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MASTER OF MILITARY STUDIES

THE MODULAR TACTICAL VEST: A CASE STUDY IN SUCCESS AND FAILURE

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EXECUTIVE SUMMARY

Title: The Modular Tactical Vest: A Case Study in Success and Failure

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Thesis: The Marine Corps currently stands at a crossroads in the development of the next generation of individual body armor and may be able to leverage lessons learned in the recent development of the Modular Tactical Vest (MTV). This research paper will examine the primary issues associated with the development, procurement, and fielding of the MTV program and will consider how the lessons learned may be applied for the acquisition of the next generation of individual body armor.

Discussion: The MTV was developed in order to satisfy immediate in-theater needs and to remedy the shortfalls of the Marine Corps' previous tactical armored vest. The MTV acquisition demonstrated the Government's ability to meet urgent requirements while still complying with all applicable statues and regulations. In the case of the MTV, the total lead-time from formal requirement (USON) to contract award was 123 days. However, the implementation and execution of training did not go as planned and there were significant repercussions across the Service as a result of this issue. Upon initial fielding of the MTV to the Operating Forces in March 2007, it appeared that there were significant issues/deficiencies with the MTV. Further analysis revealed that the majority of Marines/Sailors were not trained or fitted on the MTV and it was believed that there was a direct correlation between training and user acceptance. Meanwhile, MCCDC increased the original UUNS/USON requirement for an additional 48,000 MTVs. In late February 2008, the Commandant of the Marine Corps stopped the procurement of all MTVs. Recently, MARCORSYSCOM has resumed the procurement and delivery of additional MTVs with General Conway's concurrence. To date, training and fitting of the MTV remain a widespread issue throughout the Operating Forces and the Marine Corps is still uncertain what the "next generation" of flak jacket will be.

Lessons Learned and Conclusions: There is no doubt that the MTV procurement was successful in meeting the immediate needs of the Marines and Sailors engaged in combat operations. However, there are limitations with the use of wartime urgent acquisitions. For example, sufficient quantities cannot be procured to equip TECOM commands to provide for Service wide training. Additionally, all design changes must be vetted through the spiral acquisition process. At all levels, Marines and Commanders must be familiar with their body armor systems. Moreover, annual body armor training should be implemented across the Service. Furthermore, incorporating direct feedback from combat experienced Marines and Sailors in structured evaluations is key in the development of relevant and practical individual body armor systems. Finally, the Marine Corps must perform the required analytical rigor prior to commencing a formal program of record.

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DISCLAIMER

PREFACE

The following study is a result of my experience as the Acquisition Project Officer for the Modular Tactical Vest and as the Team Leader for the Individual Armor and Load Bearing Equipment, PM-Infantry Combat Equipment, U.S. Marine Corps Systems Command, from February 2005 to July 2008, as well as, my continued study on this topic. The author would like to acknowledge the many people that offered support, advice, encouragement and assistance along the way.

This document is labeled "For Official Use Only" due to the citations made from sensitive casualty data, as well as, acquisition source selection sensitive material. I am especially indebted to the Marines and civilian professionals of the Individual Armor and Load Bearing Equipment Team, PM-Infantry Combat Equipment, PM-Marine Expeditionary Rifle Squad, and the superb support staff at Human*systems*® Incorporated. Additionally, I am indebted to the staff of the Marine Corps Command and Staff College who helped make this work possible, including COL Cherry, U.S. Army and Dr. Bruce Bechtol.

Finally, a much deserved acknowledgement of my parents, whose encouragement and personal sacrifices laid the foundation for who I am today. I would also like to thank my children Sofia Rose and Samuel Lorne for providing me with inspiration, imagination and love each day. To my best friend, confidante, critic, and greatest supporter, regardless of the outcome–Kimberly, my wife, thank you for understanding my passion of being a Marine and enduring all of the challenges and sacrifices that accompany this profession. I am convinced that you have made me a better human being. No one has ever had a better partner in life, and it is to you and our children that this work is dedicated.

INTRODUCTION

"I'm not quite sure how we got to where we are, but what I do know is it is not a winner ..... I think it is foolish to buy more. I've asked them to tell me — to walk me through — the whole process ... how it evolved. I want to know who authorized the costly purchase of the nearly 30-pound flak jacket."[1]

So began General Conway's statements regarding the Marine Corps' Modular Tactical Vest (MTV) during a Fox news story that aired on February 27, 2008. With this statement came a number of inquiries from the media, concerned parents, business-seeking opportunists, numerous General Officers, and members of Congress. His comments echoed many of the voices he encountered on his tours to Iraq and highlighted many widespread issues associated with the MTV. Additionally, the Commandant's comments acted as a watershed moment in the lifecycle of the MTV, as well as, for the future of the Marine Corps' individual body armor programs.

The Marine Corps currently stands at a crossroads in the development of the next generation of individual body armor and may be able to leverage lessons learned in the recent development of the MTV. In early 2006, combat operations highlighted the need for operational enhancements to the "flak jacket" known as the Outer Tactical Vest (OTV). The Marine Corps quickly sought a solution to meet this requirement and executed an extremely aggressive and unconventional acquisition strategy to procure this item. This acquisition demonstrated the Government's ability to meet urgent requirements while still complying with all applicable statues and regulations. In the case of the MTV, the total lead-time from formal requirement to contract award was 123 days. However, the implementation

and execution of training did not go as planned and there were significant repercussions across the Service as a result of this issue. To date, the acceptability, training, and fitting of the MTV remain a widespread issue throughout the Operating Forces, consequently, the Marine Corps is still uncertain what the "next generation" of flak jacket will be. This research paper will examine the primary issues associated with the development, procurement, and fielding of the MTV program and will consider how the lessons learned may be applied for the acquisition of the next generation of individual body armor.

BACKGROUND

The Marine Corps has used Kevlar body armor since the 1980's to provide ballistic protection for Marines and Sailors in harms way. The Corps initially fielded the Personnel Armor System for Ground Troops (PASGT) Vest in the early 1980's based upon state of the art 1970's ballistic technology that provided fragmentation protection only. As threats evolved and ballistic technologies improved, the Marine Corps developed the OTV in the late 1990s. The OTV consisted of advanced soft armor for fragmentation and handgun protection that covered the torso, groin, and neck areas. Additionally, the OTV could carry front and back ballistic ceramic plates, known as Small Arms Protective Insert (SAPI), to protect against rifle fire.[2] Ballistic ceramic plate technology improved as well and the Corps adopted Enhanced Small Arms Protective Inserts (ESAPI), which provides protection against armor piercing rifle fire, in 2006.

Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF) were the first time in U.S. history that all wartime casualties have been autopsied by Armed Forces Institute

of Pathology (AFIP) to determine a cause of death. In late 2004, the Marine Corps Systems Command (MARCORSYSCOM) contracted the AFIP to evaluate data collected from autopsies performed on Marines in order to analyze casualty data and assess areas of vulnerability in its entire line of body armor systems with the intent of identifying areas for enhancement.[3] Additionally, MARCORSYCOM sought casualty data from other sources, with the intent of improving its body armor systems.

The information from these sources had a profound influence on the future of Marine body armor programs. The AFIP published results that correlated casualty data and body armor design in their Lethal Torso Injury Report dated August 29, 2005. Specifically, between March 19, 2003 and June 30, 2005, 401 Marines died from combat injuries during OIF. Of them, nearly 24% died from a primary lethal injury of the torso. AFIP's research concluded that as many as 42% of the Marine casualties who died from isolated torso injuries could have been prevented with improved protection in the non-plated areas of the vest. Both studies found that the majority of fatal torso injuries, resulting from ongoing combat operations, resulted from penetration of the protective vest in those areas not currently protected by the SAPI/ESAPI plates.[4] During this same timeframe, the First Marine Expeditionary Force (I MEF) Surgeon's Office studied combat casualty rates sustained by Marine forces in the Al Anbar Province, during OIF II. Their research found that 23.5% of fatalities occurred from side torso wounds not covered by the OTV and SAPI/ESAPI protected areas. Additionally, their research found that 1/3 of casualties had injuries superior (above) the area of the body covered by the SAPI/ESAPI plate. This study also found that most lethal injuries were sustained from direct fire (primarily small arms) wounds.[5] The evidence from these sources clearly

indicated that casualty rates could be reduced if the current body armor system (i.e., OTV) was redesigned. Thus, the casualty data and analysis' obtained from AFIP and other sources eventually led to the developments of Side-SAPI, QuadGard (i.e., extremity armor), fire retardant combat clothing, and the MTV.

REQUIREMENTS GENERATION

Based upon operational insight and wound trend analysis, MARCORSYSCOM anticipated a requirement to meet the operational and protective deficiencies of the Corps' next generation of tactical armored vest. Additionally, MARCORSYSCOM anticipated the need to redesign an armored tactical vest to carry a Marine's assault load (i.e. magazines, water, grenades, etc.), as well as, soft and hard armor. Owing to these factors, MARCORSYSCOM coordinated with the Marine Corps Combat Development Command (MCCDC) and Plans, Policies and Operations (PP&O) in the development of MTV requirements.

In reality, most wartime acquisition requirements or Urgent Universal Needs Statements (UUNS) are generated within the Operating Forces. The requests for UUNS solutions flow from the applicable Marine Forces Commander and Marine Component Commanders with General Officer endorsement. The UUNS process is not intended to field equipment Marine Corps wide, but to fill immediate operational needs of deployed forces or those getting ready to deploy. The capabilities fielded through the UUNS process will not normally be supported in the same manner as formal programs of record and there are limitations regarding capabilities for UUNS procurements. For example, many UUNS procurements lack comprehensive training plans and lack long-term sustainment.[6] The benefit to the warfighter is a streamlined acquisition process that

reduces many of the statutory and regulatory requirements, resulting in a material solution in less time than a traditional program of record acquisition. The Marine Corps' acquisition system puts these UUNS requests through a series of checks to validate, research, and fulfill the requests. Representatives from the Marine Requirements Oversight Council (MROC), Deputy Commandant Programs & Resources (DC P&R), and the Deputy Commandant Combat Development & Integration (DC CD&I) are designated to handle an UUNS. These are the action organizations within the Marine Corps who validate and resolve submitted requests and distribute those items requested to the Marine warfighter.[7]

The MTV procurement was unique in that MARCORSYSCOM, MCCDC and PP&O identified an "urgent" requirement for a new tactical armored vest based upon casualty data and analyses. In addition to these reports, in December 2005, MARCORSYSCOM and MCCDC conducted two "requirements generation" workshops at with the 1st Marine Division at Camp Pendleton, CA and the 2d Marine Division at Camp Lejeune, NC. These workshops targeted Marines and Sailors with recent combat experience to generate user requirements, to make design considerations, to gather load configuration recommendations and to collect feedback on current equipment solutions in order to improve the next generation of tactical armored vest. These Subject Matter Expert (SME) requirements conferences incorporated a user-based prioritization of features that provided useful guidance to the "next generation" of tactical armored vest development process and supported critical design trade-off decisions in requirements specification, and subsequent user testing and evaluation of candidate tactical vests.

Based upon these SME conferences, Marines and Sailors determined that there

was a requirement to combine torso ballistic protection with an integrated and scalable load-carrying capability. Additionally, the results of this requirements evaluation determined that the future vest design must provide a high degree of modularity to support the needs of different Military Occupational Specialties (MOS), different mission and terrain requirements, and different threat conditions. The requirements analysis determined that:

> The successful design will provide modular, integrated soft, hard, and add-on armor options; the capability to add and secure a wide range of different pouches and attachments; a secure, stable, comfortable, adjustable fit that provides the necessary areas of protection coverage without compromising mobility and range of movement; with a quick release capability and a means of easy, quick access for medical treatment; compatible with the complete range of Marine Corps weapons, crew stations, equipment, and clothing; in a seamlessly integrated design solution.[8]

On December 20, 2005 MARCORSYSCOM and MCCDC held a widely attended Industry Day Conference to provide an informal forum for information exchange between the Government and potential offerors for the "next generation" of tactical armored vest requirement. The purpose was to improve the understanding of Government requirements and industry capabilities, thereby allowing potential offerors to judge whether or how they could satisfy the Government's requirements, and enhancing the Government's ability to satisfy its requirement at the best value (i.e. cost, schedule and performance).[9] From this conference, MARCORSYSCOM and MCCDC personnel determined that it would be years before commercial industry could develop and produce a breakthrough ballistic technology. However, they determined that industry could immediately produce a "system" that could better integrate the front and back ESAPI and Side SAPI plates, extend lower back protection, provide a modified protective collar, and have a quick-release (doffing) mechanism. With these changes, MARCORSYSCOM and

MCCDC personnel determined that many of the deficiencies highlighted in the casualty reports could be immediately addressed. Consequently, MARCORSYSCOM and MCCDC personnel began drafting an UUNS outlining the requirements for the Corps' next generation of tactical vest.

On January 26, 2006 the MTV Project Officer released an e-mail to all attendees of the Industry Day Conference that outlined a rough draft of the acquisition strategy, as well as, a draft of the UUNS requirements. On January 30, 2006, the Commanding General of MCCDC, LtGen James Mattis, approved an UUNS for an improved Outer Tactical Vest.[10] Thus, MARCORSYSCOM and MCCDC personnel were successful in incorporating requirements as outlined in casualty reports and from Marines with recent combat experience into an approved wartime requirement or UUNS. However, policy would require that this requirement be further refined, validated and approved via a Universal Statement of Need (USON) prior to awarding any future body armor contracts.

ACQUISITION STRATEGY

A methodical spiral acquisition strategy was used in the development of the MTV. The strategy employed by MARCORSYSCOM sought maximum practicable competition under urgent circumstances, while remaining compliant with all applicable statutes and regulations. Spiral development is the iterative process by which a capability is developed or matured within an increment. Typically the "desired capability" is identified, but end-state requirements are not known at program initiation. Requirements for future increments are dependent upon technology maturation and user feedback from the preceding increment. The iterative nature of spirals provides a continuous feedback

within the increment ensuring that the desired capability is fielded.[11]

The MTV acquisition strategy employed a "targeted market research" methodology that sought to streamline the acquisition process while remaining compliant with all applicable statutory and regulatory requirements. Although full and open competition was not required for the MTV UUNS requirement, Federal Acquisition Regulation (FAR) Section 6.302-2 required that, "agencies shall request offers from as many potential sources as is practicable under the circumstances." In accordance with FAR 15.201, "Exchanges with Industry Before Receipt of Proposals" and FAR 15.202 "Advisory Multi-Step Process," procedures were utilized to ensure that as many potential sources as possible were identified and evaluated.[12] To this end, targeted market research was undertaken in response to the above UUNS that included: (a) issuing a Request for Information (RFI) to industry (through FedBizOpps) on 22 November 2005 that announced USMC OTV/MTV needs in performance characteristic/capability need terms; (b) the hosting of a widely-attended Industry Day Conference on 20 December 2005; (c) evaluation of RFI responses (data and prototypes), by a panel of Government Subject Matter Experts (SMEs); (d) a limited field evaluation of selected and refined prototypes; (e) an extended field evaluation of selected and refined prototypes; (f) contract award through limited competition; and, (g) a final field evaluation to verify the selected prototype vest prior to production and fielding.[13]

During each step or spiral of this process, requirements and prototypes were refined based upon field evaluation findings and upon direct feedback from the Marines and Sailors participating throughout the development process. Additionally, throughout this process MARCORSYSCOM worked closely with each vendor and noted minor

modifications to each vendor's candidate product solutions in an iterative manner to mitigate performance risk, to assess ongoing degree of vendor interest in competing, and to ensure that a best value final solution was achieved. Thus, the traditional development time by using this methodical acquisition strategy was significantly reduced.

REQUIREMENT DEVELOPMENT PROCESS

The development process of the MTV began with a SME evaluation of 15 RFI responses and prototypes in three different areas (i.e., design expertise, rapid prototyping ability and capacity for improvement). Between February 15 to 17 February 2006, a board of 15 Government SMEs consisting of Marines from MARCORSYSCOM, MCCDC, PP&O, I MEF, II MEF, and III MEF, as well as, civilians from MARCORSYSCOM, U.S. Naval Research Laboratory and the U.S. Army Natick Soldier Research, Development and Engineering Center evaluated each company's capability to meet the immediate UUNS design requirements and the outlined OTV enhancement objectives. Additionally, Government SMEs rated each company's design improvement potential. This process consisted of a systematic evaluation of each company using standardized rating scales, in which each evaluator rated the prototype vest against the OTV to establish a baseline score.[14]

At the conclusion of this two-day evaluation, the Government identified six companies that were rated at least 75% in three identified areas as the best potential designs. These companies were later de-briefed and were provided feedback on changes that could be made to their prototype vests to better meet the Government's requirement. At the same time, these six companies were informed that their design would be evaluated during a limited field trial to be conducted in April 2006. During each step of

the evaluation process, MARCORSYSCOM worked closely with each vendor and noted minor modifications to each vendor's candidate product solutions in an iterative manner to mitigate performance risk, to assess ongoing degree of vendor interest in competing, and to ensure that a best value final solution was achieved.

Following the initial SME evaluation, MARCORSYSCOM purchased twenty-five prototype tactical vests from each of the six companies, via micro-purchase methods, for continuing market research analysis. An eight day Limited User Evaluation (LUE) was then undertaken at Marine Corps Base, Quantico, VA over the period of 17 to 24 April 2006 with a goal of down selecting the three preferred prototype vest for a future evaluation. Forty Marines and Sailors with recent combat experience undertook a battery of human factors tests while wearing six different prototype tactical vest designs in a partially balanced incomplete block experimental design.[15] Each Marine evaluated four of six prototype tactical vest designs. To reduce bias in the evaluation process, company names and trade-marks were removed from all prototype tactical vests and each vest was labeled Alpha, Bravo, Charlie, Delta, Echo, Fox or Golf.

The order of evaluation conditions was balanced among participants and test serials. Human factors tests included: assessments of training, assembly, fit, adjustability, protective coverage, first aid access and emergency doff, compatibility with clothing/equipment, weapons systems and vehicles, performance of select endurance course obstacles, grenade throwing, marching, performance in movement to contact and MOUT assault combat tasks, range firing, thermal load, and comfort. Data collection included questionnaires, focus groups, performance measures, and Human Factors observer assessments.[16] At the conclusion of the LUE, only three acceptable prototype

MTV designs (i.e. Echo – rated first, Bravo – rated second, and Delta – rated third) were found acceptable for final testing at an extended field evaluation to be conducted in July 2006 (See Appendix A). Once again, the selected companies were later de-briefed and were provided feedback on changes that could be made to their prototype vests to better meet the Government's requirement. MARCORSYSCOM worked closely with each vendor and recommended minor modifications to each vendor's candidate product solutions, based upon LUE participant input, in an iterative manner to further refine the design, as well as, the formal USON requirement.

Based upon findings from the SME RFI and prototype evaluations and upon the data from the LUE, the original UUNS requirement was further validated, refined and approved in a MCCDC USON dated May 23, 2006.[17] The USON established an Acquisition Objective of 60,000 based on one MTV per Marine within the Marine Central Command (MARCENT) Area of Responsibility (AOR) and required complete delivery no later than December 30, 2007. The USON required the re-use of the same front, back, groin, collar and throat soft ballistic panels from the OTV, and added to these a new yoke/collar assembly and kidney area protectors. Additionally, the USON requirement called for an integrated load carriage capability for the basic and SAPI/ESAPI front and rear plates, as well as, both the Marine Corps' Side-SAPI and the Army's Enhanced Side Ballistic Insert (ESBI) plates. The USON also required a material solution that addressed OTV shortfalls related to casualty treatment, comfort of wear, integration and overall user safety. Last, the USON required that the contractor provide New Equipment Training (NET) through onsite training and through on-call help desk support.[18] Thus, with a formal requirement now in hand, MARCORSYSCOM personnel

were clear to finally begin the formal acquisition process that would eventually lead to contract award.

FURTHER EVALUATION & CONTRACT AWARD

On 26 June 2006 a formal Request for Proposal (RFP) was issued to all three successful LUE participants for the urgent in theater need of 60,000 MTVs to be delivered by 30 December 2007. The Marine Corps identified five areas in which these proposals would be evaluated for contract award: 1) technical capability; 2) manufacturing; 3) training; 4) past performance; and 5) price. Of these evaluation factors technical capability was rated more important than manufacturing and training which were rated equally important. Additionally, past performance was determined less important than manufacturing and training. Last, all four areas when combined were determined more important than price.[19]

Contractor technical capabilities were evaluated through: 1) a Field User Evaluation (FUE) to be conducted at Camp Lejeune, NC; and 2) through ballistic testing, durability testing and casualty reduction model analysis. Manufacturing capabilities were evaluated through: 1) their ability to manufacture 60,000 MTVs by 30 December 2006; 2) an assessment of the contractor's quality assurance system; 3) an evaluation of the contractor's configuration management plan; and 4) by analyzing the contractor's Government Furnished Equipment (GFE) management plan (i.e., ballistic soft armor). Training capabilities were evaluated through: 1) an evaluation of training provided at the FUE; 2) an evaluation of the contractor's written training plan for conducting on-site NET at MTV delivery locations; and 3) an evaluation of the contractor's plan to provide on-call help desk support at both Camp Lejeune, NC and Camp Pendleton, CA. Last, the

three contractor's past performance on prior Government contracts, as well as, their price proposals submitted for the MTV RFP were evaluated.[20]

Using the urgent wartime requirements outlined in the approved UUNS and USON, MARCORSYSCOM's acquisition plan for the MTV sought to use limited competition under the guise of "market research" to make final contract award.[21] In accordance with FAR 13, "Simplified Acquisition Procedures," MARCORSYSCOM initially purchased sixty prototype MTVs from each of the three down-selected vendors that participated in the LUE.[22] These sixty prototype MTVs would eventually be further subjected to additional technical evaluations. In fact, MTV test evaluation plan designated that the three MTV prototype designs undergo intensive ballistic testing, durability testing and casualty reduction model analysis at the U.S. Army's Natick Soldier Systems Center (NSSC) at Natick, MA; as well as, a water safety evaluation at the U.S. Navy's Naval Survival Training Institute (NSTI) at Pensacola, FL. Additionally, MARCORSYSCOM planned another technical evaluation of the three prototype MTVs designs during an extended field evaluation, known as a FUE, at Camp LeJeune, NC. Thus, the purpose of the evaluations was to: (1) evaluate the final prototype MTV designs selected from the LUE to determine those that best meet the requirements outlined in the UUNS/USON, and (2) identify areas of concern in the prototype MTV designs.[23]

The evaluations conducted at NSSC and at NSTI revealed that all three-prototype MTV designs met the UUNS/USON ballistic, durability, water safety and casualty reduction requirements with no significant variations. Additionally, a three-week FUE was undertaken at Camp Lejeune, NC over the period of 10 to 28 July 2006. In all, eighty-two (82) Marine and Sailors with recent OIF or OEF experience were organized

into two platoons and underwent a battery of human factors tests while wearing three different MTV prototype designs in a completely balanced, repeated measures experimental design. Participants were drawn from each MEF, represented each element of the Marine Air Ground Task Force (MAGTF) and consisted of multiple MOS'. Every Marine and Sailor individually evaluated all three MTV designs for a one-week period. As with the LUE, the order of conditions was balanced among participants and test serials. Additionally, the same LUE human factors tests were conducted and company names/trade-marks were removed from all prototype tactical vests and each vest was labeled either Bravo, Delta, or Echo.

In test after test the Echo vest stood out as the most accepted design by Marines and Sailors. Overall mean ratings for the trial exit questionnaire indicated that only MTV Echo was considered acceptable and rated highly by Marines; MTVs Bravo, and Delta were rated as unacceptable. Based on overall rankings, almost all Marines and Sailors (89%) ranked the Echo vest as their first choice. The Bravo and Delta vests were only ranked first by 6% and 5% respectively. In fact many FUE participants ranked these vests as the worst vest (Bravo (43%) and Delta (57%)), while no Marines or Sailors indicated Echo as the worst choice (See Appendix B).[24] The Echo vest's manufacturer was also rated superior in areas of manufacturing, training, past performance and cost. Thus, on 25 September 2006 MARCORSYSCOM awarded a contract to Protective Products International (PPI) for 60,000 MTVs, NET training and help-desk support for over $60,000,000. Once again, the selected company (i.e., PPI) was later de-briefed and was provided feedback on changes that could be made to their prototype vests to better meet the Government's requirement.

VERIFICATION & INITIAL FIELDING

Prior to committing a design to mass production, MARCORSYSCOM conducted a five-day First Article Test (FAT) to finalize the MTV design and to verify changes made to the FUE MTV Echo variant. The FAT was undertaken to evaluate user acceptance and preferences for the design characteristics and features of two MTV design variants. Design variant Echo was the prototype previously tested during the FUE and Zulu was a new Echo prototype design with feature modifications recommended by the Marines from the FUE. The FAT testing was designed to investigate and validate these modifications.

The FAT was undertaken at Marine Corps Base Hawaii over the period of 4 to 8 December 2006. Thirty-nine Marines and Sailors, with recent combat experience in either Iraq or Afghanistan, were organized into three squads and undertook a battery of human factors tests while wearing the two MTV design variants in a completely balanced, repeated measures experimental design. Participants were all male and were primarily infantry, combat engineers or Corpsman assigned to either 3d Marines, 6th Marines or 7th Marines. Additionally, participants had an average of five years time in service and varied in rank from Private First Class to First Lieutenant. Every Marine and Sailor evaluated both MTV designs. As with the LUE and the FUE, the order of conditions was balanced among participants and test serials. Additionally, the same LUE and FUE human factors tests were conducted and company names/trade-marks were removed from all prototype tactical vests and each vest was labeled either Echo or Zulu. Data collection included questionnaires, focus groups, performance measures, and Human Factors observer assessments.[25]

Generally, Marines and Sailors rated both the Echo and Zulu vests favorably during the FAT. However, the Zulu vest was preferred for most design features, was ranked best in all vest capability areas, and was rated as significantly more acceptable overall than the Echo vest. Accepting that the Zulu design successfully improved on the shortcomings of the Echo design, several important design modifications were recommended by Marines to finalize the MTV first article design.[26]

On 16 January 2007, the DC CD&I issued change 1 to the MTV USON. This change required that MARCORSYSCOM modify the previous acquisition strategy of re-using OTV soft armor panels (i.e. two separate panels joined in the front) in the MTV and instead replace them with a slightly modified single soft armor panel. The rationale was that the FAT had revealed that a single front panel provided more comfort (i.e., less restrictive) and would reduce the overall weight of the vest by 0.5 lbs.[27] However, the requirement to begin fielding MTVs by February 2007 had not changed. In fact, MARCORSYSCOM was required to deliver 1,000 MTVs to III MEF units no later than 28 February 2007. Owing to these factors, MARCORSYSCOM collaborated with PPI to develop a new armor package for the MTV in a matter of weeks. This collaboration resulted in a modified armor package that offered a slightly increased area of coverage (i.e., 5%) at a weight penalty of 1.5 lbs more than the OTV and resulted in slight vest design changes. For example, the designs of the neck opening and collar attachment were changed from the Zulu MTV variant tested during the FAT. Additionally, due to the fielding schedule time constraints and political pressure to field the MTV by the end of February 2007, MARCORSYSCOM did not conduct a final user evaluation to verify the MTV design changes prior to production. Thus, the methodical spiral acquisition and

user evaluation process abruptly ended at this time.

Fielding of the 60,000 MTVs began in February 2007 and was completed by September 2007. The MTV fielding plan was intended to field the MTV to units in CONUS, Okinawa and Hawaii in order to allow Marines and Sailors adequate time to train in the MTV prior to deploying to OIF/OEF. Fielding priority was given to units and Iraqi Transition Teams (ITTs) deploying in support of OIF 06-08.2 and OEF Embedded Training Teams (ETTs) deploying on similar timelines. Additionally, the fielding plan outlined the basic features of the new vest and described the MTV training concept-using contractor New Equipment Training Teams (NETT). NETTs would be organized by the MTV contractor and sustained by Marines as a result of train-the-trainer initiatives to support the MEFs. Last, the fielding plan outlined the strategy for conducting on-site NET, as well as, the procedures for units to contact the help-desks for on-call training assistance.[28] The training and associated fitting of the MTV was published to be a three-hour process intended primarily for Non-Commissioned Officers and above.

ACCEPTABILITY & TRAINING

While the fielding of the MTV was a success, training and acceptance of the MTV did not go according to plan. By mid 2007 several General Officers, to include CG I MEF – LtGen Mattis and CG MCCDC – LtGen Amos, voiced concerns to MARCORSYSCOM regarding acceptance of the MTV within the Operating Forces. Upon further analysis, MARCORSYSCOM determined that as of May 2007 there has been limited participation from the Operating Forces since fielding began. In fact, at that time 21,500 MTVs had been fielded to the Operating Forces, however, only 735 Marines and Sailors had been formally trained/fitted on the MTV.[29] Consequently, it was

perceived that the Marines' lack of training and fitting directly contributed to their low acceptance of the new vest. As a result, in October 2007, CG MCCDC directed a team from the Marine Corps Center for Lessons Learned (MCCLL) MARCENT Liaison conduct an MTV survey in Iraq, in order to provide DC, CD&I with an objective report on the fielding, use and acceptance of the MTV. Additionally, MARCORSYSCOM initiated an on-line survey to collect feedback from Marines who were currently, or had recently been, using the MTV regarding its performance and acceptability. The period of the survey was from 26 November 2007 to 3 March 2008.

The MCCLL survey found that the majority of survey respondents were dissatisfied with the MTV. Additionally, the MARCORSYSCOM on-line survey Respondents were asked a series of questions divided into broad sections surrounding form, fit, function, weight, and training. The survey respondents were found to evenly represent the Marine Corps population in terms of rank, military occupation field code, and, gender. Respondents had an average of 10 years experience and one deployment to either Iraq or Afghanistan. The majority of participants did not receive the full duration of formal training on the MTV intended (88.5%).[30] In general, a large majority of respondents rated the MTV features to be acceptable in both functionality and durability. However, respondents frequently noted weight (noted by 17.4% of respondents), bulk (9.1%), mobility/flexibility (7.7%), thermal discomfort (6.9%), physical discomfort (6.2%), side SAPI issues (5.7%), and quick release (4.1%) as issues with the MTV.[31] Surprisingly, the survey results demonstrated that the there was no relationship between length of formal training and overall acceptance of the MTV (See Appendix C).

CONFLICTING REQUIREMENTS & THE WAY AHEAD

During a Video Teleconference with I MEF, II MEF, III MEF, Marine Forces Reserve (MARFORRES), MARCENT, Installations and Logistics (I&L), PP&O, MARCORSYSCOM, and Training and Education Command (TECOM), DC CD&I revalidated the need for the MTV with the Operating Forces. Additionally, all three MEFs, MARFORRES and MARCENT identified a shortfall in both MTVs, as well as, replacement component parts. Owing to these shortfalls, the DC CD&I issued change 3 to the MTV USON, which increased the MTV requirement to 108,000 on 25 February 2008.[32] As previously indicated, General Conway halted future MTV procurements on 27 February 2008. Consequently, the Marine Corps was in the crux of procuring additional MTVs to meet the needs of the Operating Forces and addressing the Commandant's concerns regarding user acceptance.

At the behest of the Commandant, MARCORSYSCOM quickly began to examine possible solutions that would meet the immediate need for additional MTVs within the Operating Forces while addressing design and training concerns from the Marines forward deployed. To this end, in June 2008 MARCORSYSCOM conducted a series of SME workshops to gather feedback on the MTV and develop user guidance for future armor and load bearing equipment. The SME feedback on the MTV reviewed participants use of the MTV (sizing/fit, training, durability), measured user acceptance of the current design, and the potential of suggested design improvements. User preferences were documented to guide future armor systems development.

A total of 215 Marines were recruited from the 2d Marine Division and the 2d Marine Logistics Group at Camp Lejeune, NC. All Marine SMEs had recently returned

from an operational deployment to Iraq during which time they used the MTV. The workshop revealed that 97% of Marines were improperly sized for the MTV. Additionally, interviews with the SME participants revealed that the Marines were not receiving the intended type or duration of training (See Appendix D). Furthermore, this evolution revealed that there were frequent user concerns with MTV soft armor panels that were consistently bunching within the back extension, throat protector, and groin protector. Thus, these discrepancies directly contribute to the discomfort to the wearer and may also provide for a gap in ballistic coverage.

A modified version of the MTV survey conducted online was administered during the workshop and the survey results from Marines participating in the SME workshops were highly similar to the results obtained from the online survey of Marines. Thus, this data validated the results from the online survey. Consequently, 59.9% of respondents rated the MTV as borderline or better. As with the online survey, Marine comments re-emphasized the importance of mobility limitations, the impact of MTV bulk, the physical and thermal comfort associated with MTV wear, and the perceived system weight of the MTV with plates and combat load.[33]

Finally, SMEs were asked if MTV with changes would be acceptable or if a totally new vest design was needed. Approximately 94% of Marine SMEs indicated the MTV with changes would be acceptable. Some of the changes address the same problem and may be redundant while others are contradictory. Therefore, prototyping and evaluation of samples in a controlled user trial is recommended. The following modifications were positively rated and supported in Marine SME focus groups and are recommended for prototyping and further evaluation:

- Training/Fitting at Central Issue Facility
- Reduce width at shoulders/upper chest
- Replace Velcro/mesh with comfort material
- One point sling attachment point
- Add-on lumbar support
- Form fitting side-SAPI pocket
- Cummerbund issued separately

- Optimized area of coverage for mobility
- Pad side-SAPI pocket
- Reduce thickness over shoulder
- Cummerbund under back SAPI
- Quick release cable channel
- Re-cut armor for larger neck circumference
- Reduce material overlap for weight reduction
- Side-SAPI height adjustment system
- Pad inside of cummerbund
- Fixed throat protector
- Anchor cummerbund
- 6x6 side-SAPI[34]

An Improved Modular Tactical Vest (IMTV) is currently being designed based upon the issues and recommended changes identified during the online survey and 2008 SME conference. This effort will lead to the production of prototypes that will be evaluated by the Marine Corps to ensure that the required improvements have been made to the system. MARCORSYSCOM anticipates that a contract will be awarded for production of the IMTV in the last quarter of FY09 or early FY10 for a quantity of 108,000.[35] Additionally, the requirement for the next generation of body armor that will go beyond the scope of the MTV and that will eventually replace the MTV/IMTV is currently being validated at MCCDC.

LESSONS LEARNED & CONCLUSIONS

The primary issues associated with the development, procurement, and fielding of the MTV that may be applied to future body armor procurements are that : 1) while wartime procurements streamline the acquisition process, there are serious consequences of not formally establishing a program of record; 2) UUNS/USON procurements do not provide the flexibility to procure quantities to implement a robust training program in concert with TECOM; 3) all design changes, regardless of scope, must be vetted through

the spiral acquisition process; 4) Marines and Commanders at all levels must be educated on the form, fit and function of body armor systems; 5) since body armor constitutes a Marines last method of "Force Protection, " MTV training/fitting verification should be implemented across the Service akin to annual Nuclear, Biological and Chemical (NBC) training requirement; 6) incorporating feedback from user evaluations is key in the design, evaluation and selection of future Marine Corps body armor programs; and 7) before investing resources to obtain permanent material solutions (i.e., programs of record), the Marine Corps must perform the analytical rigor involved in the Doctrine, Organization, Training, Material, Leadership and Education, Personnel, and Facilities (DOTMILPF) process in order to determine specific military capability gaps that require a material solution. This process recognizes that closing a gap may require either a material or non-material solutions, such as training or doctrine. In some cases a combination of both may be required.

As previously indicated, the Marine Corps currently stands at the crossroads in the development of the next generations of individual body armor and may be able to leverage lessons learned in the recent development of the MTV. The MTV acquisition was successful in that it demonstrated the Government's ability to meet urgent requirements while still complying with all applicable statues and regulations. In the case of the MTV, the total lead-time from formal requirement (i.e., USON) to contract award was 123 days. However, the implementation and execution of training did not go as planned and there were significant repercussions across the Service as a result of this issue. The application of the above lessons learned may

prove useful in the development of the IMTV, as well as, in the development of the next generation of Marine Corps body armor.

APPENDIX A

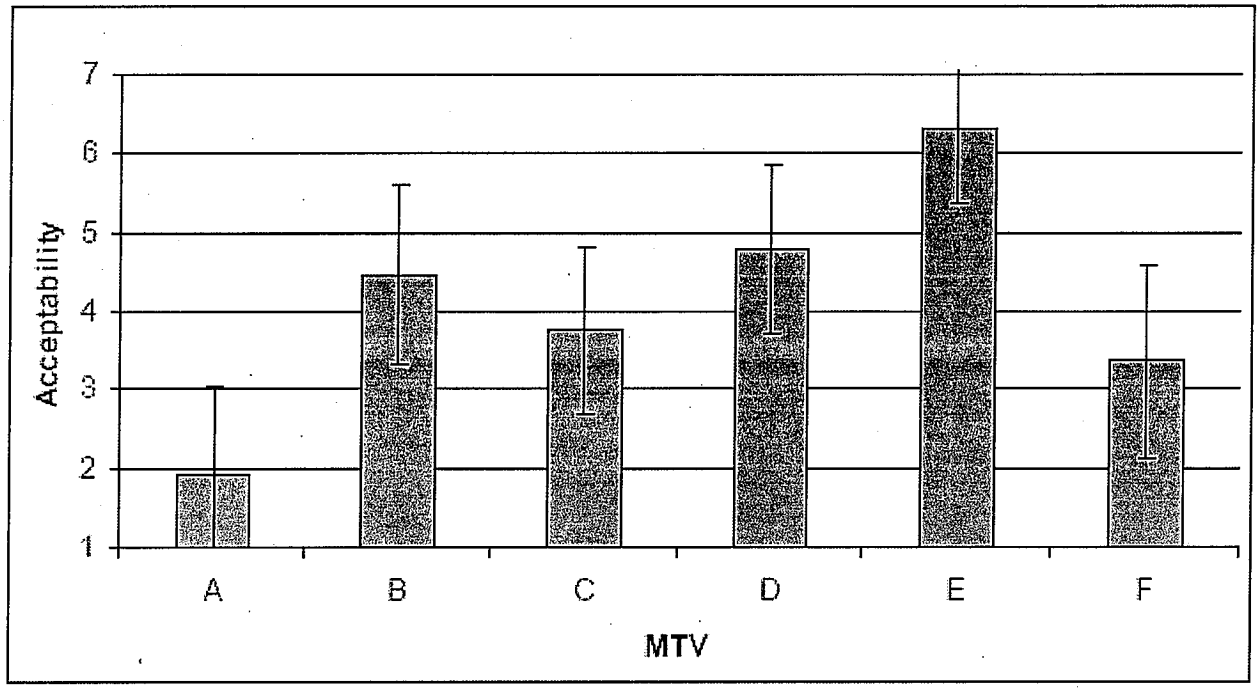

Figure 1: Overall MTV Prototype Ratings from the LUE[36]

APPENDIX B

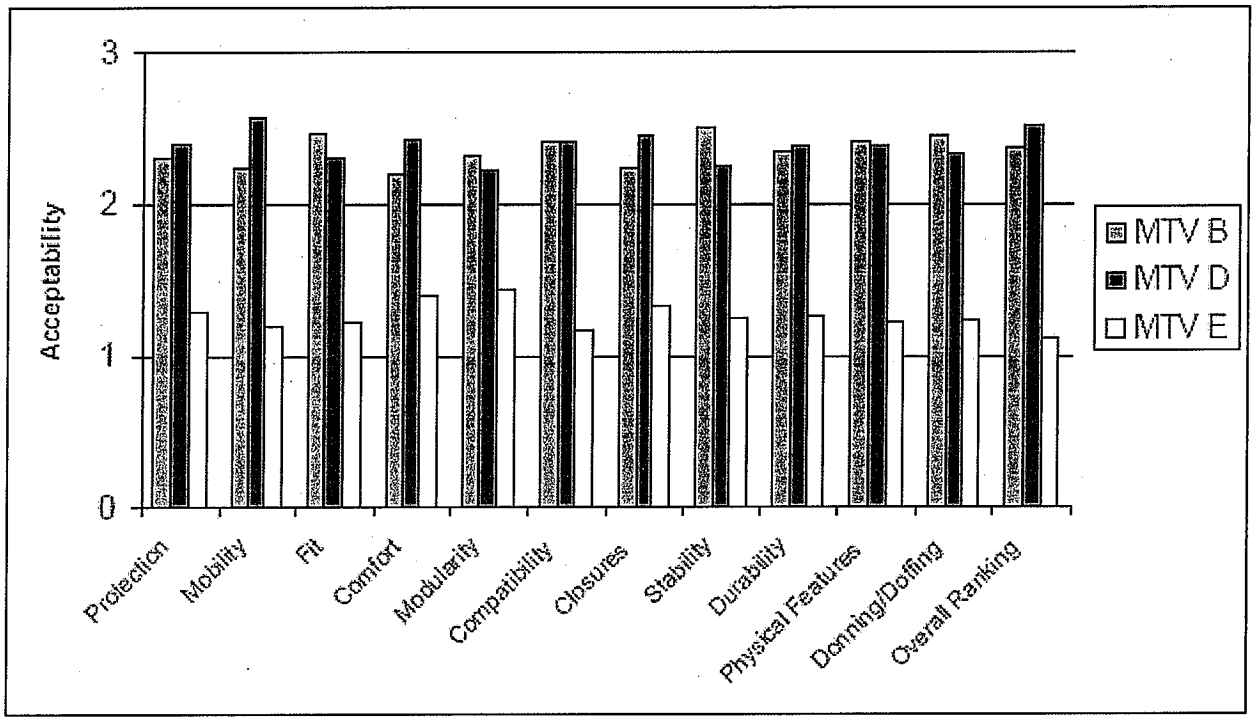

Figure 2: Overall MTV Prototype Ratings from the FUE[37]

APPENDIX C

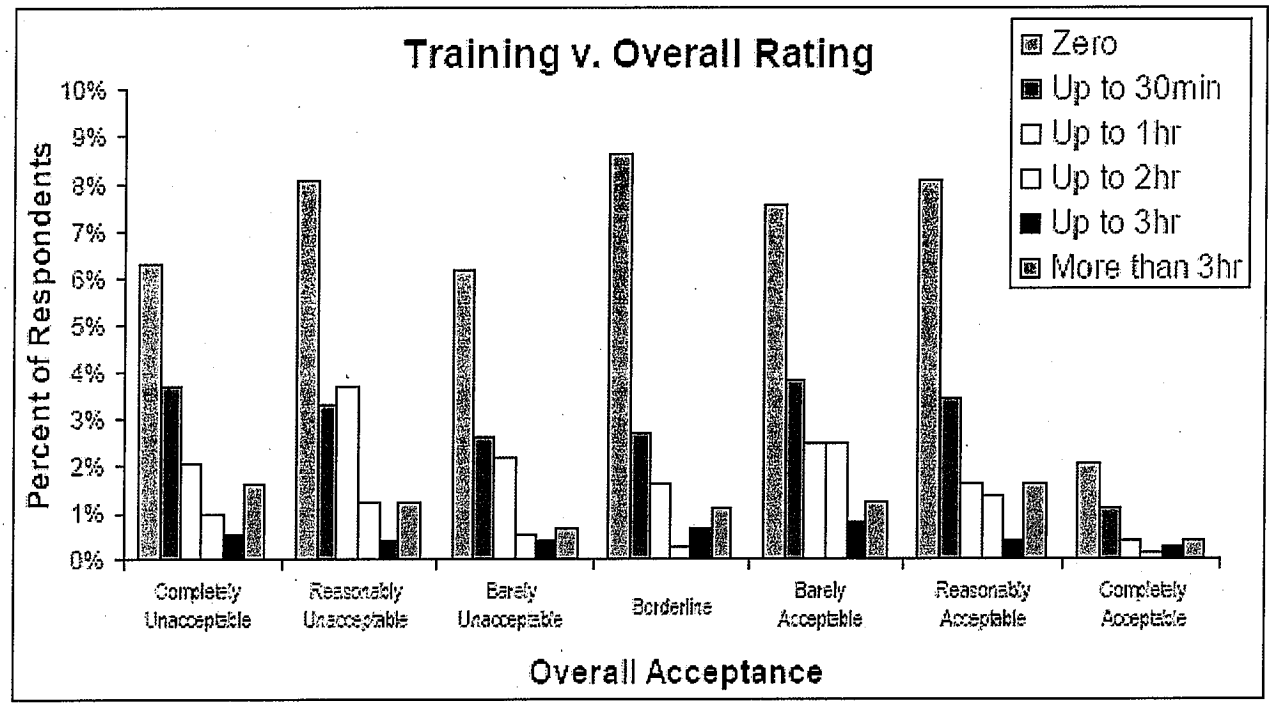

Figure 3: Formal Training Reported versus Overall Acceptability Rating[38]

APPENDIX D

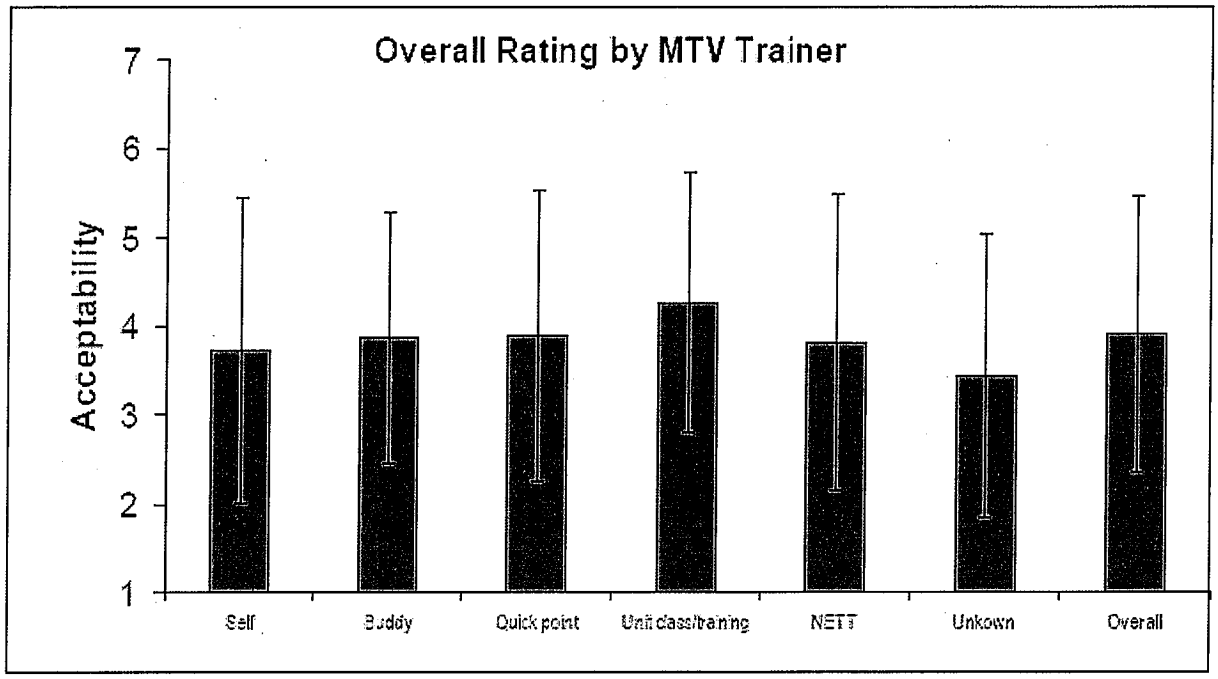

Figure 4: Overall Rating by MTV Training Type Received[39]

APPENDIX E

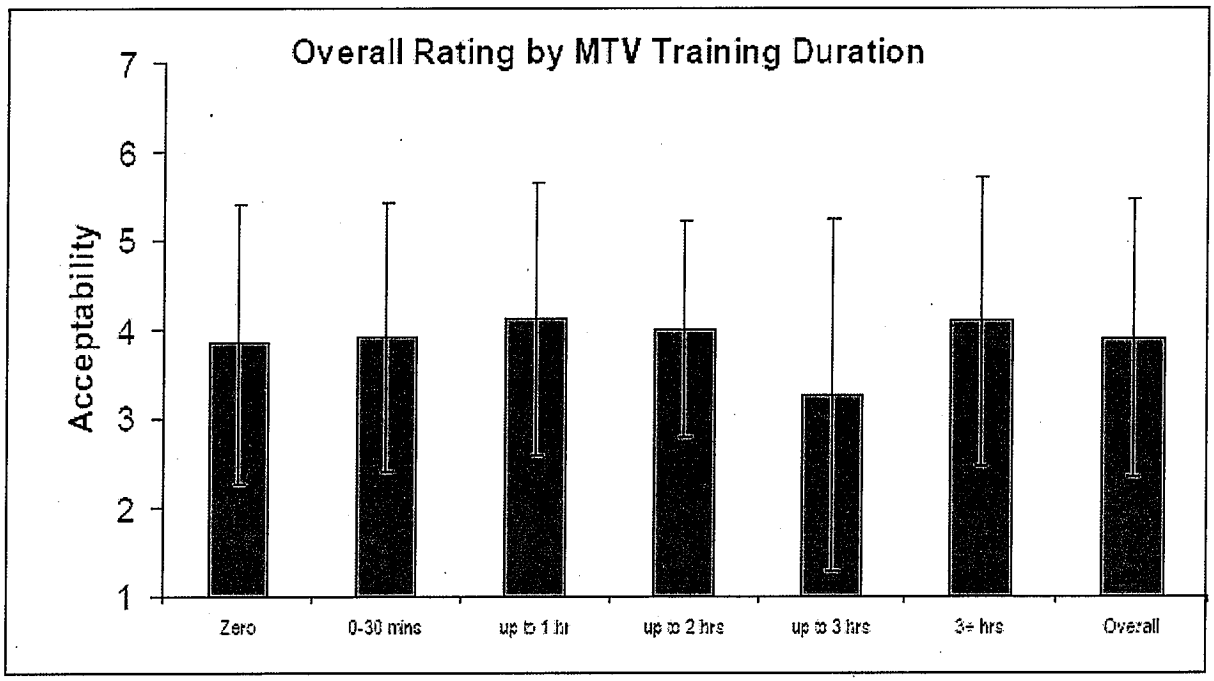

Figure 5: Overall Rating by MTV Training Duration[40]

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