

identified that:

"Considering H450 operations are critically dependent on the distributed team and thus distributed situation awareness, none of the crews had been trained on maintaining team awareness and the risks of team situation awareness error. Moreover, IPs were usually required to complete 7-9 hour missions, most of which were conducted within the GCS monitoring the imagery. None of the IPs had received training on maintaining vigilance, maintaining situation awareness and the risks of change blindness (failure to identify a change in the displayed image or parameters)".

Exhibit 16

The Panel agrees wholeheartedly with this finding of the RAF CAM report. In the specific case of ZK515, the crew initially displayed good SA during the aircraft's recovery; for example, by negotiating a deconfliction vertically and laterally with the H450 that was recovering ahead of them, so they could make their approach as soon as possible. However, making an approach to the wrong runway was an example of a loss of SA when the workload and severity of the emergency situation increased. The Panel therefore considers the ability of crews to maintain situational awareness, particularly during periods of high workload, an **area of weakness**.

Witness 9, 10

c. Captaincy. The subject of captaincy will be dealt with in detail in the next section. In sum, the UAS-c receives exactly the same training as the UAS-p. There is no specific training or dedicated captaincy assessment before assuming command; the appointment as UAS-c is based primarily on achieving the rank of Bombardier. The Panel considers the captaincy skills of UAS-cs to be an **area with potential significant weakness**.

Witness 27

d. Knowledge/Training. Technical knowledge is an area that a degree of emphasis is placed upon; the Panel observed evidence of this during the visit to **(S26)** and also in Theatre but has already commented earlier in the report that it is considered insufficient. In **(S26)**, the Panel also observed valuable airmanship learning points that were highlighted to the crews. Factors relating to training have already been discussed earlier in this section and thus the Panel has concluded that the 'feast versus famine' approach to live flying and the limitations of UK simulator currency are severely constraining the ability of UAS-ps to consolidate previous training, practise different scenarios and develop experience. It is widely acknowledged that the training is delivering 'just enough, just in time' as a consequence of the enduring UOR. The limitations of the H450 training pipeline are therefore directly hampering the ability of crews to develop their airmanship.

Witness 32, 34,
27

1.4.64. The Panel has found that, by using the RA's own model of the foundations of airmanship, there are weaknesses in the development of each area. At present, airmanship appears to be a subject that is taught on the Level 3 course and considered largely to be a completed TO, rather than an ethos of continual development and nurturing of airmanship through every stage of the training pipeline and beyond. Whilst the 1 Arty Bde Risk Register acknowledges

Witness 31

Exhibit 15

that a lack of airmanship is a risk to operations, the mitigation strategies do not address the specific weaknesses identified by the Panel. It is encouraging to note that the DDH has tasked his SO to conduct a review of the Level 3 training provided into airmanship. However, the Panel consider the weaknesses in airmanship to have a much broader cause than the deficiency of a single course. An observation of the Panel is that airmanship development of H450 crews is limited by two factors:

- a. The truncated training pipeline does not adequately equip students with the foundations of airmanship.
- b. The periods of intense training interspersed by periods of zero flying (live or simulated) does not enable consolidation of knowledge or development of experience.

H450 Pilot Captaincy

1.4.65. The requirements for UAS captaincy are laid down clearly in the 1 Arty Bde FOB. Issue 5 was in force at the time of 57 Bty's preparation and deployment. Order 115 states:

"Captaincy is a generic term used for the judgement and asset management skills undertaken when performing the duties of the UAV-c. Before being given the qualification of a UAV-c, a UAV-p must satisfy the supervisory chain that he is capable of carrying out all duties that may be required of him, including captaincy."

From interviews across the organisation, a recurring opinion was apparent in respect of their internal view of the standard of their UAS captains which highlighted that on the whole the UAS-cs are very good, especially given their amount of experience and hours on type.

1.4.66. Following the examination of airmanship above, the Panel was keen to understand to what extent the captaincy skills of the UAS-c had contributed to the outcome of the accident. In the specific case of ZK515's accident, the UAS-c tried hard to deal with the developing situation and seek advice, initially displaying some positive captaincy skills. However, as the situation developed, the UAS-c struggled with workload management and prioritisation. As the emergency situation worsened, a weakness in captaincy skills led to a number of significant captaincy errors:

- a. A landing brief was not conducted by the UAS-c, who acknowledged that this should have been carried out in accordance with the H450 QRH, and this contributed towards the lack of SA of the GCS crew when preparing for an approach to the wrong runway. The Panel found the omission of a landing brief was a **contributory factor** in the accident.
- b. As the workload increased during the initial approach and UA self-abort from the GTOLS approach, there was a breakdown of the 2-man check procedure, mandated within the 1 Arty FOB. The Panel found this breakdown of standard operating procedures was a **contributory factor** in the accident.
- c. A decision was made to abbreviate the GTOLS go-around safe route following the UA's self abort. This decision was contrary to an

Witness 33, 34

Exhibit 20

Witness 27, 32,
17

Witness 9, 10

Exhibit 7
Witness 10

Witness 10
Exhibit 7
Exhibit 3

Witness 9, 10
Exhibit 9
Exhibit 7

Witness 9, 10,
12

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instruction contained within the GTOLS Handover notes.

Exhibit 11

1.4.67. The Panel was keen to understand if a weakness in captaincy skills was due to the individual UAS-c, or whether it was due to wider factors. The Panel were interested to note the earlier finding of the RAF CAM HF report from Jun 11 regarding UAS captaincy:

"The UAS-c role equates to that of a Captain in a manned aircraft. However, pre-requisites for a Captain of a manned aircraft include more platform experience and potentially a more senior rank, whereas the UAS-c role on the H450 is based on a subjective judgement of the IPs ability to cope with the UAS-c role, i.e. it is based on personal readiness rather than technical and personal readiness. This meant the UAS-c role could be as or less experienced as the new UAS-p role next to him."

Therefore, the Panel investigated the captaincy training, experience and assessment requirements to satisfy 1 Arty Bde FOB order 115.

Exhibit 16

1.4.68. The training provided for a UAS-c is identical to that of a UAS-p; there is no specific captaincy training provided or other method used to develop captaincy skills. Furthermore, there is no pre-requisite of minimum experience level required before a student can become suitable for consideration for captaincy. The only difference in requirement between a UAS-c and UAS-p is that the UAS-c must hold the minimum substantive rank of Bombardier³⁸; by virtue of rank it is assumed the individual is capable of captaincy.

Exhibit 21

• 1.4.69. All pilots must complete an annual CofC, usually carried out during the technical confirmation training in (S26) , before they are qualified to operate an UAS unsupervised. Prior to this phase, all training is conducted as a single pilot; the technical confirmation flying is the first occasion when a UAS-p and UAS-c are paired together, but the Panel found no evidence of any specific preparation of the UAS-c for this phase of training. During the CofC check, there is no specific assessment of aviation command performance or potential; the UAS-c is assessed against the same criteria as the UAS-p, but is expected to perform to a higher standard.³⁹ The captaincy performance of the student should be commented upon in the Form 3 narrative report, but there is no formal guidance on what the assessor is looking for from the student. Thus, the current assessment of captaincy skills appears to be an informal and subjective process that could lead to a new UAS-c being unsure of what criteria they are being assessed against and what exactly is required of them.

Witness 35

Exhibit 22

Witness 35

Exhibit 23

Witness 32

Exhibit 24
Witness 32

Witness 27

Witness 27

Exhibit 25

Witness 32

Witness 27

Exhibit 26

1.4.70. Following the CofC, the Form 3 is passed to the BC who has the authority to appoint captaincy. The BC awards a UAS-c qualification based upon the competency assessment and on other personal soldiering skills and his or her own military judgement. However, as the BC is not a qualified UAS-c, a heavy reliance must be placed on the narrative within the Form 3. The award of captaincy is made by the BC who is not a qualified UAS captain and may have no previous aviation experience.

1.4.71. Once the UAS-c has qualified, prior to deployment, there will be a period in the UK where simulator currency will be required. There are no specific captaincy training objectives in the H450 Simulator Currency

³⁸ This requirement was set by Cmdr 1 Arty Bde in 2007, following consultation with all relevant stakeholders.

³⁹ The CofC assessment is recorded on the Army UAS Form 3 and the CofC is entered into the Logbooks.

requirement and 3 of the 10 serials are conducted in the SCT; this limits the opportunities for development of crew skills, 2-man checks, airmanship and captaincy skills. The Bty conduct a final exercise prior to deployment, operating as a sub-unit over a period of 4 days. The exercise has been developed significantly over time to a stage where it now provides the Bty with a good test of working together and appears to be highly regarded. There is a specific TO against a UAS-c and during this exercise the crew will operate together. Exercise FINALE is a very positive step, although it appears to be the only stage when a UAS-c, UAS-p and MxC will work together as a crew prior to deployment and where the UAS-c can develop captaincy skills.

Exhibit 27

1.4.72. In summary, the Panel found that a newly qualified UAS-p can be awarded captaincy by virtue of rank and may deploy to Theatre with an extremely limited amount of flying experience, typically 25 hours for ab initio students and with very limited opportunity to develop captaincy skills. Therefore, the Panel made the observation that newly qualified UAS-cs are poorly prepared for their role and their performance depends largely on individual competence. Moreover, as the H450 UAS-c role did not receive any extra training, nor did it have any prerequisite flying experience, this is likely to have negated the mitigation provided by a typical captaincy role, such as experience and authority during unexpected scenarios.

Exhibit 16

57 Bty Senior Operator

Training and Qualifications

1.4.73. Prior to appointment as SO, the individual concerned was a MxC, the role in which 57 Bty had originally intended him to deploy for HERRICK 14. In the role of MxC, he was trained, qualified and current. At the time of 57 Bty's deployment there were no pre-requisite qualifications laid down in the 1 Arty Bde FOB for the SO as it was a relatively new concept at the time and the role was still being developed. However, there was a requirement within the CO 32 Regt's Air Safety Directive, dated 8 Mar 11, that the Bty SO:

Witness 12

Exhibit 107
Exhibit 122

"Must maintain his/her TQ/C2 as a UAV-c/UAV-p when an MxC and in the Snr Op post."

Exhibit 155

1.4.74. Once it was decided by CO 32 Regt that the individual concerned was to be appointed as Bty SO, there was not enough time remaining before deployment to conduct any refresher pilot training. Therefore, the 57 Bty SO was not TQC2 on H450 as a UAS-p or UAS-c at the time of deployment. This factor is covered in more detail under Competencies below. Recent editions of the 1 Arty Bde FOB now reflect minimum competencies for the Bty SO.⁴⁰

Witness 12
Exhibit 8

Competencies

1.4.75. In theory, the SO was the most qualified and experienced UAS Operator in 57 Bty. Prior to joining 57 Bty, the SO was a member of the OSC⁴¹ and therefore required to remain current as a H450 UAS-c on the system for which he was required to instruct and examine. However, according to the SO's flying logbook he had not achieved the currency requirements laid down in the 1 Arty Bde FOB in either the simulated or live environment during the second year of his 2 year tour on the OSC. When he joined 57 Bty in Jun 10, as an MxC he

Exhibit 123
Exhibit 8

Exhibit 121

⁴⁰ 1 Arty Bde FOB Issue 6 now has criteria for this appointment.

⁴¹ The OSC are responsible for maintaining the flying and aviation standards within 32 Regt.

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was no longer required to remain current as a UAS-c. When it became clear the individual was to be appointed as 57 Bty SO, he highlighted to his command chain that he was no longer TQC2 as a H450 UAS-c. At the time of appointment, shortly before deployment, the SO had not operated H450 for 2 years, was not simulator current and did not hold a valid Certificate of Competence, therefore could not be considered TQC2 in accordance with the 1 Arty Bde FOB Issue 5.⁴² The SO did not conduct any H450 pilot training in (S26) or the UK prior to deployment as the strategy to address his lack of currency involved in-Theatre training due to time constraints.⁴³

1.4.76. The OSC have stated that the SO did conduct in-Theatre training and a ThQ process, totalling 17 hrs, which involved one EP take-off and landing but no GTOLS events.⁴⁴ However, the SO's Logbook and Pilot Record Folder did not accurately reflect these endorsements. A TQC2 Form 3 was provided to the Panel, but it is not a signed original. There is no evidence of a completed ThQ and no evidence of a waiver from 1 Arty Bde for his lapse in simulator currency⁴⁵ or to cater for the expired CofC. Furthermore, the omission of GTOLS procedures as part of his ThQ was in contravention of the requirements within the 1 Arty Bde and TUAS FOBS.⁴⁶ Given the evidence available, the Panel have found that the SO did not hold the required competencies to be a H450 UAS-c on the Theatre UAS Bty. Table 1 below summarises the competency and currency requirements against the SO's compliance at the time of the accident.

Witness 12
Exhibit 107
Exhibit 119
Exhibit 8

Exhibit 106
Witness 12
Exhibit 8
Witness 12
Exhibit 150
Exhibit 8

Requirement	FOB reference	SO Achievement ⁴⁷	Compliance
Annual Standards Check	1 Arty X FOB Issue 5 Order 360.105.1 Page 3-13	11 Mar 10 by RSA	Not compliant. Annual Standards check out of date
Annual CofC (This may be conducted as part of the Annual Standards Check)	1 Arty X FOB Issue 5 Order 115.105.1 Page 1-10	22 May 07	Not Compliant. CofC out of date
TQC2	1 Arty X FOB Issue 5 Order 105.100.2 Page 1-7	May 11 in-Theatre training. Unsigned Form 3	Partial Compliance. Log book not signed, no signed Form 3
ThQ (Including min number of GTOLS TOL)	TUAS Bty FOB Edition 8 Order 101 Page 1/2	OSC statement that in-Theatre ThQ conducted May 11	Not Compliant. No paperwork evidence of completed ThQ and Log book not signed. Not conducted minimum GTOLS events
6 Live flying hours in 6 Month Rolling Period	1 Arty X FOB Issue 5 Order U360.100.2 Page 3-12	17 Live Hrs in-Theatre Apr – May 2011	Compliant
10 Simulated hours in 3 Month Rolling Period	1 Arty X FOB Issue 5 Order U360.100.2 Page 3-12	Last simulator sortie was Apr 2010	Not Compliant. Simulator currency out of date

⁴² The SO last conducted an Annual Standards check in Mar 10 shortly before he left the OSC. This was conducted over a 5 day period where 3 simulated hrs were accrued. No Form 3s have been supplied to support this entry.

⁴³ The SO was to conduct 15 hours training in Theatre with the OSC. It is worth noting that this is only a few hours more than a UAS-p and UAS-c is required to achieve during ThQ.

⁴⁴ During interview, the SO could not recall why he had not conducted any GTOLS events as part of his ThQ.

⁴⁵ 1 Arty Bde FOB issue 5 – To be recertified as competent following a lapse in currency, minimum live and simulated hours are to be accrued.

⁴⁶ For the purpose of ThQ UAS-p/c must complete a minimum of 1 manual and 1 planned GTOLS take off and landing.

Table 1 – H450 Pilot Currency and Competency Requirement versus SO Compliance

Currency	
1.4.77. In accordance with the DDH's (S26) the SO was tasked by the BC to conduct dry drills and briefs in preparation for the OSC's arrival. The extent of the ground school provided by the SO is not clear as witness statements vary regarding the detailed training that was actually provided. The original (S26) involved the Bty SO preparing the pilots for GTOLS and then OSC, as independent experts, would deploy to Theatre to oversee the (S26). However, the 57 Bty BC was subsequently informed by the DDH that he could in fact (S26) without the OSC being present. Providing the BC was content there would be no problems, the BC only required his SO to oversee the crew's GTOLS procedures.	Exhibit 5 Witness 9, 10, 12 Exhibit: 5 Exhibit 82
1.4.78. In order to be competent to supervise the ThQ process of an incoming Bty, a UAS-p or UAS-c must have completed a minimum of 3 GTOLS procedures every 28 days for a consecutive 3 month period. ⁴⁸ Considering the SO had not completed a live GTOLS procedure for over 2 years and did not hold the required competencies to be a UAS-c, the Panel found the 57 Bty SO was not current or competent to supervise the (S26) without OSC supervision. The lack of currency and competency of the SO led to inadequate supervision of ZK515's crew during the GTOLS recovery when he did not pick up on the errors the crew made. Therefore, the Panel found that the SO's lack of GTOLS currency was a contributory factor in the accident.	Exhibit 124 Exhibit 8 Exhibit 150
Mission Commander	
1.4.79. Training & Qualifications. During interview the MxC stated he had completed all requisite training prior to assuming his position, but there is no evidence available from TDT, Training Support Group (TSG) or 32 Regt to support this claim. The MxC course content and the way it was convened has changed over the period of the UOR and whilst the RSA now convene, deliver and record the courses, this was not previously the case. Pre-2009 a formal H450 MxC course did not exist, so 1 Arty Bde generated a set of TOs and asked the RSA to deliver the training. An email was sent back to 1 Arty Bde detailing the attendees who had completed the training; however no summative or formative assessments were required or formal records kept. The Panel believes this may account for the lack of records for the MxC in this case and RA TDT, as the Training Requirements Agency (TRA), should have been responsible for creating the TOs, not 1 Arty Bde. Notwithstanding the lack of evidence available, the Panel believe the MxC was trained and qualified in role.	Witness 11 Annex B Exhibit 116
1.4.80. Currency & Competencies. With 5 years Phoenix experience and 4 years on H450, including 3 Op HERRICK tours, the MxC was an experienced operator; he was current and held the competencies required to conduct his task. The role has a job specification within the FOB but does not require the individual to be a qualified H450 pilot. With the appropriate H450 qualifications and experience the MxC could be an ideal supervisor within the GCS; however, as it currently stands, the value of this role is extremely limited.	Witness 11 Annex B Exhibit 127 Exhibit 116

⁴⁷ Data extracted from the SOs Logbook.⁴⁸ Each UAS-p/c selected by the Th UAS Bty BC to supervise ThQ MUST have completed a minimum of 3 GTOLS TOL every 28 days for a consecutive 3 month period. Any UAS-c who cannot meet this criteria cannot be considered as competent to ThQ without the DDH's authority.

GTOLS Observer

1.4.81. Training & Qualifications. The GTOLS Observer did not hold the appropriate rank of Lance Bombardier as stipulated by the 1 Arty Bde FOB in force at the time, nor had he completed any of the training in accordance with Issue 5 of the FOB. The Panel could not find any evidence of a waiver issued from 1 Arty Bde for rank or training prior to deployment. However, the Observer had completed a GTOLS Observer course prior to deploying and 1 Arty Bde FOB Issue 6 now reflects more appropriate training for this role.

Exhibit 21

1.4.82. Currency & Competencies. The GTOLS Observer course consists of a 30 minute theory lesson followed by a 30 min demonstration flight. The student then conducts 3 hrs training during the day and another 3 hrs at night. In this case the Observer had no previous aviation experience and despite being a GTOLS Observer for 5 months, (S26)

Annex B
Exhibit 126

As such, whilst he was technically competent and current, during interview the Panel discovered the depth of his aviation awareness was extremely limited.⁴⁹

Exhibit 113
Witness 23**External Pilot**

1.4.83. With the evidence provided there is nothing to suggest the EP was not competent to conduct his role to the best of his ability. U-TacS have a rigorous selection and training process before allowing EPs to commence live operations in Theatre. The EP role was originally entered into the 1 Arty Bde Risk to Life Register⁵⁰ as a significant risk to the programme, but it appears to have received appropriate attention in order to reduce this risk.

Witness 1
Exhibit 128,
129, 130
Exhibit 15**Authorising Officers and UAS System Commanders**

1.4.84. The BC, BK, Ops Officer and AO had completed the required training and all held the requisite competences as laid down within the 1 Arty Bde FOB Issue 5. They were not required to be qualified H450 pilots and all had limited military aviation experience which is covered in detail under TOR F. In particular, the AO had no aviation experience at all prior to joining 57 Bty.

Annex B
Witness 13

1.4.85. The RSA Authorising Officer Course and UAS System Commander Course is not providing the AO and UASS-c with the depth of training required; this is covered in detail in TOR F.

Air Traffic Control Personnel

1.4.86. Pre-Deployment Training. The Panel visited the Central ATC School at RAF Shawbury in order to gain further information on the Bastion Airfield specific pre-deployment training provided to ATC personnel. The 'Panther' course is a general introduction to Theatre specific issues and Bastion ATC, including UAS operations, via a series of briefings and simulated exercises in both radar and visual simulators. The Panel were impressed with the training

Exhibit 131

⁴⁹ During interview the UAS-c asked the GTOLS Observer if the WIP was a problem for the recovery of ZK515. Notwithstanding that all personnel would be clear of P01, the Observer was of the opinion that as the WIP was more than 20 meters beyond the last arrestor cable, it was safe.

⁵⁰ UAS/1ARTYX/C009 – ThQ for EP.

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content and maturity of the syllabus, given that exposure to live H450 flying can only be achieved once ATC personnel arrive at Bastion Airfield. The course receives regular feedback from controllers who have returned from Bastion, to ensure changes in Theatre are reflected in the Panther course.

1.4.87. **Bastion Work-up Training.** ATC training at Bastion is comprehensive and is the only practical way to expose controllers to more complex scenarios following the Panther course. However, the length of training required for new controllers has become protracted as the air-traffic intensity has increased. The effect is an increased training burden as some controllers are taking longer than expected to fully validate whilst others are not achieving full validation at all; thus limiting their employability within Bastion ATC. The 'fully productive' period of a controller is getting shorter, sometimes to only a matter of weeks, before they return to the UK following a 4 month tour. The tour length for ATC controllers at Bastion should be reviewed to ensure the 'fully productive' output is sufficient to ensure the burden on training is kept to a minimum.

Witness 24

1.4.88. Discrepancies were identified between the ATC Phraseology Handbook and the phraseology laid down in the TUAS Bty FOB. These discrepancies were highlighted to the respective parties in Theatre to resolve and is believed to have been actioned.

Exhibit 133
Exhibit 134
Exhibit 132

1.4.89. From evidence gathered, liaison between ATC and the UAS Bty could be improved with a formal ATC joining brief to all Bty personnel as part of their arrival procedures and a brief to new ATC controllers from the UAS Bty.⁵¹ The Panel believes this activity is now properly conducted following in-Theatre action as a result of ZK515's accident.

Witness 2, 6, 9,
10, 17, 24
Exhibit 119
Exhibit 132

1.4.90. During the course of the SI, the Panel have found no evidence that ATC training has contributed to the accident or is a concern. All ATC personnel involved in the ZK515 accident were Trained, Qualified, Current and Competent to conduct their task.

Exhibit 135

Engineering Personnel

1.4.91. **REME generic training.** Once selected to become a REME Aircraft or Avionic technician,⁵² soldiers are trained at the Defence College of Aeronautical Engineering (DCAE) in Arborfield. The Basic Aircraft technician course ranges from 14 to 18 months in duration according to trade.⁵³ Once the technician is posted to the field force a further 6 months of consolidation training is required before being assessed as competent to work on aircraft. Once competent, the technician is awarded class 2 status and would spend the next 3 years working under supervision.

Exhibit 137

1.4.92. **H450 Equipment Training.** REME Aviation technicians are not posted to a UAS Regiment until they are qualified as a class 2 technician.⁵⁴ Before working on H450, the technicians are required to undergo a 4 week equipment course in (S26) , delivered by Elbit Systems. The H450 system is very simple in comparison to the other AAvin systems REME technicians are

Exhibit 138

⁵¹ ATC and Airfield Orientation Briefs are a pre-requisite for the ThQ process as laid down in the Theatre UAS Bty FOB Edition 8.

⁵² Aircraft and Avionic technicians are selected as having the minimum requirement of GCSE Grade C or above in English language, Mathematics and a Science, plus a GTI score of 48 or above.

⁵³ Training consists of further technical education, generic aircraft systems and airframe repair. As part of this course the technician would also become qualified on the Lynx helicopter and graduate as a class 3 technician.

⁵⁴ At 32 Regt there is not the infrastructure nor required technical depth of work available to a class 3 technician to complete 6 months training prior to being awarded class 2.

trained on, so the Panel believes the training risk is low. Elbit conduct Inval at the end of each course and over the years the standard of training appears to have increased. REME TDT were involved in the early stages of training development and still monitor the training. To date, there have been no failures of the maintainer course, which indicates both the simplicity of the H450 system and the high input standard at the start of the course. Once qualified the maintainers are awarded the appropriate REA signatures by the OC Workshop and are then competent to work on H450 In accordance with the Aircraft Document Set (ADS) and MAP-01.⁵⁵

1.4.93. During the course of the SI, the Panel have found no evidence that REME training has contributed to the accident or is a concern. All personnel involved in the maintenance of ZK515 were Trained, Qualified, Current and Competent to conduct their task in accordance with the MAP-01.

1.4.94. **UAS Level 3 Course – Engineering documentation training.** Evidence from ZK515's MOD form 700 showed the crew were thorough when filling out the paperwork, had completed the forms correctly and all the appropriate signatures were in place. However, during the interview process it became apparent to the Panel that although crew were proficient at filling in the paperwork, there remained some confusion regarding the importance of some of the signatures and where this information could be found. The significance and relevance to H450 operations of the 'Acceptable Deferred Faults' (MOD Form 704) and Limitations Log (MOD Form 703) were also not fully understood. Despite these observations, it appears the UAS Bty Artificer in theatre does conduct refresher training in theatre where possible.

1.4.95. Interviews with the RSA SMIGs highlighted that documentation training as part of the UAS Level 3 course was limited to one lesson and the standard of instructor would vary. The instructor was supplied from 32 Regt RA Workshops and could range from a Cpl to an Artificer dependent upon availability. The Panel has discovered that notification of this requirement has historically been at short notice and the Workshop sometimes struggled to supply a technician who was sufficiently prepared to teach the documentation training objectives.

Miscellaneous

1.4.96. The Panel has liaised closely with TDT, TSG and 32 Regt during the evidence gathering process for courseware, TOs, individual training records, qualifications and competencies. The Panel made repeated attempts to ensure a comprehensive set of evidence was obtained. Unfortunately, the information management and records storage of all 3 organisations appears to have been poor over previous years which led to difficulties for the Panel when obtaining evidence; some records are still incomplete. The evidence provided to the Panel has also, at times, been difficult to interpret and has required 1 Arty Bde assistance to decipher.

1.4.97. The requirement for individuals to have completed specific courses prior to taking up a position of responsibility has changed since 57 Bty deployed in May 11.⁵⁶ These changes reflect an update in the courses required to provide broader and more relevant training in certain roles.

⁵⁵ Manual of Maintenance and Air Worthiness Processes MAP-01-02

⁵⁶ 1 Artillery Brigade Flying Order Book (FOB) Dated 1 Nov 09 - Issue 5 was in force when 57 Bty deployed. It was updated on 30 Jun 11 to Issue 6 whilst they were in Theatre. Issue 7 is now in effect.

Exhibit 139
Exhibit 140

Exhibit 53

Witness
9,10,12
Witness 29,31

Witness 19

Witness 29

Exhibit 125

Exhibit 116

Witness 32

Annex B

TOR F – AUTHORISATION AND SUPERVISION

Review the levels of authority and supervision covering the task during which the incident occurred.

Authorisation

1.4.98. The Panel found that the operating crew had been correctly authorised for the sortie in accordance with the 1 Arty Bde FOB. However, the SO's supervisory function during the GTOLS events of the sortie was not recorded in the flight authorisation sheets or in the mission back brief. There is no evidence that the AO had authorised the SO to conduct the supervisory function during this sortie. Furthermore, the AO, when questioned, saw no reason for the SO to be formally authorised to carry out the function of overseeing the actions of the operating crew, which contravenes MAA Regulatory Articles 2306 Authorization of Flights and 2305(5) Supervision of Flying – Aircrew Briefing.

Exhibits 51, 28

1.4.99. The flight authorisation sheet for the task contained the name of one particular GTOLS Observer; however, a different Observer carried out this function when the UA returned unexpectedly; this change was not annotated in the flight authorisation sheets by the AO. However, the Panel can find no requirement in the FOBs for the Observer to be included in the flight authorisation. Therefore, the practice of annotating a specific GTOLS Observer for each sortie should not be required; due to usual sortie length of 14 hours it is unlikely any flight will use the same Observer for the take off and landing.

Witness 13

1.4.100. During interviews it became evident that all AOs considered the AO Course run by the RSA was not fit for purpose and this is the only flight authorisation course required by the 1 Arty Bde FOB. In particular, the course is largely a theoretical overview of UAS systems rather than a detailed preparation of how to authorise H450 flights. There is no practical focus on the pitfalls of authorisation to fully equip the AOs for their job in theatre. The RAF CAM report from Jun 11 also noted that:

Exhibit 29, 30

Exhibit 51

Witness 23
Exhibits 31, 32

"The training for the AO role was not as comprehensive and qualifying as a typical aviation Flight Authoriser and neither were AOs existing or previous pilots, as are typical flight authorisers."

Witness 17, 14,
13
Exhibit 33

Exhibit 16

In addition, the 'in-house' nature of the RSA course is limiting the development of informed and experienced RA AOs without an understanding of the importance of flight authorisation from the wider military aviation community. However, the limitations of the AOs course were partly mitigated by a very good handover between the outgoing Bty and 57 Bty. This SI finding is not new; previous NSI reports⁵⁷ have recommended a complete overhaul of the AOs course, which has now been captured in the 1 Arty Bde Risk Register.⁵⁸

Exhibit 34

Witness 14

Witness 32,33
Exhibit 35

1.4.101. AOs within 57 Bty had extremely limited aviation experience and this situation was compounded by the shortcomings within their AO course. Neither the AO, Ops Officer nor Senior Supervisor (BC) had any previous military

Witness 17
Witness 14⁵⁷ NSI for ZK518 dated 25 Jul 11.⁵⁸ TUAS/1ArtyX/T003

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aviation experience; they had all served previously within non-aviation RA units. They were not qualified H450 pilots and had received very little H450 training. This lack of detailed H450 knowledge necessitated a high degree of trust in their crews and Bty SO. The Panel agrees with the findings of the RAF CAM report which stated:

“This lack of qualified and experienced over-sight may have negated the mitigation provided by a typical authorising role, i.e. that which has independent command of the bigger picture”.

There is a real possibility that the AO may not identify potential hazards or risks. For example, the Panel found there were no formal checks that the crews were ‘fit to fly’; crew fatigue was assumed to be taken care of by the rigid Crew Rest Period (CRP) system and for other factors, such as monitoring of medication and stress, the onus was on the individuals. However, it should be noted that despite these limitations, the AO and supervisors tried very hard to limit the hazards to their personnel given the constraints of their training and experience.

1.4.102. The physical H450 authorisation process follows a set pattern; a written ‘back-brief’ is prepared by the crew which was then briefed to the AO immediately prior to authorisation. The Panel found that this task was very process driven; a recording of facts and information, but there was no evidence to suggest the AOs were conducting a check of the crew’s understanding when a potential hazard or unusual event was present. A specific example in the case of ZK515’s accident is the failure of the AO to ensure the crew were fully aware of the implications of the WIP on the Papa taxiway, indicating his high degree of trust in the operators. However, it appeared during interview that the AO was not aware of the significance of the WIP himself.⁵⁹ MAA Regulatory Article 2306 states:

“The key role of the AO is to be aware of the probability and impact of potential problems and to eliminate, reduce or control the hazards involved through risk management and implementation of suitable controls.”

The Panel found no evidence of any formal risk management controls to mitigate potential hazards, other than the common sense and military judgement of the individuals concerned. The Panel has found that the omission by the AO to check ZK515’s crew were fully aware of the implications of the WIP was a **contributory factor** in the accident.

1.4.103. The ZK518 NSI from May 11 noted that there were no specific UA emergency procedure drills planned and authorised into sorties and therefore recommended:

“AOs are to direct and manage this by including directed serials into every sortie.”

The Panel found no evidence that practice emergency procedures had been implemented into every sortie. There is a lack of formal post flight ‘in-brief’ with the AO which could capture lessons, facilitate the recording of practice emergencies and ensure all post flight paperwork had been completed, that contravenes MAA Regulatory Article 2305(5):

⁵⁹ WIP is covered in detail under TOR G.

Witness 13

Witness 14

Witness 17

Exhibit 16

Witness 14

Witness 13

Witness 14

Exhibit 28

Witness 13,14

Witness 13

Exhibit 30

Exhibit 36

Witness 14

"Briefing of aircrew before flight, and subsequent de-briefing on completion of the sortie, is essential and should be conducted in a thorough and professional manner".

Exhibit 29

1.4.104. Overall, the Panel found the H450 authorisation process lacks rigour and relies heavily on trusting the operators, largely as a result of the AOs being poorly prepared for their role and their lack of aviation experience; this was a **contributory factor** in the accident.

Supervision

1.4.105. The Panel found that there was a good supervisory ethos with a strong emphasis on flight safety. From all the interviews with Bty personnel, there was unanimous agreement that the supervisory chain was trustworthy, safety focussed, maintained a good safety culture and contributed to team morale; several witnesses remarked how there was a marked improvement from previous operational tours. The strong air safety culture within the Bty is corroborated by a recent RAF CAM HF report and by the Regimental Air Safety Inspection (ASI) of 57 Bty conducted in Jun 11.

Exhibit 16

Exhibit 37

1.4.106. Despite the positive supervisory ethos, the Panel noted a few factors concerning the current supervisory activities, indicating that the specific supervision of flying activities were only being conducted to a basic level. However, it is the Panel's opinion that all these activities could be attributed to the overall minimal aviation experience of the supervisory chain and poor preparation for the role, rather than unsafe aviation practices. Many of these observations were also noted by the RAF CAM HF report from Jun 11.

Exhibit 16

1.4.107. The role of a flying supervisor is to act as the last risk control measure. In the case of H450 operations, the UAS System Commander (UASS-c) holds the role of flying supervisor, and he or she:

"is responsible for the overall command of the entire UAV system and its safe and effective operation."

Exhibit 38

CO 32 Regt RA had authorised the BC, BK and Ops O of 57 Bty to be UASS-c qualified in accordance with the requirements of the 1 Arty Bde Fob issue 5. However, there were no training requirements (at the time of 57 Bty's preparation and deployment) to be a Battery level UASS-c above that required of an AO.⁶⁰ Therefore, the 3 persons on 57 Bty authorised as UASS-c were no better prepared or experienced than the AOs. Of note, there is now a specific one day UASS-c course held at the RSA. However, by virtue of time alone this course is limited to providing a brief overview of the roles and responsibilities of a flying supervisor.

Exhibit 39

Exhibit 40

1.4.108. As a result of the lack of training for the role, the Panel observed that the 57 Bty UASS-cs had not received any guidance on what an appropriate decision making process might be required when faced with an unusual or complex risk to H450 operations. The RAF CAM HF report also made this observation and stated:

"the BC did not have access to a standardised hazard-risk decision matrix, such as that used in Rotary wing operations, rather he had to make decisions based upon subjective judgement of RTS limit, other mission parameters and his

Exhibit 16

⁶⁰ for example attendance at a MAA Flying Supervisors Course was only required for Lt Col and above.

limited H450 experience. This resulted in a process which was entirely based on an inexperienced subjective judgement of multiple and variable parameters and relied on memory of previous scenarios; a process open to decision error, recall error and the risk of an undetected near-miss scenario being perceived as positive reinforcement for future decisions. This process ultimately left scope for unintentional mission creep; a contributor in many Operational accidents.”

There is no evidence that any action was taken in response to this observation and associated recommendation in Jun 11.

1.4.109. In the specific case of this accident, the assessment of the risk posed to H450 operations by the WIP is evidence that the risk assessment process was informal and based solely on inexperienced subjective judgement.⁶¹ For example, there was no consideration of the risk posed by UA cable skip into the vehicles on landing, or risk to GTOLS landing from a laser-altimeter discrepancy caused by an approach over the vehicles. There was no formal record of the decision process captured for an audit trail; a joint decision was taken that it was safe to operate H450 following informal discussion between the BC and SATCO. As there was no record of the decision, there was no clear communication to Bty personnel that risk was considered acceptable. This led to confusion within the Bty whether it was safe to operate, highlighted by the disagreement between the UAS-c and EP whether an EP landing could be carried out with the WIP in close proximity. Finally, following the EP’s decision that it was not safe for him to land the UA manually, there appeared to be no attempt by the BC to understand why the EP had such concerns and what the risks were. Instead, because it was available as an alternative, a GTOLS landing was selected.

1.4.110. In sum, without greater aviation experience and training, the Panel believes the UASS-c is not adequately equipped to discharge his or her duty to the DDH to ensure that the risk from operation of the H450 system remains tolerable and ALARP at all times.

1.4.111. **Release To Service.** The Panel questioned 57 Bty supervisors and 1 Arty Bde staff on their understanding of the H450 RTS limitations. Whilst there was unanimous agreement on the importance of the document, there were varying responses regarding authority to breach the limitations contained within. The Panel believes an explanation for the variance in understanding emanated from a letter from CO 32 Regt RA in Apr 11 that gave authority to OC 57 Bty, as UASS-c, to breach the RTS limits provided a deliberate decision making process and consultation had taken place. This letter had been copied to HQ 1 Arty Bde and the staff were aware of its contents; however, the letter gave guidance which was in direct contravention of the 1 Arty Bde FOB⁶² and MAA Regulatory Article 2305(3) which states that:

“Except in an emergency, the pilot of an aircraft shall not exceed the engine, airframe or handling limitations quoted in the RTS”.

When questioned on this, many of the witnesses explained the weather limitations contained within the RTS were very restrictive⁶³ and used this as an example of a circumstance in which they would consider breaching the RTS limits in order to recover the UA, rather than risk losing the capability by landing

Witness 17

Witness 17, 24

Witness 2

Witness 1,10

Witness 10,17

Witness 17, 14,
32, 33, 34

Exhibit 41

Exhibit 42

Exhibit 29

Witness 17, 14,
32, 33, 34

⁶¹ See TOR G for detail.

⁶² U230.110.1 Issue 5, which was in force at the time.

⁶³ No take-off or landing in visibility below (S26) and/or crosswind above (S26)

at an ELS.

1.4.112. Following the crash of H450, ZK503, at Basra on 13 Jan 08, an Army Board of Inquiry cited one of the causes as:

*"The decision to breach the H450 RTS (**S26**) visibility limitation for landing, in favour of recovering the UAV to the COB [Basra Airfield] rather than utilising the ELS".*

The evidence collected by this SI suggests that breaching the RTS weather limits still appears to be a generally accepted practice as the perception is that this constitutes an emergency situation: the RTS weather limits have recently been breached by 57 Bty on at least 2 occasions; 5 and 11 Jun 11. The 32 Regt ASI carried out shortly after these events⁶⁴ noted these recent incidents, but the ASI report suggests the recoveries were carried out *"during a brief gap in the winds"*, despite DFSORs being raised for both events due to a landing outside RTS limits. From the evidence gathered the Panel has observed that inconsistent guidance has been provided from the command chain to the UASS-c concerning when and whether it is acceptable to breach the H450 RTS limitations. This has led to the perception amongst some personnel that it is acceptable to breach weather limitations on recovery in order to preserve operational capability.

1.4.113. **57 Bty Senior Operator.** The Bty SO was appointed by the BC as his most qualified and experienced H450 pilot, but at the time of deployment of 57 Bty the post was new and there were no specific requirements or qualifications required of the SO. The supervisory chain on the Bty trusted the SO implicitly; he was seen as the *"king-pin"* between the supervisors, particularly the BC, and the pilots. The Panel recognises the importance of such a role and it is encouraging to see the development of the requirements of an SO in the newer versions of the 1 Arty Bde FOB. However, without specific H450 experience, the UASS-cs and AOs cannot be expected to adequately supervise the Bty SO. It is unclear who has the responsibility to provide assurance that the SO is competent to conduct this role or how such assurance should be carried out. For example, the SO had not conducted a GTOLS procedure for over 2 years, yet was tasked by his command chain to oversee the GTOLS re-implementation plan. During the recovery of ZK515, whilst the SO was supervising the operating crew, he did not pick up on a number of the crew's mistakes and during interview he stated that he saw nothing wrong with the crew's actions, one of which contravened a specific direction (which it was the SO's responsibility to enforce).⁶⁵ Consequently, the Panel found the SO's inadequate supervision of the crew's GTOLS procedures was a **contributory factor** in the accident.

Exhibit 43

Witness 14, 17
Exhibit 44

Exhibit 37

Exhibit 45
Witness 14, 17

Witness 12

Exhibit 11

Witness 28

⁶⁴ Conducted by CO 32 Regt RA.

⁶⁵ Not to intervene when a UA was conducting GTOLS below 1000'.

TOR G – PLANNING AND PREPARATION

Identify if the levels of planning and preparation were commensurate with the activities' objectives

Mission Planning

1.4.114. ZK515's sortie on 2 Oct 11 consisted of a routine ISTAR task in a familiar area and was similar to the one the crew had conducted 2 days earlier. The H450 crew arrived at the Bty in good time and conducted a number of individual tasks as part of the planning process, including equipment checks and mission specifics. Of note, the duration of a sortie is normally 14 hours, divided between 2 crews. One crew would deal with the launch, transit to the tactical area and conduct the first half of the mission. The second crew take over approximately 8 hrs into the sortie, complete the remainder of the tactical phase and conduct the transit back to Bastion Airfield, to recover the UA.

Witness 9, 10

1.4.115. On reporting to the Operations room, the crew received their Tasking Sheet, which detailed mission specific details and included the timings and co-ordinates of their allocated operating area. The co-ordinates were entered into the GCS by the UAS-p and the MxC then worked out the airspace requirements and sought the relevant clearances for the mission. The route in and out of Bastion is well established and the immediate airspace around the airfield is sterilised by ATC for the H450 landing and take-off phases. Once established in **(S26) Hold**⁶⁶ the UA transits to **(S26)** before being released by ATC to tactical control.⁶⁷

Witness 9, 10

Witness 9, 11

Witness 2, 9, 10

1.4.116. The 'take-off' crew do not expect to conduct the recovery phase of the sortie as it is seen as the oncoming crews responsibility. The H450 transit in and out of Bastion Airfield is routine and follows a set route, so the crews do not normally plan for anything out of the ordinary such as an immediate return due to an un-serviceability or emergency. Should anything unforeseen happen, the Panel has determined that the crews are likely to be reactive to the situation and may revert to what they can remember from initial training, given that the majority of emergency procedures training in Theatre is done as a table top exercise as there is no Theatre simulator.

Witness 9, 10.

Evidence 27, 28

1.4.117. As part of the mission planning, the pilots ensured they had read and signed for the 'Pilots To See' folder and noted the information displayed on the 'HOT POOP' white-board, both situated in the Ops Room. Any new information was also promulgated at a daily 'prayers' briefing by the BC, usually attended by one of the MxCs on behalf of the H450 crews. ZK515's crew also read this sheet in the Ops room. On the morning of the accident a new statement had been written on the HOT POOP board concerning the WIP: the statement was "No GTOLS Take-Off 01", written in yellow marker on a whiteboard. During interview the crew stated that they were aware of GTOLS restrictions to PAPA 01, due to the WIP, but had misunderstood the HOT POOP statement, believing it to read "NO GTOLS 01". The impact of this miscomprehension became a **contributory factor** in this accident and the full impact of the WIP is considered further below.

Witness 9, 10

Exhibit 97
Exhibit 98

Witness 9, 10,
12, 13Witness 9, 10,
12⁶⁶ (S26)⁶⁷ Whilst visiting Theatre, the panel witnessed the planning process for a mission.