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**VIRTUAL REALITY GROUND FORCE COMMANDER
TRAINER**

by

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VIRTUAL REALITY GROUND FORCE COMMANDER TRAINER

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ABSTRACT

The complexity of battlespace is guaranteed to increase over time. The problem arising is that with today's innovative battlefield and the ever-connected environment, our junior officers are receiving more information, data, and feedback than ever before. With this increased amount of information at their fingertips, we expect them to process this information and make these real-world decisions faster and more precisely than before. Suppose we do not train our leaders to properly handle this information and prioritize tasks, and help them to avoid becoming overwhelmed by the multiple tasks they address. In that case, we run the risk of them becoming cognitively overloaded and making bad decisions based on poor judgment or emotions. These impulsive decisions highly increase the chance of mission failure. Today, we are expecting more out of our ground force commanders (GFCs) in their doctrinal skill set, decision making abilities under pressure, and cognitive performance; however, we are failing to adapt and advance our training at the same pace and level that we expect them to perform. If we cannot teach it, how can we expect our operators to perform at this new level in a new environment? The question: How can Special Operations Forces improve cognitive decision processing under stress and prepare GFCs for future conflicts? Our conclusion is that the adoption of advanced training and technology will help to keep SOF GFCs at the leading edge of combat proficiency.

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LIST OF ACRONYMS AND ABBREVIATIONS

AOIC	Assistant Officer in Charge
APL	Applied Physics Lab
ATC Det-HI	Advanced Training Command Detachment Hawaii
BUD/s	Basic Underwater Demolitions/SEAL
C2	Command and Control
CBSA	Chase Boat Situational Awareness
CDE	Collateral Damage Estimate
CFF	Call For Fires
CQC	Close Quarters Combat
DEVGRU	Development Group
DTS	Desktop Training Simulator
FMP	Full Mission Profile
FTX	Field Training Exercise
GFC	Ground Force Commander
GPC	Great Power Competition
HHQ	Higher Head Quarters
JO	Junior Officer
JOTC	Junior Officer Training Course
JTAC	Joint Terminal Attack Controller
LZ	Landing Zone
NSW	Naval Special Warfare
OIC	Officer in Charge
OODA Loop	Observe, Orient, Decide, Act
PLT	Platoon
PRC	Peoples Republic of China

ROC	Rehearsal of Concept
SA	Situational Awareness
SDV	SEAL Delivery Vehicle
SOCOM	Special Operations Command
SOF	Special Operations Forces
SOTF	Special Operations Task Force
SSE	Sensitive Site Exploitation
SWOT	Strengths, Weaknesses, Opportunities, Threats
TACFI	Tactical Funding Increase
TACLEAD	Tactical Leader
TL	Team Leader
TRADET	Training Detachment
TTP	Tactics, Techniques, and Procedures
ULT	Unit Level Training
VR	Virtual Reality

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I. GFC TRAINING OVERVIEW

A. BACKGROUND

Over the past 50 years, Ground Force Commander (GFC) training has changed little across all military branches. Training techniques, such as ROC drills, sand tables, and communication drills, are still used to train our junior officers for war. This type of training has worked until now because we have been relying on years of first-hand experience and lessons learned from combat. There are obvious flaws in depending on this type of training alone as it lacks realism and is only as good as the skill level of the trainers. As we shift away from the war on terror, we lose the first-hand experience that kept us sharp and prepared as a fighting force. Also, as we look towards Great Power Competition (GPC), the training becomes more difficult. With everchanging technology such as drones and artificial intelligence, a practical vision of what the battlefield will look like for our special operators in the future is anyone's guess. As our adversaries change, our next conflict may be against a more technologically advanced nation, or it may be another proxy war with a great power supporting the effort. Now, we must prepare for an enemy who is better trained, better equipped, and more technologically savvy than the one we have been facing over the past twenty years.

The complexity of the battlespace is guaranteed to increase over time. The problem arising is that with today's innovative battlefield and the ever-connected environment, our junior officers are receiving more information, data, and feedback than ever before. With this exponential increase in the amount of information at their fingertips, the military expects these battlefield commanders to process this information and make these real-world decisions faster and more precisely than they have in years past. Clausewitz said that "many of the decisions faced by the commanders resemble mathematical problems worthy of the gifts of a Newton or an Euler."¹ This has never been truer than in today's environment. Suppose we do not train our leaders to properly handle this information, prioritize, and not be overwhelmed by the multiple tasks demanded by developing

¹ Carl von Clausewitz, *On War* (Scotts Valley, CA: CreateSpace, 2012), 112.

battlefield scenarios. In that case, we risk them becoming cognitively overloaded and making bad decisions based on poor judgment or emotions. These impulsive decisions highly increase the chance of mission failure. Today we are expecting more out of our GFCs, their doctrinal skill set, their decision-making under pressure, and their cognitive performance. However, we fail to adapt and advance our training at the same pace and level that we expect them to perform. If we cannot teach it, how can we expect our operators to perform at this new level in a new environment?

This project focuses on the following question: How can Special Operations Forces improve cognitive decision processing under stress and prepare GFCs for future conflicts?

B. DEFINING THE SPACE (30,000 FT LEVEL)

The following image is road map for the first three chapters of our project, and we will refer to it for each section covered.

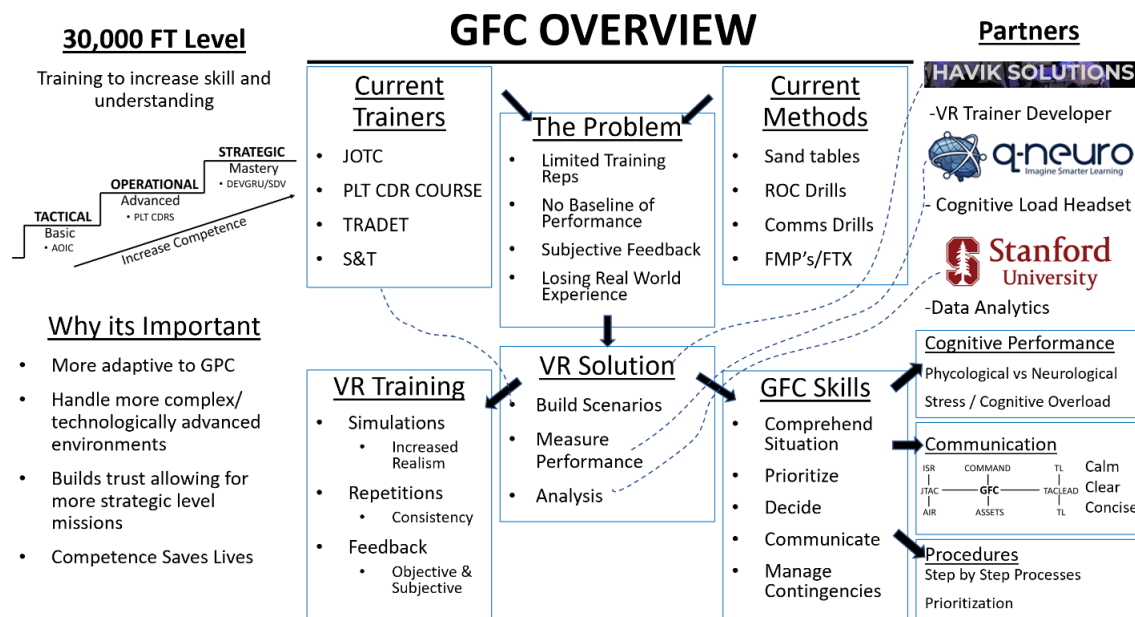


Figure 1. GFC Overview Diagram

Currently, the training of GFCs focuses on the tactical level and hardly discusses the operational or strategic level goals of a mission. Due to this fact, we can only handle missions that have clearly defined strategic and operational objectives. As we shift to the

GPC, SOF can do more than they currently are to disrupt other nation-states. However, one of the significant issues that SOF faces as a force is that we are not trained at the GFC level to handle the operational and strategic level decision making. The Joint Publication 3-0 defines the three levels of war as tactical, operational, and strategic.²

Tactical Level. Tactics is the employment, ordered arrangement, and directed actions of forces in relation to each other.³

Operational Level. The operational level of warfare links the tactical employment of forces to national strategic objectives.⁴

Strategic Level. In the context of national interests, strategy develops an idea or set of ideas of the ways to employ the instruments of national power in a synchronized and integrated fashion to achieve national, multinational, and theater objectives.⁵

Ultimately, the main goal of a GFC is to be tactically proficient on the battlefield. When in a combat environment, this is the most critical skill set that a GFC can possess and should be the main focus of training looking to the future. Still, specific actions on the battlefield could have operational and strategic impacts. The discussion on increasing the scope of GFC training to include both the operational and strategic level needs to take place in the shift towards GPC. These two levels center on understanding the bigger picture and environment you are operating in, and demand increased focus and understanding.

Presently, training for GFCs consists of the Junior Officer Training Course (JOTC), the Platoon Commander Course, and Training Detachment (TRADET) which all focus on the tactical level of training. Development Group (DEVGRU) and SEAL Vehicle Delivery Team (SDV) have advanced training pipelines that still focus on being tactically proficient, but they train more towards the operational level of understanding. Understanding the

² Joint Operations, JP 3-0 (Washington, DC: Joint Chiefs of Staff, 2017), 38–41, https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_0ch1.pdf?ver=2018-11-27-160457-910.

³ Joint Operations, 40.

⁴ Joint Operations, 39.

⁵ Joint Operations, 39.

impacts that a specific mission can produce is why these groups are trusted to conduct national strategic level missions that require an understanding of the operational and strategic level of war impacts resulting from a specific mission. At the moment, very few individuals will ever reach the level of mastery it requires with the current training and operational pipeline to conduct national strategic level missions as a GFC. Those that do achieve this are capable of successfully conducting missions such as the Abbottabad raid. National mission forces are the only ones capable of achieving this level of strategic understanding due to the current training and experience limitations. To achieve this, it takes one-on-one mentorship with senior commanders with experience and a complete understanding of the operating environment to train someone to that level. Figure 2 is a depiction of current GFC training.

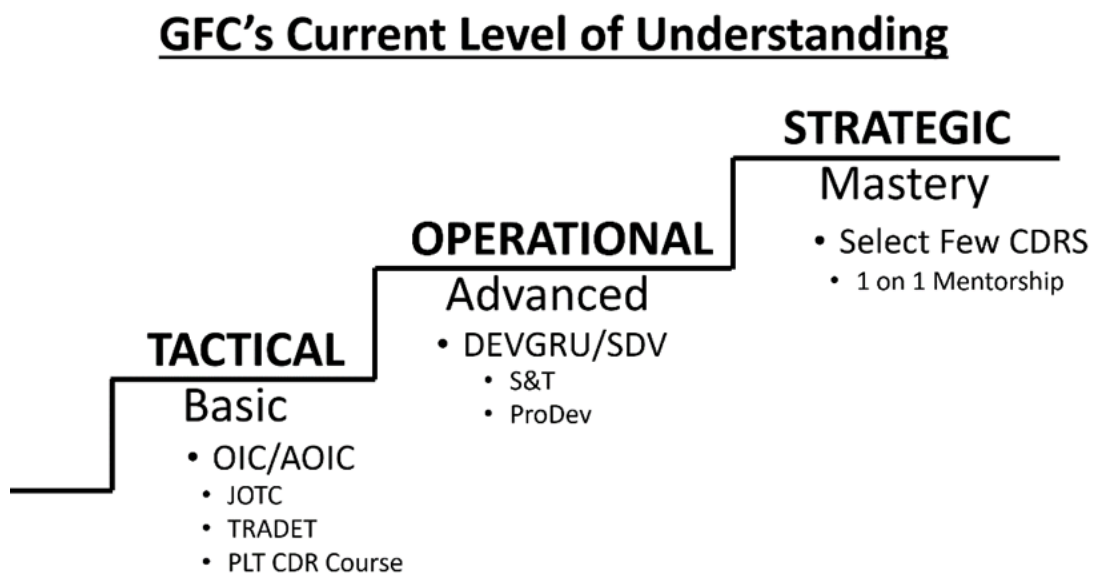


Figure 2. GFC Current Level of Understanding

To increase GFC competence in warfare levels, we need to start with training that builds a framework to improve the cognitive capacity from the Assistant Officer in Charge (AOIC)'s grade and continues throughout the ranks. An AOIC's goal should still be to attain tactical proficiency because this is the foundation of a good GFC and can be achieved through JOTC and Unit Level Training (ULT). However, the aim is not to lose proficiency

as Junior Officers (JO) are doing diversity tours, which have increased in years recently.⁶ It is to decrease the learning curve by minimizing the time spent to retrain certain skills. The longer an Officer in Charge (OIC) has spent away from an operational command, the more an OIC will require time and resources to retrain to a particular tactical level proficiency. Retraining skillsets take away from the time and resources to build their operational level of understanding. Limiting the need for retraining allows for the platoon commander course and TRADET to work in scenarios that will enhance tactical level proficiency and introductory concept of requirements for operational level proficiency. A GFC who understands the intent and purpose of Geographic Combatant Command can align the tactical mission's commander's intent to meet the operational level of warfare. Suppose both tactical and operational level proficiency is achieved at the OIC level at East and West Coast Commands. In that case, DEVGRU and SDV could increase their level of training to include strategic competence, allowing for more trust and advanced missions across the board. The below image is what we hope to achieve for our GFCs.

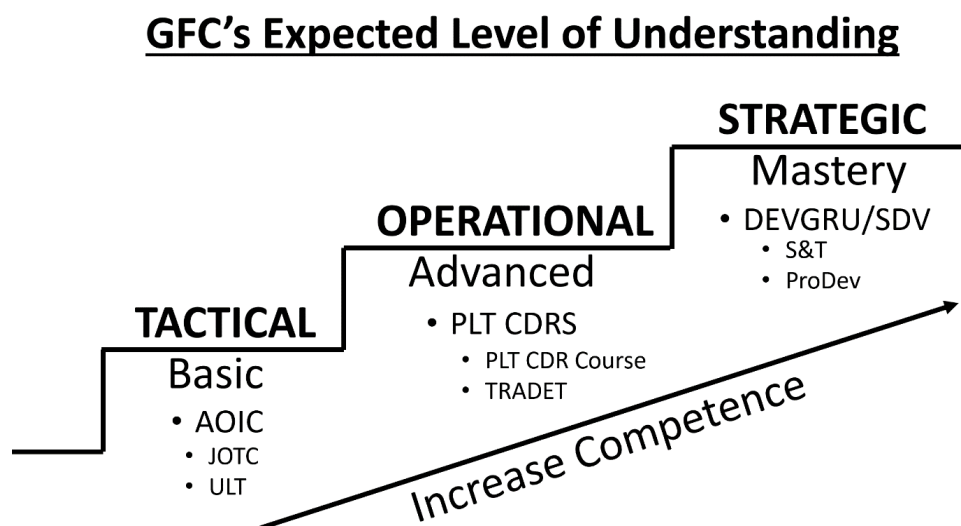


Figure 3. GFC Expected Level of Understanding

⁶ David Duffield, TRADET GFC Training, interview by Ryan Sataneck and Nicholas Wagoner, March 17, 2021.

In the end, the goal of this training is to make Special Operations Command (SOCOM) more marketable as a force in the GPC. Increased competence would allow for GFCs to handle more complex environments, build trust for CDRs, allowing for more advanced mission sets, and ultimately, maintaining the competitive advantage over our adversaries.

C. CURRENT GFC TRAINERS

In the SEAL pipeline, structured GFC training is limited in size and scope of practice. Training is currently broken down into three levels: the AOIC Level, the OIC Level and the National Mission Level.

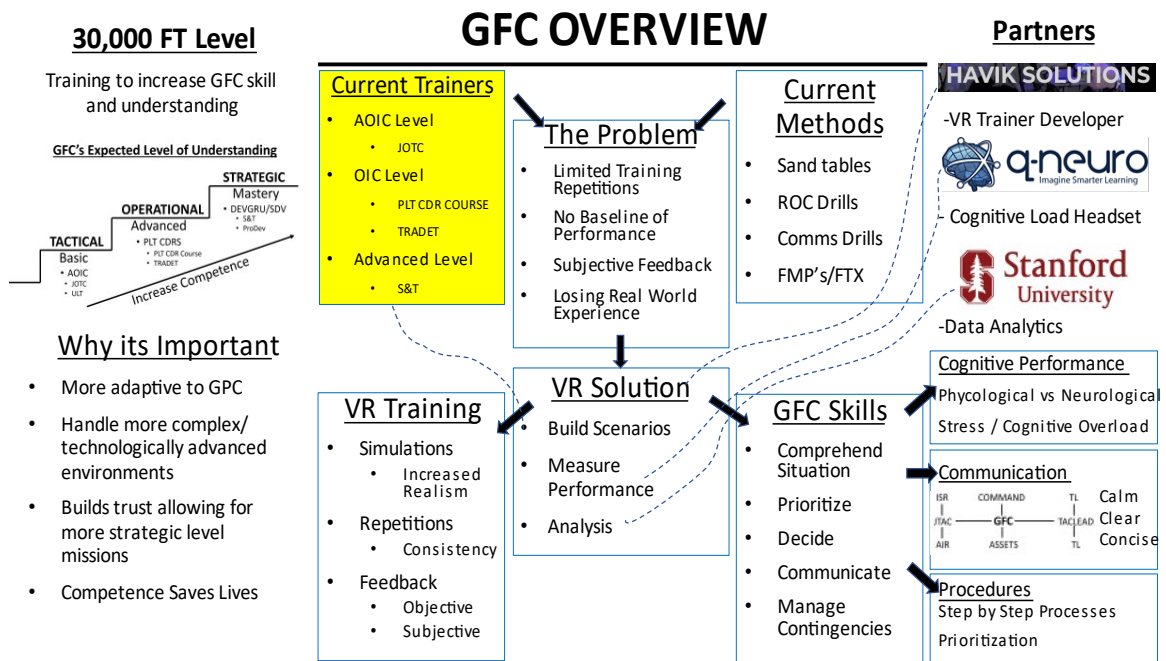


Figure 4. GFC Overview Current Trainers

AOIC (Basic)

- JOTC/SQT
- Focuses on the basic level of tactical proficiency. Understanding the basics of mission planning, doctrine, GFC skillset, procedural aspects, and basic communication.
- The first exposure that JOs get to the role of being a GFC
- No real room/requirement for expanding on the curriculum
- SQT serves as practice on GFC missions
- ULT/1st Deployment
- JOs get exposed to tactical movements and decisions from a shooter standpoint as well as limited exposure to acting as a GFC or mobility commander
- They also get time to practice and train GFC procedures with experienced operators. The time and level of additional training, outside of ULT, is dependent on the experiences and personnel within the Troop.

OIC (Advanced)

- Platoon Commander Course
- Focuses on decision making aspect of GFC role
- Asset management
- Advanced communication
- Independent from skills learned JOTC
- Refresher on mission planning and GFC skillset

- Helps to develop relationship between TACLEAD, JTAC
- 2-week course
- TRADET
- Advanced tactical skill training for GFC
- Grading and assessment takes place during ULT, but there is no set curriculum for a standardization at the East or West Coast commands.
- Takes place during ULT for OICs over the 6-month period and usually consists of one or two FMP's per OIC per block of training
- 1&2 both east coast and west coast are conducting training

National Mission (Mastery)

- S&T
- More advanced tactical training and proficiency
- Constant assessment/evaluation of skillset
- Preparation for real world national level missions
- Professional Development
- Mission specific training, currently reserved for national level missions

D. GFC TRAINING METHODS

Sand Tables, walkthroughs, ROC Drills, field training exercises (FTXs), and full mission profiles (FMPs) are all methods of training used to train GFCs throughout the SOF community. This section of the paper will break down the benefits and drawbacks of each training type.

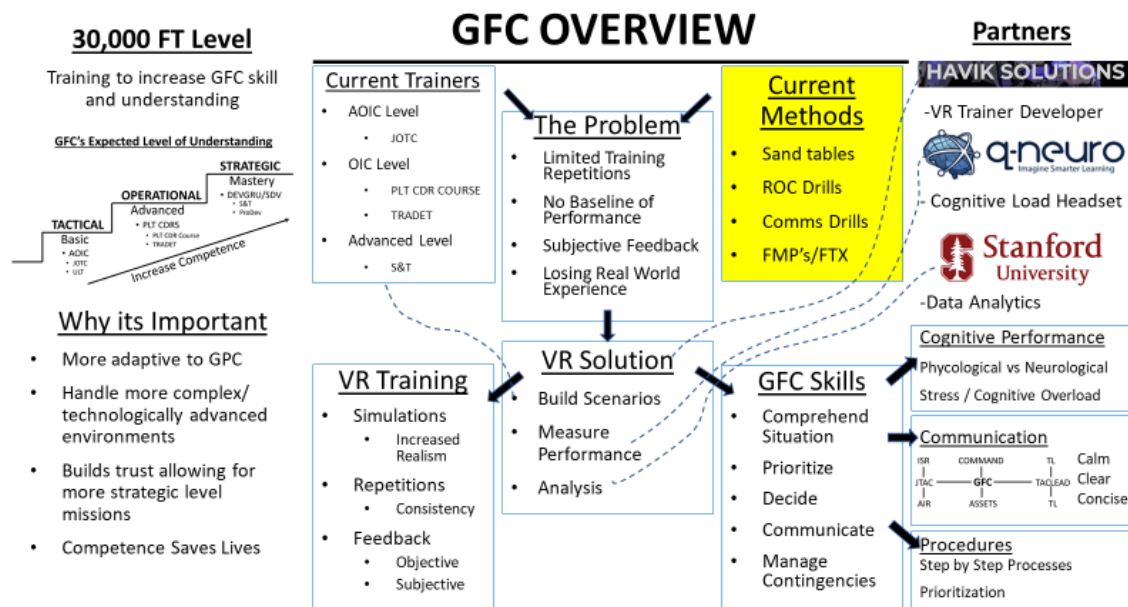


Figure 5. GFC Overview Current Methods

Sand Tables/walkthroughs: “A tactical decision game that employs a three-dimensional terrain model made from sand and various props to provide a visual representation of the situation described in the tactical decision game.”⁷

⁷ Dictionary University, accessed July 21, 2021, <https://dictionary.university/Sand%20Table%20Exercise>.

Benefits:

- Quick to put together
- A visual aid that engages all players involved participating in the sand table
- Reinforces personnel locations at each phase of the operation

Drawbacks:

- All the assets and personnel may not attend because of current locations and other obligations.
- Difficult to ensure everyone is on the same page
- The pace is unrealistic, easy to skip steps
- Feedback is limited

ROC Drills: a dry walk through of a plan that gives the unit and all players an opportunity to practice combat mission communication, scheme of maneuver, and practice contingency in a physical setting before a mission.

Benefits:

- Personnel can physically see their position in a mobility platform and who will be with them at each phase of the operation
- Personnel can rehearse critical actions in the planned phase of the operation
- Ensures that everyone involved understands their role and understands each element's reaction to different contingencies

Drawbacks:

- Time-consuming
- Need all players to participate in event
- Overly structured and complex with not a lot of time to work on contingencies

Communications Drills: exercise in which individuals practice passing vital communications between key players in an operation. This practice is designed to specifically target communication skills, increase clarity, and improve brevity for of key leaders.

Benefits:

- Using communications equipment to pass information and the utilization of distance and terrain to make comms more difficult
- More realistic use of comms, scenarios vary in size but typically along the lines of sand tables
- Good for basic GFC calls and coms

Drawbacks:

- Not very realistic
- Do not incorporate any realistic models
- Limited by those providing the training
- Require pre built scenarios and scripts

FTX's/FMP's: Field Training Exercises are training battles used to present realistic combat scenarios that a unit may face while forward deployed.⁸

Benefits:

- Most realistic and dynamic type training
- It adds real world complexity and logistics into training
- Provides a chance to work with external units and assets outside team

Drawbacks:

- Limited in size and number of FTXs
- Extremely cost and time intensive
- Most scenarios aren't focusing only on GFCs, and feedback directed at GFCs is not as precise or objective.
- Limited assets for the GFC to manage

In summary, the major drawback to the first three training methods is that the skill level of the trainers limits them. With a limited number of scenarios and experience to draw from, their understanding of what could go wrong or what's right confines the training effectiveness. The major drawbacks to FTXs and FMPs is size and resources required to put them together. As a result of their significant cost and time there are only a limited number of opportunities for these types of training to take place in a work-up. These restrictions limit the overall benefit of this training for GFCs. ULT focuses on the tactical picture but that is just one aspect of the knowledge required to succeed as a GFC.

⁸ United States and Department of the Army, *Ranger Handbook* (Washington, DC: Department of Defense, 2017), 98–112.

E. PROBLEM/GAP

GFC training covers different aspects to lead warfighters in combat and peacetime effectively. The training consists of planning, asset management, information management, and understanding and disseminating the collateral damage estimate (CDE) concerns and the tactical picture as well as the risk associated with each task. A problem throughout current training is the inability to train to all of these aspects in a single scenario. Each element is taught at one point throughout an officer's career. Still, the depth of the teaching depends on the instructor or leadership's knowledge and experiences, while the time between training varies and is limited for each officer's career and the structured training.

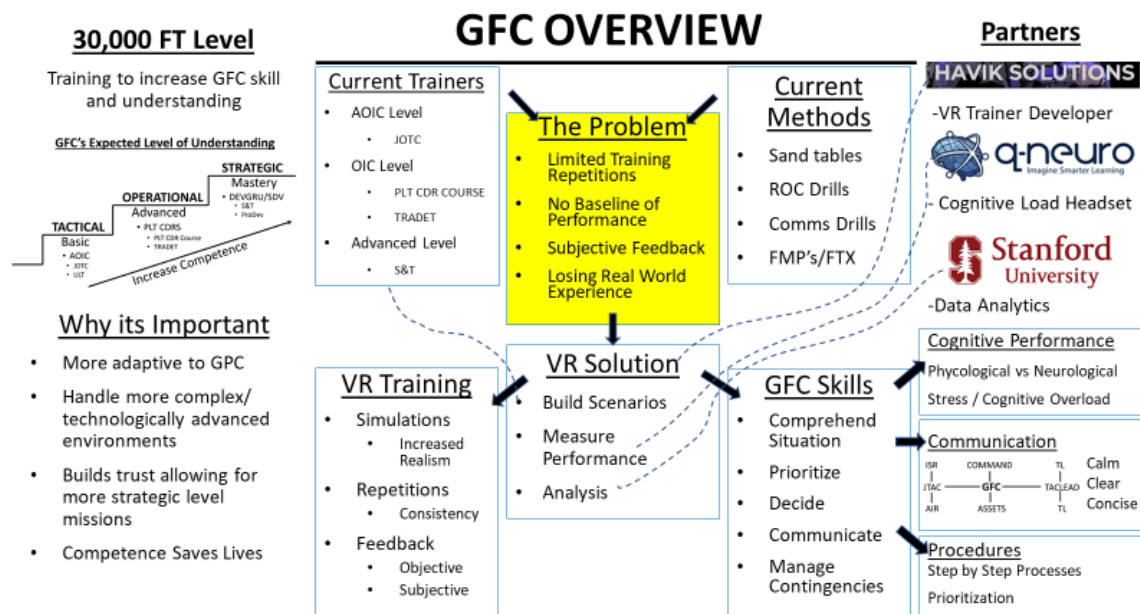


Figure 6. GFC Overview The Problem

Structured training for GFC such as JOTC and the Platoon Commander Course is limited and spaced throughout an officer's career. The spacing is due to a lack of expert trainers devoted to the subject, limited time in the training schedule, and diversity tours that take Junior officers away from the operational environment.

Training events that incorporate cognitive decision-making for the GFC in a simulated warfare environment are sparse. These include Field Training Exercises (FTXs) and Full Mission Profiles (FMPs), which incorporate a restricted time frame for planning with the information given of a fixed scenario and usually have a duration of 24 to 72 hours.⁹ Due to the complexity of these exercises, the number of individuals involved, and asset availability, they take more time to develop than to run. Incorporating multiple assets drives up the cost of these exercises, and the availability of the assets is limited due to their own training cycles. After the exercises are completed, there is a hot wash of the team's overall performance. These usually consist of three things that they did well and three things that can be improved on while highlighting any safety issues that occurred. The focus is less on GFC skills due to the lack of grading criteria for a GFC throughout the exercise and more on the team's tactical performance related to actions on the objective. As for evaluating the GFC, the feedback depends on the GFC evaluator's experience and is subjective, not definitive.

Training feedback, regardless of the method, has relied on subjective evaluation to this point. After training is conducted, feedback is typically given as opinions from the instructors. Based on their experience, skill, and background, they focus on different aspects of the training. Consistent feedback that can be used to measure performance for multiple GFCs over an extended period of time does not exist in the current way we train. Nor is there a way for GFCs to see progress in the cognitive decision-making process.

Instructors and evaluators are expected to conduct training and prepare platoons for deployment. Many instructors have not had experience in combat and lack the in-depth knowledge of the stresses and pressures put on a GFC that could overwhelm the decision-making process while in that critical role. Due to the lack of combat experience now in the teams, and as we increasingly lose more experience each day, these kinds of rehearsal of concept or ROC drills become less and less effective at simulating actual combat. As officers spend more time away from the SEAL teams and the OIC role through added diversity tours and limited operational roles, they begin to lose the operational experience

⁹ Duffield, TRADET GFC Training.

and the requirements demanded of a GFC. Nevertheless, when they come back to the teams, they are still expected to handle the complex and everchanging environment after spending two to five years away from the operational aspect of that profession.

We need a more effective way to get these officers back up to speed to the tactical level, and we cannot depend on the current training structure to do so. Being a GFC is not an intuitive skill. It takes focused practice and hundreds of hours to develop the calm and relaxed demeanor required for combat. There is no shortcut to attaining mastery. We need to ensure that the force is doing its best to train to the highest level of understanding that we can achieve. There needs to be an easier and more efficient way to train basic realistic scenarios accessible to the team's OIC and AOICs to build competence.

If we as a force chose not to train this way, one guarantee is we will not be as ready as we can be for the next war and lose the competitive advantage that we have maintained throughout the recent years. We will make avoidable mistakes, and lives will be lost as we have to relearn the past lessons. Inexperience can cause decisions to be made off of instinct and to be influenced by emotions; these types of decisions have a better chance of failing.

For GPC, we are also asking our Officers to think more operationally and strategically, and this skill has to be developed and practiced by our commanders. Incorporating the level of thinking required will take time, study, and practice to perfect, but the more we practice it now, the better we will be in the future.

F. INTERVIEWS

The Naval Postgraduate School's Institutional Review Board (IRB) reviewed and approved the research protocol, including the use of interviews of operators and trainers from the East and West Coast teams, SDV, DEVGRU, TRADET, and JOTC. Interviews lasted anywhere from twenty minutes to two and a half hours and provided much of the background information for this paper. The interview questions are in the appendix below. Findings were consistent with our experience. The present-day training throughout the Teams focuses on qualifying platoons to be deployable but lacks consistency in the grading and evaluating GFCs. There are no outlined criteria for a GFC to meet for that GFC to be C1 status; it is only for the platoon as a whole.

Our conversations were structured in a way to allow them to flow to different topics as needed. Some of our conversations focused on mission planning and organizational control conducted, most of this taking place before operations. Other discussions revolved more around the roles and responsibilities of an OIC on the ground as the operational commander. This branched off into discussions over their priorities and where the GFC's attention lies at various points throughout the mission. Still, other interviews drifted toward the thought process of GFCs that happen during contingencies and how to handle chaos on the battlefield.

After reviewing all interview responses, a clear pattern emerged around some common skills. We were able to break down these GFC skills and simplify them into six fundamental pillars of competence: Planning, Asset Management, Information Flow Management, Contingencies, Decision Making, and Tactical Picture. These pillars are built on a foundation of Trust and help support the commanders Risk Management.¹⁰ We built this out into a diagram pictured below to better illustrate how these skills interact.

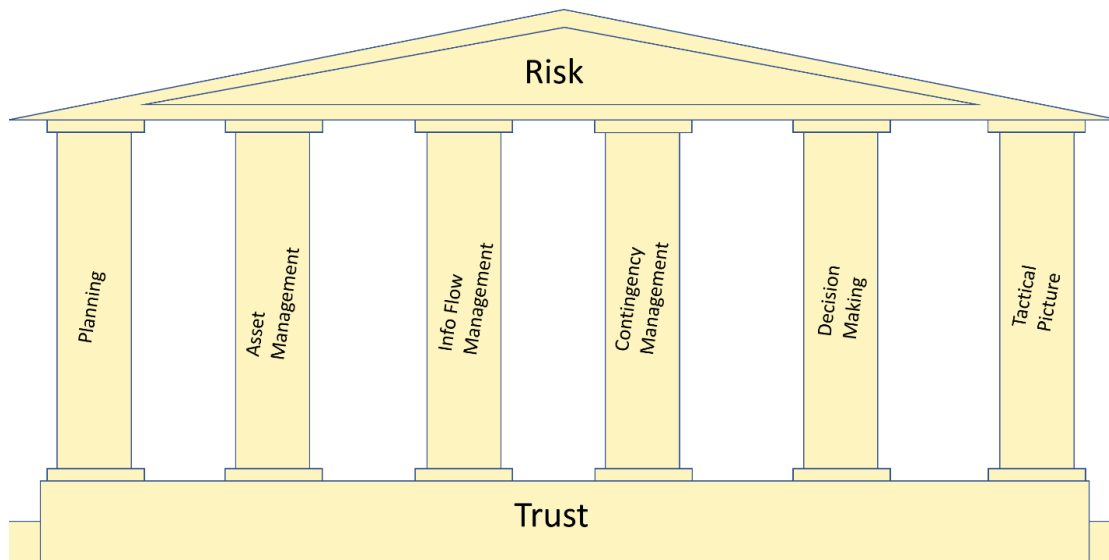


Figure 7. GFC Pillars of Success¹¹

¹⁰ Duffield.

¹¹ Source: Duffield.

Presently, GFC training just touches the wave tops of these fundamentals. At no point are all of these dimensions put together into a combined exercise. The first time a GFC will experience all of these fundamentals at the same time will be combat. Current attempts to fill the current these gaps focus on more repetition of the same flawed training techniques. If we can integrate all of these pillars into training scenarios or multiple training events, our GFCs can begin to build these cognitive processes out so that when they are in combat, they are not seeing this for the first time.

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II. VR SOLUTION

VR offers an alternative solution to training and currency problems facing the NSW community. VR technology will reduce the cost of realistic scenarios by decreasing the dependency and logistical difficulties associated with relying on supporting assets.¹² This reduced effect of a changing environment will make grading more objective as well. VR also is a less expensive way to facilitate more realistic training for GFCs through simulated scenarios with enhanced interaction. This type of training can better replicate the psychological response to combat than sand tables, ROC drills, or communication drills.

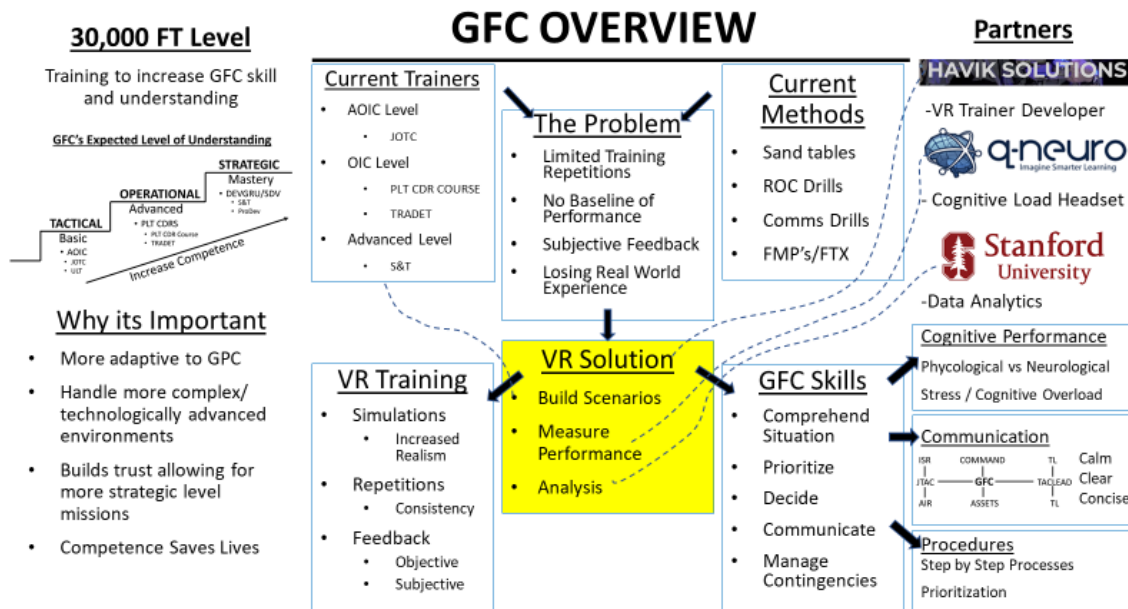


Figure 8. GFC Overview VR Solution

¹² Richard Schmidt, NSW GFC Course, interview by Ryan Sataneck, May 12, 2021.

A. VIRTUAL REALITY REQUIREMENTS

For a VR GFC trainer to be successful, it has to incorporate three things. First, it must have pre-built out scenarios to ensure training is standardized to some extent by all participants. Next, the simulator must also have some way of measuring a GFCs performance while training. Finally, a consistent pattern of analyzing a GFCs performance is essential to give accurate feedback gain the most out of the simulator.

Built Scenarios: A VR trainer will need multiple scenarios already developed, so facilitators do not have to rely on their experience or knowledge to replicate different or new scenarios every time an operator comes in to train. The scenarios should have a skeleton but allow for the addition of contingencies to scenarios so that the facilitator can add complexity. A variety of different scenarios and contingencies for the simulator should be completed and vetted before the final version of the VR simulator is delivered to SOCOM.

i: Varying complexity: The Scenarios will vary in complexity to enable training for multiple skill levels. Beyond the initial scenario, further control options will be given to the facilitator to increase the difficulty based on operator performance. i.e., the addition of contingencies and environmental factors(wind, precipitation, cloud cover, dust, etc.)

- **Basic:** Emphases on understanding tactics.

Incorporates small force/platoon management, blue force picture, communication, and understanding the basic procedure of a mission. Once this is accomplished, contingencies should be added with a focus on proper prioritization.

- **Advanced:** Emphases on understanding the tactical and operational picture.

At this point, GFCs are expected to know the basic mission procedures. They should be able to control and keep track of multiple elements such as platoon, partner forces, mobility while

dealing with various contacts. More contingencies and numerous problem sets can be thrown at the GFC to overload the operator and force them to task shed/share, requiring efficient and concise communication with JTAC, TACLEAD, JOs, etc. The addition of tasks and delegation will allow for evaluating complex decision-making and communication that can push GFCs to the point of cognitive overload. Understanding at what point a GFC is overloaded illuminates what can be worked on to improve mental performance in a combat scenario.

- **Mastery:** Emphases on understanding the operational and overall strategic picture.

At this level, the tactical and operational level of understanding has already been reached. This will focus on decision-making on a higher level, go/no go criteria, abort criteria, deconfliction, ethical and moral decisions, and strategic-level decision-making. The increase of contingencies, political factors, and civilian concerns outlines the GFC's ability to understand the overall end state through prioritization and complete the mission while mitigating the risk of unintended consequences.

ii: Scalable: These scenarios have to be able to be run as smaller elements, one to two players, or larger elements, up to five. The operational area also needs to vary in size so that the GFC has experience comprehending distance, time, and space.

Measure: Measuring performance will also be required while using a VR simulator to make this training more practical and worth the investment. Since physical and mental performance is already a significant field of study, commercially available devices can be added to the simulator without modifications.

i: Grading Criteria: Replicable grading criteria or a rubric will need to be developed to measure a GFC's performance effectively. The grading criteria would

establish a reference point of performance for the overall force. Still, more importantly, it is a way for the GFCs to track their progress and improvement over time. Later on, this data could be used to establish qualifications for GFCs to become deployable.

ii: Cognitive Load Headsets: Headsets to measure cognitive load are an essential part of the equation. They will provide immediate feedback on how the GFC is responding to the stimulus at the moment. Measuring cognitive load is vital information not only for the GFC but also for the trainers to vary the scenario's difficulty.

iii: Other Wearable Devices: There are other wearable devices such as Garmin watches, apple watches, Fitbit, and other fitness trackers on the market that could integrate with the VR system to evaluate the physiology of the operator in addition to the cognitive load headsets. These can measure heart rate variability, physical position, and oxygen levels to determine an individual's stress levels. It is known that too high of a stress level impairs the cognitive performance of an individual. Therefore, measuring these levels can help us to determine when someone gets too stressed. High stress decreases performance, and identifying the stressors allows the operator and facilitator to find ways to reduce a GFC's stress levels and increase performance. Yerks-Dodson Law provides a simple depiction of performance vs. stress.

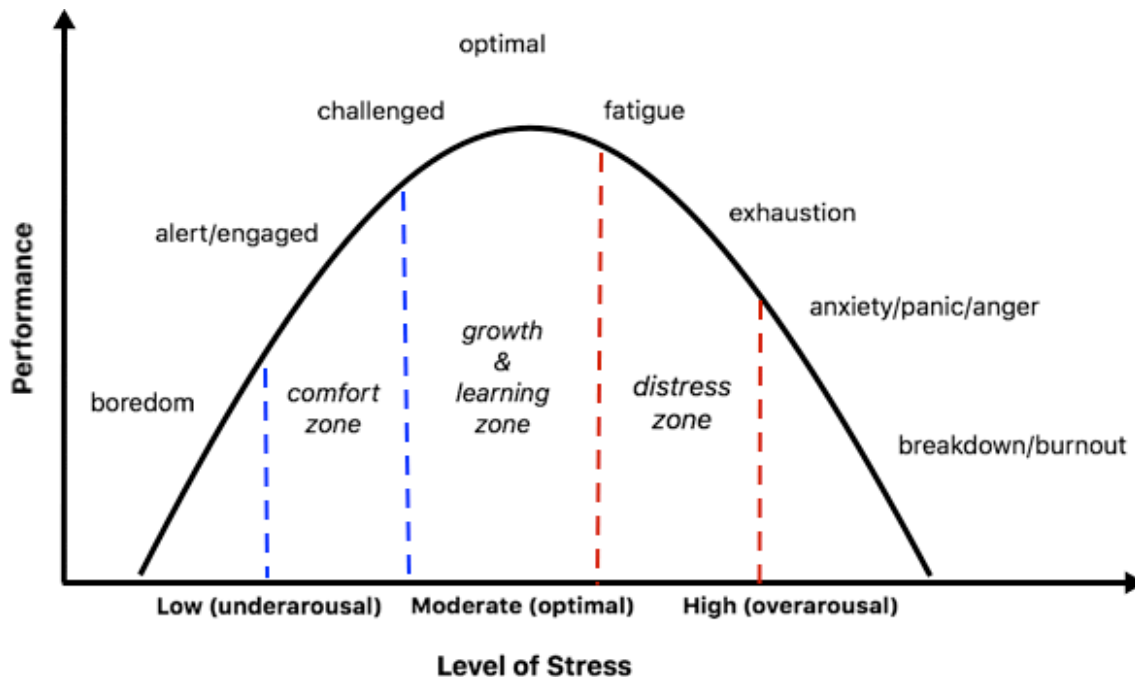


Figure 9. Yerks-Dodson Stress Performance Curve¹³

Analysis: Analysis of the data collected from the VR simulator testing is critical to the SOF community. This analysis can help determine where our strengths and weaknesses are as a force for GFC competence. From this study, we can choose how to implement GFC training best and focus on the future. Using data from the simulator can also help establish a baseline for each skill level and determine how to best progress, someone, to the next level.

¹³ Gary Klein, *Sources of Power: How People Make Decisions*, 7th print (Cambridge, Mass.: MIT, 2001), 57.

B. PROOF OF CONCEPT

SEAL Delivery Vehicle Team One (SDVT-1) and Advanced Training Command Detachment Hawaii (ATC Det-HI), the evolution of the Desktop Training Simulator (DTS)

SEAL Delivery Vehicles are manned submersibles that can transport six combat-loaded individuals. A pilot and a navigator occupy the forward compartment, while the remaining four are in the aft compartment. SDVs are used to conduct classified missions as they were used in Operation Desert Storm to accomplish demolition and mine reconnaissance missions.¹⁴ To properly employ an SDV, a 12-week intensive initial pilot and navigator training course is conducted. The issue was that there were about 16 students for every class with only one SDV. ATC Det-Hawaii only has one available SDV for training new students, which produces a bottleneck on resources and increases training time of individual lessons at the schoolhouse, which in turn raises the cost of training.

Initially, in 2010, ATC worked with Johns Hopkins University Applied Physics Lab (APL) to develop a Desktop Training Simulator (DTS). The initial DTS comprised of a computer with an uploaded program that had limited features of operating an SDV with a mouse and a keyboard. The program could show you what an SDV looked like on the inside, but from student and instructor feedback, it was too limited in use to utilize the platform effectively. By 2016 the updates to DTS allowed for a noticeable increase in student performance and decreased the overall cycle time of student training.

SDV school comprises course materials usually taught through PowerPoint and in-water instruction that begins with just one student and one instructor in an SDV and evolves into a student pilot and navigator operating the SDV with instructors on the surface monitoring the dive profile. Before DTS, instructors taught classes solely on PowerPoint and then walked the students to the high bay where the SDV is located. The students gathered around to try to comprehend what the instructor was talking about, but there was not enough room for everyone to view the instruction simultaneously.¹⁵ The lack of

¹⁴ "SEAL Delivery Vehicles," National Navy UDT-SEAL Museum, accessed July 29, 2021, <https://www.navysealmuseum.org/home-to-artifacts-from-the-secret-world-of-naval-special-warfare/seal-delivery-vehicles-sdv-manned-submersibles-for-special-operations>.

¹⁵ Troy Malesky, SDV Interview, interview by Nicholas Wagoner, June 16, 2021.

resources increased the time required to teach each topic effectively and resulted in an increased failure rate during the initial student dives.

DTS provided a way to increase efficiency in training. Each student had a desk with a DTS while each topic was being taught. Now, while the instructor spoke on the control panel and ballast and trim operations, the student could manipulate the controls in a simulated SDV with the click of a mouse, keypad, or joystick (which simulated the control stick in the SDV for turns and dives). The students could visually see inside the SDV, familiarize themselves with the controls, and develop “muscle memory” from the DTS. Though you cannot physically touch the controls on the DTS, the framework and displays are exactly the same on the DTS as it is in the SDV. The familiarization allows students to quickly adapt when adding the stressors of being underwater in a graded and unforgiving environment. Still, instructors noticed some dive profile failures, but it had been a significant decrease from years prior. To increase efficiency ATC would have to add an SDV to their resources or increase the capabilities of the DTS. Adding to the capabilities to the DTS would meet the needed gap, and another SDV was not possible due to the required mission readiness of SDVT-1.

In 2016, Johns Hopkins University APL updated DTS by incorporating physics.¹⁶ The DTS gathered data from Pearl Harbor, including salinity, bottom composition, and incorporated some sonar views from the SDV to develop a virtual environment for students to drive the simulated SDV through. APL also added data from the SDV to have a more realistic feel when operating the DTS. By adding these components, the SDV would turn, start, stop, and ascend very similar to how it would perform in the ocean by adding the physics aspects. Through all of the updates to the DTS, actual dive profiles were able to be added. By adding these profiles, students could essentially dive their dive in a simulated environment even before they physically got into the water in the SDV.

¹⁶ Luke McClain, SDV Trainer Interview, interview by Nicholas Wagoner, July 24, 2021.

After the implementation of dive profiles in DTS, the number of failures compared to previous classes decreased. Though every student class varies in competency, the following two courses of instruction produced similar results. To improve efficiency further, ATC and APL developed a chase boat situational awareness (CBSA).¹⁷ The CBSA is a cable running from the SDV to a training buoy that broadcasts a short-range wireless signal to the support boat with the receiver. The CBSA allows the instructor to view the systems in the SDV and have two-way communication with the students while they are breathing compressed air underwater. Adding the CBSA allowed for instructors to pull a detailed dive profile with the speed, course, and even communication and upload that data to the DTS and go over each leg of the dive for precise feedback during a debrief.

The DTS has shown a positive correlation in the success rate of students since the updates, the data shows that a virtual simulator can increase the capacity and training effectiveness while reducing cost in a schoolhouse environment. Johns Hopkins University started to develop a Virtual Reality simulator utilizing some of the programming from the DTS and incorporating it into an Oculus Rift headset. This product is not available at the SDV schoolhouse as of 2021.¹⁸

¹⁷ Malesky, SDV Interview.

¹⁸ McClain, SDV Trainer Interview.

C. VR TRAINING EXPECTATIONS

A VR simulator has to accomplish three goals to fill the gap that has come about from the current training methods. Initially, it has to be a realistic simulation of what an operator would be seeing or dealing with in the field. In addition, scenarios have to be repeatable and allow for multiple repetitions. Like a training exercise, if an individual or a platoon did not meet performance criteria, they would have to re-jock and do the scenario again. The same will occur in the VR simulator, allowing the GFC to repeat the mission to fix mistakes and for multiple GFC's to be compared to each other. Furthermore, a VR simulator has to give feedback to the GFC during and after the scenario. Feedback will ensure good practices are reinforced and bad practices are corrected before becoming a habit.

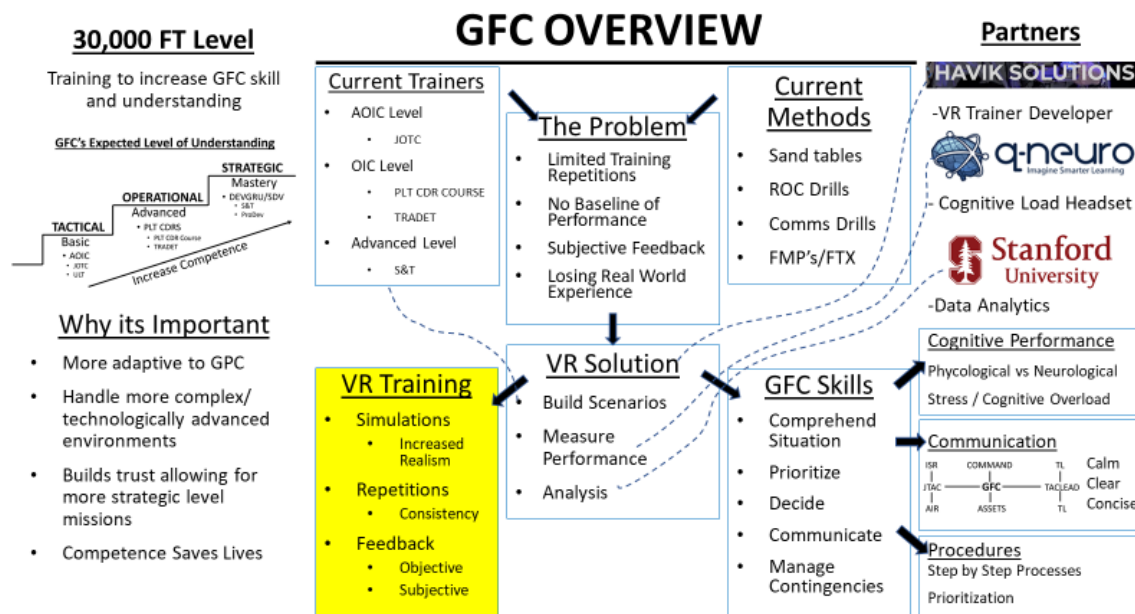


Figure 10. GFC Overview VR Training

Realistic: The importance of realism in a simulator is tenfold. The more authentic we can make the VR experience, the better chance we have of replicating actual combat level stress responses in a GFC. Realism will result in better training for those involved. The VR headset can simulate both a visual scene and add sound effects to the scenario. An essential sense of realism can also be added by operators using physical devices such as

their actual comms setups and Android Team Awareness Kit (ATAK) devices in the scenario.

Repeatable: In Adam Karaoguz's 2016 thesis, he expresses the need for "complex, repetitive training" to enhance our GFC performance on the battlefield.¹⁹ Scenarios have to be repeatable specifically to reinforce the basics of being a GFC. Just as in CQC or weapons training, we train the same movement repeatedly so that when under pressure or stress, our training takes over, and we know the response and actions through muscle memory. This is an aspect that is missing from GFC training across the board. Most runs are done only once by one GFC before the scenario is changed. Limited access to scenarios does not allow time to learn from your mistakes and redo a scenario with additional knowledge from recent corrections. The limited time and assets allotted for real-world training also do not allow other GFCs to experience the pressure of the same situation. Repetition allows for consistency and reinforcement of lessons learned while expanding a GFC's vision of developing events.

These repeatable scenarios do not have to be precisely the same either. Scenarios can change players to ensure others experience different roles after watching another GFC perform the scenario. The pace of the scenario can vary to increase or decrease the time the mission takes. A slower pace allows someone to fully break down a problem set, thinking of all possible outcomes before making a decision that is beneficial in its own right. A faster pace forces a GFC to act more instinctively based on the information provided. Depending on the skill level and performance of the GFC, the difficulty can vary through adding or subtracting contingencies and adding or removing resources.

Feedback: Feedback needs to be given in three main ways but in no particular order. One, subjective feedback needs to be delivered from the trainer to the GFC. This allows the trainer to tell the trainee what they saw and will enable them to provide reasoning or justification for their decision. Two, objective feedback from wearable devices must be given to the GFC after the training to see where they performed well or struggled

¹⁹ Adam Karaoguz, "Preparing to Be Unprepared: Ground Force Commander Decision Making in a Volatile, Uncertain, Complex, and Ambiguous World" (Master's Thesis, Naval Postgraduate School, 2016), 28, <https://calhoun.nps.edu/handle/10945/49503>.

throughout the scenario. To improve training, an instructor should log the time the GFC perceived to be having difficulty with the scenario and match it up to the wearable devices after the training to see the cognitive levels. Finally, a discussion between the team members involved with the scenario through observing or had an active role needs to occur to allow team members to hear different angles that they might not have been privy to because of their orientation in the scenario. The discussion can come from individuals or fire teams presented to the group going over each phase of the exercise, what went well, and what each group could improve on. This is the most critical form of feedback because these individuals are most likely the ones you will communicate with on the battlefield, and the GFC needs to understand the limitations of the group. Besides the simulator expectations, a VR trainer has to directly enhance GFC decision making skills.

D. GFC SKILLS

A GFC skillset derives from Boyd's OODA loop. Observe, Orient, Decide, Act.²⁰

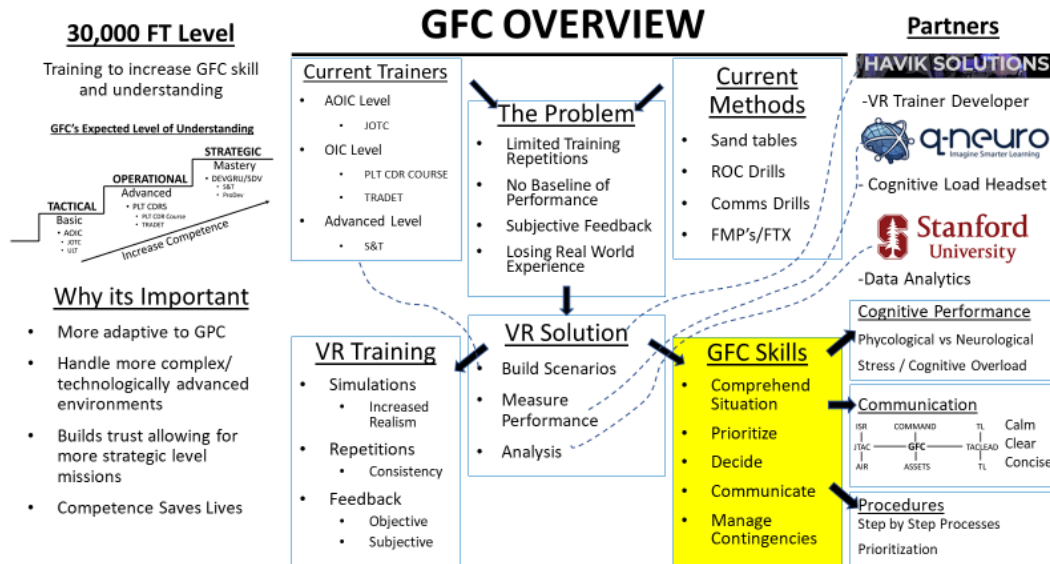


Figure 11. GFC Overview GFC Skills

²⁰ Chet Richards and J Addams, *Boyd's OODA Loop (It's Not What You Think)* (Menlo Park, CA: J. Addams and Partners, Inc, 2012).

Observe: Comprehend the situation

Understanding your environment to the best of your ability. Gaining as much SA as possible from all your senses; sight, sound, communications, ISR, etc.

Orient: Prioritize

Prioritizing who you are talking to and what tasks you are focused on. Priorities can change throughout the mission and based on where you are and what is happening. Different mission sets will cause you to prioritize things differently as well. Before you start a mission, you should have an idea of what your priorities are.

Decide: Take a breath, make the decision that makes the most sense.

Making a timely decision using the information you have and from your prioritized list. Who will you talk to? What are you going to say, do, request, or instruct someone to do?

Act: Disseminate information/communicate

Make the call, communicate with your team members and command to ensure everyone is aware of your decision, and you leave no room for second-guessing.

Manage contingencies: Think through possible outcomes

Manage multiple issues or problems at once, multi-task, and jump between them while providing intent to individuals you have delegated your authority. Contingencies are events that happen that were not part of the original plan, but it doesn't mean they were not planned for. GFC's exist to manage contingencies and make decisions under pressure that align with the morals, ethics, and overall intent of the mission. GFC skills can be further broken down into procedural, communication, and cognitive performance.

1. GFC Procedures

The basic level of GFC training requires an understanding of doctrine and procedures. The GFC baseline is to provide C2, communicate mission updates to HHQ, communicate internally with the element providing intent, and always maintain a blue, red, and green force picture. Radio calls, internally and externally, need to be made in a succinct format. External contingency calls should be memorized or kept in a battle book so that they can be recited at a moment's notice while understanding the radio net you are broadcasting the information on. If the information is not mission-critical, a theater channel should not be used to minimize traffic on the net, but a GFC needs to realize when a theater channel should be used. Training and exercises just highlight the effectiveness of streamlined communication and the use of proper channels.

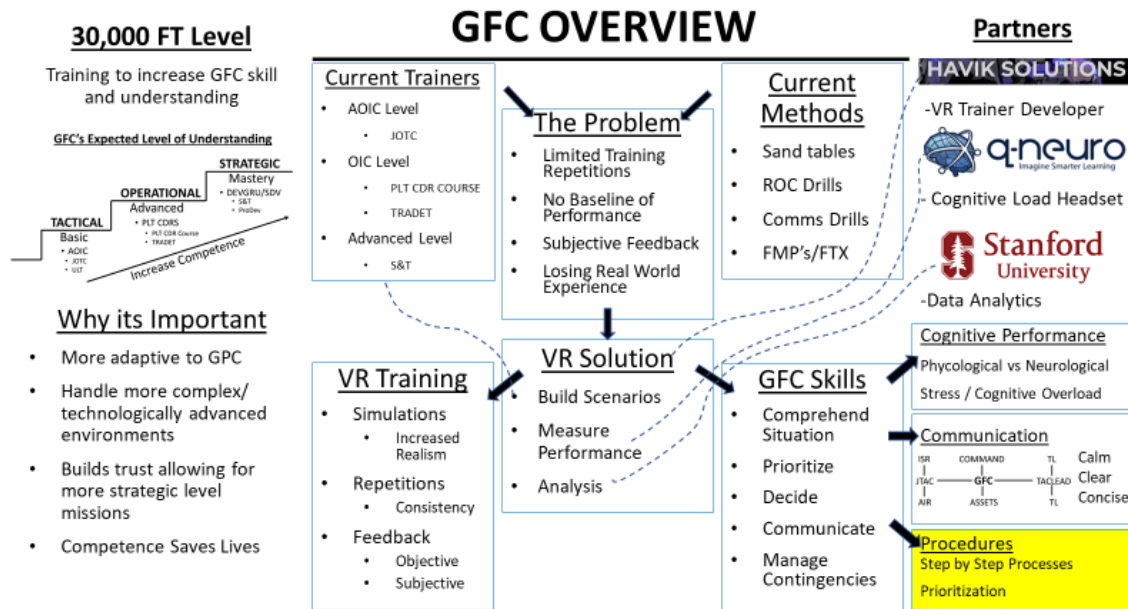


Figure 12. GFC Overview Procedures

In a stressful situation, a trained operator relies on repetition and practice. Just like getting on the range and shooting targets, a GFC must practice radio calls to ensure muscle memory in a stressful environment that could save teammates' lives. The radio procedures

for external communication are prioritized by Commander's Critical Information Requirements (CCIRs).²¹

Example of GFC Calls

- 5 Line
- Abort criteria
- CASEVAC
- CFF 9 Line
- Contingencies
- Control of Assets
- Deconfliction
- EXCheck
- Execute order
- GFC Rollup
- Go/No Go criteria
- Headcounts
- Imminent TIC
- LZ Brief
- MEDEVAC 9 Line
- Mist

²¹ Deployable Training Division, *Insights and Best Practices Focus Paper Commander's Critical Information Requirements (CCIR)* (Washington, DC: Joint Staff J7, 2020), https://www.jcs.mil/Portals/36/Documents/Doctrine/fp/ccir_fp4th_ed.pdf?ver=2020-01-13-083331-097.

- Slant
- SSE
- Timeline
- Troops in Contact (TIC)

2. GFC Communication

Communication is essential to being a good GFC. Their role is to be the middleman. They take information from the TACLEAD, JTAC, other assets, and Command. Then they disseminate that information to whoever requires it at the time. For a team to act how the GFC intends and successfully conducts the mission, the GFC needs to give them good intent, tasks, and orders as things change. A TACLEAD should be communicating some feedback, updates from their position, situational awareness, and other information pertinent to the GFC's job.

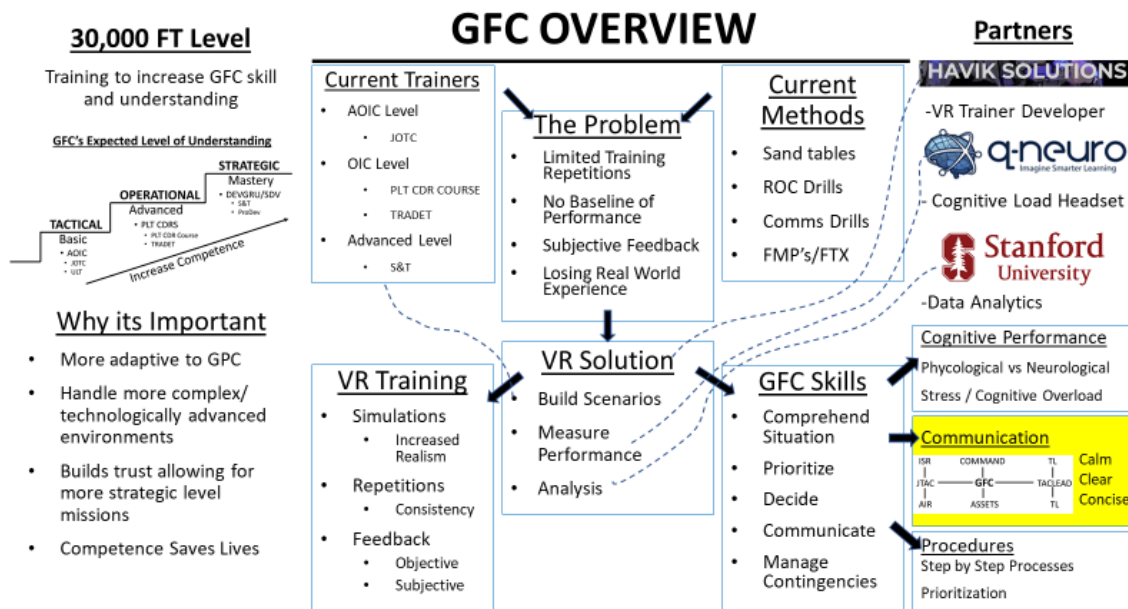


Figure 13. GFC Overview Communication

The goal is team cognition. The more in sync everyone is on the team, the smoother the operation will go, and when things go wrong, the better prepared the team will be to handle them. When a GFC gets overwhelmed, they should be able to task shed (focus on only the most important) or task share (give tasks to other team members to complete). GFC's also need to remain calm more than anything else because excitement or fear spread, especially on a battlefield. They can control the emotional response of everyone around them simply by their demeanor, and when communicating to higher command, calm breeds confidence. Their communication needs to be clear and concise when giving instructions and intent whenever they talk. The following image is a simplified depiction of a GFC's communication matrix.

GFC Basic Communication Expectations

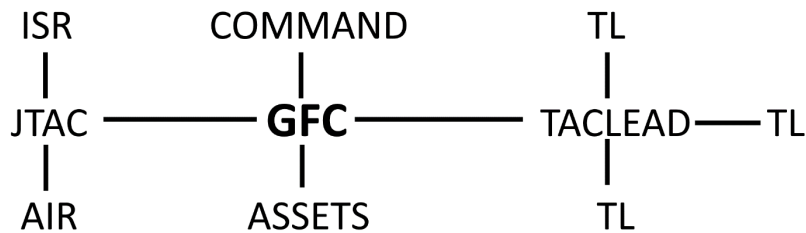


Figure 14. GFC Basic Communication Matrix

3. GFC Cognitive Performance

Cognitive performance of GFC's is not understood very well or studied much in the field. The problem is that cognitive performance is such a massive field of study spanning multiple research areas from psychological to neurological.²²

²² Minh Sutton, NPS Cognitive Performance Specialist, interview by Ryan Sataneck, February 25, 2021.

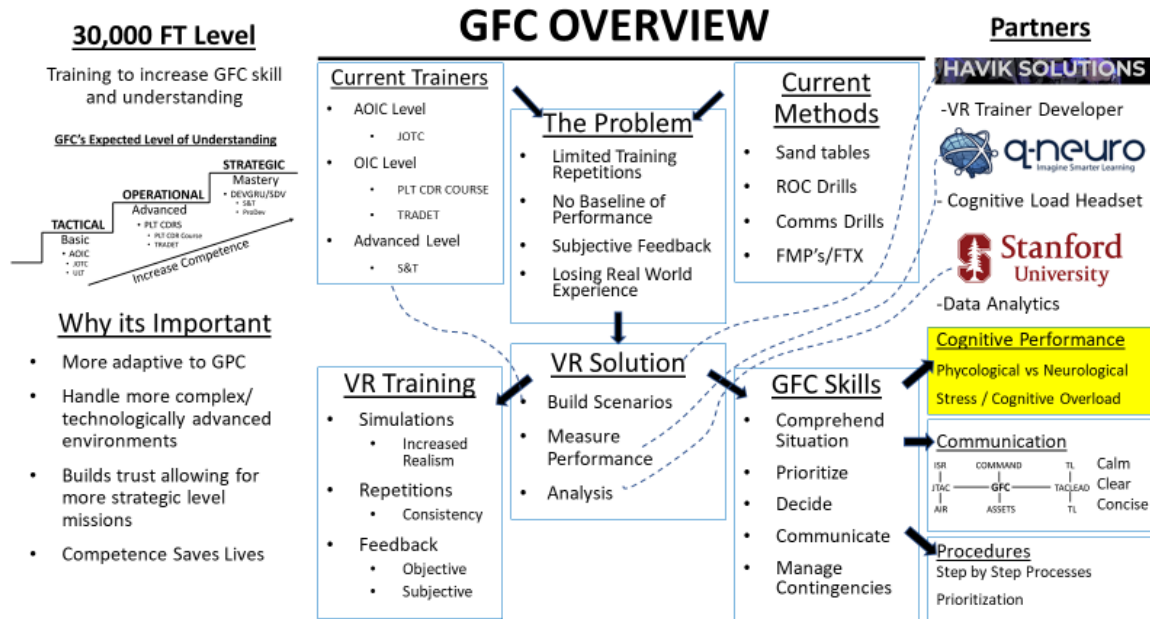


Figure 15. GFC Overview Cognitive Performance

However, the main goal is to breed calm into GFCs so that they can make the clearest and most rational decision at any given time throughout a mission. Some areas of possible study and focus moving forward are:

- Situational Awareness
- Team Cognition
- Shared SA

Working Memory:

- Task shedding
- Task sharing
- Multi-tasking

Mindfulness:

- Personal awareness/self-control
- Meditation
- Emotional intelligence
- Box breathing
- Physiologically (what can I control)

Stress:

- HPA axis
- Emotional Response
- Yerks Dodson curve
- Recognition
- Fatigue (sugar has a positive effect)
- Burnout (too many missions/deployments too quickly)

Cognitive overload/Information overload:

- Amygdala Hijack
- How do we bring someone back as swiftly and efficiently as possible?

How to personally identify stress/cognitive overload:

- Heart Rate
- Breaths
- Freezing

- BP
- Panic
- Pupil dilatation
- Pacing (comms land)
- Voice pitch/pace

Biases:

- Anchoring Bias (relying too much on the first piece of information received)
- Confirmation Bias (seeking out information that supports what you believe)
- Cultural Bias (viewing cultures as abnormal simply based on comparing them to your own culture)
- Information bias (believing that more information, no matter how irrelevant, will help you make a better decision)
- Hindsight bias (after an event occurs, people think they could have predicted the outcome before it happened or that the result was apparent given the situation)

Time factor:

- Short Duration
- Long Duration

Ethical Decisions:

- Case Studies
- Lessons Learned

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III. COLLABORATORS / FUNDING

Completing this project required collaboration with multiple outside entities; Havik Solutions will support the simulator development, Qneuro headsets will be used in measuring cognitive performance, and Stanford will assist with data analysis.

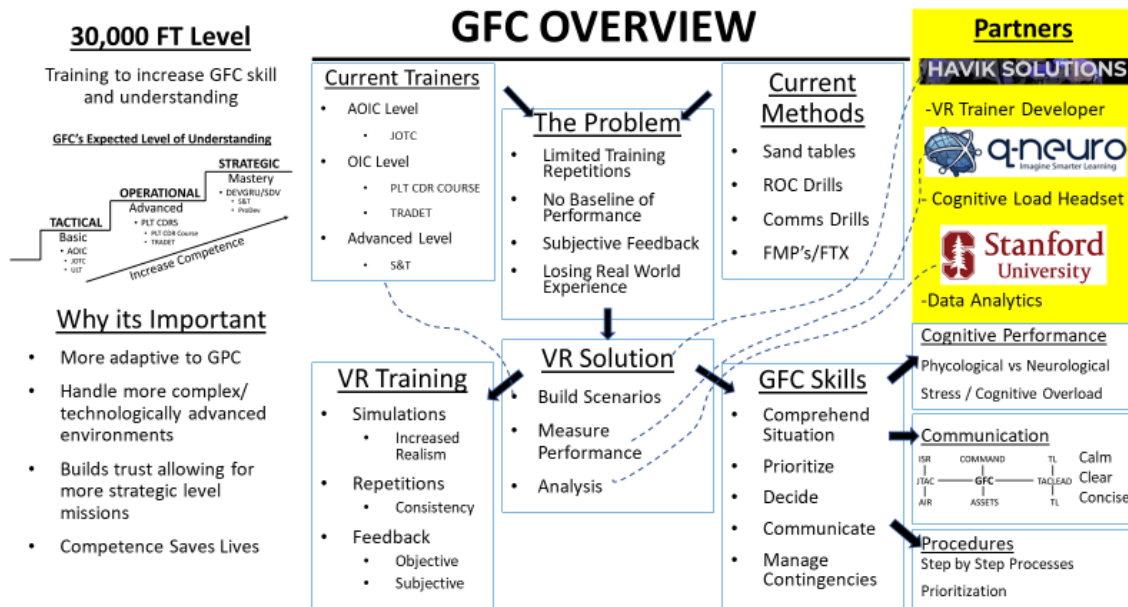


Figure 16. GFC Overview Collaborators

A. HAVIK SOLUTIONS: VR SIMULATOR

HAVIK Solutions is a company already on contract by the Air Force. They have experience producing a JTAC simulator, and it is currently the only VR simulator qualified to certify SOCOM JTACs. By adding funds to this contract and making a few updates and additions to the software, we can have a working GFC simulator for testing within a year of delivering funding. The benefits of this contract include a shorter time frame to attain and produce, understanding of the end product, and the training value that will be added by implementing this product. The plan is to use the NSW JTAC simulator, run the software through the Unreal Engine to improve the graphics, then display this on the

Oculus Rift headset for each operator. The use of already developed technologies should streamline production and allow for simple troubleshooting and future upgrades.



Figure 17. Havik website Logo²³

GFC VR simulator development

The connectivity of the device and adding additional headsets to the same scenario allows multiple players, the TACLEAD, JTAC, GFC, Command, TL's, to participate for a more realistic simulation. The inclusion of team members enables the GFC to communicate with the actual team he will be deploying with. This will significantly

²³ Brad Denn, "Havik Home," HAVIK, accessed October 12, 2021, <https://www.havik.us/>.

improve the communication practice individuals get from the training and make it more applicable to real-world scenarios. The company will also produce realistic terrain and training sights for GFC use. The VR headset will immerse the players into the environment like never before, allowing for an increase in realistic training.

We were able to secure \$375,000 in funding for HAVIK in Tactical Funding Increase (TACFI) funding for quarter 1 of fiscal year 2022. Additionally, HAVIK applied to AFWERX for a 1:1 matching of the TACFI funds. This would bring the total funding for the development of the GFC trainer to \$750,000. These extra funds will support a better product with more refined features.



Figure 18. Example of VR Headset²⁴

²⁴ Denn.

B. QNEURO: MEASURE PERFORMANCE

Qneuro is an LA-based company that specializes in wearable cognitive load sensors. It was designed as a real-time brain monitoring device to determine the optimal learning state for the user.²⁵



Figure 19. Qneuro website Logo²⁶

Importantly, it can also identify too much brain activity, the threshold wherein learning diminishes due to cognitive overload. Qneuro currently has a functional headset with user-friendly software that assesses individual performance. This cognitive load tester measures brain waves and activity to produce a real-time readout of an individual's performance. If this company can pair with HAVIK Solutions, they can create time stamps for specific events in the VR simulator. This data and information allow for a better understanding of the GFC by outlining the performance and cognitive load in stressful training environments on a second-by-second basis. This feedback would provide trainers and individuals with the tools to identify weak spots and focus their practice in these areas.

We aim to purchase 5 Qneuro headsets once they become commercially available in December 2021. Each headset costs \$320, making this total equipment expense \$1600. Obtaining headsets will allow us to test them for both day-to-day activities as well as in game testing.

Below are examples of the headsets as well as readouts from the device.

²⁵ Qneuro - Smart Headset To Improve Mental Fitness and Wellness,” Qneuro HQ, accessed October 12, 2021, <https://www.qneuro.com/>.

²⁶ Qneuro HQ.



Figure 20. Example of Qneuro Headset²⁷

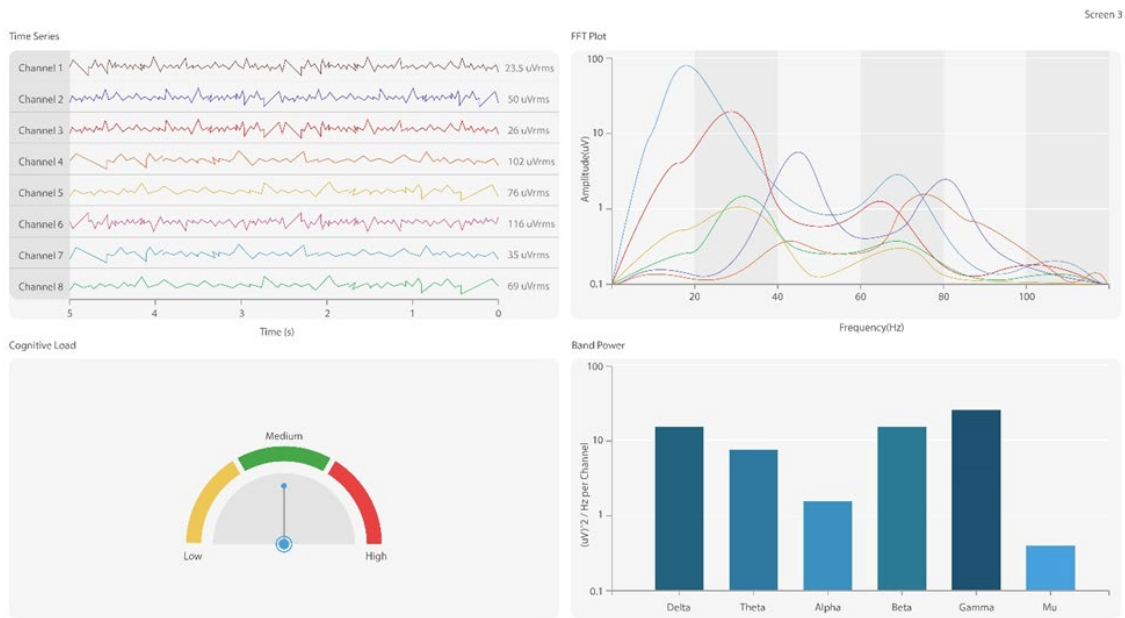


Figure 21. Example of Qneuro Readouts²⁸

²⁷ Qneuro HQ, “Qneuro: Smart Headset To Improve Mental Fitness and Wellness.”

²⁸ Qneuro HQ.

C. STANFORD: DATA ANALYSIS

Stanford University has agreed to handle the data collection and analysis of our GFC performance. They bring to the table expertise on wearable devices and increased testing facilities. Dr. Andrew Huberman's in the department of Neurobiology has agreed to spearhead the study and statistical analysis.



Figure 22. Stanford University Logo²⁹

Data collection can be done across multiple scenarios and multiple GFCs to get a baseline measurement of our operators. Once we have an initial understanding of operator performance, we can begin to test ways to increase learning under cognitive load through multiple simulated operations. The data can be used across the force to establish a rubric for objective grading of GFC performance as well as establishing a standard of competence across the board. Funding for Stanford to assist with wearables devices and data analysis will be conducted on a later date when testing procedures are finalized.

²⁹ Source: "Stanford University," Stanford University Homepage, accessed October 12, 2021, <https://www.stanford.edu/>.

IV. PROJECT DELIVERABLES

A. DESIGN DESCRIPTION

When assessing this project from a design perspective, we opted to tackle this problem through innovation or incremental change. Specifically, we chose to pursue incremental changes to an already existing simulator. This was done for a couple of reasons. First and foremost, this design is feasible. For a relatively inexpensive cost, NPS could acquire a usable GFC trainer in one year. The increased production speed is because we are not starting from scratch and requesting an entirely new trainer, but rather suggest add-ons to an already developed simulator. This is possible because an Air Force government contract already exists, and as such this capstone project will add funding to an existing project. This dramatically speeds up and simplifies the process of development.

The second reason for choosing to make incremental changes to the JTAC trainer is access and placement. JTAC trainers are used all over the SOF community for initial training and refresher training. Their benefit is well known in the SOF community across branches of the military. If the next version of these JTAC trainers were to have a GFC mode of training already built in, then the SOF community would benefit from getting two trainers in one. One trainer would require less justification for acquisition as it merely adds to an already existing program. It would also significantly decrease the cost of having two separate GFC and JTAC trainers to operate and maintain.

Third, the JTAC trainer is familiar to both the command and the operators. This familiarity creates a network effect where adoption and understanding become more manageable for the trainers, users, and the command. When it comes to acquisitions, command decision-makers are more likely to stick with what they know. JTAC trainers are well known throughout the community. This makes them easy to understand and accept, so we are not selling a whole new product. Familiarity is essential for operators as well. They are more likely to use something they know works to improve procedural performance and has a solid track record. JTAC simulators meet both of those standards.

Adding a GFC function to this already existing JTAC trainer will make it easier to get produced, acquired, and accepted by NSW and the SOF community.

This technique of gaining compliance is similar to the “foot in the door” technique studied by social psychologists.³⁰ Starting with a smaller request of an incremental innovation change is more manageable than immediately requesting a whole new trainer and funding to go with it. Using this method will allow us to prove that the JTAC trainer can be a viable option for a GFC trainer. It will then be easier to build on additional functionality and use cases to better adapt the trainer for the force’s needs.

Granted, this trainer will not solve all our GFC-related training problems; it is unlikely that any trainer can. However, it does address a large number of them for a relatively cheap initial cost. If we were to acquire a GFC trainer from scratch and develop an innovative design, we would face a slew of problems. First, there are no specific requirements for a GFC trainer. That means the design parameters would have to be studied and developed starting at ground zero, a significant undertaking in and of itself since VR simulators are a new technology. It takes an in-depth understanding of GFC training to design the product. Second, establishing an actual need for a GFC VR trainer is difficult because most of the evidence is quantitative and not qualitative. This problem exists because across all branches the military has no way of grading or rating the skillset of GFCs. Furthermore, as the military decreased combat operations worldwide, a justification for a GFC trainer also becomes increasingly difficult to show. Similarly, justifying funding and production comes with its own set of challenges. Funds to produce an entirely new GFC trainer absent an existing framework comes at a much higher financial cost, and the final product would be based on design parameters given to the developers by a contact and not a direct communication between companies and SOF forces. Fourth, testing the prototype would be necessary to determine if this trainer was a viable option. This would be costly for the military primarily in the time it would take to assess the trainer delaying the acquisition process and preventing SOF from training with the most modern

³⁰ Jonathan L. Freedman and Scott C. Fraser, “Compliance without Pressure: The Foot-in-the-Door Technique,” *Journal of Personality and Social Psychology* 4, no. 2 (August 1966): 195–202, <http://dx.doi.org/10.1037/h0023552>.

technology. Finally, the trainers could be acquired for use at the team level. This would also increase cost due to NSW having to acquire completely new trainers and maintain them. This process would take years to complete and could fail at any step along the way. When assessing both an innovative and incremental design, the safer and more viable option to use seemed to be the incremental one.

The value proposition below shows the benefit that this project provides for NSW and the SOF community.

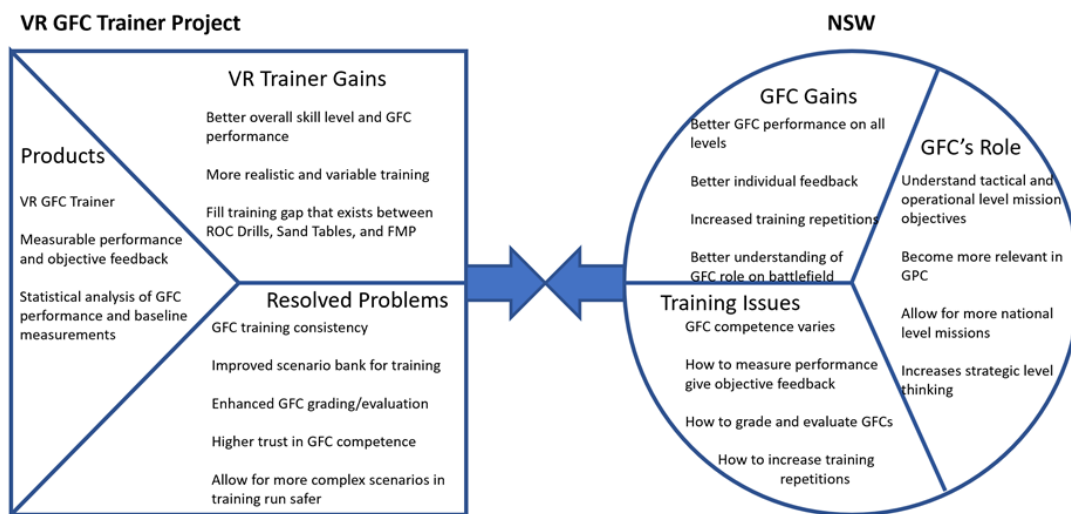


Figure 23. VR Trainer Value Proposition

B. ESTIMATED TIMELINE

This project will take approximately two and a half years to complete. This timeline accounts for all phases: product development, prototype testing, human performance testing, and data analysis. The desired end state is to have a working VR GFC trainer that can be delivered to SOCOM with baseline measurements and built-in scenarios ranging in skill level from basic, to intermediate, to advanced. A depiction of the current project timeline is below.

Table 1. Estimated Timeline

Project Projected Schedule	2021												2022												2023					
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
	Phase 1 Research / Development												Phase 2 Testing / Data Collection												Phase 3 Analysis					
Project Proposal	NPS																													
Project Funding	NPS																													
VR GFC Trainer Development																														
Qneuro Headset Production																														
Background Research/Interviews																														
Develop Testing Procedures																														
Project Turnover																														
Product Testing																														
Develop Training Scenarios																														
GFC Baseline Testing																														
VR GFC Trainer Stress Testing																														
Stanford Data Collection / Analysis																														

The project can easily be broken down into three major parts consisting of:

Phase 1: Research and Development

- Current GFC Training
- Proof of Concept with VR Technology
- Secure Funding for the Project
- Consult on the Production of the Prototype

Phase 2: Testing and Data Collection

- Prototype Testing
- Scenario Development

- Grading Criteria
- Human Performance Testing
- Data Collection

Phase 3: Data Analysis

- Data Analysis
- Human Performance Baseline
- Product Recommendations

This capstone paper will cover Phase 1 of the project.

1. Collect background information on current training methods and techniques. Determine how evaluation of GFC's are being conducted and identify gaps to be addressed in future training.
2. Justify the use of simulators and VR technology to fill training gaps and facilitate evaluations/feedback to operators.
3. Procure funding for the selected companies
4. Consult on product production and compatibility as well as develop testing procedures and determine data to be collected for the simulator.

C. STRENGTH WEAKNESS OPPORTUNITY THREAT (SWOT) ANALYSIS OF VIRTUAL REALITY APPLIED TO SPECIAL OPERATIONS TRAINING

The framework of the SWOT Analysis is displayed in Table 2.

Table 2. SWOT Analysis

Strengths 1. Consistency 2. Real-Time Feedback 3. Reduces bottleneck	Weaknesses 1. Useability and Acceptance 2. Technological immaturity 3. Lack of the Human Element
Opportunities 1. Remote Training and Evaluation 2. Integration of haptic and other technology 3. Multi-user compatibility 4. Invisible wounds treatment	Threats 1. Ethical Implications 2. Cybersecurity 3. Public policy

1. Strength

a. Consistency

In developing similar scenarios throughout Naval Special Warfare, it is difficult to maintain consistency. The reason is that the East and West Coast operate and train in different types of facilities from land, air, and the sea. Moreover, the experience of personnel varies between the coast due to different areas of where the Teams deployed to every cycle. For example, the West Coast has been deployed to more combat environments and as such tends to have more combat experience than the East Coast teams. The instructors with those experiences have lessons learned that they have lived through and intangibles that cannot be expressed through other instructors unless there is a transfer of information.

The difference in experiences of the training departments can lead to a deviation in learning due to the different training environments, personnel experience, and the environmental effects on training, but Virtual Reality can mitigate some of these factors. Weather plays a factor in training, especially with air assets, if the training heavily relied on air support and the weather was bad then in real life the training would be canceled to reduce risk to force. In a virtual environment, the instructor can control the entirety of the scenario without shifting focus if things come up out of their control. Any instructor, regardless of experience, could initiate and conduct training with the pre-programmed scenarios and contingencies in place that can be developed from a variety of operators drawn from history, past experiences, and potential future conflicts. The student's actions would be recorded for follow-up evaluation from additional instructors. There is a high turnover rate with instructors at the schoolhouse due to mission demands and career progression. Instructor experiences are customarily lost in transition, but with the development and implementation of VR scenarios and instructor feedback, the knowledge can be gathered and added to from future facilitators. Additionally, user performance data can be tracked and compared for an analytical analysis amongst peers in the virtual environment. The facilitator will give real-time feedback on safety considerations during the scenario, allowing for consistency in the training pipeline through repeatable and adjustable scenarios without a need for variation in the physical training environment.

b. Real-Time Feedback

Feedback is used as a foundation for improvement and can come from the training environment and the facilitator. Virtual Reality is inherently artificial, but it provides the opportunity to simulate combat better than real life training in certain ways. In real-world training, it is difficult to change the training environment to reflect decisions made throughout a given scenario due to limitations of personnel, communication, and terrain. The degree of difficulty is increased in a live-fire event with multiple units participating in the scenario. In real training, due to the safety considerations for the role players and operators, if an individual is a casualty due to enemy fire or other means, that individual is moved from the area to ensure the safety of the evolution. Depending on the scenario a pause in the scenario may happen to mitigate risk, and after the scenario continues, other

individuals involved will have to pretend that the casualty still exist even if that individual is not physically there.

In real-life training, if a GFC were to use an air asset to apply fires to destroy a building, facilitators of the training would have to pause training and ensure that all the safety requirements are met to conduct live-fire operations on a structure. In a virtual environment, the activity continues without a pause in momentum, and all players continue as they would during a real-world operation. The operator could see the effects of whether the target was neutralized or not and if the effects met the GFC's intent. The feedback from the effects would ensure that the operators make timely decisions for specific events, including casualties, without a pause in training for safety considerations because of the risk and positioning of actual role players.

The real-time feedback allows effective feedback in a timely, targeted, and concise way to improve the training efficacy.³¹ A virtual environment allows for real-time feedback and the opportunity to record the scenario so the operator can learn from his own decisions made in the virtual environment. The recording can also be used as a training tool for facilitators to conduct a complete mission debrief while reviewing each phase of the operation for context.

c. Reduces Bottleneck

Resources limit training capacity through manning shortages of instructors, air asset availability, and operational demand of supporting assets. In training environments there are usually multiple units using the same assets to attempt lowering the overall cost of training. The demand for the limited assets produces a bottleneck and decreases the capacity of the training activity.³² To increase capacity, resources are required and with the limited availability of operational units VR offers an alternative that can meet the

³¹ "Feedback for Learning," Columbia Center for Teaching and Learning, 2019, <https://ctl.columbia.edu/resources-and-technology/resources/feedback-for-learning/#:~:text=Types%20of%20Feedback%20%20Type%20%20,did%20you%20reach%20this%20conclusion%3F%20Think%20...%20>.

³² "Understanding Bottlenecks," Investopedia, accessed October 6, 2021, <https://www.investopedia.com/terms/b/bottleneck.asp>.

demand through realistic training environments through scalability and efficacy. Operations and training are limited by resources, and Virtual Reality provides an additional resource to increase the capacity in training that reduces a bottleneck of assets.

2. Weaknesses

a. Acceptance and Useability

Increasing training effectiveness and implementing new training resources require buy-in from the users. Skepticism of any new technology is common, in part because of the resistance to change and the fact that the technology has not been used in that compacity in training in the past. The easier it is to use the VR training, and the perceived benefits increases the chances the training platform will be accepted by the end users.. However, negative aspects can greatly affect the implementation of new platforms for training, especially if the aspect negatively affects the physical and mental capacity of the user through motion sickness. The effects of motion sickness, referred to as cybersickness in VR use, include eyestrain, vertigo, nausea, and vomiting. Studies have shown that the acceptance of VR is negatively affected through motion sickness experienced with immersive technologies and is a common negative outcome to virtual environments.³³ Though the symptoms of motion sickness are relatively short, the effect can last for several hours.³⁴ Even if users realize the benefits of training, the platform will not be accepted due to adverse reactions to the virtual environment that the technology's immaturity could cause due to latency, equipment, and realism of the programming. The effects can be mitigated through improving latency through hardware, choosing the right headsets, and limit exposure time in VR for the users more prone to motion sickness.

b. Technological Immaturity

VR has evolved exponentially since its existence, but the technology still limits the potential for VR training. Realistic VR training requires a display with a high refresh rate,

³³ Camille Sagnier et al., "User Acceptance of Virtual Reality: An Extended Technology Acceptance Model," *International Journal of Human-Computer Interaction*, January 2020, 1–15, <https://doi.org/10.1080/10447318.2019.1708612>.

³⁴ Sagnier et al.

high resolution, and the type of display used. The types of displays consist of LCD, LED, OLED, AMOLED, and others. The displays alone cannot run the programs required for the training, and the processing power demanding for running complex scenarios cannot fit into a stand-alone all-in-one unit like all-in-one Oculus devices.³⁵ The displays have to be supplemented through a network or other drives that can support the programming and the updates required to sustain training. The sensitivity and classification of the training can impose additional concerns in the networking, availability of the VR system, and the bandwidth needed to run scenarios on a classified network.

c. Lack of the Human Element

In real-world training, you learn how members of your platoon react to specific events, which could be the same for a virtual environment, but the virtual environment lacks some intangibles. The intangibles developed through sustained training are trust, accountability, and relationships.³⁶ In the military, even training events can lead to a loss of life, and with the added risk bonds are formed by looking out for one another. The continued familiarity and bonds through standard buddy checks of equipment, or taking the extra time to go over emergency procedures with other members of your unit promotes trust that cannot be replicated in a virtual environment because the chance for loss of life is low. It is also difficult to see what individuals show up prepared for the training or mission with all of the gear required in a virtual environment, and if this becomes an issue operators could wear full loadouts throughout the simulation to enhance realism.

In real-world training, every operator ensures that their first, second, third line gear and extra batteries and equipment are operational for the specific event. The repetitiveness of preparation for operations and training assists in the muscle memory of continuously checking to ensure the needed equipment is there for the operation, instilling accountability. When training with the same individuals over time, it is easy to start

³⁵ Facebook Inc, “Oculus VR Headsets, Games & Equipment,” accessed October 6, 2021, <https://www.oculus.com/>.

³⁶ “AMT_Handbook_Addendum_Human_Factors.Pdf,” accessed October 6, 2021, https://www.faa.gov/files/gslac/courses/content/258/1097/AMT_Handbook_Addendum_Human_Factors.pdf.

understanding tendencies and identifying shortfalls of the group while still developing relationships to improve the operational readiness by understanding who the individuals are outside of the work environment. Spending time and operating with the unit builds a relationship where individuals can identify each other's body language and even identify individuals in low light just by their mannerisms in their walk and demeanor. It would be difficult for VR to mimic the value-added through the human element, and that is why VR can be used to enhance training and not as a replacement for real world training

3. Opportunities

a. Remote Training and Evaluation

Virtual reality allows for remote training with a smaller footprint than the traditional ROCK drills, rehearsals, and unit-level training events. Traditional training methods are limited to resources, and everyone involved with the scenario has to be there physically. Virtual reality allows all the players involved to play their part from any location that allows for connectivity. Overseas, rehearsals are limited to walkthroughs, sand tables, and other methods that do not allow every entity involved to take part in the capacity that they would in an actual operation.

A virtual environment allows for the construct of the domain. Each player plays their role in the operation and uses the virtual communication tools that they would utilize in real life. For example, the JTAC would call for fires to the aircraft and employ the specific munitions that would meet the GFC intent and be able to watch the event unfold in the virtual world. Every individual involved in the scenario would understand their role through procedural and visual reinforcement that would enhance the situational awareness of all personnel on the operation and can be used to evaluate individuals in crucial roles of the scenario.

Evaluating is a way of selecting what individuals are suitable for the job. Recently, NSW has started interviewing for positions throughout the community. Several interviews involve mission planning, character, and ethical determination. The interviews range from in-person to virtually, and utilizing VR can enhance the interview process through visualization and manipulations of the environment. The interviewer can develop moral

and ethical dilemmas that allow for a choice to help understand the interviewee's true character. Hearing a question is entirely different than visually seeing the scenario and making a choice. Consider the classic "trolley scenario." In that scenario, there are ten people on one side of the track and a person you know on the other side of the track, and you have only a few seconds to decide which way to divert the trolley and ultimately deciding who will live and die. In a virtual environment, the scenario would run, and the decision would be made by the interviewee based on visual cues while response times play a factor in the decision as well.³⁷ VR could provide additional information that an interviewer could not attain without a scenario-based model.

b. Integration of Haptic and Other Technology

As technology advances, so too do the accessories for a virtual environment. In a VR environment, the stimulation is confined to a user's vision. Physical fitness would not play a role like it does in real-life training. As technology advances, more products will start to connect this gap where it may be challenging to differentiate the natural world from a virtual world. Training effectiveness could increase while the risk to force in training decreases exponentially by controlling the operator's physical environment. One way to do this is by adding an omnidirectional treadmill to account for added physical stress through the virtual environments, and several companies like Infinadeck and KAT VR are already producing a version of this product.³⁸ The treadmill will allow for a 360-degree moving floor that will enable operators to change direction as the virtual environment presents itself.³⁹ Muscle memory could be learned in a virtual environment with this added feature.

Additionally, Haptic gloves can be incorporated for a sense of touch to feel different textures and interact with objects in the virtual environment. Though this technology is still in its infancy, several companies are developing products to be compatible with the Unreal

³⁷ Mel Slater and Maria V. Sanchez-Vives, "Enhancing Our Lives with Immersive Virtual Reality," *Frontiers in Robotics and AI* 3 (2016): 74, <https://doi.org/10.3389/frobt.2016.00074>.

³⁸ Kat Virtual Reality Inc, "KAT Walk Mini S," KATVR, accessed October 6, 2021, <https://www.kat-vr.com/products/kat-walk-mini-s>.

³⁹ Benjamin Freeman, "About: Unbounded Natural Motion in VR," Infinadeck, accessed October 6, 2021, <https://www.infinadeck.com/about/>.

Engine, which is used in games like Call of Duty and what can be used in the prototype of the Ground Force Commander Virtual Trainer.⁴⁰ With the additional accessories, the enhancement of realism comes to fruition and can add the other stresses that can help stimulate a combat environment to better access and prepare that operator for combat.

c. Multi-user Compatibility

As a Ground Force Commander, you are responsible for the overall mission, including the equipment and personnel. In a real-world training environment, the GFC can physically see the environment and people and understand what assets and equipment are used during the operation. The whole operation revolves around multiple individuals doing supporting tasks simultaneously and consistently communicating to the GFC for situational awareness needed to make command decisions and determine which CCIR needs extra attention. With multiple users over the same domain, VR can simulate the environment, allowing units to work together to complete the task and providing effective real-time feedback that real training environments lack. For example, if a platoon member received simulated effective fire in a real-life training environment, the scenario is fictional. Depending on how much buy-in that individual has to the training, they will follow through on the role-playing scenario. In a virtual environment, the simulation can immobilize specific functions like communications, the functionality of certain limbs, and weapon manipulations, which would force the scenario to play out as it might in an actual combat situation.

The true value of multi-user compatibility is communication and understanding the different personalities and language that may come into play in different scenarios—close integration with assets overseas is vital to effective communication and the utilization of the assets available.⁴¹ Adding fixed and rotary wing asset operators force the GFC to

⁴⁰ Manus Virtual Reality, “MANUS: Prime X Haptic VR,” 2021, <https://www.manus-vr.com/www.manus-vr.com/haptic-gloves>.

⁴¹ U.S. Army, “Keeping the Ground Talking to the Sky: Brigade Aviation Officers Discuss Lessons Learned,” [www.army.mil](https://www.army.mil/article/6182/keeping_the_ground_talking_to_the_skybrigade_aviation_officers_discuss_lessons_learned), accessed October 6, 2021, https://www.army.mil/article/6182/keeping_the_ground_talking_to_the_skybrigade_aviation_officers_discuss_lessons_learned.

deliver proper intent when they check on station and throughout the operation or delegate the task to the JTAC when the GFC is dealing with other situations. With multi-users, the GFC and other unit members can start to understand what task can and should be delegated, and it assists in clearly prioritizing the commander's intent.

d. Invisible Wounds Treatment

An invisible wound can be associated with a traumatic life event and is an emotional, cognitive, or behavioral condition diagnosed as major depression, traumatic brain injury (TBI), or post-traumatic stress disorder (PTSD).⁴² Since 9/11, more than 1.5 million U.S. service members have been deployed to Afghanistan and Iraq in support of Operations Enduring Freedom (OEF) and Operations Iraqi Freedom (OIF).⁴³ Research has found that military suicides are at an all-time high for active-duty military members. Invisible wounds put individuals at a higher risk of suicide than those without, and the risk increases when the service member leaves military service.⁴⁴ A RAND study found a significant gap in care for invisible wounds even though the need for treatment is high. Members with a probable diagnosis of PTSD had reached out for help from a medical professional but did not receive adequate treatment.⁴⁵ Research from the military and civilian sectors has shown that invisible wounds' long-term effects are wide-ranging and destructive.⁴⁶

The use of virtual reality can potentially bridge the gap for invisible wounds treatment. The use of cognitive and physical rehabilitation in clinical treatments improves

⁴² Air Force Wounded Warrior Program, "Invisible Wounds Initiative," accessed October 6, 2021, <https://www.woundedwarrior.af.mil/Airmen-Veterans/Invisible-Wounds-Initiative/>.

⁴³ David M. Adamson et al., "Invisible Wounds of War: Psychological and Cognitive Injuries, Their Consequences, and Services to Assist Recovery" (RAND Corporation, March 26, 2008), <https://www.rand.org/pubs/monographs/MG720.html>.

⁴⁴ USO, "Military Suicide Rates Are at an All-Time High; Here's How We're Trying to Help," United Service Organizations, accessed October 6, 2021, <https://www.uso.org/stories/2664-military-suicide-rates-are-at-an-all-time-high-heres-how-were-trying-to-help>.

⁴⁵ Adamson, Burnam, and Burns, "Invisible Wounds of War."

⁴⁶ Adamson, Burnam, and Burns.

the outcome of the treatment of invisible wounds.⁴⁷ There are different ways to treat invisible wounds, and one way is through exposure therapy, which assists in confronting fears or traumatic events. Utilizing VR traumatic events can be recreated for exposure therapy and is scalable for what the user and the medical professional deems appropriate for that specific treatment. Instead of the user imagining and discussing the remembered events, that user can experience details that can assist in decreasing the symptoms of invisible wounds. Psychologist Barbara Rothbaum, in the 1990s, tested VR exposure therapy on veterans and found that it had a positive effect and reduced symptoms in that those who were participating in the study utilizing VR.⁴⁸ The individuals tested stated that the events haunting them did not bother them after the treatment.

Iraq and Afghanistan have led to the development of those virtual environments to create a multisensory and immersive experience for those area of operations. The technology now has allowed for the inclusion of smells including smoke, gunpowder, and even burning rubber. An analysis of 20 Iraq veterans produced significant results with the use of VR with PTSD and anxiety.⁴⁹ Now, service members and civilians can apply VR to enhance the treatment of invisible wounds that could increase our military's combat readiness while decreasing the number of suicides of active-duty service members through the advancement of invisible wound treatments.

4. Threats

a. Ethical Implications

Leaders are expected to follow moral and ethical guidelines that represent the U.S. Armed Forces on the battlefield. In training, the exact expectations are applied, and

⁴⁷ Grace Sophia Griesbach, David Allen Hovda, and Fernando Gomez-Pinilla, "Exercise-Induced Improvement in Cognitive Performance after Traumatic Brain Injury in Rats Is Dependent on BDNF Activation," *Brain Research* 1288 (September 8, 2009): 105–15, <https://doi.org/10.1016/j.brainres.2009.06.045>.

⁴⁸ "NIMH » NIMH-Funded Researcher Dr. Barbara Rothbaum Discusses Post-Traumatic Stress Disorder," accessed October 6, 2021, <https://www.nimh.nih.gov/news/media/2021/nimh-funded-researcher-dr-barbara-rothbaum-discusses-post-traumatic-stress-disorder>.

⁴⁹ Barbara O. Rothbaum, Albert "Skip" Rizzo, and JoAnn Difede, "Virtual Reality Exposure Therapy for Combat-Related Posttraumatic Stress Disorder," *Annals of the New York Academy of Sciences* 1208, no. 1 (2010): 126–32, <https://doi.org/10.1111/j.1749-6632.2010.05691.x>.

operators are evaluating on each decision they make. Physical injuries delivered to the enemy, civilians, and allies in training are simulated but can be visually seen in a virtual environment. Without proper controls in training and the virtual environment, an increase in the realism of training scenarios can lead to desensitization and moral disengagement. Mistakes are made in training to develop learning points to ensure those mistakes are not made in combat.

In combat, sometimes there is not a good option, and some training scenarios are designed to model the unpredictability of war. If an operator chooses an option that some could consider morally wrong, the operator will try to justify their decision by comparing it to something worse through reconstruction.⁵⁰ The continued exposure to particular scenarios or poor choices made in a virtual environment can lead to a displacement of accountability and desensitization, if controls are not properly introduced.

b. Cybersecurity

Cyber threats can be detrimental if the VR platform is compromised by current training, assessment of the force, and current and future mission planning. Recent government reports identify that the People's Republic of China (PRC) have been involved with malicious cyber activity that has targeted gas pipelines, civilian industries, and government facilities.⁵¹ The military uses Microsoft, and vulnerabilities were identified in Microsoft Exchange Server products. The reliance of a network puts VR training at risk for exploitation by state actors and other entities, presenting a prolific and efficient cyber-espionage threat.

c. Public Policy

The laws, policy, and funding priorities directly affect military operations and training. Changes in priorities of each administration and the varying budget cuts, raises in military spending, stopgap bills, and continuing resolutions from Congress can impact the

⁵⁰ "Moral Disengagement," *The Oxford Review* (blog), accessed October 6, 2021, <https://oxford-review.com/oxford-review-encyclopaedia-terms/moral-disengagement/>.

⁵¹ Cyber Security & Infrastructure Security Agency, "China Cyber Threat Overview and Advisories | CISA," August 2021, <https://us-cert.cisa.gov/china>.

effectiveness of VR training. Though increases in military spending can benefit specific programs, the inconsistency of funding can cause program cost to increase and delay updates, training, and delivery, resulting in degradation of the training effectiveness and limiting the advancement and sustainment of the program.⁵²

⁵² Lauren Williams, “How the Pentagon Copes with Funding Hiccups,” Defense Systems, September 16, 2021, <https://defensesystems.com/articles/2021/09/16/dod-approps-hiccups-report.aspx>.

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V. CONCLUSION AND RECOMMENDATIONS

A. WHAT IS NEXT?

With the 697 curriculum we have the ability to pass on long-term projects to students in follow-on cohorts. Some areas that we believe subsequent projects should focus on are:

- **Develop Scenarios** – Multiple scenarios need to be developed for the trainer so that there are a variety of situations that a GFC can be exposed to. This includes different geographic locations, mission types, and contingencies for complex and dynamic operations.
- **Test Prototypes** – Once the GFC trainer is delivered rigorous testing of the software to understand its capabilities and limitations will need to be conducted.
- **Assess Baseline** – Baseline tests will need to be conducted on GFC's from across the force to get a better understanding of where we are at as far as performance and what areas we need to improve on.
- **Stress Test/Cognitive Performance** – Once a baseline level is determined for GFCs we can begin to push the limits of performance for our operators by introducing extra stress. This can also be used to determine the best way to train teach and improve GFC performance over time.

B. LIMITATIONS

The VR JTAC trainer that exists for NSW is beneficial for JTACs to work 9-line and CFF reps and become proficient at “picnic table” CAS. When it comes to a VR trainer for GFC’s, this will most likely be a similar limitation as we will have to focus on the procedural aspects of the training. This system currently doesn’t really do much for a GFC seeking decision-making training. The more complex problems that GFC’s face in real world missions such as situational severity, LOAC and ROE, and even political considerations will be difficult to work into the trainer scenarios.

Nevertheless, this trainer will not solve all of our GFC-related training problems. There are still limitations to what this technology can accomplish. First, there is a limit to the realistic feel of the trainer’s base on models used and the ability to incorporate all physical gear such as weapons and equipment. Second, there is a limit on the number of players that can be included in each scenario. This will limit the comms to only a few individuals and not a whole platoon. Finally, the type of training will be limited by the scenarios given. For example, the JTAC trainer does well for basic proficiency such as 9-lines and CFF. However, it fails to emulate dynamic real-world CAS scenarios of combat. You would have to imagine that these same limitations will apply to the GFC trainer. This means it will most likely be ideal for basic scenarios and GFC procedures; however, it will require further adjustments and upgrades to simulate full mission profiles. The hope is that this will be one of many incremental changes that can be done to the trainer to make it a better and more viable training type.

C. CONCLUSION

In conclusion, the SWOT analysis assisted in the identification and measuring of the strengths, weaknesses, opportunities, and threats associated with the virtual reality trainer. The SWOT analysis identified the applicability of the uses in the current environment while identifying the limitations of the organization and the potential for future developments within the framework. The analysis assists in the understanding of potential success of the program by identifying internal and external factors.

Interviews showed us that GFC training for OICs and AOICs falls short in making proficient commanders for combat environments. As a force, we are doing a disservice to our community and operators by not training GFCs to a higher standard. We should be doing everything to address this deficiency. VR technology is one possible solution to this problem. With a lower long-term cost of training, VR can provide more realistic and immersive environments for GFCs. This forgiving environment can be used to hone GFC skills and enhance decision-making under pressure. The increased repetitions and ability to learn from mistakes instantly will improve operator proficiency over time.

During this project, we identified HAVIK as a company capable of developing the GFC trainer and secure funding for production. We also were able to identify a wearable cognitive load headset from Qneuro capable of giving real-time feedback to the operator. Furthermore, we were able to meet with Stanford in regard to data collection and analysis. From start to finish, this project is expected to take two and a half years to complete, and a final product should be delivered to NSW by June 2023 if all goes to plan.

Still, there are some limitations to what the technology can accomplish and hurdles to overcome. This trainer will not wholly replace the need for sand tables, comms drills, and FMPs. Those training techniques have been used for years because they were effective. As we shift towards the information age, VR can help fill in the gaps and augment old training techniques. Building this trainer is a much-needed step in the right direction for NSW and the advantages of investing in this technology outweigh the downsides on balance. Technology will continue to shape our future, and the sooner we incorporate it

into our training, the better off we will be. Overall, the goal is to better prepare GFCs for the difficulties they will face in modern conflicts.

APPENDIX. INTERVIEW QUESTIONS

A. GFC QUESTIONS

1. What is your currently level of expertise/experience? JO/AOIC/OIC
2. What formal GFC training has your platoon/class received up until this point in training?
3. What future training is scheduled for your platoons/classes GFC's?
4. What style/method of training has your unit identified as most effective that worked best to prepare a young officer for being GFCs?
5. What training procedures/techniques is your team currently using to improve GFC performance?
6. What gaps or problems in current training methods has your platoon identified in the way we train GFCs?
7. What have platoons done to fill these gaps?
8. What type of scenarios has training not addressed?
9. What weaknesses has the training detachment focused on improving throughout this ULT/training block?
10. Has VR technology come up in the discussion as a solution for GFC training?
11. Has the JTAC simulator been used as a GFC training aid?
 - If so, how has it been used?
 - What limitations does this trainer present?

B. GFC TRAINER QUESTIONS

1. What methods are being used for GFC training?
2. What is currently being used for grading criteria and pass-fail criteria of GFCs?
3. What are the books, doctrine, manuals, power points used to teach GFC training?
 - Is it possible to get a copy of this information?
4. What are some downfalls in the way we currently teach GFC training?
 - What methods worked well for JO/AOIC/OICs going through training?
 - Do certain methods work better for levels of expertise?
 - What methods have not work well?
 - Are there any specific training parts where individuals struggle the most, and how do trainers mitigate this/improve performance?
5. What areas is NSW currently focusing on, what areas are being neglected as a force?
6. What mistakes or training limitations cause issues?
7. In regard to GFC training, what methods, techniques and procedures are teams investing in now to prepare for upcoming deployments?
8. Has VR technology come up in the discussion as a solution for training gaps?
9. Has the JTAC trainer been used as a GFC aid?
 - If so, how has it been used?
 - What limitations does this trainer have?

10. Is there anyone else we should talk to regarding present for future GFC training?

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