

Blue Suit OJT: Knowledge Management in the UAV World

Susan Johnston, Ph.D., Ilya Lipkin, M.S.E., M.B.A., Brad Sims, B.S.P.A.
Air Force Materiel Command - Aeronautical Systems Center

Wright-Patterson AFB, Ohio

Susan.johnston@wpafb.af.mil

Ilya.lipkin@wpafb.af.mil

Bradley.sims@wpafb.af.mil

ABSTRACT

The confluence of rapid technological change and increased threat levels creates a challenge to professionals who operate in the net-centric environment. Due to shortened time frames from advanced concept technology demonstration (ACTD) to full operational deployment, the need to integrate and develop new knowledge in the operational arena has emerged as the central focus of readiness. This paper describes the challenges to implementing training systems which support the rapid integration of new knowledge into operational environments. One area which exemplifies the criticality of need for rapid response to training requirements is unmanned aerial vehicles (UAV) payload operations. Currently payload operators function without adequate training and preparation to meet the urgent demands that their position requires. In response to the lack of traditional training options, payload operators have compensated through informal peer-to-peer (P2P) learning. The ACTD UAV system has emerged as a model for adaptable response to training needs. While P2P learning is a proven method for acquiring necessary skills, it does not meet the need for comprehensive training. Through ongoing P2P training, the ACTD UAV fielded system response suggests an avenue for continuing adaptation to ongoing change. An examination of the system in use to support training for the ACTD UAV fielded platform will be presented. An analysis of the strengths, weaknesses, opportunities and threats will be examined. Furthermore, the critical nature of the net-centric battlefield requires the adaptive models for training represented by this finely-tuned approach to learning and knowledge management in the field. Finally, a model for P2P training which offers the critical support necessary to maintain capability will be provided.

ABOUT THE AUTHORS

Dr. Susan Johnston is a contract negotiator for the Air Force Materiel Command, Aeronautical Systems Center, Wright-Patterson, AFB, Dayton, Ohio. Her research interests are focused on adult learning systems in the workplace and knowledge management in high-stakes, high-stress operation settings.

Ilya Lipkin is a project engineer for the Aeronautical Systems Center, Global Hawk Simulations at Wright Patterson AFB. His current research interests include artificial intelligence, human knowledge capture and analysis, neural networks, fuzzy logic, user interface design, software engineering, UML, supply chain control, and customer relations management. Lipkin has a bachelor's degree in computer engineering, an MBA in operations management, and a master's degree in computer engineering. He is currently a doctoral student at the University of Toledo's College of Business Administration.

Brad Sims is a logistics professional specializing in simulation and training systems. Mr. Sims holds a Bachelor of Science in Professional Aeronautics and is currently enrolled in the Masters of Aeronautical Science program at Embry-Riddle University.

Blue Suit OJT: Knowledge Management in the UAV World

Susan Johnston, Ph.D., Ilya Lipkin, M.S.E., M.B.A., Brad Sims, B. S. P. A.

Air Force Materiel Command - Aeronautical Systems Center

Wright-Patterson AFB, Ohio

Susan.johnston@wpafb.af.mil

Ilya.lipkin@wpafb.af.mil

Bradley.sims@wpafb.af.mil

INTRODUCTION

The operational needs of the Air Force in today's environment indicate the need to confront and address challenges to the changing concept of operations (CONOPS). To that end there is an acute need to develop new technologies to respond to those needs. Accordingly, the intelligence, surveillance, and reconnaissance (ISR) missions have changed from being primarily based on the manned platforms to more autonomous mission platforms such as UAV Global Hawk. The new environment demands greater emphasis on electronic means of information collection, the greater use of unmanned or remote capabilities, and greater need for rapid dissemination of information gathered by the ISR platforms to the warfighter.

To this end ISR platform Global Hawk (GH) is becoming a cornerstone of the combat power in the United States Air Force (USAF) arsenal. This is due to increased dependence on the new information based warfare and the greater reliance on the network centric information dissemination. This in turn will be used to determine how limited operational resources in combat are allocated and effectively applied. This CONOPS is based on the USAF goal to create a superiority of information technology both in the electronic battle-space and on the battle field. This contributes to the advantage necessary to drive operational success.

To prepare the ISR GH platform for operational use, the Department of Defense (DoD) is pursuing a spiral development acquisition strategy designed to maximize use of the commercial and government off-the-shelf (COTS/GOTS) parts and subsystems. To achieve this goal the ISR GH was started in 1994 as a Defense Advanced Research Projects Agency (DARPA), and later transitioned to the Advanced Concept Technology Demonstration (ACTD) program under the USAF in 1999. The ISR GH has since been put on the accelerated development direction to allow participation in Operation Enduring Freedom and Operation Iraqi Freedom.

One of the operational challenges for the ISR GH is that accelerated fielding and operations schedules have created major gaps for the platform such as logistics, operations, fielding, and training. To that end it is of interest to examine an operational gap that has resulted from a lack of training for the ISR GH. The accelerated tempo of deployment has created a need to fast-track the ISR GH into the operational environment without following standard acquisition guidelines, favoring ISR functionality over lifetime supportability, maintainability, and usability. Therefore, there were a number of shortcuts taken to allow initial fielding of the ISR GH which, as time progressed, were never fully addressed by the platform. As a result ten years from initial ACTD date, there is still a lack of full mission training simulation, crew resource management training, a complete set of classroom training materials, and a full cadre of qualified instructors to teach students on an operationally fielded platform. This training gap threatens mission integrity by relying on individual operator capability to compensate for systemic deficiencies in training. Recent studies confirm that training deficiencies have contributed to the lack of pilot/operator capabilities critical to UAV performance and to the incidence of human error in UAV mishaps. (Associated Press, 2008; Herz, 2008). Predator UAV incidents, Herz (2008) found that 71% of the mishaps occurring between 2003 and 2006 were attributed to human error, primarily related to lack of adequate training.

This paper will address current issues with training as they exist today in ISR GH. It will also present issues faced everyday with training UAV crew, its strength, weaknesses, opportunities, and threats. This paper will also present options and mitigation strategies designed to address training deficiencies in the current operational environment.

CURRENT TRAINING

With the ISR GH there are two major functional tracks: the pilot track and the payload operator (sensor) track. The pilot track for the ISR GH is

staffed with officers while the payload track is staffed with enlisted personnel. To date neither track has developed full and certifiable training materials or complete classroom training beyond very basic concepts of ISR GH operations. Both tracks are trained on-the-job and certified during operational flying events. One of the more critical differences between the two tracks is the scope and range of how much is conducted in classroom versus operational on-the-job training events.

The pilot track utilizes a part task training emulator with basic low fidelity training capability for the ISR GH Command and Control (C2) software. The emulator is a software development laboratory tool which has been converted into a trainer. This tool is used for initial training events as well as refresher courses. As a result an extensive background in software architecture is required to understand how to manipulate the software development emulator tool for training use. The esoteric nature of the part task training device effectively limits usability at the training level. Further, technological deficiencies of the emulator require instructors to provide “creative” solutions to maximize training value. For example, flight instructions are mimicked to represent actual radio chatter by the instructor’s manipulation of his voice commands by placing his hands together and imitating the communication channels from the tower instead of using an actual simulation. This may simulate operation, but does not provide training which adequately represents functioning in the net-centric battle-space.

The payload operator track cannot utilize the part task training emulator, instead relying on a computer laboratory application through which they familiarize themselves with the basic menu structures of the payload software management tool. The laboratory cannot provide any feedback or additional training value beyond how the software interacts with operating system, file management, and menu tree. Another major deficiency with the payload operator track is a critical lack of fully qualified training instructors and certification standards. To date there is only a small handful of payload operators that are qualified to properly control sensors on the ISR GH and oftentimes those instructors are pulled into the operation environment to support missions over classroom training of the next cadre of operators. This situation is not helped because, once trained, the payload operator enlisted personnel only have limited time slotted to the ISR GH before moving on to their next career assignment. The risk of increased human error as a factor in UAV performance is exacerbated by these training deficiencies. As Herz (2008) noted

when examining payload/sensor operator training for the Predator UAV:

Training in theater must cover many factors which cannot be covered while in the United States. Safety Investigation Board findings express that stateside Predator units do not have adequate satellite communication link training that affect the ability to command the aircraft outside of line-of-sight environments. Specific training for task has been determined to be insufficient for the conditions that the operators are being faced with. Pilots are being deployed to other countries and being asked to fly the Predator without ever running mission specific checklists prior to the mission. Investigators have criticized the fact that pilots are being forced to deviate from checklists and do not have adequate supervision available to help make the call for particular circumstances and have resulted in unnecessary Class A aviation mishaps (P.111).

As a result of the lack of training personnel, training material, and a training simulator, payload operators are trained on-the-job by their peers primarily during operational flying events when the sensor software toolset becomes operational and actual hardware is used. It is at this time in training that the payload operators have an opportunity to experience the full scope of how the payload software management tool works and what the specific requirements for productive operation are. It is also at this time that they can experience the failure modes of operation as they occur during operation scenarios or training flight events. The payload operators rely on their peers and over-the-shoulder instructor supervision during flight events to train and understand how to deal with failure modes of operation as well as normal operating situations. This poses a critical challenge and a risk to the ISR GH platform by training the crew to respond to emergencies that they might or might not experience during flight events. These approaches to training do not generally support the requirements for efficient and precise implementation in the field and are largely related to quality and maturity issues with the current training capabilities.

Another challenge to the pilots and payload operators in this ACTD environment is the aging of the COTS/GOTS fielded assets. As the assets reach the end of their support life cycle of use, they need to be

replaced by the next technology refresh spiral. Since the previous spiral never fully developed or designed training courseware materials to support operations, the next cycle now has to accommodate differences in training which have never been standardized to reflect actual field deployment in the prior spiral. In case of payload operators, this poses a greater challenge as they rely heavily on peer-to-peer (P2P) training and, as a result, will not initially have a cadre of master trainers available with the new cycle, instead relying on the gradual development of training capability as operators and pilots learn the new system on the job and compensate for training gaps.

These challenges exist separately from one of the most basic and important requirements for training in the UAV field: crew teamwork training. Although the ISR GH is an unmanned platform while in flight, it is still operated by a highly skilled and motivated crew which forms a core unit on the ground. For the ISR GH the first time the crew is assembled and functions as a single unit is during operational live flight events. To this end the pilots and payload operators get to experience the crew dynamics on-the-job. This poses many significant challenges to operating the ISR GH, specifically the lead time to develop the group cohesion necessary to understand requirements and needs during operations. This in turn can prevent significant issues and failures during operations if the crew is acclimated and comfortable working together. An example of possible problems that this can generate is the miscommunication between crewmembers that work together for the first time during operational flight events. If a payload operator directs a pilot to turn 180 degrees without specific delineation, it could mean turn the plane 180 degrees or turn the sensor pod 180 degrees. As posited by Herz (2008), "Each operator (UAV) must work together seamlessly to minimize the opportunity for human error. Any disconnect through miscommunication, difficulties during handoff procedures or differences in personal techniques have been found to set the mission up for disaster." This issue is best addressed by crew training prior to operational flight events.

TRAINING ASSESSMENT

The current state of training which supports the ISR GH is characteristic of other UAV platforms. Accordingly, it represents the best and worst of those issues present in operational environments. The following assessment of ISR GH training as deployed in the net-centric battle-space analyzes strengths,

weaknesses, opportunities, and threats to deepen understanding of training challenges.

Strengths

The capacity to attract and recruit potential ISR GH operators through voluntary or career opportunities presents a significant advantage in creating a highly agile human capital base with potential for high return-on-investment. Further, retention of this workforce is a priority reinforced by recognition of the unique requirements of the payload/sensor operator role and associated incentives to attract and retain individuals with appropriate capability. This has been strengthened by the creation of a new career designation (1U) specifically for ISR GH.

The current recruitment strategy uses experienced imagery analysts as the sensor operator base. This limits the risk of academic failures that may be associated with typical pipe line training and provides a higher level of maturity in applicants.

The model for P2P training provides a dynamic context for training curriculum that is real-world based and uses the most viable method for skill development in adult training -- praxis (Vella, 2002). Praxis is an approach to skill development which suggests peer-to-peer dialogue as an ongoing exercise in skill mastery. The core process engages the operator in practice guided by a skilled practitioner that exposes the operator to new processes, provides feedback on performance, and demands reflective examination of outcomes and corrective responses leading to improvement. The current on-the-job training used by ISR GH operators and their peers provides for a praxis experience and offers customized applications. This encourages immediacy and motivation, and enhances learning. This is the greatest strength of the current training approach.

Weaknesses

The USAF relies on the 1N1 imagery analyst career field for the ISR GH payload sensor operator. This creates a retention management issue since these skills are also in demand in civilian industry. Providing practical experience increases the marketability of the first level analyst further straining retention. This in combination with the limited pool of qualified operators drawn from one area of expertise creates an ongoing skill deficit.

In addition, lack of knowledge management capability creates circumstances in which continuing training may not address deficiencies and is heavily dependent on the specific capability and expertise levels of the peer trainer available at the time training

is delivered. Differing capability and knowledge levels create the potential for significantly differing operational capabilities depending on the subject matter experts available and their ability to provide training support. As suggested by Noe (2008), the lack of explicit knowledge available through non-standardized training creates a greater need for P2P training to fill gaps. This is an inherent weakness that relies on the tacit knowledge of the individual to identify appropriate skill needs, provide appropriate training using approaches that meet the need, and adjust for performance outcomes. This requires individuals to continually compensate for systemic deficiencies.

Attempts to compensate through on-the-job training models have addressed an immediate need, but gaps exist that threaten operations from a performance and policy perspective. Errors traced to training deficits due to lack of standardization in training, training hours, and experience (Herz, 2008), have contributed to mishaps and incidents which have threatened operational objectives (ISAF Release, 2010).

Opportunities

With the creation of the 1U career field for the payload sensor operator position, an opportunity now exists for development of P2P training models with a standardized training curriculum. This would require creation of P2P training modules implemented by master level trainers who respond to training needs in the field. Recommendations emerging from investigation of UAV incidents have suggested that skilled trainers be deployed to provide training intervention (ISAF Release, 2010). The development of a track for master level training certification would require development of a train-the-trainer curriculum. Train-the-trainer programs would provide a base level training system which would then separate to qualification tracks for different types of UAV platforms such as Global Hawk, Predator, and Reaper. This, in turn, will allow for USAF to respond rapidly to ongoing technological advancements.

Further, the model of P2P training, which reinforces the praxis experience of active learning for skill development, reduces costs and time in training associated with traditional models conducted in classrooms and laboratories. It also encourages small unit cohesion built on reliance on peer expertise.

Threats

With the limited low fidelity emulation assets that currently exist in the ISR GH system, a scheduling challenge presents an obstacle to meeting training needs. The initial qualification at the Formal Training

Unit (FTU) and operational currency training requirements strain already limited assets. It is highly likely that qualification and currency training requirements will not be met in certain instances.

Further, the ISR GH is a dynamic system with unique capabilities that are in high demand. Depending on the tempo of operations, the potential exists for a shortage of qualified operators to man and operate the ISR GH system. These deficiencies may influence effectiveness and capability further threatening mission effectiveness.

P2P TRAINING IN THE NET-CENTRIC BATTLE-SPACE

The capability offered by rapidly-fielded technology creates new challenges for skill transformation at the operational level. The acceleration from ACTD to fielding provides the warfighter with enhanced capability that requires training which drives performance, a critical factor in fielding. As technology continues to evolve, there will be an increasing recognition that retiring to the traditional classroom for training is a luxury that the pace of operations will not permit. Models which provide agile training support at all levels of operation will be necessary to address the pace of operations and ongoing technological change in UAV platforms.

The role of the broader institution, in this case USAF, is to define the protocols and requirements for meeting operational training needs (Schmidtchen, 2006). These decisions orchestrate the interaction of operators and create the framework minimizing threats and weaknesses. Within this context, the need for training for ISR GH pilots and payload operators creates an opportunity to develop a model responding to the need to bring technological advances to the field as rapidly and effectively as possible.

Given the need for rapid fielding, a P2P model of structured on-the-job training (S-OJT®) adapted to meet program needs¹ provides a source for training which supports the skill development of ISR GH operators. The nature of S-OJT® takes advantage of learning models which enhance productivity and reduce costs associated with training. The following model is presented as a proposed response to the increasing need for trained payload operators in the ISR GH system.

¹ S-OJT® is a trademark wholly owned by Dr. Ronald Jacobs (Jacobs, 2003).

ISR GLOBAL HAWK TRAINING MODEL

The critical issue confronting implementation of systems is the influence of emerging technology which continually ramps-up technical capability. For example, while training on the current generation of unmanned aerial vehicles like the MQ-1 Predator and MQ-9 Reaper is being implemented, the next generation of UAVs will deploy sensors with cameras that can provide much greater imaging capability than current systems. The technological platform known as Gorgon Stare will operate five electro-optical still cameras, four infrared imaging (IIR) cameras that are each able to capture images from three moving targets at the same time and video systems that can store 65 video segments for analysis by ground commanders (Gresham, 2009).

This is the leading edge of an era of technological growth that will accelerate training needs beyond the capacity of traditional training models now in use. The value of innovative methods like the P2P approach to training is founded in reduced time in training while at the same time ensuring that

Figure 1 represents a comparison of the time involved in developing expert level capability in sensor operations using non-standardized methods of training versus a model which introduces P2P training. The lack of standardization and the difficulty in providing a full range of exposure to technical capability through routine operations delay full expert mastery. While routine exposure to day-to-day operations may familiarize operators with certain functions and build skills to expert level, other less routine, but more critical functions may not be included in the training curriculum. Additionally, the skill development process relies heavily on the capability and expertise of the individual peer trainer creating an unreliable standard of performance. The development and implementation of a master P2P learning program offers an approach to the continuing challenge of fielding new technology in the era of increased ops tempo. The following model, which uses the ISR GH platform as a context for implementation, is offered as a frame for responding to this challenge.

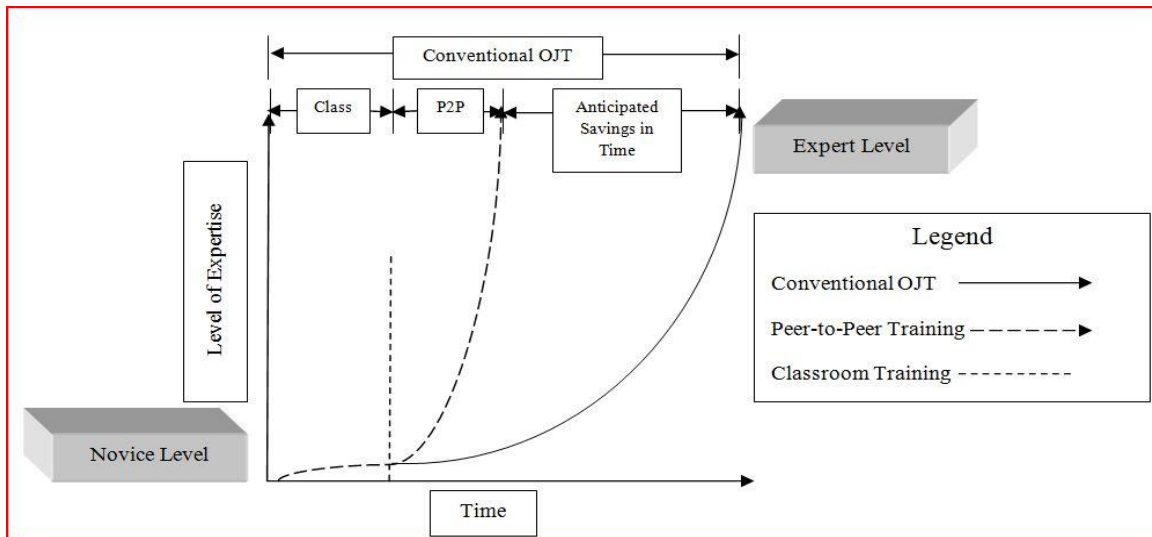


Figure 1: Proposed P2P Training Model
Anticipated savings in time using the proposed P2P training model

consistency is maintained in content and performance. The key factor is competency of the trainer in both content and in the P2P training process. The Figure 1 represents the learning curve which P2P learning may offer and presents a possible format for implementation in a UAV platform, the ISR GH (Jacobs, 2003).

OVERVIEW OF IMPLEMENTATION OF THE P2P TRAINING PLAN

A framework for implementation of a P2P training plan is presented by Jacobs (2003) as a means to standardize and accelerate attaining higher level skills by using peer expertise. The key role is rendered by the master trainer, usually a highly experienced operator who is familiar with the

complete range of functions available on the system. Further, the master trainer also possesses highly developed skills as a trainer. The initial phase of the plan requires a fully realized train-the-trainer program to familiarize the trainer with the use of the systematic training approaches necessary to implement the P2P training plan.

The training plan is based in a functional analysis of the operation of the ISR GH system, breaking down each capability by task analysis into a unit of work which is then translated into measurable performance metrics, i.e., time, quantity, quality, etc. A step-by-step process for each unit of work is compiled into in a process checklist with explanatory information as addenda to the bulleted or checklist feature. This compilation of tasks or modules associated with functional work capability becomes the manual guiding the P2P training process.

The master trainer uses a structured approach for conducting the training process which begins by introducing the sensor operator trainee to the approach and reasoning which is foundational to the P2P experience. The trainer reviews the preparation and the prerequisites which will ensure successful training and responds to any questions the trainee may have. After reviewing the module to be covered during the training, the master trainer asks the trainee to recap the content of the P2P module, allowing the trainee to “walk-through” the protocol which is the focus of training. The master trainer offers feedback, coaching the trainee through the model and evaluating the trainee’s response verbally. The trainer then will allow the trainee to observe and monitor the trainer performing the unit of work. The master trainer then will ask the trainee to comment on the of the trainer to identify those areas of the performance which were noteworthy to the trainee, and ask any questions. Further monitoring and observation may be deemed appropriate by either the master trainer or the trainee.

When the trainee and master trainer are assured that the trainee is adequately prepared, the trainee may perform the unit of work, starting with the least challenging aspect and proceeding through successively more demanding requirements. After the unit of work is complete, the master trainer will ask the trainee to comment on the performance during the operation of the sensor, prompting self-reflection on the areas in which performance was superior or which may require further practice. The master trainer will provide feedback, evaluating performance of the trainee and complete a feedback form. When both the master trainer and the trainee feel it is

appropriate, the trainee may progress to the next module of more challenging sensor operation. The process is repeated until all modules have been successfully mastered.

P2P IMPLEMENTATION ON THE ISR GH

As suggested for the ISR GH platform, P2P training would initiate with basic familiarization accomplished through brief exposure to the system in a classroom setting. Following examination of system operations and the modules associated with each task/work unit, operators could then be engaged in the P2P training in the actual operations setting. The most basic functions would be used as part of the introductory process to the system. An introductory function which would be considered appropriate for the new operator would be learning the steps and process protocol associated with basic image capture. The protocol for the P2P training associated with this task would proceed as described here.

Initially, the master trainer would provide an overview of logic and approach which are foundational to the operation of the ISR GH system and review the preparation engaged to that point. The trainer would solicit questions from the trainee prior to initiating the image capture module, respond to questions and then review the module, in this case, set-up and operation of the sensors for the purposes of gathering photos during reconnaissance sorties. After review of the protocol, the trainer then asks the trainee to “walk through” the module while the trainer evaluates and guides the trainee in operation of the sensor technology used in image capture.

At this point, the trainer engages in a live demonstration of the module with the trainee observing and, on conclusion, solicits the trainee’s evaluation of the trainer’s performance, engaging the trainee in discussion of the image capture process and how well the trainer conducted the operation. The trainee may request further opportunity to observe and comment until both parties feel that the trainee is ready to perform the process of determining the settings and operating the sensor for image capture. After completing the module, the trainer will ask the trainee to go back over their performance using the image capture module and reflect on those areas which were performed well, those which were adequate, and those which would benefit from further practice. The trainee would assess their performance and the ways in which they could improve.

This metacognitive approach to assessing learning functions accelerates the trainee’s ability to focus on

the areas in which learning can be adjusted to achieve improvement (Vella, 2002). It engages the learner in his/her own development and encourages the trainee to take responsibility for training advancement. The trainer guides the trainee through the process by allowing the trainee to struggle with the challenge of seeking improvement. The trainer does this by asking questions, providing feedback and evaluating performance. The trainee becomes an active participant in his/her development in an iterative process in which the trainer provides content expertise while modeling the performance and capability required to reach expert levels of skill mastery.

The final stage of the module offers the trainee a written assessment of performance and multiple opportunities to engage in further performance opportunities. Appendix 1 represents an abbreviated sample module for Image Capture for the ISR GH.

CONCLUSION

The P2P model offers an approach to training needs created by accelerated ops tempo. It is suggested as a protocol to support the dynamic needs of a program prior to transition into sustainment and maintenance phases of the life cycle. Additionally, it provides a response to the demands of a new era of continuing technological innovation that rolls out enhanced capability on an on-going basis. The proposed P2P model demonstrates methods supporting UAV operational capability which, if implemented successfully, would offer accelerated skill development of sensor operators. At present, it is a short-term solution to a pressing need; however, if successful, it may offer an approach to training which fills the gap between ACTD and fielding of technology on a long-term basis as well. The process is flexible enough to be fine-tuned to differing platforms while ensuring standardization of performance outcomes that may reduce the impact of human error on field performance. Further, it opens the door to a process of individual training which may act as a platform for training at the team level.

REFERENCES

Air-Attack.com: Military Aviation News & Media. (2009). *Creech AFB MQ-9 Reaper pilots train remote split operations*. Retrieved June 11, 2010, from <http://www.air-attack.com/news/article/3520/Creech-AFB-MQ-9-Reaper-Pilots-train-remote-split-operations.html>.

Associated Press. (2008) Human error cited in most UAV crashes. *Military Times*. Retrieved June 10, 2010, from <http://www.military.com/news/article/human-error-cited-in-most-uav-crashes.html>.

Gresham, J. (2010). Blind drones: Improving eyesight with Gorgon Stare. *Military Strategy*. Retrieved June 11, 2010, from <http://militarystrategy.wordpress.com/2010/03/27/blind-drones-improving-eyesight-with-the-gorgon-stare>.

Herz, R. (2008). *Assessing the Influence of Human Factors and Experience on Predator Mishaps* (Doctoral dissertation). Available from Dissertations and Theses database. (UMI Microform 3299218)

ISAF Public Affairs Office. (2010). U.S. releases Uruzgan investigation findings. 100528-NR-019. Retrieved June 10, 2010, from <http://www.isaf.nato.int/article/isaf-releases/u.s.-releases-uruzgan-investigation-findings.html>

Jacobs, R. (2003). *Structured on-the-job training: Unleashing employee expertise in the workplace, 2nd Ed.* San Francisco: Berrett-Koehler.

Noe, R. 2008. *Employee Training and Development, 4th Ed.* Columbus, Ohio: McGraw-Hill/Irwin.

Schmidtchen, D. (2006). *The rise of the strategic private: Technology, control and change in a network enabled military*. Duntroon, Australia: Land Warfare Studies Center.

Vella, J. (2002). *Learning to listen, learning to teach: The power of dialogue in educating adults*. San Francisco: Jossey-Bass.

Appendix 1

Module Title: Image Capture for ISR GH Sensor Operations		
<ul style="list-style-type: none"> • Prerequisites: ISR GH sensor familiarization for image capture; address image capture module training; familiarization with evaluation and feedback process and paperwork; • Required Resources: ISR GH sensor equipment and training module for image capture; any hardware and/or software related to image capture function; • General Quality: ISR GH sensor operations are central to mission requirements. Operators must meet the requirements stipulated in the instructional tools provided by the master trainer for operating the ISR GH platform. This module addresses one function of this platform, image capture from reconnaissance missions. The master trainer will be responsible for ensuring training protocols are followed according to training specifications entailed in this module. Feedback and input will be provided to the trainee and trainee input will be solicited to facilitate training performance. Trainee performance will be evaluated to facilitate workplace learning. • Location: TBD • Security: All materials and information related to training for image capture will be maintained in a secure file. • Qualified Trainers: The following individuals are qualified to deliver the training: 		
Step	Comments	Quality
1. Log on to system	Sensor station as assigned.	
2. Verify system capabilities are operational	Coordinate with master trainer	
3. Prepare support documentation and operational aids	Use ISR GH software and image capture protocol with criteria for performance	
4. Review image capture process	Master trainer will lead thorough review. Trainee will demonstrate grasp of process by repeating understanding of requirements back to master trainer. Master trainer will provide feedback, correcting and coaching as appropriate.	
5. Ask questions as required and appropriate.		
6. Ensure sensor technology is functioning.	Master trainer verifies technology capability.	
7. Monitor operation of sensor technology as demonstrated by master trainer. Continue process.	Trainee will note nature of settings based on mission requirements and use of resources; questions will be solicited and feedback provided. When appropriate and both trainer and trainee agree, trainee may take over operations.	
8. Trainee will engage in sensor operation for image capture.	Master trainer will monitor performance ensuring goals are met and provide feedback.	
9. Review performance.	Both trainee and master trainer will offer feedback on performance with written evaluation provided.	

10. Set goals for improvement.	Trainee will evaluate performance and record comments.	
11. Complete any back-up documentation related to image capture operations for ISR GH.		