environment through the process of recording and interpreting photographic images and patterns of electromagnetic radiant imagery to create a point cloud inside a virtual environment.

EVENT SCHEDULE

0900 -0930hrs:	**Attendee Arrival.** Industry and unit displays are located in the main hall alongside refreshments.
0930-0950hrs:	**Opening Address.** Parish notices followed by the Commandant RSME opening address.
0950-1030hs:	**Capt Bass 42 Regiment Engineer Regiment (Geographic).** Military 3D surveying capability via traditional and drone data capture and data exploitation via analytical software.
1030-1110hrs:	**Maj Fry 170 (Infrastructure Support) Engineer Group.** Development of building information modelling and initiative thinking in a military environment.
1110-1125hrs:	**Refreshment Break.** Display stands will be available in the main all with refreshments.
1125-1200hrs:	**WO2 Egan 36 Engineer Regiment (Force Support).** Use of innovative low technology to enable rapid capture and exploitation. Photogrammetry to Virtual Reality.
1200-1240hrs:	**Capt Turner 22 Engineer Regiment (Close Support).** Urban visualisation of the battlefield and 3D printing topographical terrain.
1240-1300hrs:	**Lt Col Anders-Brown MOD Capability Development Director.** British Army Framework for Additive Manufacturing.
1300-1330hrs:	**Working Lunch.** Display stands will be available in the main hall, booked attendees working lunch will be served in the Science Technology Engineering and mathematics (STEM) activity room.



1330-1410hrs: **Lt Col McDonnel Chief of Staff (COS) Royal School of Military Engineering (RSME).**
RSME led visit to the RSME innovation makerspace laboratory. A coach will leave at 1330hrs from outside the Museum, for a 40 visit to the innovation laboratory, all are welcomed to attend.

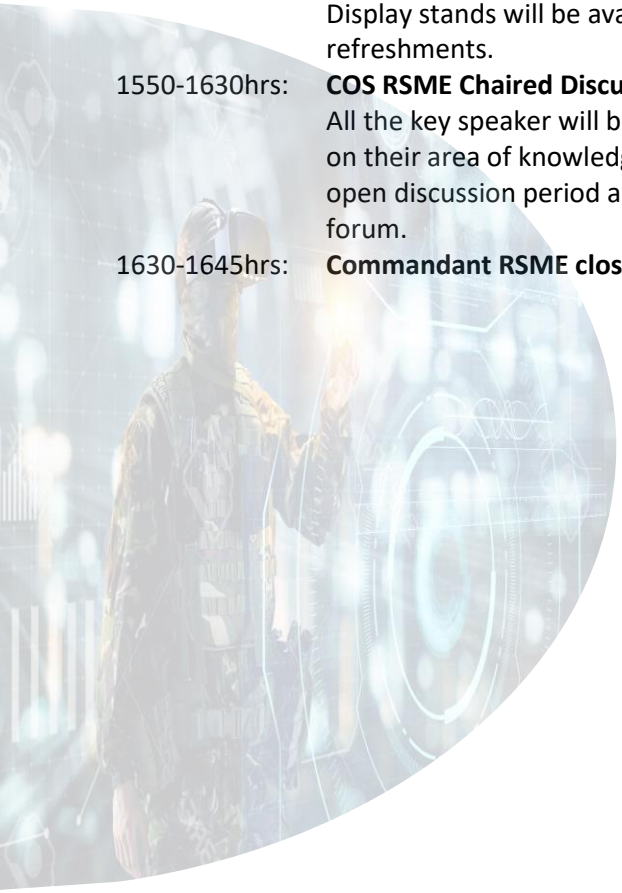
1410-1450hrs: **Mr Cross Rail.**
Adapting for a traditional design and management framework to collaborative 3D BIM industry.

1450-1530hrs: **Maj Delaney Officer Commanding Royal Engineers Trials and Development Unit (OC RETDU).**
The future military need and routes to drive innovative solutions to military capability.

1530-1550hrs: **Refreshment Break.**
Display stands will be available in the main all with refreshments.

1550-1630hrs: **COS RSME Chaired Discussion Group.**
All the key speaker will be available to answer questions on their area of knowledge in 3D space capabilities. This open discussion period aims to collaboration in an open forum.

1630-1645hrs: **Commandant RSME closing address.**



BIO'S

Brig Rowell

Commandant Royal School of Military Engineering

Originally from Zimbabwe I joined the British Army on relocating to the UK. His early career took him to Germany in 21 Engineer Regiment, where he served in a number of roles including leading a troop on the fire-fighting strikes in the UK.

As a major I worked in the Ministry of Defence and the Army Headquarters before taking over 31 Armoured Engineer Squadron as the Officer Commanding in Germany and operations in Iraq. On leaving 32 Engineer Regiment he took up the role of deputy chief of staff for 4th Mechanised Brigade facilitating exercising in the UK, Canada and operations in Afghanistan were the key activities leading to be awarded the MBE. After attending the Advanced Command and Staff Course he moved to Army HQ writing concepts on the future of warfare and the Army before returning to 32 Engineer Regiment as Commanding Officer initially in Hohne, Germany and then in Catterick, North Yorkshire was incredible; with deployment in Canada, Cyprus, the Falkland Islands, Germany, Spain and Kenya – not to mention the flood responses in North Yorkshire. Returning to the Army Headquarters in 2016 as a colonel leading a team driving forward the Army's research and experimentation programme; robotic and autonomous systems and designing the Army of the future. Attending the Higher Command and Staff Course in 2018 before taking up his present post as Commandant of the Royal School of Military Engineering Group in August 2019. The Group delivers training for leadership, combat and artisan skills of the Royal Engineers; search, explosive and ordnance disposal; counter-chemical, biological, radiological and nuclear, military working animals and Army musicians. Each year approximately 10,000 personnel from across Defence and over 100 animals pass through the Group's schools and units. Part of the Group is supported by a highly successful £3.2bn, thirty-year public-private partnership.

Capt Bass

OC Special Support Team (SST) 42 Engineer Regiment (Geographic)

A Geospatial Intelligence (GEOINT) MSc qualified officer, Capt Joe Bass commands the SST within 42 Engineer Regiment (Geographic). SST is responsible for providing deployable geospatial support to United Kingdom (UK) operations at extremely high readiness,

	including the ability to operate a number of unique capabilities in Chemical Biological Radiological Nuclear (CBRN) contaminated environments. Prior to specialising in GEOINT, Capt Bass served as a Troop Commander in 70 Gurkha Field Squadron and subsequently as a Phase 1 Troop Commander at Army Training Centre Pirbright. He is a keen mountaineer, skier and climber and spends more time than he probably should on Adventurous Training expeditions.
Maj Fry	**OC 527 Special Team Royal Engineers.** Is a Professionally Qualified Chartered Engineering with a wealth of experience across the military engineering discipline and was previously the Senior Instructor Force Protection Engineering at the Royal Engineers Professional Engineering Wing. He is presently serving as Officer Commanding 527 Special Team Royal Engineers, leading 170 Infrastructure Support Groups digital innovation team.
WO2 Egan	**QMSI Construction 36 Engineer Regiment.** A Fellow and Trustee of the Institution of Royal Engineers with over 24 years' experience serving in the Corps of Royal Engineers. Since returning from the role of Principal Engineer in South Sudan at the beginning of 2019, he has been researching innovative solutions to incorporating digital and sustainable practises into the military engineering practises, to reduce the exposure of risk to UK MOD personnel and enable future operations.
Capt Turner	**Intelligence Officer 22 Engineer Regiment.** Captain Benjamin Turner is the Engineer Intelligence Officer (IO) at 22 Engineer Regiment and within the 20th Armoured Infantry Brigade HQ (20X). After reading Politics and Parliamentary Studies at the University of Leeds, he worked in Congress for the House Foreign Affairs committee and in Parliament for Robert Walter MP. Commissioning into the Royal Engineers in 2015, Captain Turner spent his troop command at 101 Engineer Regiment (Explosive Ordnance Disposal), where he completed his Defence Explosive Ordnance Disposal Operators courses. He deployed on Operation SHADER 7 as OC Counter- Improvised Explosive Device (C-IED) in the Kurdish Region of Iraq, fulfilling the role of J3/5 C-IED in the Kurdish Training Co-ordination Centre (KTCC) and running the UK IED Tactical Exploitation Facility. Since posting to 22 Engineer Regiment, he has deployed as the Engineer IO in 20X where he leads the

	Engineer Geographic Cell; it was through this role, his concept for 3D printing topographical terrain was developed.
Lt Col Anders-Brown	**MOD Capability Development Director.** A Chartered Mechanical Engineer and Fellow of the Institute of Mechanical Engineers, with a long successful career in the REME. An experience strategic and operational engineering leadership and management in complex and dynamic environments, including military operations in Afghanistan, Bosnia-Herzegovina and Cyprus with the United Nations. Extensive experience of Change and Programme Management.
Lt Col MacDonald	**Chief of Staff Royal School of Military Engineering** Lt Col Bob MacDonald commissioned into the Corps In April 1998 having read Civil Engineering at Plymouth University. He deployed as a Troop Commander to Gibraltar, Kuwait and Egypt for construction Tours, and on posting to 26 Engineer Regiment deployed to Kosovo as the Recce Troop Commander, moving to Squadron second in command deploying to IRAQ in February 2003 on vanguard operations with 16 Air Assault Brigade. He conducted a second tour of Iraq during 2004 before commencing Professional Engineer Training and gaining Chartered Engineer status in 2006. During his civilian placements in the UK saw him working as a Project Engineer with Laing O'Rourke and as a Design Engineer with Giffords. Following Staff College and the Force Protection Engineering Course, he assumed command as Deputy Commander Royal Engineers at RAF Odiham deploying to Afghanistan in 2008 to produce the UK Infrastructure Development Planning. He returned in 2009 to Afghanistan to command a Specialist Team Royal Engineers as Programme manager for UK infrastructure delivery in Helmand. He subsequently completed tours as a Staff Officer within 8 Engineer Brigade Headquarters a second command tour with 170 (Infrastructure Support) Engineer Group and a tour in Army HQ as the senior Force Protection Engineering. On promotion his last post in the Field Army was as Deputy Command of 12 (Force Support) Engineer Group. He has just finished 3 years in the Manoeuvre Support Capability branch in Capability Directorate Ground Manoeuvre. His current appointment is now as the Chief of Staff for the Headquarters Royal School of Military Engineering which includes being the Contract Management lead for the RSME/Holdfast PPP.

Mr Iain Miskimmin

Digital (BIM) Advisor

With over 20 years' experience working in infrastructure, most notably as a Digital (BIM) Advisor involved in the UK Government's BIM task group and the Crossrail Program of works. Delivering advice worldwide to governments, major projects, owners, contractors and supply chain organisations on how to improve productivity through digital means. Running the Crossrail Information Management Academy, he helped inform and shape the direction of BIM on a global level. Iain also runs the COMIT construction innovations initiative, which has been striving to change our industry's culture for 17 years. He is also a reservist with 26 years of both Engineering and Infantry experience, recently transferring into 65 Works Group, part of 170 (Infrastructure Support) Engineer Group.

Maj Delaney

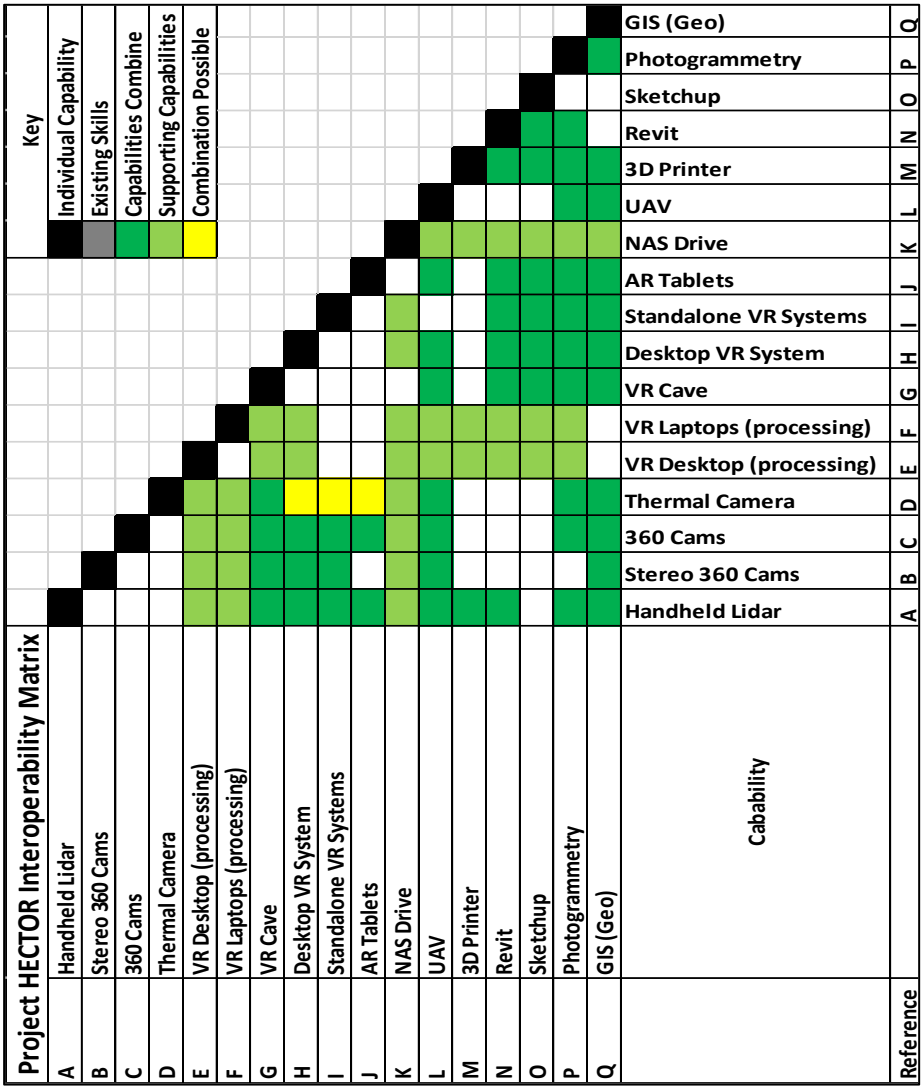
OC Royal Engineers Trails and Development Unit.

Major Tel Delaney joined the Corps as a Sapper in August 1987 and was initially posted to 1 Field Squadron, 21 Engineer Regiment, Nienburg Germany in April 1988. During his career he has completed operations in Kuwait, Northern Ireland, Bosnia-Herzegovina, Kosovo, Iraq, Afghanistan and Somalia, and has served as Squadron Sergeant Major 31 Armoured Engineer Squadron and Regimental Sergeant Major 73 Engineer Regiment. In 2008 he was awarded the Meritorious Service Medal for his commitment to operations.

Commissioning in June 2009, his first appointment as a Captain was as SO3 Trg Resources at Defence School of Transport, Leconfield. Subsequent employments as SO3 ARRC at HQ British Forces Germany, JHQ Rheindahlen and SO3 J2/Engr for Operation BACKWELL in Mogadishu, followed prior to attending ICSC(L) at JSCSC Shrivenham. On completion of staff training he took up appointment as SO2 Mil Engr Ops at the Royal Engineers Warfare Wing prior to taking command of 591 (Air Assault) Field Squadron Royal Engineers, Bangor, Northern Ireland in June 2017. During command, he expanded the sub-unit in line with Army 2020(R) and deployed the Squadron to Belize and Poland as part of a Joint Multi-National Exercises. On completion of squadron command in Jun 19, he took up appointment as OC RETDU in Minley.

COLLABRATIVE WORKING

The aim of this conference is to promote collaborative working and to drive innovation ideas towards becoming real capabilities within the Royal Engineers and wider Defence. The following snap shots show areas where collaborative can enable success not just in are infrastructure but across the engineering discipline. We hope theses pieces will assist in facilitating questions across the day's events.



DIGITAL SUPPORT TO IPE

1. Observe
Data collected from sensors mounted on UAVs and UGVs and used to create a 3D model

2. Detect
Automated detection of anomalies or Objects of Interest in the 3D model

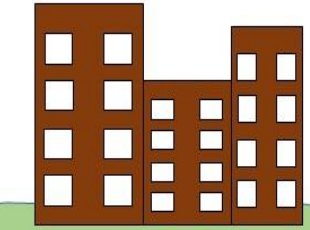
Decision Support

3. Define
3D model used to define the problem

4. Concepts
Solutions collaboratively developed in the 3D model

5. Assessment
Solutions war gamed and simulated in the 3D model

6. Detail Design
Final selection and refinement of the plan



7. Future: ROC Drills/ Rehearsals
3D models enable:
- Plans to be communicated and rehearsed through use of Virtual Reality
- Digital Scheme of Manoeuvre to be sent to supporting UGVs and UAVs

8. Future: In-Mission Support
3D models enable:
- Real time Common Operating Picture and control of tactical unmanned assets
- Personnel on the ground to be guided using Augmented Reality

9. Review
Data collected during the mission used for After Action Reviews and Collateral Damage Assessments

10. Retain and Exploit
Plans and 3D models, along with scores of effectiveness, saved for use in future operations

CONTACT DEATAILS

The Institution of Royal Engineers
Brompton Barracks, Chatham
Kent, ME4 4UG
Tel: 01634 822371

Please tell us what you think of this event, our publications, our organisation, or anything else that comes to mind. We welcome all of your comments and suggestions.

Chief Executive	ChiefExec@InstRE.org	Jon Acornley
Registrar	Registration@InstRE.org	Nick Larkin
Assistant Registrar, Membership and Admin	admin@InstRE.org	Jason Farnell
Registration Enquiries & book orders	a.inst@InstRE.org	Emma Murphy
Journal	journal@InstRE.org	Nigel Montagu
Supplement	supplement@InstRE.org	Hazel Whamond
Sapper Magazine	sappermag@rhqre.co.uk	Beverley Kelly
Royal Engineers Officers' Widows Society	secretary@reows.co.uk	Nick Mifsud

Today's event was organised by:

InstRE Trustee (Elected Member)	Peter.Egan293@mod.gov.uk	WO2 Peter Egan

If you have any recommendation for a future event topic or wish to speak at an event, please let the organiser know.

www.instre.org