Managing distributed training events – lessons learned from the Mission Training through Distributed Simulation Capability Concept Demonstrator

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ABSTRACT

The UK Ministry Of Defense (MOD) has a vision of providing Mission Training through Distributed Simulation (MTDS) for the air component of the joint battlespace. The MTDS Capability Concept Demonstrator (CCD) programme was funded to determine the key requirements for this system, which included understanding the range of training achievable. A demonstrator facility was developed including fast jet and Airborne Warning and Control System (AWACS) simulators, and an extensive exercise management capability (including virtual role players and Computer Generated Forces). A synthetic air battlespace (air, land and maritime) was created for the exercises and the MTDS CCD was connected to national and international facilities, all operating within a shared virtual world. Critical to the delivery of training was exercise management. As the programme matured and the training audience expanded to increasingly joint air-land-maritime coalition warfighters, the exercise management model used evolved. The core "White Force" (WF) team was led by an Exercise Director supported by Red and Blue Force leads, a Technical Liaison Officer (TLO) and an Exercise Management Officer (EMO) in an adapted command room. As necessary, 'Role Specialists', such as intelligence officers, supported the training to provide expert input. White Force Liaison Officers (WFLO) were visible points of contact at distributed sites. Critical factors identified in the successful delivery of training were a dynamic and responsive environment with an intuitive chain of command. Decentralised execution was critical without compromise of the Exercise Director's 'big picture'. Hence, a 'centralised control, decentralised execution' model was the optimum solution. The key tenets of clear accountability, centralised planning, and a simple but modular command structure, can be adapted for use in future distributed training events and help inform a common approach.

ABOUT THE AUTHORS

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James Kearse is a business development manager within the Simulation and Training group, Farnborough. He joined QinetiQ in 2004 as a training analyst supporting land collective training research for the UK MOD. In 2006 he joined the MTDS CCD programme, and spent much of the next 3 years on this project, while continuing to support land programmes. He was responsible for delivering large sections of the MTDS CCD research, focusing particularly on the training value, exercise management and operational utility areas. Following the successful completion of the programme in 2009 he assumed a new role as business development manager for QinetiQ's augmented reality technology.

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INTRODUCTION

Since the end of the cold war, the environment faced by military warfighters has become increasingly challenging. Not only have threat systems continued to improve in effectiveness, but today's warfighters have to operate under complex rules of engagement, with a lack of clear distinctions between combatants and non-combatants. In the air domain, UK personnel are increasingly required to interoperate with land, maritime and coalition assets within a multi-dimensional command and control environment. The degree of co-ordination required to achieve mission success in this complex battlespace requires specific skills. The key is providing an environment in which personnel from diverse backgrounds can come together to plan and execute air battlespace operations.

Recognition of the importance and benefit of coalition training in the UK was reflected in the RAF Air Policy documents:

"Coalition Capability. Military forces employing air power systems generally share commonality of purpose, training and outlook….Based on this large measure of commonality, air power can be integrated into combined forces for multinational and coalition operations. Likely coalition partners may have similar doctrine and may train and exercise together on a regular basis. This synergy, coupled with the use of English as the internationally agreed language of the air, can represent an important force multiplier."

In the UK, the requirement had been articulated for the delivery of collective mission training[1] to front line aircrew. Typically, this training was only provided through live flying exercises, e.g. RED FLAG in the US or UK based Tactical Leadership Training. Often, aircrew will experience the complexities of large scale military operations for the first time in theatre when doing it for real.

In the early 2000s the UK MOD funded research to demonstrate that a network of synthetic training devices could be used to deliver cost effective, realistic and immersive collective mission training (Smith, 2003). Several exercises were conducted led by the Defence Science and Technology Laboratory (Dstl) linking to the Air Force Research Laboratory (AFRL) in Mesa, Arizona. These exercises proved that appropriate simulator technology existed, that training could be delivered and that the technical challenges of long haul distributed simulation could be overcome. In the US, collective distributed training technology and processes (Bennett and Schreiber, 2005; Gehr et al, 2005) had matured significantly and the 'train as you fight' philosophy was endorsed by these developments.

Consequently, the UK Mission Training through Distributed Simulation (MTDS) programme was born; however, many questions about its implementation remained to be answered.

MTDS CCD

In 2005 the UK MOD instigated the MTDS Capability Concept Demonstrator (MTDS CCD) programme to de-risk the delivery of UK MTDS. The aim of the MTDS CCD was to provide evidence-backed answers to a set of Key Investigative Areas (KIAs), through a series of experiments, using a contractor-owned demonstration facility situated at RAF Waddington.

The KIAs broadly broke down into 5 themes:

- Overall functionality of the system, including fidelity and debriefing requirements

[1] NATO SAS-013 defined the term collective mission training as "two or more teams training to interoperate in an environment defined by a common set of collective mission training objectives, where each team fulfils a different military role".

- Networking and security, including linking to US training systems
- Maximising utility, in terms of how best to deliver what types of training
- Scale and scope, including boundaries and collocated versus dispersed training
- Contractual and commercial, including how to contract for a future capability

In October 2005, having won the competition, QinetiQ formed Team ACTIVE (Aircrew Collective Training through Immersive Virtual Events) to bid and deliver the programme with a team that included Boeing, cueSim, Rockwell Collins, Aviation Training International Limited (ATIL) and HVR Consulting.

This paper will focus on the management of the training delivered in the facility; many of the other KIAs have recently been presented elsewhere (Saltmarsh and Mackenzie, 2008; Mackenzie, 2008; Costello Wg. Cdr, 2009; Dudfield et al 2009; Kearse et al, 2009).

THE MTDS CCD FACILITY

The MTDS CCD facility consisted of eight fast jet simulators, four Typhoons and four Tornado GR4 aircraft, a seven seat AWACS capability, and a comprehensive exercise management and control suite. A 40-seat briefing and de-briefing room and a selection of smaller planning rooms were provided. These incorporated standard in-service planning aids and video conferencing, telephone and smart board technology so that the subjects could undertake a condensed cycle of planning, briefing, execution and debriefing (PBED). A networking hub allowed for secure connections to other training facilities in the UK, US and worldwide.

EXERCISES

The exercises conducted were large in scale and driven by the requirement to evaluate the training value of MTDS through the KIAs. In meeting this goal there was a requirement to involve trainees and role players at tactical, operational and strategic levels in the virtual theatre of war. Events were planned with a range of primary and secondary training audiences.

Each phase of the MTDS CCD was unique but relied heavily upon the infrastructure and experience gained from the previous phases. Phase One built, integrated and accredited the baseline capability. In Phase Two, four Team and Collective Training: exercises were completed. By Phase Three, significant, more complex events were conducted to analyse, evaluate and determine a robust exercise management approach.

Training participants were drawn initially from the fast jet community (Table 1).

Table 1. MTDS CCD training participants.

EXERCISE / Location and Roles	BATTLE BUZZARD	CONDOR CAPTURE	NORTHERN GOSHAWK	ARCTIC OWL	AVENGING EAGLE
UK Tornado GR4	*	*	*	*	*
UK Typhoon				*	*
US Distributed Missions Operation Center (DMOC) F15e			*		
US F15c Langley					*
US AFRL F16	*	*	*		*
US A10 Spangdahlem					*
US A10 Mesa					*
US AWACS Tinker					*
UK AWACS				*	*
UK Attack Helicopter				*	
UK Type 42 Fighter Controllers (FCs)				*	
UK Intelligence Officers			*	*	*
UK Joint Force Air Component (JFAC) mini combat ops		*			
UK Forward Air Controller (FAC)	*				*
US Joint Terminal Attack Controller (JTAC)		*			
Canadian FAC			*		
US DMOC Control and Reporting Centre (CRC)			*		
US DMOC AWACS			*		
UK Air Support Operations Centre (ASOC)		*			
US DMOC VSTARS			*		

As the programme matured, participants from joint and coalition elements were increasingly involved.

EXERCISE MANAGEMENT OVERVIEW

The model of Exercise Management demonstrated during the MTDS CCD programme had evolved from earlier MoD research (Smith, 2003). In each exercise, the White Force (WF) drove the training audience through a condensed cycle of PBED akin to that demonstrated during live collective training events. During these earlier events, the WF had been provided by UK Air Warfare Centre tactics and training personnel. This ensured that experts in the relevant domains were provided to develop the scenario and control the mission execution phase in real time. Later in the research programme, the model was adapted to meet the needs for distributed multinational training by providing WF Liaison Officers (WFLOs) for the remote sites.

The WFLO role was shown to be critical in meeting dispersed training needs. Tasks undertaken by WFLOs during the MTDS CCD programme included:

- Acting as a conduit for information of all kinds;
- Operating Planning, Briefing and Debriefing (PBD) equipment;
- Providing support to planning activities of the training audience (e.g. creating timelines);
- Role playing functions to support the training audience; and
- Reporting to the 'hub' site on technical faults throughout the exercise.

This model was used throughout the MTDS CCD and, while it was refined to accommodate different types of training (e.g. joint), it proved robust and flexible in most cases. Unlike earlier research, the majority of the WF was provided by an RAF contractor[2]. The WF featured many of the same individuals from the previous research programme, providing continuity.

A key tenet of the exercise management philosophy developed under prior research and through the MTDS CCD programme is the concept of "centralised control, decentralised execution" as described in the RAF Air Power doctrine (AP3002):

- Centralised Control: Executive authority for planning, co-ordinating and directing air and space capabilities is placed with a single commander. This single point of contact oversees the prioritisation, synchronisation and integration of all assets, thus avoiding the duplication of effort. This model is commensurate with another principle of C2, "Unity of Command", where a single commander retains the broad focus to balance training requirements as necessary;
- Decentralised Execution: While a single commander retains control, authority for execution is delegated to sub-ordinate personnel who are better able to make on-scene decisions at a low level in line with an overall directive or WF 'game plan'. This means that responsiveness is retained and exercise management is fluid enough to cope with dynamic scenarios.

The initial model for MTDS CCD was based on earlier experiences and for the co-located team was headed by a Blue force leader who also retained overall executive control of the event. Following EXERCISE BATTLE BUZZARD, separate individuals were allocated the roles of Blue force lead and Exercise Director, as it was observed that it was too demanding for one person to lead the blue force and maintain overall control of the scenario. A flow of authority to the single point of command, the exercise director, was clearly established.

A key element then was the provision of a core WF team including a single individual in charge of the event (Exercise Director); supported by Red and Blue Force leads, a Technical Liaison Officer (TLO) and an Exercise Management Officer (EMO). A high degree of integration between the Exercise Director, TLO and EMO was observed as the MTDS CCD programme progressed, with these three individuals forming an 'executive team' within which the key decisions were made (Figure 1).

[2] http://www.inzpire.com/

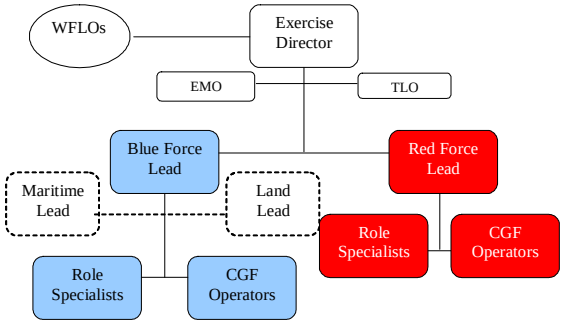

Figure 1. MTDS CCD final WF structure

This 'core' White Force team had significant experience in the air battlespace training domain with a wealth of current tactical experience to stimulate the training audience and maximize their learning. The team was competent in MTDS and understood how to mitigate the effects of distributed joint synthetic training (e.g. the effects of dispersion). Here communication of intent (EMO) must be joined up with technological performance (TLO) as represented in Figure 2.

The WF structure endured throughout the event and was appended with Subject Matter Experts (SMEs), known as 'Role Specialists' from the relevant domains to provide expert input. Additionally, for the larger events a Land SME was appointed as "Land Lead" and for EXERCISE ARCTIC OWL, a Maritime Lead was appointed.

Figure 2: Centralised exercise director supported by his red and blue lead and TLO.

Other management roles not included within the core WF team included an Information Manager (IM) managing the large amount of information associated with an event, including administrative documentation and planning data. This role became increasingly significant to assure timely coordination of the documentation to all dispersed sites.

The importance of a WFLO as a visible point of contact at distributed sites was emphasised during the MTDS CCD. Indeed, providing single, identifiable points of contact within the WF is best practice.

EXERCISE MANAGEMENT ROLES

As the range of warfighter participation and sites involved increased, exercise management roles evolved to support the training participants' needs. The central WF team managed collocated and dispersed role specialists and Computer Generated Forces (CGF) operators (Table 2). These roles became ever increasingly joint and specific as the range of training expanded as can be seen in the changing roles required for the different exercises.

Table 2. Exercise Management role players, CGF operators and virtual players.

EXERCISE White Force elements	BATTLE BUZZARD	CONDOR CAPTURE	NORTHERRN GOSHAWK	ARCTIC OWL	AVENGING EAGLE
Intelligence officer; WFLO; SEAD; F3 and Land CGF; Unmanned Air Vehicle (UAV) RP; Ground Based Air Defence; and Red air virtual player; Support Helicopter; TAC AT	*	*	*	*	*
Land Force Commander		*		*	
AWACS fighter controller	*				
AWACS weapons control team	*	*			
Maritime Force Commander				*	
JFACC (JFAC commander)	*	*			
JFAC mini combat ops team	*	*			
F15-C	*				

EXERCISE White Force elements	BATTLE BUZZARD	CONDOR CAPTURE	NORTHERRN GOSHAWK	ARCTIC OWL	AVENGING EAGLE
FAC Role Player (RP)	*				*
Harrier RP				*	
AH 64 RP			*		
C130 virtual				*	
CH-47 RP					*
Air Traffic Control RP		*	*	*	*
Combined Air Operations Centre (CAOC)			*	*	*
ASOC	*		*	*	*
SIGINT				*	*

For UK MTDS, this may mean that a consistent core team is needed for the majority of events with flexibility retained to accommodate a wide range of training scenarios. Some role specialists (e.g. Fast jet SMEs) are likely to be permanent roles, as they will be required for the majority of events. Others will only be required occasionally (e.g. joint SMEs).

The requirement to balance manpower costs, availability and operational currency will mean that a mixture of military and trained civilian manpower is required. Giving the WF multiple responsibilities (e.g. Blue Force lead and advisor to civilian CGF operators) is one cost-effective way to maximise the output from a given group and was successfully demonstrated in the MTDS CCD programme. Care needs to be exercised to ensure that individuals are not overloaded.

RED FORCE ROLES

The opposing force played a key role in challenging the training audience and ensuring training benefit was provided. Reflecting on the MTDS CCD, the opposing force (referred to as the 'Red Force', although multiple opposing forces could in theory be provided) is likely to come under the control of the Red Force lead. However, the relationship between the Red Force lead and the Blue Force equivalent must not be competitive; a high degree of coherence between Red and Blue WF leads is required to ensure training benefit is provided. This was especially true with the red virtual players who were often highly experienced and constantly needed to maintain their red plan while confirming their tactics with the red lead to meet training objectives (Figure 3).

Figure 3. Red Air role player stations used in EXERCISE CONDOR CAPTURE

The size and composition of the opposing (Red) forces will vary considerably according to the training requirement and the needs of a particular training audience.

CGF provide a large volume of entities to oppose the Blue Force, and provide wider context to their air picture as detected by a platform's sensors and as replayed in the debrief. CGF air entities must have representative performance, weapons, and tactics in order to provide a credible threat service to the training audience.

Providing opposing forces using virtual role player stations provides a higher degree of representative performance and greater flexibility. The number of manned, role-played entities will be relatively low in volume to minimize the costs of providing the WF.

BLUE FORCE ROLES

A key cost driver is the manning required for Blue (friendly) forces. Due to cost and availability, it was worth considering if Blue force roles could be replaced by non-military operators. This 'force mix' required for a given training scenario, should define the optimal mix to meet the range of training types (team, collective, joint and combined).

The optimal mix of expert Blue Force role specialists and non-specialist CGF operators will vary according to the scale of MTDS events and the associated

training objectives. As such, flexibility within any manning solution will be essential.

In broad terms, Blue force personnel were divided into two categories:

• Role specialists: Experienced military or ex-military personnel who utilise specific domain knowledge to support the training audience, both during the mission execution phase (through voice inputs etc) and through a degree of 'coaching' during the planning phase. These may also be drawn from multi-national partners, as demonstrated in MTDS CCD events, further de-risking coalition training.

• CGF operators: Non-specialist (typically civilian) personnel who, with a robust training programme and the support of role specialists, operate CGF systems.

The MTDS CCD used a combination of these two categories of personnel with a successful outcome.

It was found that the ad hoc training benefit accorded to some military role players during the MTDS CCD suggested that expert role players could constitute a secondary training audience in some cases. Further, the participation of role players in events also provided unique opportunities for cross-chain training. For example, participation of the UAV as a role player was endorsed by the fast jet participant's providing valuable insight into joint COMAOs.

EXERCISE PROCESS

Preparation

The novelty, scale and complexity of exercises required that the planning process for each event began many months before with a series of co-ordination meetings for face-to-face planning. Subsequently, exercise planning materials were produced including:

- The Trial Instruction includes the aim of the event, the KIAs to be investigated and detailed the technical elements;
- The intelligence background to the event;
- SPINS, special instructions are essential and there was value in reusing these in a playbook;
- Airspace Control Order (ACO), a key input to mission planning for collective training events;
- Political, doctrinal, capability and economic info for each of the participating nations;
- A daily datasheet specifying platforms and scenario details;
- An exercise timeline including the relevant trigger events; and
- WF Concept of Operations (CONOPS) detailing the key daily PBED activities, including the organisations, equipment and outputs required.

The exercise week was preceded by testing and integration activities and two familiarisation days. A familiarisation process was undertaken during which WF and technical personnel introduced the training audience to the CCD facilities and allowed them to gain experience of the relevant systems.

Exercise execution

Typically, four exercise days were undertaken, each of which included a cycle of PBED activities. The exercise scenario developed over the course of the week within the context of an escalation to conflict. The final day was designated a debriefing session in which technical staff, WF and representatives from all elements of the training audience discussed the relevant lessons from the exercise week.

Daily Flow

During the training day, a daily flow of activities developed to address the needs of the expanding roles and responsibilities the final exercise shown in Figure 4. By the end of the MTDS CCD, this included representations from all key elements, air, land and maritime, as required.

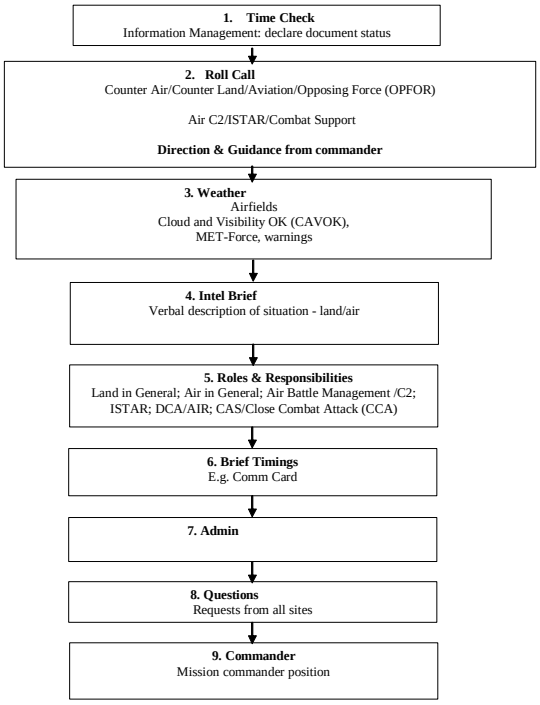

Figure 4. Daily Flow of warfighter activities

Wrapped around these training participant events were a series of actions based around the core WF. Each day, the tempo and nature of preceding days would be analysed and plans adapted to ensure training needs were being met. This included 'Honest Joes' (open forums to discuss any significant training or technical issues) to raise issues and highlight any limiting factors. It also included liaison with WFLOs at the dispersed sites before and after major events using Video Tele Conferencing (VTC) technology and shared white boards.

EXERCISE MANAGEMENT ROOM

The Exercise Management facility was originally a single large room co-locating the whole of the WF within the MTDS CCD in a single space to allow for ease of communication between all members. During the MTDS CCD, this arrangement went through a number of reconfigurations exploring different physical layouts to allow for optimal WF exercise control. Some of these changes reflected the reorganisation of the core team so that red and blue leads had a clear line of collocated role players and CGF operators in their view. It also led to the centralisation of the exercise director and TLO as illustrated in Figure 5 and 6.

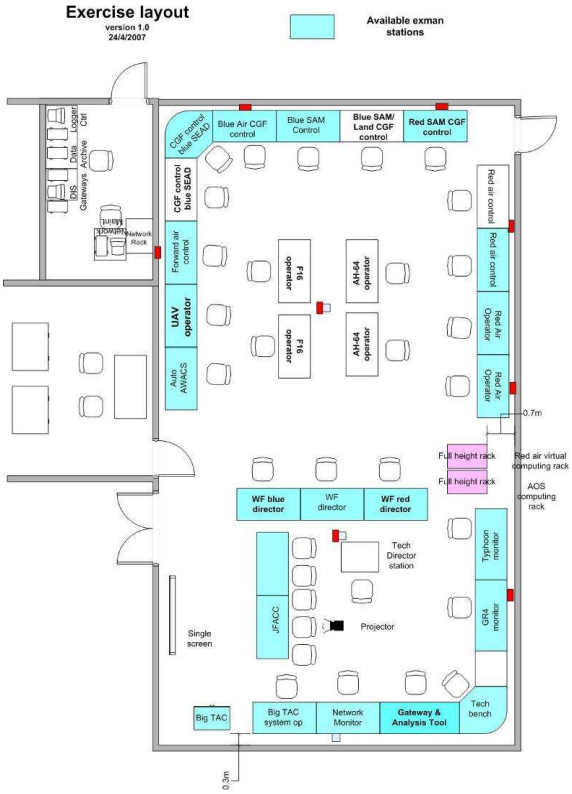

Figure 5. MTDS CCD final exercise management room layout.

As the training audience expanded and became increasingly joint, more role players were required and reorganisations of the exercise management room occurred to manage these additional roles against the command structure.

Figure 6. Overview of the core WF facing the technical team

Technical stations were positioned in front of the Exercise Director so that he could easily access support and provided a clearer delineation between WF

members and those supporting the execution technically.

Planning Briefing and Debriefing

One of the essential roles of the WF was to act as the overseer of the training lessons being learnt and to facilitate the sharing of these in mass debriefs (Figure 7). The WF also coordinated with the IM in the timings and information during mass events and maintained a presence to assure smooth running as participants joined in each event via VTC across the dispersed sites.

Figure 7: Mass Debrief room

Blue role players were also part of the blue planning process and involved in all blue activities, such as when brainstorms were held with dispersed players. Here, they assisted in the immersion of trainees by adding role-specific information to the plan (Figure 8).

Figure 8: Blue force planning room

EXERCISE OUTCOMES

The combined capability resulted in a number of substantial leaps of understanding for MTDS. The exercise management model was the foundation stone that managed the inclusion of new sites, new roles and training participation from joint and combined domains. Notable examples of this include:

- In EXERCISE BATTLE BUZZARD, there was a first interaction between the Forward Air Controller (FAC) and RAF aircrew trainees in a UK and US synthetic training trial.
- EXERCISE CONDOR CAPTURE demonstrated the potential operational utility of wider role participation from the operational chain, including Intelligence and Joint Forward Air Component (JFAC) mini combat operation cell participation, and the benefit of cross-capability joint training, including the UAV and fast jet cooperation.
- During EXERCISE NORTHERN GOSHAWK, as well as the US AFRL linkage, a Canadian FAC participated and a link to US Distributed Mission Operations Command was achieved.
- EXERCISE ARCTIC OWL demonstrated the joint interaction of Air Force (AWACS, GR4, and Typhoon), Navy (Type 42 controllers) and Army (Apache helicopter) elements, emphasising the potential of UK MTDS to support a tri-service training requirement.
- EXERCISE AVENGING EAGLE was the most complex distributed combined training event. In total, four US Air Force sites in the US and Europe participated, facilitated by the US Distributed Mission Operations Network (DMON).

DISCUSSION

To summarise, the key Exercise Management lessons emerging from the MTDS CCD were as follows. Firstly, creating a dynamic and responsive environment is a key requirement in order to challenge the training audience. This demand means that the WF must be able to adapt quickly; an intuitive chain of command is required in which the relevant individuals can be rapidly identified and tasks allocated. Further, decentralised execution is crucial to ensure that scenarios can be changed rapidly, but this should not compromise the Exercise Director's view of the 'big picture'. Hence, a 'centralised control, decentralised execution' model is the optimum solution.

Secondly, the adage of 'use the experts' that arose during the earlier research trials was equally relevant during the MTDS CCD. Having the right level of experience within the WF is critical, and as a general rule a small but highly experienced WF can create a better environment than a large but inexperienced team. Introducing role specialists as required for training events provided relevance and added benefit to the blue force.

In the broader context, the MTDS CCD demonstrated a model of exercise management that could be applied to other future distributed exercises. The key tenets of clear accountability, centralised planning, and a simple but modular command structure, could be adapted for use elsewhere in future distributed training events outside of UK MTDS, or form a common format for use across the UK MoD.

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