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THESIS

REENGINEERING THE MARINE CORPS RIFLE RANGE

by

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June 2000

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REENGINEERING THE MARINE CORPS RIFLE RANGE

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requirements for the degree of

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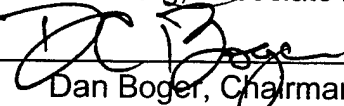
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ABSTRACT

With no significant changes in the design of rifle ranges in more than 100 years, the current range systems are not keeping pace with technological advancements. The Marine Corps rifle ranges are manpower and material intensive, requiring unit commanders to lose personnel to the training evolution for extended periods of non-productive time. Manual target operation, excessive transition time, and extra duties all contribute to eight to ten hours per day to accomplish one hour of live-fire training per individual Marine. Marines must remain at the range to act as scorekeepers, target makers, and/or target operators when not assigned to shoot. The design and implementation of an automated range system with capabilities specifically designed to operate, score, mark, and maintain targets would reduce the non-productive time a Marine spends on the rifle range. Results from this comparative analysis indicate that the automated range would reduce man-hours by seventy-five percent. Furthermore, the implementation of computerized technology will enable instructors and shooters to better analyze each training evolution.

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LIST OF ABBREVIATIONS

BPR	BUSINESS PROCESS REENGINEERING
BZO	BATTLE SIGHT ZERO
CIAP	COMPETITION IN ARMS PROGRAM
CPI	CONTINUOUS PROCESS IMPROVEMENT
ELR	ENTRY LEVEL RIFLE TRAINING
FAP	FLEET ASSISTANCE PROGRAM
GUI	GRAPHICAL USER INTERFACE
ISMT	INDOOR SIMULATED MARKSMANSHIP TRAINING
IT	INFORMATION TECHNOLOGY
LOMAH	LOCATION OF HIT AND MISS SYSTEM
LTI	LIMITED TECHNICAL INSPECTION
MCO	MARINE CORPS ORDER
MCTFS	MARINE CORPS TOTAL FORCE SYSTEM
MOS	MILITARY OCCUPATIONAL SPECIALTY
MPMS	MARKSMANSHIP PROGRAMS MANAGEMENT SECTION
MTU	MARKSMANSHIP TRAINING UNIT
NCO	NONCOMMISSIONED OFFICER
NMC	NATIONAL MATCH COURSE
NRA	NATIONAL RIFLE ASSOCIATION
OJT	ON-THE-JOB TRAINING
PPC	PRACTICAL PISTOL COURSE
RETS	REMOTED TARGET SYSTEM
RFMSS	RANGE FACILITY MANAGEMENT SUPPORT SYSTEM
RIF	REDUCTION IN FORCES
SLR	SUSTAINMENT LEVEL RIFLE TRAINING
SNCO	STAFF NONCOMMISSIONED OFFICER

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I would like to thank the participating Range Officers for their honest feedback. Special recognition is extended to the former Marines who despite all odds kept the Corps Marksmanship Programs alive throughout the years. Most important, I would like to thank my wife Mary and my children--Matthew, Kyra, Rebekah and Samuel--for all their unwavering support and love.

I. INTRODUCTION

All Marines share a common warfighting belief. The essence of this belief is captured by a simple yet powerful credo: "Every Marine a rifleman." In other words, every Marine, regardless of specialty, has a fundamental purpose. All Marines are forged from a common experience, share a common set of values, and are trained as members of an expeditionary force in readiness. There are no "rear area" Marines. The range, mobility, and lethality of modern weapons ensure that no one is too far from potentially life threatening situations when Marines respond to a crisis. The Marine rifleman of the next conflict will be, as in the past, among the first to confront the enemy and last to hang his weapon on the rack after hostilities cease. (MCRP 3-01A)

A. BACKGROUND

The Marine Corps has a philosophy that "every Marine is a rifleman"; therefore, it considers marksmanship training a key factor in providing Marines with an advantage in combat situations. With few exceptions, all Marines must qualify annually with their assigned weapon, usually the M-16 rifle. During the last 100 years, the Marine Corps has made substantial changes to its marksmanship program. Beginning with the Springfield "03", the rifle itself has been replaced five times; the most recent weapon is the M-16A2. With the rise of computer technology, most progress has been made with simulated computer training. Classroom instruction has changed little, mainly because the fundamentals of marksmanship are taught in their simplest form. The Corps has yet to apply computer technologies to the operations of their rifle ranges, where the evaluation of marksmanship takes place.

From the beginning of their careers Marines are taught skills to enable them to survive in battle. No Marine will deny that rifle marksmanship is an essential warfighting skill. Regardless of occupational specialty, Marines know that they may have to engage the enemy on the battlefield. Marine history is filled with stories of how superior-shooting abilities helped Marines overcome extreme odds. Despite the history and tradition, every fiscal year many Marines do not train or qualify with the basic tool of a Marine: the rifle. This lack of training was evident during the Gulf War when it was reported that a staggering number of Marines could not properly adjust the sights on their rifle (Lubold and Cain, 1999).

Whether intentional or not, some view the rifle range as a negative event. Commands overburdened with operational commitments may put the rifle range towards the bottom in their list of priorities. The Commander's priorities usually are followed without fail; hence, the commands range quotas go unfilled. Most Marines only touch a rifle when they go to the range. Recent changes in the requalification course have reduced some of the negative views associated with the rifle range. Marines previously were required to fire all week, commencing on Monday and qualifying on Friday. Marines currently can declare to shoot for qualification as early as Tuesday. Marines who are more comfortable with their rifle theoretically can train for only three days vice five. They fire on Monday; declare on Tuesday; and return for Field Firing (Phase III) on Friday. This is a win-win situation for the Corps, Commands, and the Marines. The Corps realizes substantial cost savings in the form of ammunition. Commands get their Marines

back earlier than on the old course of fire. Also, Marines enjoy having more control over when they fire for score (Malachowsky, 1995).

Other issues have been debated over the years. The most significant of them is whether the marksmanship program is adequately preparing Marines for combat (Stanford, 1993). The field firing portion of the range has reduced some of this argument; however, the debate continues with two recent Marine Corps Gazette articles by Captains Bradney and Gibbs. They assert the need for more realistic combat training, arguing for "action shooting." Action shooting is popular with law enforcement and Practical Pistol Courses (PPC) since they focus on accuracy, speed, and skill. While it cannot be denied that action shooting would be beneficial to the warfighter, this would once again require spending more time on the range.

B. OBJECTIVE

The objective of this thesis is to make recommendations for the design of a new automated rifle range system for the United States Marine Corps. Rather than alter the fundamentals of marksmanship training, the focus is on the reduction of man-hours and the enhancement of marksmanship training through the use of computer technology.

C. SCOPE AND METHODOLOGY

This research effort includes a literature search of books, magazine articles, Internet resources, phone interviews, and informal collaboration of fellow Marines. The literature survey included an initial review of the U.S. Marine Corps

doctrine relating to Marksmanship training, specifically, Sustainment Level Rifle. Additionally, literature involving management issues such as, change management, business process reengineering, and workflow management was reviewed.

The author relied on his experience as a Competitive Marksman and as a Primary Marksmanship Instructor (MOS 8531). Operational expertise was gained by interviewing four Range Officers whose occupation involves marksmanship training and range operations. Interviews and telephone conversations varied in length from two to four hours per Range Officer. The author traveled to Wilcox and Edison rifle ranges at Camp Pendleton, California for interviews and observation of the current system. Phone interviews were conducted to clarify statements made during the personal interviews. Questions focused on the existing system and how it could be improved through the use of computer technology. Recommendations were solicited for ideas on how an automated range system would function. Additionally, the author documented an entire range detail from start to finish. The information obtained was used for an analysis that compared the current manual system to the hypothetical automated system.

D. EXPECTED BENEFITS OF THIS THESIS

The purpose of this research is to identify management and Information Technology (IT) methods to improve the structure of the Rifle Range System. By examining the doctrine of the Sustainment Level Rifle (SLR) with the current range operations, the author suggests areas that can benefit from IT

implementation. The author's goal is to conceptualize a futuristic range support structure that would enhance the SLR through IT.

The transition towards an automated range has already begun. Marine Corps Base Hawaii and Naval Air Station Miramar are both in the development stage of an automated range system (Interview, Matthews). The system described in this thesis expands on the ideas already in development. This is not intended to answer every scenario for a redesigned range; therefore, the intent is to stimulate ideas of how to improve and enhance our range operations and training.

E. THESIS STRUCTURE

This thesis consists of five chapters. Chapter II provides the historical background of Marine Corps Marksmanship, Ranges, and courses of fire. Chapter III explains the current range structure to include the stages of fire and the operations involved at each stage. Chapter IV discusses the author's views on how the implementation of technology can change the system. Each change presents potential benefits and improved capabilities. Lastly, Chapter V provides the author's conclusions and recommendations.

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II. BACKGROUND

A. INTRODUCTION TO MARINE CORPS MARKSMANSHIP

The United States Marine Corps takes pride in their ability to transform a young high school graduate into a highly disciplined Marine. From the beginning of their career, Marines are molded into the image of a warfighter. As previously stated, every Marine is considered a basic rifleman. A Marine becomes a rifleman through one of two avenues: from qualifying on the rifle range either at a Recruit Depot or at The Basic School. This is one of many common experiences that bond Marines both junior and senior.

Society as a whole looks towards the Marines as "America's 911 Force." Our hymn states, "First to fight for right and freedom," which basically equates to the Marine with the rifle in hand. In the 1800s the slogan, "a few good Men," was used to attract young men into joining the Marine Corps. During those times men would join the Corps ranks already proficient in arms. Formalized marksmanship training was not yet developed. Contrary to the 1800s, when the entering recruit had some proficiency with a rifle, civilians who join today have typically never touched a rifle. Books, training aids, and accurate weapons depict the rifle range training that is currently used to develop an effective fighting force.

The fundamentals of rifle marksmanship are aiming, breath control, trigger control and follow-through. These fundamentals can be broken down further into elements such as: sight alignment, sight picture and eye relief. Despite the progress in technology, a well-trained marksman is nothing more than a rifleman

that properly applies simple fundamentals. When the hammer falls, the placement of the round on the intended target relies on how well the basics were applied.

B. HISTORY OF MARINE CORPS MARKSMANSHIP

1. Early Ranges

In 1904, First Lieutenant William C. Harllee supervised the construction of the first Rifle Range built, and operated, by United States Marines. Harllee, known as the father of Rifle Practice, had systematically studied shooting and small arms. He concluded that theory without application would not help the Marine Corps advance in marksmanship (Harllee, 1984). Little has changed since the inception of those initial ranges in the early 1900s.

The basic design has static target positions behind the safety of a bank of dirt. Figure 1 shows how targets are placed in carriages that are manually operated up and down. Ranges vary in capabilities and sizes with the most standard having firing positions from the 200 to 600 yard line. All command and control for the pits and firing line come from the center of the range. On the firing line the control point is known as the tower.

For the most part, the only two significant advancements in rifle ranges over the past 96 years have come in the form of communication. These are the public address system for communicating on the firing line and the field phones for coordination between the target positions (pits) and the firing line.

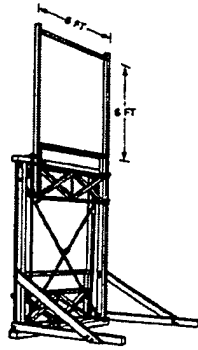


Figure 1. Manually Operated Target Carriage

2. The Combat Training versus Competition Debate

Since the beginning of the Marine Corps rifle qualification process, there has been contention over the methods of training Marines for combat shooting and instilling the fundamentals of marksmanship. Over the years articles have been written discussing the inadequacy of the qualification system. Most discussions have centered on the type of training: firing on a course of known distance under heavy supervision with standardized positions does not prepare Marines for combat firing (Stanford, 1993). It violates the old adage, "train in peace as you practice in war." Initial courses of fire focused on the National Match Course (NMC) used for competitive shooting. Competitive shooters fire with gloves, shooting jackets, scopes, and modified weapons. Additionally, the targets used for competition score hits outside of the bullseye which is counter productive for combat training. A shot outside the bullseye equates to an unharmed enemy force that now has a fix on your position. In a sense, the NMC was instilling a false sense of ability when looked at through a combatant's perspective. Therefore some Marines argue that competition has no place in the Corps since it does not focus on combat training. The other side of the argument

asserts that the NMC produces an understanding of the fundamentals, which can effectively be applied during peace or war. There is no doubt that competitive shooting reinforces the fundamentals and, in many instances, the Marine gains a deeper understanding of marksmanship by firing with more experienced competitors.

Currently, the Marine Corps separates marksmanship training into two categories. Entry level rifle (ELR) training is for recruits and new lieutenants who both fire on targets used for NMC competition. ELR builds the foundation on which Marines will rely on for the remainder of their careers. Sustainment level rifle training (SLR) is the course of fire on which all Marines are evaluated annually to ensure that rifle proficiency is being maintained. The SLR fires on a more realistic target shown in Figure 2, that awards points for hits in the black only. Instead of the traditional circular bullseye shown in Figure 3, the SLR uses a silhouette of a torso representing an enemy combatant. At the 200 and 300 yard lines the silhouette is smaller depicting a figure exposed from the chest up. From 500 yards the silhouette is a torso from the waist up. (MCO 3574.2J)



Figure 2. "D" Target

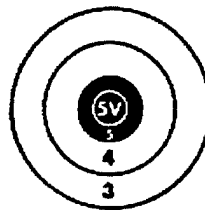


Figure 3. "A" Target

3. Shot Quantity versus Shot Placement

The year was 1965. His company was moving to a new position when it received fire from what he described as an "island" in the rice paddies, a small piece of high ground about 250 meters away. When the Marines returned fire, the sniper fled the cover of the island and headed for a village in a treeline about 100 meters away. A hail of small arms fire engulfed him as he ran through ankle-deep water on a course nearly parallel to the Marine column. Anxious marines fired in any position from standing to prone, with numerous variations of each. However, their enthusiasm proved to be greater than their marksmanship skill. Erratically fired bullets sprayed the rice paddy everywhere, impacting at points from immediately in front of the Marines to well beyond the Viet Cong, as well as in front of and behind him. On at least two occasions the water splashing up from the combination of M14, M60, and M79 fire obscured the runner completely from view. An estimated 3,000 rounds were fired; all, apparently, to no avail. At the end of the frantic; "100-meter dash" the troops watched haplessly as he faded into the village. No evidence was found of his having been hit. (Jeppesen, 1985, p. 22)

One well placed round from any weapon would have taken the enemy down at 250 meters. One can assume that the unknown distance and lack of skill were to blame for the above story. Marines now fire on targets of unknown distance during the field firing, Phase III, portion of the annual requalification process. Additionally, M-16s are now designed with the capability to fire three round bursts vice automatic fire thus supporting the position that shot placement is more important than shot quantity. Before a Marine can place that well aimed shot, he or she must understand the fundamentals of marksmanship (Interview, Demille). More importantly, the physical act of applying the fundamentals to the weapon is what will achieve the end result.

4. Memory and Perfect Practice

“Perfect practice makes perfect!”
Unknown author

In an April 1986 Marine Corps Gazette, Maj. Jeppesen adequately explained the relationship between “fact memory” and “skill memory.” Fact memory, or knowledge, is associated with lectures and the learning of information. Classroom instruction is the primary conveyance of fact memory. Preparatory training is designed to give the Marine the fact memory needed to fire the M-16.

Skill memory, or practical application, is acquired by practicing what is known or taught. Driving a car is a good example of a skill memory. Once taught how to drive a car, an individual will under most conditions remember how to drive a car. Over time drivers develop poor habits such as; driving while talking on a phone, making improper lane changes, failing to use a signal indicator. If a driver doesn't drive for an extended period of time, he or she becomes less accustomed to applying brakes, judging distances, and maneuvering in traffic. Although the skill memory is retained the driver is less proficient in application (Jeppesen, 1986).

In general, many Marines lack knowledge on the fundamentals of marksmanship. Some never fully grasped the concepts to begin with (Smith, 1997). Others haven't had a class in marksmanship since boot camp or The Basic School. Either way, without the fact memory to reinforce the skill memory, a rifleman is not as effective. In the analogy of the driver, it can be seen that without frequent application a person becomes less effective in execution. Even

worse is when a rifleman has poor habits and is infrequent in practicing. Figure 4 illustrates the importance of building a solid foundation on the ELR and SLR Training. This model demonstrates the steps taken to train an effective rifleman. The fundamentals in ELR teach a Marine to understand the factors that produce hits and misses and to make necessary corrections. The SLR Phases provide the Marine the opportunity to test his or her knowledge on an annual basis with a realistic target. Even though a realistic target is introduced into the training evolution, firing at targets that do not fire back is not indicative of combat. Therefore, the rifleman is not training under conditions similar to combat. Only during combat can the uppermost building block be tested. Under this learning process, if a building block is skipped, a Marine will be less proficient.

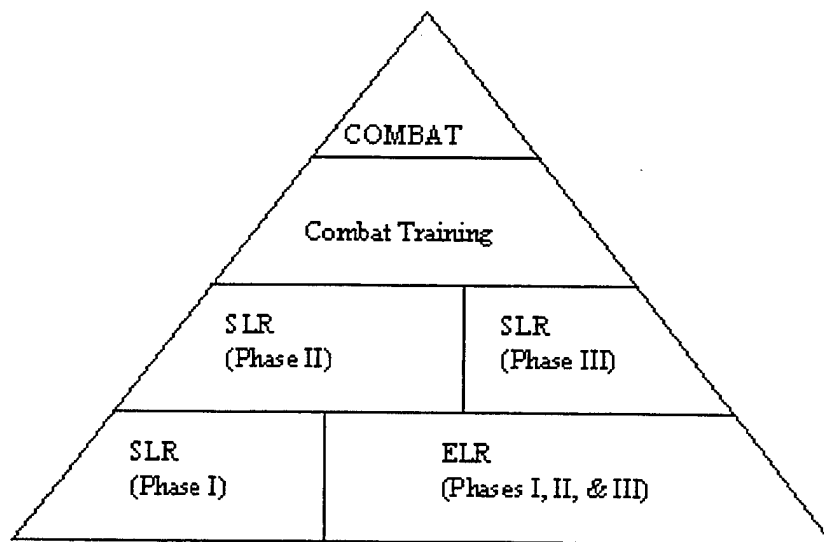


Figure 4. Building blocks for Marine Marksmanship Training

C. WHY THE EMPHASIS ON “EVERY MARINE A RIFLEMAN?”

“Remember the most deadly thing on the battlefield is one well-aimed shot.”

Gunnery Sergeant Carlos N. Hathcock

Marines across the globe are taught that two training evolutions are of vital importance to their heritage: the Physical Fitness Test and the Rifle Range. This is emphasized from the top down. With few exceptions every Marine must annually qualify with the service rifle. The Corps relies on the ability to put rounds on target and the Infantry rifleman, also known as a 03, is the key component. The 03 are the focal point of the Corps. Every Marine is either a 03 or is in support of the 03 at all times. In order to support the 03, Marines of all disciplines go forward into battle. As simple as it sounds, a mechanic, cook, and clerk must all be proficient in marksmanship so they can provide for their own security. In combat only hits count and that is the mission of the Marine Rifleman. Marksmanship, like physical training, is a pillar on which a Marine stands. Without it, he or she is defenseless.

D. WHY FIX A SYSTEM THAT ISN'T BROKEN?

Technological advancements are bountiful. New technological devices have affected every aspect of life. The Corps is no exception. Mechanics are ordering repair parts on the Internet, reconnaissance and surveillance is conducted by Unmanned Aerial Vehicles (UAV), and dog tags are going digital. Many processes are stable and have served their purposes for years; however, opportunities for training smarter and more efficiently are open to the imagination. For example, a combination of process improvement and

reengineering methods were used to design a new support structure for the rifle range. The focus was to identify bottlenecks in the process flow of the training cycle. The application of information technology to the bottlenecks resulted in the development of a hypothetical automated range system. The new system will increase efficiency, foster safety and enhance learning.

1. Information Technology

Shared databases, expert systems, and other information technologies fill Journals and Technical reports everyday. Reports and statistics on everything from equipment deadline reports to 5.56 ammunition expenditures are constantly in the works. When properly designed and employed, information technology (IT) can reduce man-hours and capture information for use in a variety of ways. The real power of technology is not that it can make old processes work better, but that it enables organizations to break old rules and creates new ways of working. (Hammer & Champy, 1993)

2. Continuous Process Improvement

Continuous process improvement (CPI) is thought of as "business as usual" only that you do it better. Steps are taken to find problems within a process. Once a problem is identified, adjustments or modifications are made. Progress is measured by viewing things such as cost, time, or customer satisfaction. The Marine Corps has embraced this approach over the last decade. In many ways CPI is merely a different name for Total Quality Management. Bottom-up initiatives are encouraged, with an emphasis on

ownership of processes. When someone feels “empowered” and has a sense of ownership, ideas flow and improvements can be obtained relatively cheaply (Davenport, 1993).

3. Process Reengineering

CPI and process reengineering (PR) differ significantly in that PR focuses chiefly on starting from scratch. CPI looks for minor gains of an existing system. PR focuses on radical changes that re-create a process with current and future technology in mind. Reengineering is defined as fundamentally rethinking and radically redesigning of business processes to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service, and speed (Hammer and Champy, 1993). When a process is reengineered, all preconceived ideas must be eliminated. Existing structure cannot be a restricting factor for a new design. Indices such as throughput and performance are the driving forces. With the end state in mind and technology as an enabler, the new design will be significantly more effective than the previous process.

III. CURRENT RIFLE RANGE SYSTEM

Before a process can be reengineered or improved, it must be understood. This chapter describes operations and training involved with the evaluation of a Marine on the Rifle Range. It also provides insight towards inefficiencies that exist with the current rifle range course of fire.

A. MISSION OF THE MARKSMANSHIP PROGRAM

Marine Corps Order 3574.2J establishes the policy and requirements for annual marksmanship training. Specifically, paragraph 4 states:

- a. Marksmanship proficiency is the foundation for military effectiveness in ground combat operations. It is required that all Marines be trained in the effective use of weapons with which they are armed.
- b. Marine Corps marksmanship doctrine, as outlined in MCRP 3-01A, Rifle marksmanship and FMFM 0-8, Basic marksmanship, forms the basis for all marksmanship training. The objective of marksmanship training is to develop and maintain individual skills to a combat capable level.
- c. To measure proficiency with the M16A2 service rifle and the M9 service pistol, Marines are required to fire the weapon with which they are armed as outlined in this Order.
- d. The prescribed minimum requirements of this Order should not be interpreted as limiting the commander in conducting additional training to enhance performance.

Marine Corps Reference Publication (MCRP) 3-01A, Rifle Marksmanship, discusses the individual skills needed to achieve effective proficiency with the rifle. Issues covered in the MCRP 3-01A are: M16A2, Weapons Handling, Fundamentals of Marksmanship, Rifle Firing Positions, Use of Cover and Concealment, Rifle Presentation, Effects of Weather, Zeroing, and Engagement Techniques.

B. UNIT RESPONSIBILITIES

1. Administrative

Each command's training office receives range quotas for firing details from higher headquarters. In some situations commands may request block training so that large portions of their unit may go to the range at one time. This works especially well for Infantry units that are preparing for deployment. Range Officers currently have periodic meetings with Training Officers from tenant commands so quotas can be redistributed as needed. Proper planning is required to prevent units from running out of time towards the end of the fiscal year.

Upon the completion of each detail, the training office receives scores in paper format or electronically for all Marines. Once at the units, a training office representative takes the scores to the administration section for entry into the Marine Corps Total Force System (MCTFS). The move towards giving each Range control over submitting scores directly into MCTFS is underway. Eliminating the extra steps involved with calculating scores reduces man-hours and the chance that scores could be modified.

2. Personnel

Most of the ranges in the Marine Corps belong to permanent bases or stations and are staffed through the Fleet Assistance Program (FAP). Under FAP, tenant units that fire on the range must contribute personnel, usually for six months at a time, to operate the range facilities. In most cases, an entire range

will be operated with only ten percent permanent personnel, the remainder being FAP Marines. (Interview, Chatelin)

For each and every detail a unit sends to the range, they also must provide coaches for their shooters. On the average, a unit sends one coach for every fifteen shooters. Additionally, a Non-firing Staff Noncommissioned Officer (SNCO) must accompany a detail. Unless a bus is provided from higher headquarters, units also must send vehicle operators for transportation purposes, which increases the number of Marines in support roles. Furthermore, according to MCO 3574.2J, commands must provide pit verifiers on any given day a Marine goes for score. Pit verifiers are called to targets that have questionable circumstances that could affect the qualification score.

3. Preparatory Training

This training is the beginning of the marksmanship process and is labeled Phase I. MCO 3574.2J directs that lessons on the fundamentals of marksmanship be conducted by the parent command. Most commands have a Marksmanship Training Unit (MTU) located with the training office whose main function is to educate shooters and provide qualified range coaches for each detail. Dry firing exercises usually are conducted the week prior to going to the range. Emphasis is placed on weapons handling and safety procedures on the range.

4. Field Firing and Combat Training

Units are responsible for two stages of Field Firing: engaging targets under low-light conditions and targets of unknown distance. Further combat oriented training is at the sole discretion of the unit commander. Each installation has various live fire ranges that can be scheduled for conducting training; however, priority is given to Infantry units.

C. RANGE RESPONSIBILITIES

1. Operations

As previously described, ranges rely heavily on FAP from tenant commands. Unfortunately, Marines arriving for six months of duty have minimal shooting experience and many are not even trained as an 8531. The MOS 8531 is a secondary occupational specialty of marksmanship instructor. These circumstances put an undue burden on range supervisors who must quickly train and keep the range running at the same time. On-the-job (OJT) training is status quo at most ranges in the Marine Corps with the exception of the Recruit Depots and The Basic School. (Interview, Chatelin)

Although the evaluation of the Marines firing is the overall objective, the primary concern at all ranges is safety. Heavy supervision and rules leave little room for error. Marines are always taught to be aware of which direction their rifle muzzle is pointed. Unfortunately with the volume of shooters that come to the range, safety violations must be enforced for the safety of other shooters.

2. Evaluation

Recent changes to the Marksmanship program have put the responsibility of training on the command. Previously, ranges had MTU sections that would instruct, supervise, and reinforce the fundamentals for all details on a range. With this change the realistic function of the range is now similar to an inspection team. The role of any Marine Corps inspection team is to determine if a unit is capable of accomplishing its mission while complying with predefined orders and standards. The role of the rifle range is to evaluate each and every shooter on their skill level of basic marksmanship.

3. Administrative

Databases, computers, statistics, and technology have changed many an organization. The Corps is no exception to the rule. Information technology acts as an enabler that allows organizations to do work in radically different ways (Hammer and Champy, 1993). Qualification percentages are used like a report card whereby Marines, ranges, and commands are judged on their effectiveness. Scores are used in a variety of ways with the most common being: actual percentage of Marines qualified and the score they received.

Before percentages can be reviewed the data take a long journey before they get into electronic format. Marines manually record each shot on a score card for target and relay. Marines in the pits are not aware of whose target they are scoring in the pits. Upon completion of firing, one of the pit verifiers must review and initial each scorecard. Then the pit NCO collects the cards. The pit NCO ensures that all cards are accounted for and that any discrepancy is

addressed before the pit operator and verifier leaves the pits. The cards are then taken to the range house for review to ensure that no mathematical errors exist. The scores from the cards are then manually entered into a spreadsheet for further use. Percentages can easily be calculated from the spreadsheet. Rosters can be submitted electronically back to units instead of a paper report. Figure 5 illustrates the entire process that takes a minimum of twelve man-hours to complete per firing detail. This does not include Field Firing scores or further manipulation of the data like entry into a Marines permanent record. (Interview, Skeer)

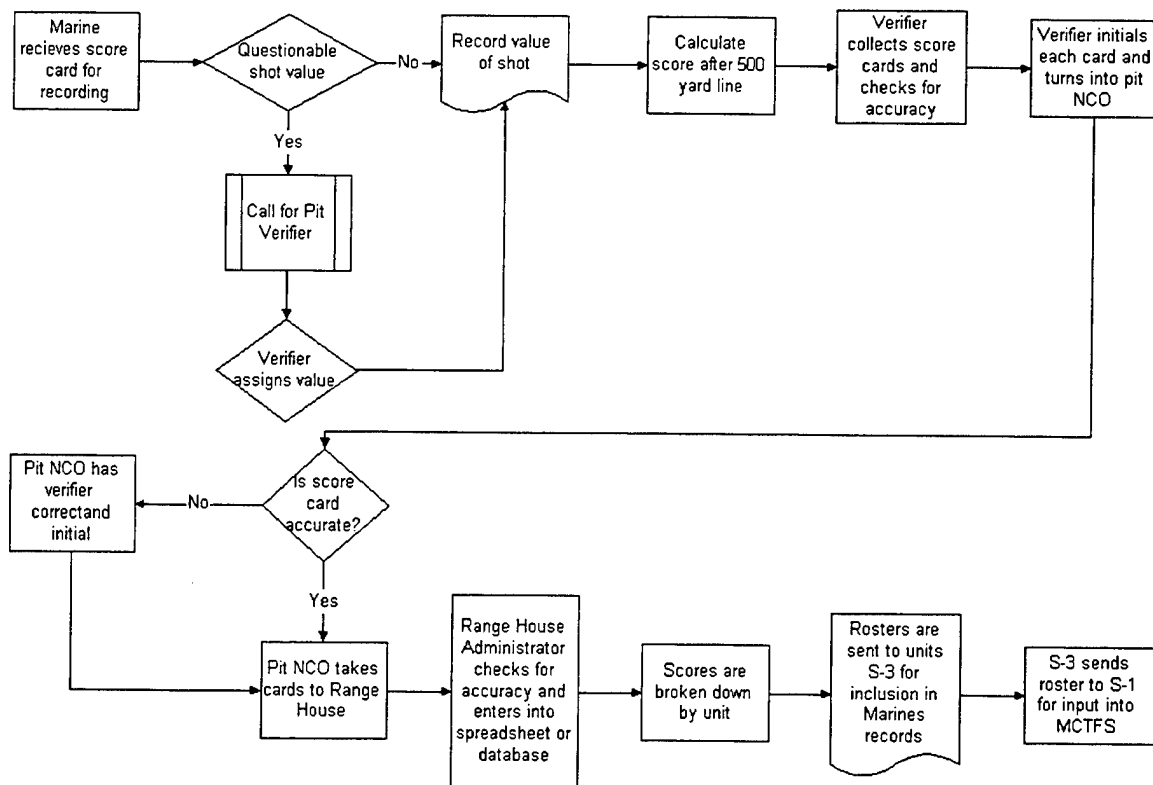


Figure 5. Process flow of a score card

D. RANGE OPERATIONS

1. Known-distance firing

Monday mornings on the range signals a fresh beginning. Mondays are when most rifle ranges pick up new SLR details for the beginning of Phase II. Each unit that sends Marines to the range must provide rosters of personnel. The rosters list names of Marines training, verification that preparatory training and weapons handling was conducted, and that a Limited Technical Inspection (LTI) was conducted on each Marine's weapon. Ranges are responsible for the receipt and review of the paperwork for each detail.

Marines from various units are combined to form a range detail of about 200 or less. This is further broken down into about five relays of forty Marines on each relay. No one is allowed to fire for score on day one of training.

A typical day at the range begins rather early for all shooters. Marines arrive to the range at about 0600 in order to prepare themselves and the range for a day of training. Prior to that they had to commute to the range and draw their weapon from the armory. Depending on location, some details start as early as 0400 in the morning. Once on the range, each individual Marine is assigned a target (firing position) and relay (order in which each shooter fires). This process is known as squading. Relays 1, 2 and 3 proceed to the 200-yard line with all of their equipment and receive that days allocation of ammunition. Relays 4 and 5 go to the pits and function as pit operators. They set-up the targets in the carriages, keep score if necessary, and pull the target when an impact is

received, or on command in rapid-fire stages. The target placed in the carriage first is the D-mod target.

Once the pits are sealed and the range is authorized to commence fire, the first relay moves to the firing line and fires stage one of the SLR. Stage one is 200-yard line slow fire, firing fifteen rounds in twenty minutes in the sitting, kneeling, and standing positions. After each and every shot, the Marine firing immediately calls where he/she last saw the front sight of the rifle. This "call" procedure helps a shooter determine if they are properly watching their sights and if their sights are properly adjusted. Once the first relay has completed fire and the line has been cleared, the second relay moves up and commences firing stage one. After second completes stage one, the third moves online and fires. Throughout the remainder of the day second relay follows first relay, and third follows the second.

Stage two is 200-yard line rapid fire, firing ten rounds in seventy seconds. The position is from standing to kneeling and Marines are not allowed to move into the kneeling position until the targets are raised in the air. The timing for rapid fires are controlled by the pits NCO. All targets go up at the same time and come down at the same time. During rapid fire, Marines are required to load two magazines with five rounds each in order to execute a magazine change under a stressful condition. Upon completion of the 200-yard rapid fire, all three relays move back to the 300-yard line.

Stages three and four are fired at the 300-yard line. Stage three is five rounds in five minutes in the kneeling position. Stage four is rapid fire from

standing to prone, firing ten rounds in seventy seconds. Like stage two, stage four must consist of a magazine change. Up until this point all firing has been conducted on the "D" mod target.

The last stage of fire is stage five, 500 yards slow fire firing ten rounds in ten minutes at the "E" target. After the first three relays have completed the 500-yard line slow fire, they are briefly inspected for ammo and then change over with the relays in the pits. Relays 4 and 5 complete the same process that was previously described.

At this point some Marines from the first three relays could be used as a working party, get assigned various extra duties or they could fire on the pistol range. In most cases they make the targets for the next range detail. Marines firing for score fire upon a fresh target. Theoretically, each target is only fired upon for one detail. (Interview, Chatelin)

Mondays take longer because every shooter fires; an average day takes approximately six hours. Although the stages of fire themselves are relatively short, the extraneous factors account for most of the time. Preparation time, different relays moving to the firing point, moving between yard lines, and slow target manipulation from Marines in the pits all contribute to a long day at the range. Other issues to consider are for all days after Monday when a Marine can declare to qualify. Separate logistical considerations must be adhered to when a Marine fires for score. New targets, a different target and relay, pit verifiers, and score cards all add to the already hectic schedule on the range. All remaining Marines must fire for score on Thursday, which is the last day for Phase II.

2. Field Firing

Phase III is conducted on Friday of each firing week for the entire detail.

Phase III addresses the following: Battle Sight Zero (BZO), Limited Exposure, Low Light/Darkness, Field Protective Mask Firing, Multiple Targets, Moving Targets, and Unknown Distance.

E. SIMULATED TRAINING

1. Dry Firing

Dry firing is the simulated shooting of an unloaded firearm for the purpose of helping the shooter master fundamental shooting skills. Skills developed during dry fire are trigger squeeze, sight alignment, and sight picture. When a shooter can manipulate the trigger without disturbing the sight alignment, they are properly dry firing. Further training is done with white fifty-five gallon barrels that have miniature D and E targets painted in black on the side. This process helps the shooter further develop their skills by combining body alignment and sight picture with the skills previously mentioned. Shooting consists of mental and motor skills combined to form a well placed shot on target. Dry firing allows a shooter to go through the steps necessary to fire their rifle without ammunition. When the shooter goes to the range their mind will already have become accustomed to the process thereby reducing human errors. Shooters that do not shoot on a regular basis and fail to adequately dry fire before shooting usually experience mistakes such as flinching and jerking. Dry firing process is considered the most cost-effective training aide.

2. Indoor Simulated Marksmanship Training (ISMT)

ISMT is an indoor training device that the Marine Corps has adopted for its simulated marksmanship training. ISMT trainers compliment firearms training at a substantially lower cost than live fire training. Utilizing computers, pneumatic weapons, and a video display, Marines can complete an entire course of fire without ever firing a single round. Studies have consistently shown that trainees using simulated training systems generally are able to improve their marksmanship faster than those using only live fire training. (FATS, 2000)

3. BEAMHIT

The BEAMHIT Marksmanship Training Systems are indoor, laser-activated target systems that can use actual weapons, without the use of live ammunition. The system operates by adapting a laser transmitter to the rifle barrel that interacts with a target sensor down range. Squeezing the rifle's trigger activates the laser on the rifle, which simulates firing a bullet. BEAMHIT designed their system with varying target sizes and capabilities. This target system provides hit or miss feedback to the shooter through use of a computer. Subsequent laser shots appear on the monitor, this also enables coaches to determine if a shooter is able to consecutively hit in the same area. Pneumatic capabilities allow the rifle to fire automatically every time the trigger is pulled. The shooter is monitored by a coach or instructor for obvious shooting errors, such as improper breathing or trigger jerk. The use of the BEAMHIT system provides avenues for remedial training in order to give a shooter more confidence in his or her shooting ability. BEAMHIT is a very simplistic cost-effective training system.

Better described as a "virtual reality" range, BEAMHIT is in use by other Branches of Service; however, the Marine Corps has not adopted this system for use. (BEAMHIT, 2000)

4. NOPTEL

Currently under review, is the NOPTEL training system. NOPTEL developed an electronic shooting system that uses laser beams and computers to detect all the basics of shooting during actual live fire. Outdoors under all imaginable weather conditions, the NOPTEL sniper variant can operate from 200 to 600 yards attached to an M16A2 rifle. The sniper variant can operate with one or more shooters connected to only one computer. Its accuracy of 0.1 mm and measuring speed of 1000 coordinates per second gives you exact feedback on your holding, aiming and triggering techniques. The whole shooting performance can be observed in real time on the computer screen and can be repeated, in slow motion if desired, by simply pressing one key; it also can be stored on hard disc for later analysis. The computer can provide data to the coach and shooter like breathing, sight alignment, shot placement on target and follow through of the shot. The technical quality of a shot can be seen visually from the computer monitor at the firing line. (NOPTEL, 2000)

IV. VISION OF A NEW SYSTEM

A. DESIGN VALUES

Increasing efficiency, proficiency, and safety guarantee added value to the training system. The ideal design would be scalable; consequently, it could support firing details of varying size. Additionally, the range should be built with open architecture so that future changes in doctrine and training will enable the range to be adaptable to future technology.

B. UNIT CAPABILITIES

1. Administrative Management

Computer technology and distributed networks have eased the burden of routine administrative tasks for most offices. By applying this principle to the tasks on the rifle range, it can be seen how the range can operate more efficiently while saving precious man-hours.

a. Quotas

Training offices have historically had a hard time filling range quotas unless it is close to the end of a fiscal year. Range personnel go to great lengths to optimize details for each unit and assign quotas based on that assessment. Furthermore, Range Officers have regular meetings with unit training representatives to ensure that quotas don't go unfilled (Interview, Chatelin and Skeer). Adopting business practices from the civilian sector would best solve this case. Airlines have more of a scheduling problem than we do and

they accomplish many of their tasks on-line. The Marine Corps currently has a system called Range Facility Management Support System (RFMSS), which allow training offices to reserve firing ranges in advance via computer; however, the use of an interactive real-time database would achieve a more satisfactory fill rate. The inevitable is just around the corner, technology exists to where the range could have a website that allows training office representatives to make reservations on-line. The training office representative could select the number of quotas and the days for firing if it were available. It would function similar to the airline reservation that gives instant feedback of availability, open seats, and booked flights. In this case the training office would be reserving time slots for Marines to show up to the range instead of scheduling a flight.

b. Armory/LTI and Weapons Handling

Smart Card technology is already on the move with Armory operations. MCRD San Diego is developing an automated armory that can automatically retrieve a weapon when a Marine uses a smart card. This process has proven to be an asset for armory personnel and is very easily scaled to handle the additional requirements of an automated range (Interview, Sacca). When a Marine is assigned to a range detail, the armory can conduct a Limited Technical Inspection (LTI) and store the results in the armory database. When a Marine checks their rifle from the armory using the smart card, the LTI is automatically logged on the smart card's memory. This can also work for the weapons handling requirements that a Marine must have prior to firing on the range. Upon arrival to the range, a Marine swipes their smart card and the range

system instantaneously detects whether the LTI and weapons handling training has been conducted. This would eliminate the need for any advance paperwork prior to a Marine reporting to the range.

2. Marksmanship Training

The Marine Corps currently requires that all preparatory training be conducted at the unit level. Therefore this mission lies squarely on the shoulders of the unit commander. Unfortunately, many units do not properly execute the Marine Corps Order as it was intended (Lubold and Cain, 1999). Most Marines arrive on the rifle range ill prepared for firing their weapon, much less a weapons handling test. The problem stems back to time or the lack thereof. Most classes on the fundamentals of marksmanship haven't changed in years. What was trigger control fifty years ago is still applicable today. The only exception to this would most likely be a class in sight adjustment because of the transitions from the M-1, M-14, and the M-16A1. Some units have adequate Marksmanship Training Units; however, few comply with the MCO 3574.2J by giving all necessary classes and dry firing exercises. Here is a prime example of how technology can be used to help Marines across the globe with minimal cost.

The IT solution for the lack of properly trained instructors is to create digital videos of lessons for viewing via the Internet. Distribution would be available to each unit on video, for download from the USMC website in the form of a digital movie, or as streaming video on the Internet. The most skilled instructors can be video recorded for producing the videos. Cover all the fundamentals, positions, courses of fire, and weapons maintenance. Those

Marines who choose to further their understanding, or were never afforded the opportunity, on the fundamentals and techniques will have a digital movie at their disposal at work and at home. With a digital video library Marines can review as much information as needed, before, during, and after a range detail. Digital movies answer the need for low cost, easily distributed, educational material.

Some issues that must remain the sole responsibility of the unit are the Battle Sight Zero exercise, dry firing exercises, weapons handling test, and the Limited Technical Inspection. Dry firing could be conducted during routine weapons cleaning thereby ensuring that the skills memory is exercised on a frequent basis (Stanford, 1993).

C. RANGE STRUCTURE

The rifle range of the future will operate more like the pistol range than a rifle range. The pistol range is known for getting Marines on and off the firing line in a fast and efficient manner. Little can be done to further speed the operations of a pistol range. The pistol range in Camp Lejeune has an automated target track that brings the targets to the firing point instead of having to walk down to a pit area.

1. Firing Point

The future rifle range's firing point would be static. Like Camp Lejeune's pistol range, all firing would be conducted from the same line. The targets would be at different yard lines (i.e. 200, 300, 500 and in some cases 600 and 1000). The 600 and 1000 yard lines only would need a few firing positions depending on

whether they had snipers utilizing the range or had operational commitments for competitions (e.g. the National Rifle Association [NRA] or the Division and Marine Corps Matches). The actual firing line itself would be made of composition rubber that has high durability and yields when Marines get into firing positions. Wilcox Rifle Range in Camp Pendleton currently has implemented the rubber composite firing positions. The author found them to be fully functional and conducive for continuous use on a rifle range. Again the emphasis is to evaluate the Marine on the basics of marksmanship, not to simulate combat. The firing line will have an overhead cover to shelter the equipment and the Marine from the elements. A covered firing line would prevent Marines from having to quit training during adverse weather conditions. The combination of the rubber firing line and the overhead also would help absorb noise on the range.

Further enhancements to the firing line would include a trap system in front of the firing point for collection of the spent brass casings and any other debris. Each firing point will have its own hard-wired display with a screen that resembles a data book. The use of hard-wired equipment will negate the need for batteries that could fail during training. The emphasis on the firing line is to have functionality combined with low maintenance.

2. Range Tower

The command and control will remain at the center of the firing line with the tower. The complete control of all targets during slow, rapid, and field firing will be interactive through a computer software program. For simplicity, the

interface should be designed as a Windows application through the use of a graphical user interface (GUI). The design of the software should be intuitive like standard “point and click” programs. Minimal training will be required to operate the tower since the stages of fire will be pre-programmed. One mandatory feature will be a safety button that will allow the tower to override any course of fire and lower the targets in the event of an unsafe condition. Total centralized control of the entire range will be at the fingertips of the tower NCO.

As with all critical computer hardware, a back-up system will provide redundancy in the event of a system failure. Uninterrupted power supplies and backup generators will prevent the loss of data in the event of a power outage.

3. Pits

The targets themselves will be silhouettes that are standard Marine Corps sizes but are made of self-sealing rubber for long life. Besides the fixed distance targets, Remote Target System (RETS) will be implemented into the range so that field firing also can be automated. Current commercial technology is available for developing targets that are very low maintenance. Material used is similar to latex that seals after the round penetrates the target. Other commercial applications include moving targets, pop-up targets for limited exposure, and computerized target controls. Combining an automatic scoring system with the capability of moving targets opens the door for very realistic field firing (Interview, Skeer).

D. RANGE CAPABILITIES

1. Assignment

Units may send whom they desire to the range as long as they have the required information on their smart card. Sometimes Marines get dropped off of a range detail at the last minute for various reasons; however, this will no longer be a severe burden to the range since the actual "squading" will take place as a Marine swipes his or her Smart Card. In times past Marines would potentially be on the same target and relay for the entire detail. Under the new system a Marine could be on a different target every day. This doesn't matter though if the fundamentals of marksmanship are applied. The computerized system at the range would: a) detect if the Marine has meet the required prerequisites, b) assign a target and relay assignment for that day, and c) randomly select individuals for weapons handling test by range personnel. On days 2, 3, and 4, the display that assigns the target and relay also will have a prompt that allows Marines to declare for qualification. The system would instantaneously detect shooter's previous day's score and will either accept the "declare to request" or will deny based on the inability to demonstrate the minimal proficient score. Some Commanders request that Marines fire the entire week and are not allowed to qualify early (Interview, Skeer). In this case the computer can be programmed to deny requests from certain units. Special circumstances create an administrative burden on an already understaffed range unit. With an automated range, tasks can be simplified and supervised with minimal personnel.

2. Data Management

The automated range system would be able to detect weaker shooters or Marines that are potentially having a difficult time firing. The computer system would be able to instantaneously notify the tower that targets X relay Y are grouping outside the hit zone, is all over the target, or is entirely missing the target. The days of "no impact no idea" or trying to follow a vapor trail through a pair of binoculars is obsolete. The machine now will be able to detect where the round is impacting to give the coach and shooter a reference point with which to work.

Automatic feedback will help the shooter and the coaches. The tower will get a prompt on a display screen when the computer detects a problem target. Data analysis software has the ability to give responses when a certain criterion is met. A possible software package will be for the firing points digital data book to prompt the Marine to make an elevation or windage correction based on consecutive shot placements outside of the black. Of course this feature will be disabled when a Marine declares to qualify.

Shots cross-fired on the wrong target by a shooter will automatically be disregarded due to a muzzle blast detector at each firing point. For example, if a shooter on target 20 fires on target 21, the system will acknowledge that it received an impact on target 21; however, it knows that 21 did not fire so it will ignore that impact. In the case of target 20, the muzzle blast was detected but no impact was received therefore the system will check for a disregard on the targets to the right and left. If a disregard is detected the display will indicate that

a crossfire occurred and assign target 20 a zero. This verifying process will ensure that all shots are accounted for and will prevent an adjacent target from being penalized in the event of a crossfire.

3. Scoring

This system will eliminate any errors, especially on qualification day. There would no longer be a need for a Marine to sit behind the shooter to call for a mark or to keep score. The database will keep track of everything. By using a computerized scoring system the need for score cards will be eliminated. Scores will be calculated immediately and could be sent straight to the Marine Corps Total Force System (MCTFS) from the range. The Range Officer could be granted the authority to update the MCTFS with newly fired scores which eliminates the extra processing of scores currently required by a Marine's parent command. Discrepancies between the score on the firing line and the score in the pits will be non-existent. Human error will be eliminated from the process. Additionally, each unit with Marines on the range could easily access the range's database and view a roster listing the scores of their shooters. The data could be viewed in read-only mode to ensure unauthorized modifications were not conducted.

4. Data Book

Marines keep track of their shooting in data books from day one of Phase II. This concept is sufficient, but it has two flaws. First, Marines do not carry data books in combat. Second, those Marines that are deficient in shooting usually

lack the ability to properly analyze and use their data book. It is important to properly analyze a data book to provide insight on what a shooter is doing wrong and what adjustments need to be made to the rifle sights. The fact is that the data book doesn't efficiently serve the purpose for which it was intended. Therefore, the author believes the data book has no added value to the training program. With a durable digital display at each firing point, accurate shot placement would be instantaneously available on the display for both shooter and coach.

Several features can be developed that would be beneficial for training purposes. For instance, Marines would be prompted to enter their sight settings in the display for storage. Each day the display will show the Marine their sight settings for each yard line. Accurate weather conditions will be stored automatically for the shooter to see. This capability will aid the Marine in recognizing actual weather conditions rather than guessing. Currently a Marine could guess conditions such as wind but nothing is in place to reinforce the Marines guess. As described, the Marine can now see the true wind condition on the display and then compare with the observed surroundings of the range.

Another feature of digitizing the data book would be the call and plot procedure. After each and every slow fire shot the Marine would be required to "call" the shot. That is to record the expected placement of the most recent shot fired. After the call is recorded the automated scoring system would accurately plot the shot onto the data book image of the screen. The call and plot process confirms the shooters sight settings are properly adjusted. If a Marine

consistently calls the shots in the center; however, the impact is on the left of the black then the system would prompt the shooter to make an adjustment. Other data recorded for recall or printout will include facts such as; shot groups, time fired, temperature, wind, shadow, and weather.

E. RANGE OPERATIONS

1. Sustainment Training

Once Marines receive their target and relay assignment they would move to the ready area behind the firing point they were issued. Marines declaring for score will have been assigned positions from the center of the range outward. Once behind their firing point Marines can verify they are at the proper target since the digital display would show the name of the shooter assigned to that target. With the new automated system Marines would fire the entire course of fire in less than an hour. With turnover between relays every hour or less, five relays would finish before noon. This would allow all shooters to return to work by 1300, excluding possibly the 5th relay. No slow pit service, no moving from yard line to yard line, no change over with the pits, no marks, or disregards. Basically the range would operate like the pistol range. With a range starting at 0700, the first relay would show up at 0630, the second at 0730, and so on. After each relay has completed firing, the Marine would then swipe his or her smart card and get the cumulative results with a date/time stamp for that day's firing evolution. Only Marines qualifying with a 30 or above would be allowed to accept their score. Since Marines are taught to continuously strive for improvement,

shooters with less than a median score should continue to train until they have either exhausted all time allotted or can demonstrate improvement.

If a firing point were available on a later relay, a shooter would be able to continue to train once he or she swiped his or her card and was assigned another target. Marines would only be allowed to fire the course four times in any given fiscal year unless they were unqualified and needed remedial training. This would prevent abuse of precious ammunition and range resources since Marines are currently only allowed to fire for four consecutive days. Early qualification would also free ammo for redistribution back to units for combat scenario training at the commander's discretion.

Instead of an entire day spent on the range, Marines would be away from their unit for three hours per day, which in most cases would include transit time to and from the rifle range. Unless some unusual circumstance occurred, a detail could be finished firing in slightly less than fifty minutes (Interview, Matthews).

2. Field Firing

With the addition of a field firing software package, Phase III could be accomplished in the same manner as Phase II. Marines that qualify can remain on the range until all Phase II firing is complete and then complete Phase III the same day. Unlike the current process, Marines will not be required to return on Fridays for mass Phase III training. Automated scoring will allow for an accurate indication of overall marksmanship skill. Currently field firing is not included in Marines official records; however, the possibility of a standardized course of fire would allow field firing to be integrated with the Phase II score for inclusion in a

Marines record. Meaningful field firing built on the basics of Phase II will reinforce the importance of proper marksmanship.

3. Remedial Training

Currently, coaches must search for weak shooters and then hope that they have kept an accurate databook. In the future, the coach will be able to visually check the display on the firing line and see each shot (what number it was and where it impacted). Once the range ceases firing, coaches can go to the tower and immediately find out which targets and relays require extra instruction based on the statistics from the database. Finding a weak shooter on Monday affords the coach and the Marine an opportunity to develop the basic fundamentals over time. This method ingrains the principles over a longer period of time and has traditionally produced a better shooter come qualification day. Unfortunately, very few instructors and coaches can detect a need for remediation on day one.

In the event the system identifies a weak shooter, a coach will provide for extra instruction to the Marine on that target. If a coach is unable to assist, he or she could then move the shooter to either the ISMT or selected targets on the firing line that would have the "Noptel" system installed. Integrating the Noptel sniper variant on five targets with the automated range system that can detect shooters with problems would provide for a well-rounded system with powerful capabilities. Even an inexperienced coach who only understood the basic fundamentals would have the most complete tools at his disposal for review of a remedial shooters action for each and every shot.

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V. DISCUSSION AND ANALYSIS

A. DISCUSSION

Digitized equipment is infiltrating the military at an amazing rate. Process improvement has made its mark on the courses of fire for Rifle Range training. The time has come to take advantage of computer technology and decrease the time Marines spend on the range, increase the quality of tools for training, and improve the combat readiness of the warfighter. The costs associated with building new ranges will have to compete for a place on the budget; however, the value of training with the most effective equipment can only be measured on the battlefield. The first months of battle are the wrong time to recognize errors in our marksmanship program (Marlin, 1987). Hindsight is an option that cannot be exercised when challenged with the need to build a better system. The following paragraphs outline tangible benefits that will be gained once a redesigned range is implemented.

1. Time Management

a. Reduce time spent on the Range

The overall objective is to get more Marines on the range firing and less in support positions. On any given day, a shooter spends more than six times the amount of time in non-productive periods compared to actual firing time. Towards the end of a firing week the time on the range reduces because of familiarity with the operations and early qualifications; yet on average a Marine

spends a minimum of six hours per day on the range. The implementation of the automated range system will eliminate non-firing commitments and drastically reduce the time a Marine spends on the range

b. Support personnel

Implementing an automated range will eliminate the need for Fleet Assistance Program (FAP) Marines, personnel in the pits, range verifiers, and excessive support roles. Reduction in Forces (RIF) continue to plague the Armed Forces. As reductions take hold, the Marine Corps must efficiently adapt and rapidly overcome the deficiencies of training basic rifleman. Every commander knows that time is money. Both field and garrison commitments make it very challenging to get your Marines to the rifle range, pistol range, gas chamber and fulfill other various requirements. It is common for fill rates to be at fifty percent during the first half of a fiscal year because of commitments or mismanagement by units (Interview, Skeer). In one way or another every unit will supports the range with FAP Marines for six to twelve months and SNCO verifiers a week at a time. By automating the range, Marines will be relieved of the responsibilities of all but a few overhead billets. Marines on the range firing will maximize the training in a condensed period of time without affecting quality.

Based on the simplistic design of a Windows based operating system, the need for specialized occupations will be non-existent. Although the need for a Pit NCO and assistant will be removed, a new requirement for a computer specialist will be created due to equipment needs. Marksmanship instructors will adjust to the Noptel system easier than the ISMT based on the

inherent design of firing live ammunition with a standard M16A2. The clerk that once verified score cards will need to be replaced with a specialty occupation of Unit Diary Clerk since the scores will be submitted to the MCTFS directly from the range. All other range personnel billets will remain intact. Further studies could determine if the coach and instructor to shooter ratio could be reduced.

2. Quality of Learning

The implementation of computerized assets will enable the instructors and shooters to better analyze each training evolution. The learning curve for combining technology applications and simulation will become a great combat multiplier in terms of riflemen putting bullets on target.

a. Computer analysis

Electronic pits and software applications will manage the scoring of data for each firing point and relay. It will provide instantaneous, accurate shot groups to each firing point and the range tower. Real time statistics can be readily viewed from qualification rates to time spent on the range. Realistic hit ratios can be viewed within seconds of calling up a database in the tower or remotely in the range office. As stated earlier, the computer analysis will greatly enhance the coaching ability for even the novice instructor.

b. Instantaneous feedback

An effective feedback process fosters trust throughout an organization. The digital data book will act as a positive feedback mechanism that will lead to greater learning and better performance. Trust, feedback, and

innovation form a continuous loop that is effective towards growing a learning organization. Initially Marines may be resistant to change. As they realize the new attributes of the range are for their benefit they will accept and finally embrace the change. (Sullivan & Harper, 1996)

B. ANALYSIS

As illustrated in Figure 6, tasks have been separated into four categories. Tasks are arranged in priority starting from left to right. No task can be accomplished without the successful completion of the other three. For example, the task labeled misc. includes manufacturing new targets, pulling the moveable tower down range, and setting up and tearing down the range. If these tasks are not completed, the range cannot fire. All support operations must function for the range to perform.

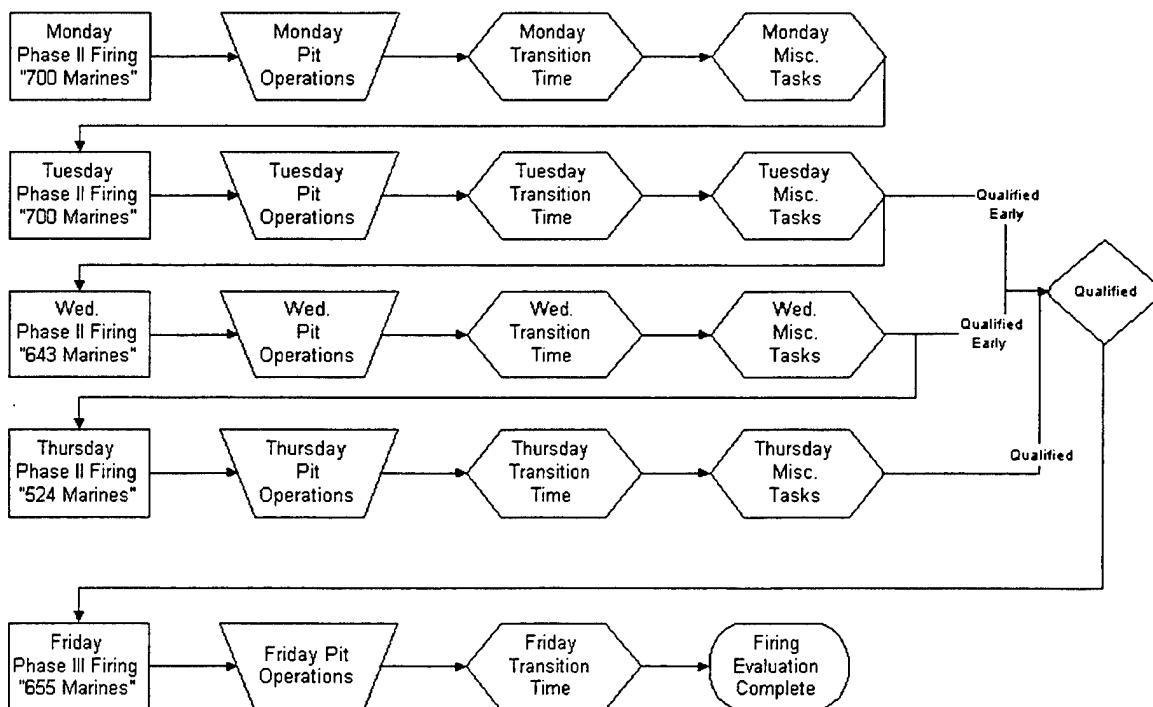


Figure 6. Flow of events for current rifle range.

The new process flow shown in Figure 7 demonstrates that a relay of Marines would arrive at the range in intervals of one hour. The elimination of nonproductive tasks would allow Marines to focus on the main objective of mastering the M16A2. Wednesday and Thursday would operate in the same manner as described for Tuesday. Towards the end of the week, Phase III relays would increase to accommodate the majority of the detail. In the event that time becomes a factor, Friday could be used as an overflow day.

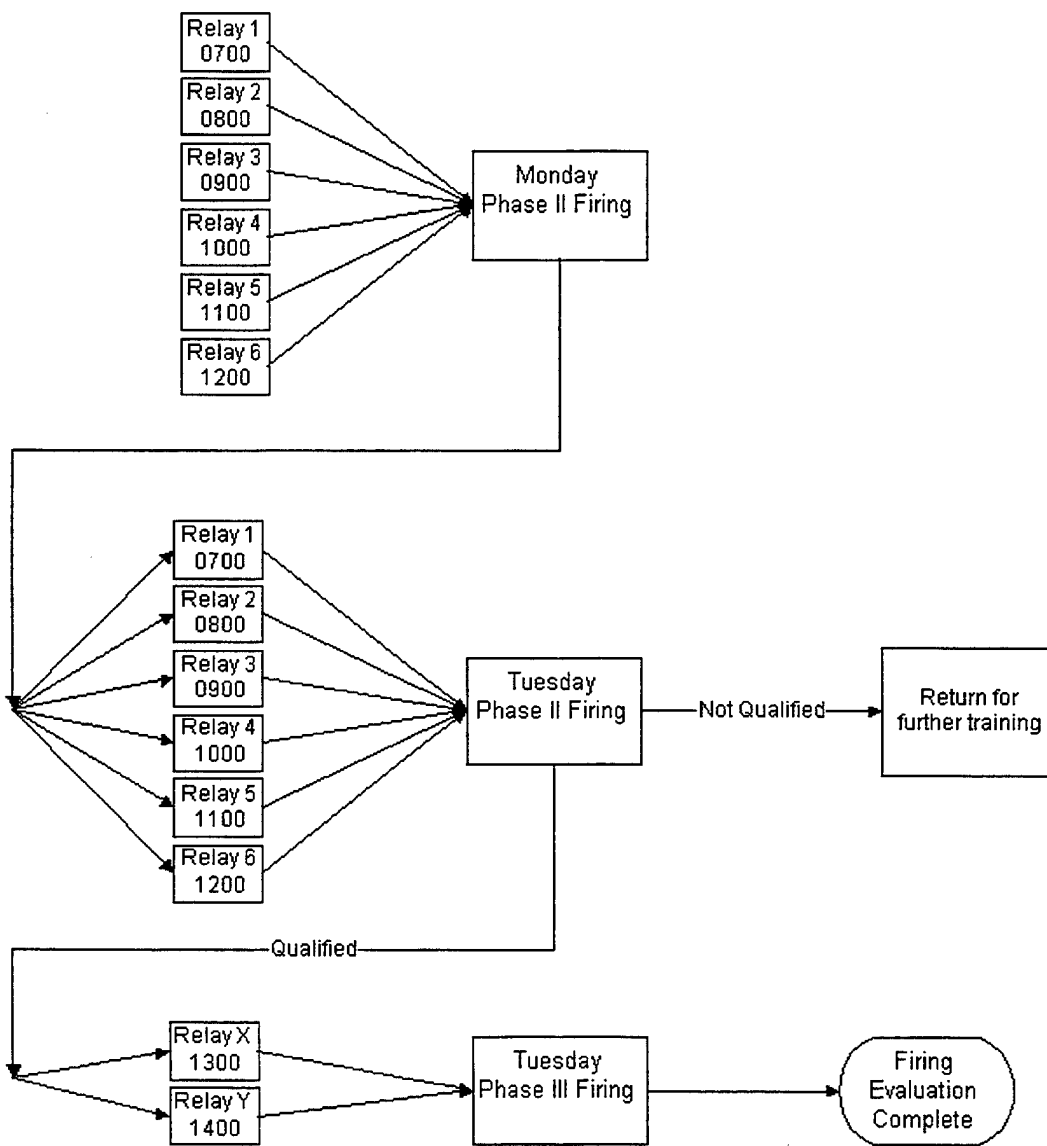


Figure 7. Redesigned flow of events for rifle range.

Calculations can further explain the reduction of man-hours once an automated range system is implemented. Assuming an average size detail of 700 Marines, the comparison can be made between the current range system and an automated system. The appendix shows statistics for the first nine months of fiscal year 2000 from the Rifle Range in 29 Palms, California (Interview, Skeer). The example 700 Marine detail can be reduced for firing days Wednesday and Thursday by applying the percentages of Marines declaring to qualify early from the appendix. Table 1 demonstrates how an automated range system would result in the seventy-five percent reduction of man-hours involved with a rifle range detail.

As-Is Range

	# Marines	Firing	Pits	Transition	Misc.	Total Hours	Total Man- hours
Day1	700	1.5	3.5	1.5	2	8.5	5950
Day2	700	1	3	1	2	7	4900
Day3	644	1	3	1	2	7	4508
Day4	524	1	2.5	0.5	2	6	3144
Day5	655	2	4	2		8	5240
							23742

Redesigned Range

	# Marines	Firing	Transition	Total Hours	Total Man- hours
Day1	700	1.5	0.5	2	1400
Day2	700	1	0.5	1.5	1050
Day3	644	1	0.5	1.5	966
Day4	524	1	0.5	1.5	786
Day5	655	2	0.5	2.5	1637.5
					5839.5

Reduction of Man-hours (percentage)

0.754

Table 1. Comparison of man-hours between range designs

VI. CONCLUSION

"The Marine Corps must embrace the winds of change, make them our ally, and make them our force multiplier. We must be a forward-thinking, learning organization that strives, day in and day out, to improve our efficiency, to improve our effectiveness, and to challenge the status quo."

General C.C. Krulak

A. RECOMMENDATIONS

1. Entry Level Rifle Training

ELR training must remain separate and distinct. Every Marine can relate to hearing the sound of a live round break through a target some two feet away from his or her head. These experiences contribute to the distinction of being called a Marine. Most important is the foundation that is built during entry level training is tested on an annual basis. Figure 8 illustrates the building blocks that form an effective combat marksman. Teaching the core fundamentals to Marines early in their career creates a lasting effect that can never be duplicated.

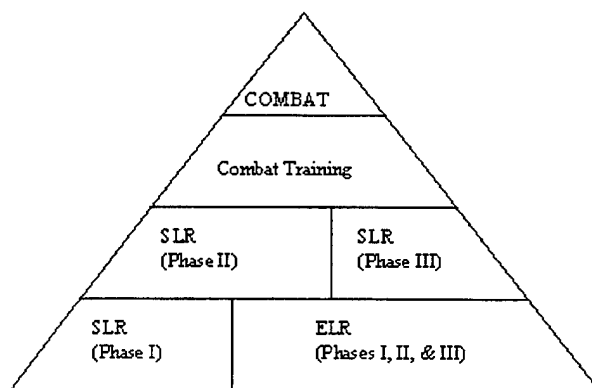


Figure 8. Building blocks for Marine Marksmanship Training

2. Focus on Building a Combat Marksman

Develop realistic combat shooting scenarios and provide the resources by which they can be employed. Several quality papers have been written that describes the necessity for training towards combat shooting. This is only accomplished by building on the fundamentals of marksmanship as taught in ELR and reinforced in SLR training. Jeppesen (1986 and 1985) recognized and identified that the Marine Corps was deficient in teaching combat shooting skills. Stanford (2000) further describes how the Marine Corps Phase III is not receiving the attention it deserves. ELR and SLR are merely stepping stones towards a enforcing the importance of the fundamentals. The tactical combat training should be the next step in the training process.

3. Create Digital Lessons

Develop and publish lessons in electronic movie format. Quality lessons have already been developed; the next step is digitizing them. According to Sullivan and Harper (1996), the challenge of transformation is to bridge discontinuity while continuing to operate. The creation of electronic media and the subsequent publication on a website will be transparent to the average Marine or command. This poses no challenge or risks of any sort. The benefits of these easily accessible lessons will be applied on ranges weekly; however, the most important benefit will be realized on the battlefield.

4. Investigate Technological Possibilities for New Rifle Ranges

Research and budget for new automated ranges. The concept of automating rifle ranges is not new. Initial requirements for the Marine Corps were identified in 1995 with the conceptualization of the Location of Miss and Hit system (Interview, Matthews). The Army has several functional automated pop-up target ranges. The Canadian Land Forces have a fully functional, low maintenance range with digital displays at each firing point. The cost of developing a Marine Corps specific rifle range would be relatively inexpensive because existing commercial applications already are on the market. Adapting to existing automated ranges would mainly consist of the development of range software unique to the Marine Corps. Additionally, integrating the automated range concept with the Smart Card provides an avenue for streamlining the score reporting process.

5. Reinforce Established Orders

Either enforce established orders or rescind them. The focus of the Marine Corps Competition-in-Arms Program (CIAP) is to motivate, stimulate, and enhance marksmanship proficiency and combat readiness of the Corps. The method for accomplishing these tasks is to encourage qualified Marines to participate in as much training as possible. The CIAP itself is a form of training. Some of the best and brightest Marksmanship Instructors have matured under the CIAP. Without the grooming of future leaders in all areas of expertise, our heritage of stellar marksmanship is destined to fade away. Commands must

enthusiastically support the CIAP for the sole purpose of the experience and training for those involved.

B. SUGGESTED FURTHER STUDIES

Two Marine Corps Rifle Ranges are scheduled for the implementation of distinctly different automated pit systems (Interview, Matthews). It would be prudent for all involved with these ranges to keep extensive records for statistical analysis. Furthermore, all Marines involved with the ranges should be encouraged to make recommendations regardless of the issue. With its limited budget, bottom up initiative has proved to be a tremendous asset for the Corps.

Further application of practical combat firing should be foremost on the topics for future range expansion. Continuous improvement is the appropriate model. Once the automated range is operational, new courses of fire and techniques need to be developed to keep up the pace of training smarter, more effective warriors. All work associated with the marksmanship program and evaluation needs to build on the concept of developing a more effective combat rifleman.

APPENDIX

The table below displays the data collected for the first nine months of fiscal year 2000 for the Rifle Range, 29 Palms, California (Interview, Skeer). Day one shows the total amount of Marines that were assigned to firing details. All 2383 Marines fired on Day two; however, 194 Marines declared to shoot for qualification score on that day. The last four columns display the qualification received out of the 194 that declared. The column labeled "UNQ" shows the Marines that failed to qualify. Marines that fail to qualify on days two and three can shoot again until day four. If a Marine fails to qualify, and on a subsequent attempt qualifies, the highest qualification allowed will be that of a marksman.

	Total	Declared	% of Total	Expert	Sharpshooter	Marksman	UNQ
Day1	2383.00						
Day2		194	8.14	109	38	42	3
Day3		427	17.92	168	104	126	18
Day4		1784	74.86	645	385	627	133
		2405					
			Total	922	527	795	154
			Percent	38.45	21.98	33.15	6.42

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LIST OF REFERENCES

- BEAMHIT, URL: <http://www.beamhit.com/military/index.htm>, (18 March 2000).
- Bradney, David P., "Our Marksmanship Program Is Not Doing All It Should," *Marine Corps Gazette*, September 1999.
- Davenport, Thomas H., *Process Innovation: Reengineering Work through Information Technology*, Harvard Business School Press, Boston, MA 1993.
- Davenport, Thomas H. and James E. Short, "The New Industrial Engineering: Information Technology and Business Process Redesign," *Sloan Management Review*, Summer 1990.
- Firearms Training Systems, URL: <http://www.fatsinc.com/html/products/military/marksmanship.htm>, (18 March 2000).
- Gibbs, Robert R., "Is Every Marine Really a Rifleman?" *Marine Corps Gazette*, August 1997.
- Hammer, Michael and James Champy, *Reengineering the Corporation*, Harper Business, New York, 1993.
- Harlee, John, *The Marine from Manatee: A Tradition of Rifle Marksmanship*, National Rifle Association, Washington, D.C., 1984.
- Interview between Andy Chatelin, Chief Warrant Officer, USMC, Range Officer, Wilcox Range, Camp Pendleton, California, and author, 3 May 2000.
- Interview between Dennis Demille, Chief Warrant Officer, USMC, Officer-in-Charge, Marksmanship Training Unit, Edison Range, Camp Pendleton, California, and author, 1 May 2000.
- Interview between Cynthia Sacca, Chief Warrant Officer, USMC, Ordnance Officer, MCRD San Diego, California, and author, 25 May 2000.
- Jeppesen, R.N., "Neglected Area of Marksmanship," *Marine Corps Gazette*, December 1985.
- Jeppesen, R.N., "Programming Inconsistency: Reexamining Marksmanship Training," *Marine Corps Gazette*, April 1986.
- Lubold, Gordon and Stephanie Cain, "How the program evolved," *The Times*, 25 October, 1999.

- Malachowsky, Michael A., "Marksmanship Requalification: Training Smarter," *Marine Corps Gazette*, September 1995.
- Marlin, Jeffrey A., "Defining the Marksmanship Program," *Marine Corps Gazette*, July 1987.
- MCO 3574.2J, *Entry Level and Sustainment Level Marksmanship Training with the M16A2 Service Rifle and M9 Service Pistol*, Headquarters, United States Marine Corps, 1999.
- MCRP 3-01A, *Rifle Marksmanship*, Headquarters, United States Marine Corps, 1999.
- NOPTel, URL: http://www.noptel.fi/nop_eng/index.html, (18 March 2000).
- Smith, Randy R., "Changes in Camp Lejeune's Marksmanship Program," *Marine Corps Gazette*, August 1997.
- Stanford, Andy, "The History of the Call for Progress in Marine Rifle Training," *Marine Corps Gazette*, July 1993.
- Stanford, Andy, "Combat Rifle Drills," *Guns-Combat Annual 2000*, Vol. 4, pp. 22-25, May 2000.
- Sullivan, Gordon R. and Michael V. Harper, *Hope is not a Method*, Broadway Books, New York, 1996.
- Telephone conversation between Gary Matthews, Chief Warrant Officer, USMC, Training Ranges Support Branch, Quantico, Virginia, and author, 8 May 2000.
- Telephone conversation between Thomas Skeer, Chief Warrant Officer, USMC, Range Officer, 29 Palms, California, and author, 3 May 2000.

BIBLIOGRAPHY

- Brewster, Rollin D., *Business Process Reengineering: A Primer for the Marine Corps' Process Owner*, Master's Thesis, Naval Postgraduate School, December 1997.
- Bitzer, Sharon M., *Workflow Reengineering: A Methodology for Business Process Reengineering with Workflow Management Technology*, Master's Thesis, Naval Postgraduate School, September 1997.
- Cohen, Bernard H., *The Proud: Inside the Marine Corps*, William Morrow and Company, Inc., New York, 1992.
- Currid, Cheryl, *The Reengineering ToolKit: 15 Tools and Technologies for Reengineering Your Organization*, Prima Publishing, Rocklin, CA, 1994.
- Daft, Richard L., *Organization Theory and Design*, 6th ed., South-Western College Publishing, Cincinnati, Ohio, 1998.
- Wertheim, Edward G., "A Model for Case Analysis and Problem Solving," URL: <http://www.cba.neu.edu/~ewertheim/introd/cases.htm>, (19 March 2000).
- Wincentzen, Bruce M., "Marine Corps marksmanship ain't what it used to be," *Marine Corps Gazette*, February 1979.
- Wilson, Stephen M., *Improvement of the United States Marine Corps Combat Development System*, Master's Thesis, Naval Postgraduate School, September 1999.

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