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ANALYSIS OF THE INTEGRATION OF FEMALE MARINES INTO GROUND COMBAT ARMS AND UNITS

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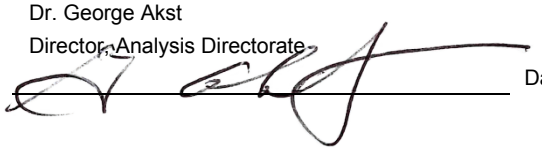
Signature:		Date:	27 Aug 2015
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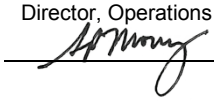
Signature:		Date:	27 Aug 2015
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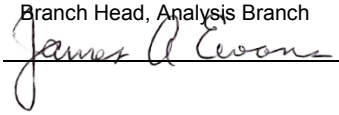
Signature:		Date:	27 Aug 2015
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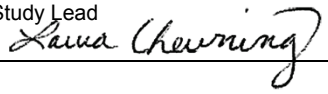
Signature:		Date:	27 Aug 2015

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EXECUTIVE SUMMARY

The Marine Corps Force Integration Plan

Background

In 2013, the Secretary of Defense rescinded the Direct Ground Combat Definition and Assignment Rule. In this rescission, the Secretary instructed the Services to plan for gender integration of previously closed units and military occupational specialties (MOSs) beginning in January 2016.

Purpose

The purpose of this research is to provide analytical support to the Marine Corps' recommendation to the Secretary of Defense, in response to the direction to open all currently-closed Marine billets and units to females.

Scope

The research conducted in support of the Commandant of the Marine Corps' decision on gender integration of ground combat arms (MOSs and units) was a very large effort spanning three of the four lines of effort (LOEs):

- LOE 1: Expanded Unit Assignments (EUA)
- LOE 2: Entry Level Training (ELT)
- LOE 3: Ground Combat Element-Integrated Task Force (GCE-ITF)

This research was supported by a large number of analytical organizations, both within and external to the Marine Corps, to ensure the broadest possible analytical coverage.

Methodology

In order to support the Commandant's recommendation about the integration of females into combat arms MOSs and units, we researched the potential impacts of integration in four areas: Combat Effectiveness, Unit Readiness, Individual Marine Success, and Institutional Costs. The objective of this research was to identify positive implications, as well as risks/downsides, of integration. For those areas of risk, where possible and supported by research, we also provide potential mitigating factors to help reduce those areas of risk.

The objective of this report is not to provide a particular recommendation to open or close combat arms MOSs or units, but rather to assess the relative levels of risk and mitigation in doing so. In the end, the recommendation of the Commandant will have to be based on best military judgment, as there cannot be a definitive correct answer, but simply one that is best supported by empirical evidence, and formulated with the needs of the Marine Corps in mind.

Summary and Conclusions

As a general comment, we see very little data that distinguishes the effects of integration within the non-infantry combat arms MOSs (08xx, 1371, 18xx). Within the infantry occupational field, a portion of the data (such as Formal Learning Center [FLC] attrition, injuries, etc.) does not distinguish individual MOSs. However, performance results from the GCE-ITF indicate integration of the crew-served weapons MOSs (0331/41/51) may impose a greater risk on infantry battalions compared to the integration of 0311s because of the larger impact on combat effectiveness. Further, we have very little data to distinguish between opening an MOS versus opening an associated unit to assignment for female non-combat arms MOSs (e.g., 0311s and infantry battalions). What we do have on these categories comes from the Provisional Infantry in the GCE-ITF research, which does not shed clear light on distinguishing between those two. Thus, for the remainder of this section, the only distinctions we will make are those between infantryman and crew-served infantry MOSs and units, as well as the overall infantry occupational field compared to non-infantry, combat arms MOSs and units. Any further distinctions would not be supported by analysis.

One byproduct of this entire gender integration discussion is the development of gender-neutral standards, MOS school classification standards, and MOS-specific performance standards to augment/replace the current Training & Readiness (T&R) Manual standards, which are currently not fully adequate. Regardless of the way ahead on female integration, all of the aforementioned standards should strengthen the current Marine Corps' processes for selection to an MOS and training, and continuation in an MOS, and may ultimately improve such intangible factors such as unit morale and task cohesion.

Before getting into some of the detailed discussions of the potential positive and negative aspects of integration, it is worthwhile to point out that some of the initial negative impacts are likely to diminish over time. Based on Marine Corps' experiences with previous integration efforts (such as aviation and logistics), as well as the experiences of foreign militaries, we can expect gradual improvements in certain areas over time. For example, the initial numbers of females integrated into these units are likely to be very small, but can be expected to increase gradually over time. However, based on the experience in other nations, it is likely the ultimate numbers in the combat arms will never reach the current 7% figure for females in the Marine Corps today. Similarly, while we might initially expect higher (both end of active service [EAS] and non-EAS) female attrition rates when compared to male attrition rates, these are also likely to diminish over time. Furthermore, any initial detrimental effects on cohesion can eventually be mitigated with good training and solid leadership.

Positive Implications of Integration

Further integration of females into the combat arms brings with it many of the general benefits of diversity that we experience across the spectrum of the workforce, both within the military as well as the private sector. This was perhaps best illustrated in a decision-making study that we ran in which all-male and integrated groups attempted to solve challenging field problems. Each of the problems involved varying levels of both physical and cognitive difficulty. For those more cognitively challenging problems, the female integrated teams (with one female, and three to four males), performed as well or better than the all-male teams.

We also see benefits to integrated units in areas in which females traditionally have better outcomes than males, e.g., incidents pertaining to disciplinary issues. Integration of females is likely to

lower the instance of disciplinary action, and this has been shown in general across the Marine Corps, as well as in the comparison of integrated (e.g., Aviation Combat Element [ACE], Logistics Combat Element [LCE]) to non-integrated units.

From a recruiting and propensity perspective, the opening up of these formerly closed MOSs/units would likely have a neutral to positive effect, based on survey data. However, this presumes a voluntary assignment process; if females were to be involuntarily ordered into combat arms units, this could actually lower propensity and female enlistments.

We also identified some physiological characteristics (e.g., lactate threshold and flexibility), and a few performance tasks (e.g., .50 caliber marksmanship), in which females, or female-integrated groups, excelled. However, none of these formed strong predictors of overall improved mission performance or reduced injuries.

Negative Implications of Integration

Throughout the research effort, there were numerous indications of lower performance levels from combat arms females, or female-integrated groups. The most direct results come from the GCE-ITF, in which, of the 134 different observed tasks, 93 showed statistically significant differences when comparing the all-male control group and at least one of the integrated groups (low and/or high density). Of these 93, the all-male control group performed statistically better than at least one of the integrated groups in 88 of the tasks. Moreover, at least one of the integrated groups performed statistically better than the all-male control group in 5 of the tasks. Furthermore, of the 134 tasks and within the 93 that showed statistical differences, 30 tasks showed statistical significance of a 30% or greater difference. Of these 30, the all-male control group performed 30% better than at least one of the integrated groups in 28 of the tasks. Also, at least one of the integrated groups performed 30% better than the all-male control group in 2 of the tasks (both were employment of the M2 machine gun). Of the group of 30 tasks with operationally relevant differences, the majority occurred in the infantry and Provisional Infantry, again with the all-male teams typically performing better.

Moreover, within these units, there were significant differences (e.g., lower performance levels, especially in hiking under load) between crew-served weapons MOSs and 0311s. It is significant that the majority of the operationally relevant differences occurred in the most physically demanding tasks, such as casualty evacuations, long hikes under load, and negotiating obstacles. This is consistent with the research results, both within the Marine Corps as well as across many foreign nations, indicating that men have significantly higher upper- and lower-body strength and VO2 max,[1] which leads to less fatigue in physically demanding tasks and better performance.

In addition to the strict performance data from the GCE-ITF, we have also qualitative/subjective observations that have further discerned differences. These are important because a live test that measures team performance can mask individual differences. We have seen numerous cases of compensation during physically demanding tasks, in which males have shifted positions to take over certain aspects of the tasks from females, such as loading ammo into trucks or heaving loaded packs on top of a wall.

[1] VO2 max is a measure of the maximum volume of oxygen that an athlete can use. It is measured in milliliters per kilogram of body weight per minute (ml/kg/min).

Earlier indicators of differences can be observed in the performance at the formal learning centers. While the ability to drop on request (DOR) for the female volunteers confounds the statistical analysis of the school graduation rate analysis, the differences are large enough to draw conclusions about the relative ability of females versus males at these schools. The difference is most stark for the infantry. At the Infantry Training Battalion (ITB), the graduation rates for females range from 36% (including DORs) to 46% (excluding DORs), compared to the male graduation rate of about 98%. For the other combat arms schools (e.g., artillery, tanks, Amphibious Assault Vehicles [AAVs]), graduation rates range from approximately the same (excluding DORs), to somewhat lower for females (with DORs). Further, a more careful examination of some of the physically demanding tasks, such as artillery projectile lift/load and tank ordnance handle/load, showed significantly higher initial completion rates by males. Some of these tasks were not even graduation requirements, although that may change shortly with the development of the MOS-specific performance standards. Furthermore, the success rate for female Marine officers at Infantry Officer Course (IOC), albeit based on a small sample, is 0%. Thus, integration of females into the infantry runs the risk of having very few officer role models for these new infantry females.

In addition to performance, we see significant evidence of higher injury rates for females when compared to males. The aforementioned upper- and lower-body strength and higher fatigue levels lead to greater incidents of overuse injuries, such as stress fractures. This leads to significantly higher levels of non-deployable status for females, of which, medical non-deployability comprises the largest fraction. We have seen this not only for GCE-ITF and ITB females, but also for female Marines in general, and for females throughout foreign militaries that were studied. Further, for all GCE-ITF volunteers, we saw higher levels of injuries within the 'hiking' MOSs (03xx [less 0313] and 1371) compared to the 'riding' ones (08xx, 18xx, and 0313).

When we examine the institutional costs of integrating females into the combat arms, it helps to divide this into the direct and indirect costs. The direct costs, such as modifications to equipment and facilities, are likely to be relatively small. The indirect costs, such as increases to the training, transient, prisoner, and patient (T2P2) population, medical separations, non-deployability rates, attrition, and recycling or reclassification, will be more significant.

Mitigation to Risks

Along with the negative implications of integration, we have learned that there are many actions the Marine Corps could take to mitigate the risks of those implications. While most of these would not likely eliminate entire shortfalls, they could certainly lessen the risks. These typically fall in the areas of screening and standards, and training and education.

While we have seen FLC graduation rates that range from comparable to considerably lower for females, when compared against males, by better screening students before entry, we can substantially improve female graduation rates (the example for ITB showed the potential to improve the graduation rate from 35% to approximately 64%). The downside of such screening is that we would drastically reduce the number of females eligible for these schools; as a result, leadership must weigh this against the improved graduation rates. We would also slightly reduce the number of males eligible; however, this may also serve to cull the lower-performing male combat arms Marines. Screening has also been shown to reduce the numbers of injuries in these schools. Similar screening techniques could also be used to determine eligibility for non-combat arms Marines (both male and female), who are eligible for assignment to combat

arms units, to better ensure success in those units. Useful screening measures include pull-ups, components of the Combat Fitness Test (CFT), and lean body mass (LBM) (because LBM is not readily available, we use height and weight as a surrogate). Interestingly, LBM was also a good predictor of injuries in LOE 3 – the higher the LBM, the lower the injury rate.

In addition to screening at the end of recruit training for ultimate eligibility for combat arms FLCs, we could also develop initial screening tests for the recruiters to better assign program enlisted for (PEF) codes to Marine poolees. This action could effectively reduce the likelihood of PEF reclassification at the end of recruit training. The Marine Corps can develop and refine occupational field standards to ensure trained Marines can continue to satisfactorily perform the tasks necessary for their MOSs.

When we looked into height and weight standards as possible screening criteria, we also uncovered a discrepancy in these standards between male and female Marines, with a stricter resultant body mass index (BMI) standards for females (25) than for males (27.5). This appears to be counterproductive, especially for enabling females to enter physically demanding MOSs, as the higher weight and body fat female Marines may actually be more successful in these MOSs than lower-weight Marines possessing less body fat who currently meet the current standards.

Numerous studies and live tests have indicated that physical training regimens are critical to success in preparing service men and women for entering physically demanding MOSs. Experience in separated training at Marine recruit training, along with the recent United Kingdom (UK) experience of moving to integrated, and then back to separated initial training, indicated that initial training can be better tailored when men and women are separated early on. However, even with gender-separated initial training, the Marine Corps should look for integrated training opportunities in order to prepare these young men and women to serve together in the near future. Beyond initial training, we have seen tremendous value in assigning physical trainers to units at the battalion level to help tailor physical training, identify sources of injury, and to help commanders and staffs construct training regimens to support training objectives while minimizing injuries.

In addition to physical training, the Marine Corps should provide training in other aspects of integrating units, ranging from sexual harassment, common obstacles in integration, and general respect for others, to best ensure success, especially during the early years of integration. The ground combat units have many years of historical bias, much of which will take time to eliminate.

While we described the potential negative implications to readiness earlier, predominantly from medical issues, our analysis has showed that the number of females entering these combat arms MOSs and units likely will be a very small percentage—significantly lower than the current 7% female Marine Corps population overall. Thus, the overall impact on unit readiness will be buffered by the dominant numbers of male Marines, and should not show a significant difference.

Conclusions

Based on the body of evidence developed in support of this research, as well as existing related research, the integration of females into the combat arms MOSs and units will add a level of risk in performance/effectiveness and cost. While this risk can be mitigated by various methods to address failure rates, injuries, and ability to perform the mission, the bottom line is that the physiological differences between males and females will likely always be evident to some extent.

The decision to recommend the opening of an MOS and unit will never be a black and white one; it is not simply a matter of setting standards and letting any Marine into the MOS or unit who passes those standards. There are costs to the institution to be considered in the final recommendation. Setting standards too high will preclude many qualified Marines from serving, while setting them too low will introduce high levels of risk for attrition, injury, and degradation of unit performance. The data in this report indicates that even striking what appears to be a balance for setting standards will likely introduce some level of risk across all of these factors. That level of risk is highest for infantry MOSs and units, and within the infantry, highest for the crew-served weapons MOSs. The risks appear to be significantly lower for the non-infantry combat arms.

The recommendation to open or to request an exception to policy for any MOS or unit will depend on the Marine Corps' tolerance for the level of risk that such a change would impose. This report can help quantify those risks, and the effects of certain mitigation efforts, but it cannot analytically provide a definitive answer to the level of risk tolerable by the Marine Corps—that is a decision that can only be made by senior Marine Corps leadership. This decision will clearly be influenced by the levels of risk described, and the ability to mitigate those risks, balanced against the beneficial aspects of integration. Many of the mitigation efforts identified in this report would serve the Marine Corps well and would help strengthen performance and reduce risks for both male and female Marines, regardless of the recommendation pertaining to integration.

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1 The Marine Corps Force Integration Plan: Direction & Execution

A series of legislative acts and Department of Defense (DoD) directives necessitated development of the Marine Corps Force Integration Plan (MCFIP). The Marine Corps Force Innovation Office (MCFIO) published the plan in the second quarter of fiscal year 2014 (2QFY14). Events leading up to this plan, as well as key elements of the plan, are discussed in the following sub-sections. The material in these sections will:

- Provide context for the MCFIP
- Give an overview of the four lines of effort (LOE)
- Describe the research performers and their roles

1.1 MCFIP: Direction

As noted above, a series of legislative acts and DoD directives form the basis for the MCFIP.

1.1.1 Legislation

Three pieces of legislation had a significant impact on development of the MCFIP:

- 2009: The National Defense Authorization Act (NDAA) for FY09 established the Military Leadership Diversity Commission (MLDC) in order to "…conduct a comprehensive evaluation and assessment of policies and practices that shape diversity among military leaders." Sixteen interrelated tasks, given by Congress, informed the Commission's final report, From Representation to Inclusion: Diversity Leadership for the 21st-Century Military."[2]
- 2011: The NDAA for FY11 required an extensive review of barriers to the expansion of roles and responsibilities to women in the military. This effort became known as the Women In Service Restrictions Review (WISRR).[3] As a result of the WISRR, the Commandant established an operational planning team (OPT) to oversee planning for, and execution of, policy changes directed by the Secretary of Defense.[4]
- 2014: The NDAA for FY14 provided guidance on development of gender-neutral standards. The legislation directed "…all members of the Armed Forces serving in or assigned to the military career designator must meet the same performance outcome-based standards for the successful accomplishment of the necessary and required specific tasks associated with the qualifications and duties performed while serving in or assigned to the military career designator."[5]

[2] MLDC Final Report
[3] MCFIP Campaign Plan with Attachments - 20150101
[4] USMC WISRR Terms of Reference
[5] NDAA FY14

1.1.2 Department of Defense Directives

Three directives from the Secretary of Defense (SecDef) had a significant impact on development of the MCFIP. All dealt with the Direct Ground Combat Definition and Assignment Rule (DGCDAR), and are described below:

- 1994: DGCDAR Established. The ground combat exclusion policy of 1948 was amended by the Pentagon in 1994 and declared that Service members are eligible to be assigned to all positions for which they are qualified, except that women shall be excluded from assignment to units below the brigade level whose primary mission is to engage in direct combat on the ground. The policy further excluded women being assigned to certain organizations based upon proximity to direct combat or "co-location" as the policy specifically refers to it.
- 2012: Co-location restriction relaxed. Based on recommendations of the 2011 Military Leadership Diversity Commission to ease the co-location restriction, and exceptions to policy requested by the Army, Navy, and Marine Corps, more than 14,000 additional positions were opened to women by allowing them to be assigned to support positions in ground combat units, other than infantry, down to the battalion level
- 2013: DGCDAR Rescinded. In January 2013, the Joint Chiefs recommended rescission of the DGCDAR. In making this recommendation to the SecDef, they requested the time necessary to institutionalize this change and to integrate women into occupational fields in a climate where they can succeed. This included the formal review of the roles and employment of women in special operations, modifications to accommodate reasonable privacy and berthing for women, and time to review and validate occupational standards to ensure they are current and directly tied to an operational requirement and applied on a gender-neutral basis. [6] In rescinding the DGCDAR, the SecDef instructed the Services to plan for gender integration of previously closed units and military occupational specialties (MOSs). Further, the Services were directed to adhere to five guiding principles published by the Chairman of the Joint Chiefs of Staff (CJCS), described below.

1.1.3 CJCS Directive: Five Guiding Principles

The CJCS directive required that the Services successfully integrate women into the remaining restricted occupational fields, while keeping the following principles at the forefront:

- Ensuring the success of our Nation's warfighting forces by preserving unit readiness, cohesion, and morale.
- Ensuring all servicemen and women are given the opportunity to succeed and are set up for success with viable career paths.
- Retaining the trust and confidence of the American people to defend this Nation by promoting policies that maintain the best quality and most qualified people.

[6] Report-to-Congress-on-WISR-August-2013

- Validating occupational performance standards, both physical and mental, for MOSs, specifically those that remain closed to women. Eligibility for training and development within designated occupational fields should consist of qualitative and quantifiable standards reflecting the knowledge, skills, and abilities necessary for each occupation. For occupational specialties open to women, the occupational performance standards must be gender-neutral as required by Public Law 103-160, Section 543 (1993).
- Ensuring that a sufficient cadre of midgrade/senior women enlisted and officers are assigned to commands at the point of introduction to ensure success in the long run. This may require an adjustment to our recruiting efforts, assignment processes and personnel policies. Assimilation of women into heretofore "closed units" will be informed by continual in-stride assessments and pilot efforts.[7]

1.1.4 Commandant of the Marine Corps (CMC) Directives

Responding to direction and guidance provided by the SecDef and the CJCS, the Commandant provided direction to the Marine Corps staff in order to plan for gender integration, described below.

- 2012: The Marine Corps initiated efforts to integrate female Marines into ground combat units. Two principal features of this approach were:
    - Assignment of female Marine officers and staff noncommissioned officers (SNCOs) in open MOSs (e.g., supply, admin, communications) to more than 20 closed ground combat units,[8] in order to assess the viability of female Marines in these previously all-male units and determine the process for completely opening these units to female Marines in all MOSs.
    - Affording female Marine officers and enlisted Marines the opportunity to attend the Infantry Officer Course (IOC)[9] and the Infantry Training Battalion (ITB),[10] respectively. Attendance at these Formal Learning Centers (FLCs) [11] was offered to assess the ability of female Marines to complete a physically demanding program of instruction (POI) at an MOS-producing school.
- 2013: Implementation Plan. In this plan, published in May of 2013, the Commandant expanded on the deliberate, measured, and responsible approach started in 2012 and emphasized the five guiding principles put forward by the CJCS:
    - "The Commandant and the entire Marine Corps are dedicated to maintaining the highest levels of combat readiness and capitalizing upon every opportunity to enhance our warfighting capabilities and the contributions of every Marine; it's

[7] CJCS Info Memo, *Women in the Service Implementation Plan*, CM-0017-13, 9 January 2013, signed by General Martin E. Dempsey
[8] Infantry units were excluded
[9] Protocol MCCDC.2012.0007 – Collection and Assessment of Training Performance Data at Infantry Officer Course (IOC) Institutional Official (IO) approved the recommendation of the convened Institutional Review Board (IRB) on 19 April 2012
[10] Protocol MCCDC.2013.0005 – Assessment of Training Performance of Female Enlisted Marines at Infantry Training Battalion (ITB) Institutional Official (IO) approved the recommendation of the convened Institutional Review Board (IRB) on 9 September 2013
[11] Protocol USMC.2014.000-IR-CONV-A – Assessment of Female Enlisted Marine Volunteers in the Combat Arms (Non-Infantry) Formal Learning Centers (FLC) Research Studies. Institutional Official approved the recommendation of the convened Institutional Review Board on 24 June 2014

simply the right thing to do. Our ongoing deliberate, measured, and responsible approach is consistent with SecDef's decision to rescind the direct combat exclusion rule for women. As our Corps moves forward with this process, our focus will remain on combat readiness and generating combat-ready units while simultaneously ensuring maximum success for every Marine. The talent pool from which we select our finest warfighters will consist of all qualified individuals, regardless of gender."[12]

- "As we continue to broaden opportunities for female Marines, we will not lower standards, and we will not sacrifice the high combat readiness that America demands of her Marines. Those MOSs that are deemed ready will be opened as soon as possible. Should our research efforts conclude that we should not open a particular MOS or occupational field, we will pursue an exception to the current policy with the Secretary of the Navy and the Secretary of Defense."[13]

- 2014: MCFIP Developed. Using the 2013 Implementation Plan as a foundation, the Marine Corps developed the Marine Corps Force Integration Plan (MCFIP). In accordance with the FY14 NDAA, in addition to expanding opportunities to women beyond Marine Infantry entry-level training to other ground combat learning centers, the MCFIP also focused on the mandate to review and validate gender-neutral occupational standards. Taken together, this effort in its entirety assured that:
  - Gender integration will occur to the maximum extent possible.
  - All Marines, male and female, assigned to ground combat arms will be set up for success.
  - Standards will not be lowered
  - Combat effectiveness and readiness will be preserved or enhanced[14]

1.2 MCFIP: Execution

In addition to the direction and coordinating instructions directed to the operating forces and the supporting establishment, the MCFIP describes the four LOE at the heart of the plan.

1.2.1 LOE 1: Expanded Unit Assignments (EUA)

Starting in 2012, the headquarters of 21 ground combat arms units[15] at the battalion level and above were opened to the assignment of female officers and SNCOs serving in a currently open MOS (e.g., supply, logistics). LOE 1 built upon this effort by:

- Continuing assignment of female officers and SNCOs to these units
- Expanding the assignment of female Marines to these units to include noncommissioned officers (NCOs)

[12] White Letter No 1-14, Commandant of the Marine Corps. CMC 12 MAR 14
[13] White Letter No 1-14, Commandant of the Marine Corps. CMC 12 MAR 14
[14] MCFIP Campaign Plan with Attachments - 20150101
[15] Infantry units were excluded

- Expanding assignments down to the company and battery levels
- Authorizing deployment of assigned female Marines in accordance with the current training, exercise, and employment plans (TEEPs)

1.2.2 LOE 2: Entry Level Training (ELT)

Building on the ongoing research studies at IOC and ITB, LOE 2 afforded female Marines the opportunity to attend the FLC for other combat arms (i.e., 0313, 0331, 0341, 0351, 0352, 0811, 1812, 1833). Marines for this LOE were recruited from the 4th Recruit Training Battalion at Marine Corps Recruit Depot (MCRD) Parris Island.

1.2.3 LOE 3: Ground Combat Element Integrated Task Force (GCE-ITF)

The GCE-ITF, consisting of approximately 600 Marines (male and female) drawn from the operating forces and supporting establishment, was established to evaluate the physical performance of individual Marine volunteers in the execution of individual and collective ground combat tasks in an operational environment. The purpose of the assessment was to estimate the effect of gender integration in closed and open MOSs. The unit had a volunteer requirement T/O strength of 330 Marines, 253 male Marines, and 77 female Marines.[16] The ITF actually peaked at 382 volunteers at the outset, but was down to 285 at the time of the deployment to the Marine Corps Air Ground Combat Center (MCAGCC). Research, to include live fire with volunteer Marines, was conducted to measure the ability of a gender-integrated unit to accomplish team, crew, and squad-level collective tasks. In addition, researchers collected an array of physiological and non-physiological data on each Marine at various points during the GCE-ITF's life-cycle.

1.2.4 LOE 4: Early MOS Opening

Research conducted under the deliberate, measured, and responsible approach made it apparent that some MOSs could be opened without further research. Based on the recommendations of the occupational field sponsors for artillery, ground ordnance, and low altitude air defense, the Commandant opened 11 MOSs and provided Congress with the required notification.

1.3 Research Synchronization and Integration

The research conducted in support of the Commandant's decision on gender integration of ground combat arms (MOS and units) was a very large effort, involving a multitude of organizations internal and external to the Marine Corps.

1.3.1 Internal Agencies

In addition to MCFIO, the following Marine Corps organizations played a significant role in execution of the MCFIP.

[16] MCFIP Coordination Meeting 20150109 MCOTEA, slide #9, identified total volunteers on-hand at 357 (263 M and 94 F)

1.3.1.1 Operations Analysis Division (OAD)

Using the Research Integration Framework[17] (RIF), OAD organized, coordinated, and synchronized the research efforts carried out under LOE 1, 2, and 3. In addition, OAD led studies that supported the Commandant's decision (i.e., deployment patterns,[18] equipment modifications[19]) as well as studies that support implementation (e.g., talent management,[20] data quality[21]). OAD personnel analyzed the data generated under LOE 2, providing leadership with key insights and understanding on the effects of gender integration. Finally, the OAD/MCFIO team integrated the research results from the three LOEs, as well as relevant findings from the Services and Allied nations.

1.3.1.2 Training and Education Command (TECOM)

TECOM was responsible for planning and executing all of the LOE 2 research. In addition to recruiting the volunteers, TECOM monitored their passage through the several FLC, conducted exit interviews, collected information on performance, and analyzed the data for senior leaders. Both CG TECOM and Director, MCFIO were provided regular updates as the research progressed.

1.3.1.3 Marine Corps Operational Test and Evaluation Activity (MCOTEA)

MCOTEA was responsible for planning and executing all of the LOE 3 research. In addition to recruiting the volunteers, MCOTEA designed the live testing in order to collect performance information in a manner that supported subsequent statistical analysis. MCOTEA coordinated requirements for training support (e.g., access to ranges, transportation, ammunition, data collection systems) and provided the personnel & equipment required for data collection. Following the completion of live testing by all elements of the GCE-ITF, MCOTEA analyzed the data to determine if differences existed between baseline and gender-integrated units.

1.3.1.4 Marine Corps Recruiting Command (MCRC)

MCRC conducted, or commissioned, several studies to analyze variables/factors affecting the propensity of the recruitment-age population to join the Marine Corps. In addition, MCRC developed information on the qualified population of quality female applicants and their influencers. Finally, MCRC sought to determine the potential effects of lifting combat exclusion provisions on the propensity to enlist and commission male and female applicants.

1.3.2 External Agencies

Given the scope of research, and impact of the Commandant's decision, the Marine Corps solicited the expertise of several outside organizations to enable a full-spectrum research effort.

[17] For details on the RIF, please see – Research Integration Framework
[18] Rook, Capt. Chad, and Jessica Hancock. *Assessment of Marine Non-deployability and the Effects on Readiness*: Operations Analysis Division, March 2014. Microsoft PowerPoint.
[19] Jadro, Capt Bryan, Mark Desens, and Mary Bosserman. *Smart Adaptations Study*: Operations Analysis Division, May 2015. Print.
[20] Zukoski, Mary J., Dr. David Trott, and Nancy Luciani. *Study of Talent, Attrition, Retention, and Success (STARS)*: Operations Analysis Division, to be completed in FY16.
[21] Clinger, Richard. *Data Quality Study*: Operations Analysis Division, to begin in FY16.

1.3.2.1 University of Pittsburgh Warrior Human Performance Research Center (U-Pitt)

Working closely with MCOTEA and the GCE-ITF Marines, U-Pitt researchers assessed individual musculoskeletal and physiological characteristics during execution of physically demanding tasks under laboratory and operational conditions. This research was conducted to:

- Identify predictors of injury and performance
- Establish musculoskeletal and physiological demands
- Determine relationships among physical fitness test/combat fitness test (PFT/CFT) scores, field data, lab data, and physical performance requirements for tactical tasks
- Develop injury mitigation protocols and improve physical training regimens

1.3.2.2 Center for Naval Analyses (CNA)

CNA supported LOE 1 and 3 by conducting surveys (i.e., development, distribution, and analysis) of and interviews with, Marines affected by these two LOEs. In addition, CNA personnel provided statistical support to MCOTEA during the course of the GCE-ITF evaluation, direct support to several of the MCRC studies, and performed historical analysis of previous integration efforts.

1.3.2.3 Research and Development (RAND) Corporation

RAND conducted a meta-analysis of gender integration, looking across the history of DoD and other nations' efforts to incorporate females in the combat arms. This study included other physically-demanding/male-dominated jobs (e.g., fire departments) in order to give the Marine Corps a sense of the challenges and opportunities presented by gender integration.

1.3.2.4 Naval Health Research Center (NHRC)

Working closely with GCE-ITF leadership, NHRC researchers employed the Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS) to evaluate the behavioral and psychological health of the task force. In addition to the NUBHNAS, NHRC researchers provided Marines of the GCE-ITF with a surveillance system that included:

- Anonymous, self-reported assessment of behavioral health, including sexual assault and suicidal ideation
- Assessment of biomarkers related to stress and immune function (i.e., C- Reactive Protein, Salivary Immunoglobulin A, Alpha-Amylase)
- Immediate survey feedback to individuals and leadership, through the use of tablet computers

1.3.2.5 Michigan State University (MSU)

MSU conducted live testing on decision making in small teams, using male and female Marines recruited from units at Marine Corps Base (MCB) Quantico and Camp Lejeune. The research identified how within-team variations of gender composition and attitude affect performance and communication.

1.3.2.6 Center for Strategic and International Studies (CSIS)

CSIS provided a Red Team to review study methodology and procedures to ensure all aspects of the analysis are suitable for presentation to the highest levels of government.

1.3.2.7 George Mason University (GMU)

GMU provided peer review of the live testing designed by MCOTEA, as well as their approach to data collection and analysis.

2 Purpose, Scope, and Methodology

2.1 Purpose

In accordance with the MCFIP Campaign Plan, OAD provided comprehensive analysis across all LOEs to Director, MCFIO. This analytical support included integration of all relevant research in order to inform the Commandant's decision on opening ground combat arms MOSs and units.

2.2 Scope

In order to inform the Commandant's decision, research assets were allocated to the following focus areas (FAs):

- Combat Effectiveness: determine the effect gender integration has on the mission
- Unit Readiness: determine the effect gender integration has on the force
- Individual Marine Success: determine the effect gender integration has on the Marines
- Institutional Costs: determine the effect gender integration has on the institution

2.3 Methodology

To determine the effect of gender integration on each of the FA, the research integration team executed the five-step process described below.

2.3.1 Develop Essential Elements of Analysis for Each Focus Area

The research integration team, consisting of personnel from OAD and MCFIO, developed a series of questions to break each FA into its constituent elements. These questions, the Essential Elements of Analysis[22] (EEAs), focused the research process, ensuring that the team obtained comprehensive, complete, reliable, and useful findings. The EEA, some drawn directly from the RIF, are shown in Table 2-1.

Table 2-1: Focus Areas and Essential Elements of Analysis

Focus Area	Essential Element of Analysis
Combat Effectiveness	What, if any, effect does gender integration have on mission effectiveness of the GCE?
	What, if any, effect does gender integration have on task execution?
	What, if any, effect does gender integration have on small unit dynamics?
Unit Readiness	What, if any, were the effects on units under previous gender integration efforts?
	What, if any, effect does gender integration have on deployability rates?
	What, if any, effect does gender integration have on discipline rates?
	What, if any, effect does gender integration have on unit morale?
	What, if any, effect does gender integration have on task or social cohesion?
	What, if any, effect does gender integration have on rates of sexual harassment and sexual assault?
Individual Marine	What are the indicators for effective performance at Formal Learning Centers (FLC)?

[22] For the analyst, EEA are analogous to Commander's Critical Information Requirements (CCIR)

Focus Area	Essential Element of Analysis
Success	What are the indicators for effective performance in a ground combat MOS and unit?
	What, if any, effect does gender integration have on injury rates?
Institutional Cost	What, if any, effect does gender integration have on female attrition rates?
	What, if any, effect does gender integration have on the T2P2 population?
	What, if any, effect does gender integration have on medical separation rates?
	What, if any, effect does gender integration have on equipment costs?
	What, if any, effect does gender integration have on facilities?
	What, if any, effect does gender integration have on recruiting?

2.3.2 Develop Criteria for Each EEA

Next, the research integration team developed the set of information needed to answer each EEA. These sets, termed 'criteria', were developed independent of, and prior to, any review of the research conducted under LOE 1–4. By maintaining separation between criteria and research products, analysts were able to preserve the independence of their judgment while identifying information needed to answer each EEA.

2.3.3 Collect Evidence

With the criteria for each EEA established, the research integration team turned its attention to the body of research conducted under LOE 1–4.[23] Using the EEA and criteria as a guide, researchers collected evidence from existing research products. Their efforts were guided by five principles:

- Work from Primary Sources: MCFIO leadership designated the initial set of research products and documents to be reviewed. The document set was broad based and could be expanded if necessary
- Work in Parallel: Two teams of researchers were formed, one led by MCFIO and one led by OAD. Each team was assigned a sub-set of documents to review
- Nominate and Map: While reviewing a given research product, the teams looked for evidence to satisfy the several criteria for each EEA. As evidence was identified, the teams mapped each item to one or more EEA, and marked the evidence as supporting the Commandant's decision, supporting implementation, or both
- Verify Evidence: Following evidence collection, the teams brought in the author of each research product (when available) to review their work. This ensured the collected evidence was complete and taken within the intended context.
- Close and Continuous Direction: As the teams completed their review of a given document, they briefed OAD and MCFIO leadership on the evidence collected, what EEA it answered and how it was marked (i.e., decision, implementation, or both)

[23] The list of documents reviewed in this step begins on page B-1

2.3.4 Answer the EEA

Once the set of collected evidence was approved, analysts began the task of developing written responses to each EEA. These responses integrated the information available to answer each question and summarized the findings in one or two paragraphs. The integration team reviewed each response at length, and then briefed them to OAD/MCFIO leadership. Once approved, the EEA responses were combined to determine the effect gender integration will have on each FA.

2.3.5 Research Integration Red Team

Concurrent with the evidence collection effort, a Research Integration Red Team was recruited from the Analytic Federation[24] to review our methodology and emerging results. The Red Team had representatives from CNA, HQMC (Installation and Logistics [I&L], Manpower and Reserve Affairs [M&RA], Programs & Resources [P&R]), and MCOTEA (separate from the ITF analysis team). Through close working relationship with the Red Team, the research integration team continuously refined and updated the evidence collection tool.

2.3.6 Summary

By executing the five-step process described above, the research integration team organized the available information into the structure shown in Figure 2-1. Findings on the effect of gender integration on each of the FA are based on the answers to underlying EEA, with answers based on evidence collected from vetted sources. Findings for each FA are provided in the following section.

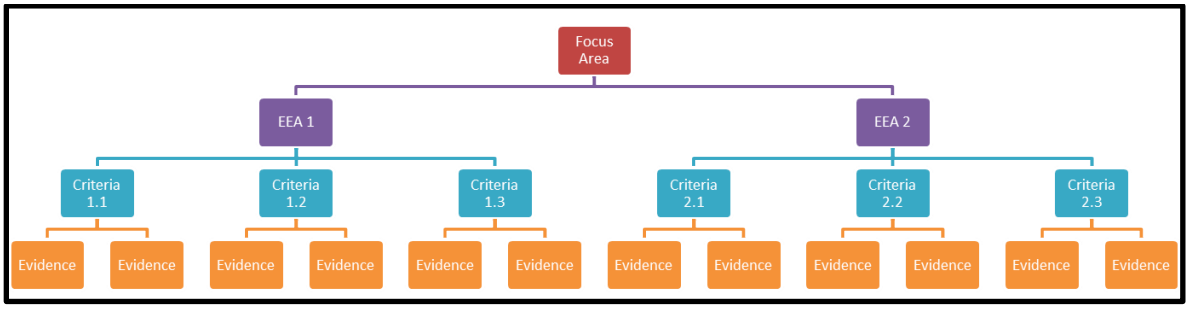

Figure 2-1: Evidentiary support to each FA

[24] The Marine Corps Federated Analytic Community Charter, signed by LtGen James B. Laster, was published on 3 April 2015. The Analytic Federation consists of a Senior Advisory Group (i.e., Director PA&E, Director Analysis Directorate, and Director CNA) and community members. The latter element draws from OAD, MCWL, PA&E, I&L, MCLC, TECOM, MCSC, M&RA, NPS, and CNA.

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3 Findings

In the following sections, the findings for each FA are detailed. Within each sub-section, the finding is followed by an assessment for each supporting EEA. Evidence supporting the assessment closes out each sub-section.

3.1 Combat Effectiveness

Finding: Within the ITF, across all MOSs executing 134 combat tasks, all-male control groups typically performed significantly (statistically) better than integrated groups across all MOSs. Numerous foreign and U.S. analyses showed that females have less strength than males, in both upper and lower body, and have a lower oxygen intake, which leads to lower levels of performance on physically demanding tasks. Additionally, the physiological composition of the female body typically has a higher concentration of fat and lower lean muscle mass, which is a significant disadvantage when hiking under load. These physiological disadvantages for females provide insight as to why females of the ITF were more likely than the males to incur an occupational-related injury.

A study on small unit decision making, led by Michigan State University researchers, showed that all-male teams perform better at tasks requiring lower levels of problem solving skills, while teams with one female tended to perform at least as well as the male teams if not better on tasks requiring high levels of problem solving skills. This exercise was executed on non-fatigued Marines, who were not subjected to physically demanding activities prior to the exercise.

- While some evidence for select team tasks indicates that the differences between men and women in combat arms MOSs is negligible, the overwhelming majority of quantitative evidence appears to indicate that combat effectiveness will decrease with the integration of female Marines into combat arms MOSs. Further, from a qualitative perspective, over time the perceptions of the effect of women on combat effectiveness decreased from positive to negative for both male and female ITF volunteers. Females started with a higher positive view prior to the ITF, but those views had become negative; however, by post ITF, women retained a slightly more positive outlook than those of men.

3.1.1 What, if any, effect does gender integration have on the mission effectiveness of the GCE?

Assessment: For the measured tasks in the GCE-ITF, across all MOSs, integrated teams typically performed significantly (statistically) worse than all-male teams, especially within the infantry MOSs and the casualty evacuation (CASEVAC) tasks. Females have less strength than males in both upper and lower body, leading to lower levels of performance on physically demanding tasks. Further, when marching under load, most females will be carrying a significantly greater load than the average male, when measuring the load plus their body fat as a percentage of their lean body mass.

Evidence:

- For the measured tasks in the GCE-ITF, across all MOSs, integrated teams typically performed significantly (statistically) worse than all-male teams.

- These differences occasionally rose to more than a 30% performance difference, which was a percent used in the experimental design to detect statistical significant group differences.[25]
    - A majority of tasks with greater than 30% performance difference were in the infantry (03xx).[26]
    - The CASEVAC task often had performance differences greater than 30% across many different MOSs (035X, 0331, Provisional Infantry Machine Gun [PIMG], 1833, 0313)[27]
    - Of the tasks, 93 had statistically significant differences between control (all male) and integrated units. Integrated units performed better in five of the 93 tasks (M2 accuracy and M240 reload).[28]
    - Differences of greater than 30% were observed in 30 tasks. Integrated units performed better in two of the 30 tasks. (M2 accuracy for both 0331 and PIMG).[29]
    - The all-male control group had a higher probability of hits compared to integrated group for the M4 (.43 vs. .35), M27 (.44 vs. .33) and M203 (.27 vs. .15); however, integrated machine gun teams (M2 .50 caliber) shot more accurately than the all-male control group. (Infantry 36% higher and Provisional Infantry 59% higher).[30]
    - The 0311 integrated group averaged 10.4% degradation in accuracy when compared to the all-male group. To better understand the operational impact of this, a simulation of 200,000 engagements was run where the integrated team would fight an enemy who was equal to the all-male group. The results revealed a 6.2% degradation in tactical level engagement wins for the integrated group.[31]
    - Females from the ITF were 19% more likely to incur an occupational-related injury whereas males were 12% more likely to incur an injury outside of the occupation.[32]
    - Females from the ITF incurred live testing-related injuries two times higher than their male counterparts.[33]
- Multiple nations have determined that females possess significantly less upper and lower body strength than men.
    - Women have roughly 60% of the lower body strength and 40% of the upper body strength of men (South Africa, Austria, U.S., and UK).[34]

[25] Paul Johnson. EOS slides, *MCOTEA GCE-ITF Experiment Results*. Slides 3-6.
[26] Ibid. Slides 3-6
[27] Ibid. Slides 3-6.
[28] Ibid. Slides 3-6.
[29] Ibid. Slides 3-6.
[30] Ibid. Slide 10.
[31] Paul Johnson. *GCE-ITF Experimental Assessment Report Annex A*. A-17.
[32] Paul Johnson. EOS slides, *MCOTEA GCE-ITF Experiment Results*. Slide 8.
[33] Ibid. Slide 8.
[34] Nolte, H.W., et al. *Impacts of Gender Differences on Conducting Operational Activities.* NATO, 2013. 14-13, 15-7.

- Female hand and grip strength is significantly weaker than males.
    - 90% of females produced maximal handgrip forces smaller than the lowest fifth percentile of their male counterparts (South Africa and UK).[35]
- Females generally run slower and possess a lower VO2 max than males.
    - Initial testing of Israeli recruits revealed that only 25% of females scored equivalent to or better than the lower 5% of their male counterparts in the VO2 max test.[36]
    - The slowest male Israeli recruit ran faster than 75% of female recruits.[37]
    - Female run times are significantly slower than males and less than 3% of females meet or exceed the average male run time. (U.S. Army Reserve Officers' Training Corps [ROTC] study).[38]
- Females, on average, are shorter, lighter, have less muscle mass, more fat, and have overall smaller and weaker bones than males.
    - On average women are 17% shorter, 16% lighter, possess 30% less muscle mass, and possess 28% more fat than males (UK and Austria).[39]
- Females are disadvantaged when carrying heavy loads due to their smaller size and lower overall lean body mass.[40]
    - Individual performance decreases significantly as loads increase past 30% of body weight. Individuals with greater lean body mass tend to be less affected by load weight. (Marine Corps study).[41]
    - For the ITF Marines, males averaged 178 lbs., with 20% body fat; females averaged 142 lbs., with 24% body fat. For these Marines, the percentage of lean body mass carried using the 81 lbs. fighting load (plus the individual's body fat) was under 100% for almost all of the males, but over 100% for about 75% of the females.[42]
    - A study of U.S. Army soldiers having similar fat-free mass showed the group that had <18% body fat performed significantly better on seven out of 10 fitness tests.[43]
    - During the infantry and combat engineer MOS execution of the 7km hike, all-male squads (regardless of MOS) were able to meet or exceed the standard of 4km per hour. The only integrated MOS to achieve the 4km per hour standard

[35] Leyk, D., et al. *Optimizing Operational Physical Fitness Final Report*. NATO, January 2009. 7-9.
[36] Moran, Daniel S., et al. *Impacts of Gender Differences on Conducting Operational Activities*. NATO, 2013. 13-9.
[37] IBID. 13-9
[38] Gregor, Dr. William J., *Why Can't Anything be Done?* Chicago, IL, 2011. 19.
[39] *Women in Ground Close Combat (GCC) Review Paper*. United Kingdom, 2014. 6-9.
[40] NHRC. *Changes in Combat Task Performance Under Increasing Loads in Active Duty Marines* (p. 6)
[41] Ibid. 4
[42] Jadro, Capt Bryan. *Body Weight and Load Weight Comparative Analysis*. Quantico, VA, 2015. Slides 2-10
[43] Crawford, Kim, et al. *Less Body Fat Improves Physical and Physiological Performance in Army Soldiers*. 2011. 40.

was the 0311 MOS, which demonstrates how the increase in weight of the crew-served weapons decreases the hiking pace of integrated infantry units.[44]

3.1.2 What, if any, effect does gender integration have on task execution (e.g., adaptation strategies, team compensation)?

Assessment: During the conduct of the GCE-ITF research, there were instances when male compensation enabled integrated teams to compete at the same level as their all-male counterparts. For example, male 0341s and 0331s were primarily responsible for the casualty evacuation testing when operating in integrated teams. Prior to negotiating the 8-foot wall, male 0311s would typically assist the female 0311s by throwing their packs on top of the wall. Compensation was also noticed amongst the engineers during the destruction of captured munitions. During this testing, male engineers were responsible for picking up, moving, and lifting 155mm artillery round onto a 7-ton truck, whereas females would position themselves on the truck and only be responsible for receiving the round and preparing it for onward movement. An adaptation was also documented during the live testing—0351 females would use a configuration of Marine Corps Martial Arts Program (MCMAP) belts to essentially form a ladder that would assist the last Marine in climbing over the 8-foot wall.

Evidence:

- During CASEVAC testing, the 0341s showed no significant differences in evacuation times. However, the 0341s primarily used a single-Marine fireman's carry to move the casualty; in 16 of 18 trials, a male Marine did this. Similar results were seen when comparing the control and the low-density 0331 squads. The top one-third of the 0331 results of the low-density squads was almost exclusively male fireman's carry results.[45]
- There was no significant difference between the integrated 0341 squad and the all-male 0341 squad with respect to emplacement and displacement times. However, a masking effect that occurred within the emplacement portion is not captured by the current results. It was observed that when slower members of the squad fell back during the initial movement, their delay was hidden by the fact that the rest of the team began emplacing the 81-mm mortar system concurrently. By the time the weapon system was fire capable, all members had arrived at the mortar firing position.[46]
- During the destruction of captured munitions, integrated combat engineer squads showed no significant differences in times for loading, digging, unloading, or rigging for detonation. In the most demanding portion of the task, loading the ammunition onto the bed of the 7-ton truck, the female Marines would position themselves on the bed of the vehicle to aid in the loading and stowing of the ammunition rather than at the base of the vehicle, where they would have to lift the artillery shells up from the ground at least 62 inches or higher to the bed of the 7-ton truck.[47]

[44] Paul Johnson. *GCE ITF Experimental Assessment Report*. 21.
[45] Paul Johnson. *GCE ITF Experimental Assessment Report*. 16.
[46] Ibid. 23.
[47] Ibid. 57.

- When comparing integrated 0311 squads to all-male 0311 squads navigating obstacles, there were no significant differences in times. There was, however, an issue with getting assault packs over the wall. Prior to negotiating the wall, 0311 Marines removed their assault packs and individually threw them on top of the 8-foot wall prior to climbing. Females in integrated squads were often noted as requiring assistance from male squad members in order to get their packs onto the wall.[48]
- The 035X assault squads were formed by combining two, two-Marine teams. When both teams in a squad were all-female, the 035X squad used their belts as a ladder to aid in getting the last Marine over the obstacle, a technique that was not required when there was at least one male in the high-density squads as the male would pull the last Marine over the wall.[49]

3.1.3 What, if any, effect does gender integration have on small unit dynamics?

Assessment: During the MSU research, all-male teams perform better at tasks requiring low levels of problem solving skills; however, integrated teams with one female perform as well or better at tasks requiring a high degree of problem solving. Of note, these live tests were completed with non-fatigued Marines; i.e., Marines were not required to conduct any physically demanding tasks prior to performing the live testing. Therefore, the impact of fatigue was not a factor in this assessment.

Evidence:

- MSU research teams containing all males, or male-led teams, performed better on tasks requiring low levels of problem solving skills[50]
- MSU research teams containing one female, or female-led teams, performed better on tasks requiring a high degree of problem solving[51]
- GCE-ITF baseline surveys on integrating females into ground combat units/MOSs identified negative opinions towards social cohesion, disciplinary actions, unit readiness, and the overall success of individual Marines[52]

3.2 Unit Readiness

Finding: Based on propensity, female Marines will likely fill a small number of billets in ground combat arms units. Accordingly, gender integration will have limited impact on unit readiness as measured in the Defense Readiness Reporting System (DRRS). Historically, the non-deployable rate for female Marines is significantly higher than male Marines (up to 4x higher), and non-deployability is predominantly due to medical reasons. Further, gender integration may increase the rate at which female Marines become non-deployable—an effect that might be felt at the company/battery level. For example,

[48] Ibid. 11.
[49] Ibid. 11.
[50] Hollenbeck, John R., et al. *Gender Diversity in Male-dominated Teams: The Impact of Compositional Configurations over Time*. East Lansing, MI, 2015. Slide 39
[51] Ibid. Slide 52
[52] Bradley Dickey, et al. *A Quick-Look Analysis of the GCE ITF Baseline Climate Survey*. Arlington, VA, 2015. 21-29

while training events injured ITF females at approximately twice the rate of their male counterparts[53], ITF females were available for training 96.8% of the time and ITF males were available 98.4% of the time[54]. Further, U-Pitt research indicates that injury prevention programs would eliminate the preponderance of time-loss injuries suffered by ITF females.

The experience of prior integration efforts shows that leadership, training, and the maintenance of high standards are critical to success. While there may be higher attrition among female Marines in newly opened occupational fields, in previous integration efforts these differences faded over time. In addition, female Marines have found viable career paths each time an occupational field is opened to them. While it takes time to realize the full effect of gender integration, it appears that gender, in and of itself, has not been a barrier to success.

In addition to providing a wealth of data on task performance, the Marines of the GCE-ITF participated in attitude surveys and focus groups at three points during the research: at forming, at completion of the training at Camp Lejeune, and at the end of the live testing at the MCAGCC in Twentynine Palms. Attitudes towards gender integration were little changed across the three surveys, with female Marines having a more positive attitude towards integration than male Marines do. Perceptions of combat effectiveness, unit cohesion, trust, teamwork, and morale started high, and then declined over time. Such a decline is not unexpected, given the demanding nature of the live testing and the normal social dynamics of organizations under study.[55] Of note, the perceptions of the GCE-ITF Marines about the state of their unit were significantly higher than the perceptions of their peers in another gender integrated unit. Formal reports of sexual harassment and sexual assault in the GCE-ITF were lower than comparably sized units in the operating forces. In addition, there are no indications that rates of sexual harassment and sexual assault will rise following gender integration.

3.2.1 What, if any, were the effects on units under previous gender integration efforts?

Assessment: A thorough review of previous gender integration efforts, in particular the opening of Marine Corps logistics and aviation occupational fields, suggested that unit and personnel readiness do not change significantly following gender integration. The history of prior gender integration efforts shows that establishing females in a newly opened field requires a significant amount of time. Further, first term non-EAS attrition for female Marines usually runs above their male counterparts. However, these differences in first term non-EAS attrition lessen over time, and fade over subsequent enlistments. We now know that female Marines found viable career paths in both the logistics and aviation occupational fields. Ultimately, the effect of gender integration, at both the unit and individual Marine level, was largely determined by leadership and training.

Evidence:

- Research on prior gender integration efforts did not detect any change in unit readiness. While much of this research focused on Marine Corps efforts, MCFIO personnel

[53] Allison, Dr. Katelyn F. *United States Marine Corps Ground Combat Element Integrated Task Force Research ONR Award #N00014-14-1-0021. Draft Final Report August 14, 2015*. University of Pittsburgh, August 2015. Print. Page 44
[54] Moore, Col K. M. *Ground Combat Element Integrated Task Force Experimental Assessment Report.* MCOTEA, August 2015. Print. Page 67
[55] The Hawthorne effect is a term from management science; it refers the effect that teams become more productive when under study. Once the observation period ends, the team falls back to its previous levels of productivity. In 1965, Dr. Bruce Tuckman proposed a model of team formation, with several distinct phases: forming, storming, norming, performing, and mourning. It is possible that the attitude surveys may have taken place when the ITF Marines were in distinctly different phases of the team formation process.

conducted a series of country visits to exchange information with commanders of gender-integrated units.[56],[57],[58] In addition, a thorough review of the experience of NATO and Allied nations was conducted. The review of these studies indicated that concerns about the detrimental impact of women on military readiness and cohesion have not materialized.[59]

- In previous Marine Corps integration efforts (aviation and logistics), promotion and retention findings suggest that the observed differences in male and female officer retention, as well as attrition during first-term enlistments, are not due to differences in male and female performance.[60]
- A thorough assessment of gender integration efforts requires the passage of time, as female Marines progress through their careers. RAND estimates, as well as experiences when the Marine Corps opened previously-closed occupations to women in the past, suggest that the number of women entering the infantry will be modest and the increase in representation will be slow.[61] Likewise, RAND expects the total number of women entering the Marine Corps to continue to grow in the near future, but at a modest rate.[62] CNA conducted a long-term analysis of the logistics and aviation occupational fields, covering a period from FY87 to FY14. Their study showed:[63]
    - The proportion of female Marines in the logistics occupational fields grew from 5.6% to 14.6%
    - The proportion of female Marines in non-pilot/non-NFO aviation occupational fields grew from 6.6% to 10.8%
    - The proportion of female Marines in pilot/NFO aviation occupational fields grew from 0% to 3.8%
- Examination of women's past integration into the aviation field revealed that women were less likely than men were to have Flight Aptitude Rating (FAR) scores that qualified them for naval aviator (pilot)/naval flight officer (NFO) MOSs.[64] Lower scores on certain

[56] Samarov, LtCol Michael, LtCol Benjamin Venning, and Maj Beth Wolny. *Marine Corps Force Innovation Office (MCFIO) Visit to the Israeli Defense Force (IDF) Ground Forces International Talks and the United Kingdom (UK) Ground Close Combat Review Team: September 2014*. Print.
[57] Samarov, LtCol Michael, LtCol Benjamin Venning, and Maj Beth Wolny. *Marine Corps Force Innovation Office (MCFIO) Visit to the Canadian Armed Forces (CAF): November 2014*. Print.
[58] Samarov, LtCol Michael, LtCol Benjamin Venning, and Maj Beth Wolny. *Marine Corps Force Innovation Office (MCFIO) Visit to the Australian Army: February 2015*. Print.
[59] Schaefer, Agnes G., et al. *Implications of Integrating Women into the Marine Corps Infantry.* RAND National Defense Institute, February 2015. Print. Page vii
[60] Schulte, Jennifer. *An Analysis of Female Representation and Marines' Performance in Aviation and Logistics Occupations.* Center for Naval Analyses, April 2015. Print. Page 56
[61] Schaefer, Agnes G., et al. *Implications of Integrating Women into the Marine Corps Infantry.* RAND National Defense Institute, February 2015. Print. Page xii
[62] Schaefer, Agnes G., et al *Implications of Integrating Women into the Marine Corps Infantry.* RAND National Defense Institute, February 2015. Print. Page xiii
[63] Schulte, Jennifer. *An Analysis of Female Representation and Marines' Performance in Aviation and Logistics Occupations.* Center for Naval Analyses, April 2015. Print. Pages 8-10
[64] Schulte, Jennifer. *An Analysis of Female Representation and Marines' Performance in Aviation and Logistics Occupations.* Center for Naval Analyses, April 2015. Print. "FAR scores are based on components of the Aviation Selection Test Battery, which includes section tests on math/verbal ability, mechanical comprehension, spatial apperception, and aviation and nautical information. Of the Officer Candidate Course/Platoon Leaders Class officer candidates for whom we observe FARs since FY 1994, male FARs are about 1 point higher than female FARs (6.1 versus 5.2), on average, and 83 percent of men and 65 percent of women had FARs high enough to qualify for flight contracts."

knowledge- or experience-based topics could suggest areas for which recruiters could encourage applicants to seek remediation through appropriate test preparation services.[65] This may be less of an issue for some currently closed MOSs, such as infantry, which generally require lower technical test scores.

- Non-EAS Attrition: While attrition rates for first-term female Marines in the aviation and logistics occupational fields are higher than those of their male counterparts, this difference fades in second and subsequent terms.[66]
- Viable career paths: Marine female logistics and aviation officers were selected for promotion to O3-O5 at similar rates as men within their occupational group, after controlling for other factors. This suggests male and female officers are equally qualified for these ranks and that female officers have not experienced any obvious bias or discrimination in promotion selections and, by extension, in their performance evaluations.[67]
- To understand the long-term effects of gender integration, the STARS team analyzed retention after five years of commissioned service among the present day population of Marine officers in the logistics and aviation occupational fields.[68] Their findings are summarized below:

Table 3-1: Retention by occupational field: 0-5 years of commissioned service

		# in OccFld		% of OccFld		Retention Rate	
OccFld	**Occ Field Description**	**F**	**M**	**F**	**M**	**F**	**M**
60	Aircraft Maintenance	9	121	7%	93%	100%	75%
75	Pilots/Naval Flight Officers	96	1860	5%	95%	86%	96%
04	Logistics	103	624	14%	86%	60%	66%
66	Aviation Logistics	13	92	12%	88%	46%	72%
72	Air Cntrl/Air Spt/Antiair Warfare	48	286	14%	86%	46%	59%

- The STARS team also analyzed the population of lieutenant colonels in the 0602 community, in order to determine which billets were most commonly associated with career success. Female Marines were well represented in top 10 billet assignments, indicating that they were competitive with their male peers.[69]

[65] Recruiters are prohibited from coaching applicants on the ASVAB but may recommend that they use test preparation services. See http://official-asvab.com/prepare_rec.htm.
[66] Schulte, Jennifer. *An Analysis of Female Representation and Marines' Performance in Aviation and Logistics Occupations.* Center for Naval Analyses, April 2015. Print. Pages 40, 41, 46, 47, 49
[67] Schulte, Jennifer. *An Analysis of Female Representation and Marines' Performance in Aviation and Logistics Occupations.* Center for Naval Analyses, April 2015. Print.
[68] Zukoski, Mary J., et al. *Study of Talent, Attrition, Retention, and Success (STARS).* Operations Analysis Division, IPR #1 2015. Microsoft PowerPoint. Slide 19. Note: the table shown here is a sub-set of the table on slide 19, showing only aviation & logistic MOS
[69] Zukoski, Mary J., et al. *Study of Talent, Attrition, Retention, and Success (STARS).* Operations Analysis Division, IPR #2 2015. Microsoft PowerPoint. Slide 47. Note: Analysis of data for the 0402 and 1302 communities was not complete at the time of this report

In the end, meta-analysis of prior gender integration efforts found that the detrimental effects on cohesion can be mitigated through good leadership, cohesion-building activities, and a shared sense of identity among men and women.[70]

3.2.2 What, if any, effect does gender integration have on deployability rates?

Assessment: Historically, female Marines become non-deployable at approximately three to four times the rate of male Marines, with the incidence of non-deployability peaking at lance corporal. In addition, the rate of medical separation for female Marines is approximately one-and-a-half times the rate of male Marines.[71] Research conducted by Allied nations indicates that female Marines in ground combat arms will be at greater risk of overuse injury, but this risk can be mitigated with proper training.[72] As this exposure will be particularly acute in the infantry occupational field, the number of medically non-deployable female Marines is likely to increase slightly. Whether the number of medically separated female Marines will increase following gender integration remains to be seen. For example, while a female Marine in the ITF was almost twice as likely to become ill or injured when compared to male Marines, she was only slightly more likely to miss a training day. The Israeli Defense Forces (IDF) achieved a significant reduction in overuse injuries in gender integrated combat units,[73] and are satisfied with the effectiveness of these units. However, due to differences in operating environments, force composition, public law, and employment patterns, it appears these techniques would be unsuitable for the Marine Corps. Further, during the GCE-ITF, there were significantly higher injuries rates for hiking MOSs (03xx minus 0313, 1371, and Provisional 03xx) compared to riding MOSs (08xx, 0313, 18xx).

Evidence:

- Female Marines enter the non-deployable state at a rate substantially higher than that of male Marines. In 2012, OAD conducted a study on the impact of medically non-deployable Marines. Considering a four-year period (FY08-12), and counting the incidence of non-deployable periods that exceeded 90 days, the study found that female Marines become medically non-deployable (MND) at a higher rate than males did (overall, female: 20.2% and male: 5.4%).[74] It should be noted that the majority of Marines who enter a non-deployable state do so as a result of medical issues. The study, summarized in Table 3-2, also found:[75]
    - Overall, female Marines have a higher rate of medical separations than males (female: 2.4% and male: 1.6%)

[70] Schaefer, Agnes G., et al *Implications of Integrating Women into the Marine Corps Infantry.* RAND National Defense Institute, February 2015. Print. Page ix
[71] Figures in this paragraph are taken from an OAD study conducted in 2012. The study is reviewed in greater detail in subsequent sections.
[72] Epstein, Yoram, et al. "Physiological Employment Standards IV: Integration of Women in combat Units Physiological and Medical Considerations." *European Journal of Applied Physiology* 11 (2013): 2673-90. Print.
[73] Currently, female soldiers in the IDF can volunteer to serve in the following specialties that the IDF defines as combat arms: rocket artillery, cannon artillery (Fire Direction [FDC] only), combat engineers, combat collection, combat instruction, and light infantry. Of note, light infantry in the IDF is a vehicle-mounted, border-security force. Further, IDF combat instructors are exclusively teachers. They do not join combat arms units and do not have direct combat experience.
[74] Rook, Capt. Chad, and Jessica Hancock. *Assessment of Marine Non-deployability and the Effects on Readiness*. Operations Analysis Division, March 2014. Microsoft PowerPoint.
[75] Rook, Capt. Chad, and Jessica Hancock. *Assessment of Marine Non-deployability and the Effects on Readiness*. Operations Analysis Division, March 2014. Microsoft PowerPoint. Slide 16

- The rank with the greatest rate of medically non-deployable female Marines is lance corporal
- It appears that pregnancy is not the dominant cause for female Marines to become medically non-deployable.[76] For example, during the period from October 2010 to October 2012, the number of pregnant lance corporals averaged around 50 per month. This represents 12% to 17% of medically non-deployable female lance corporals.[77]

Table 3-2: Outcome from entering medically non-deployable status

Data Category[78]	Male Marines:	Female Marines:
Records Reviewed: Sep 2008 to Oct 2012:	280,279	20,937
Number Declared Medically Non-Deployable:	15,110 (5.4%)	4,228 (20.2%)
Number Subsequently Separated:	8,437 (56%)	1,684 (40%)
Medical Separation	4,493 (53%)	506 (30%)
Normal Separation	2,928 (34%)	1,014 (60%)
Legal Separation	540 (6%)	50 (3%)
Admin Separation	428 (5%)	111 (7%)
Death	44 (0.5%)	1 (0.06%)

- In addition to reviewing the existing body of research on previous gender integration efforts, the study team also considered a large body of medical research on overuse injuries experienced by female military personnel. Several themes emerged from this research:
  - The development of lower extremity overuse injuries has been associated with low levels of physical fitness. Suboptimal levels of anaerobic power have been directly related to an increased risk of injury and impaired performance.[79]
  - Women have been shown to be more susceptible to overuse injuries, such as stress fractures, when compared to males engaged in similar activities. Stress fractures, an overuse injury to bone, are one of the most common and potentially debilitating overuse injuries seen in military recruits.[80]
  - Physiological differences in women, such as lower muscle mass, higher fat percentage, lower aerobic and anaerobic capacity, higher susceptibility to stress

[76] The 2012 OAD study on non-deployability noted that inconsistencies in TFDW records (e.g., changes in coding practices) made tracking of pregnancy as the cause for a non-deployable status difficult
[77] Rook, Capt. Chad, and Jessica Hancock. *Assessment of Marine Non-deployability and the Effects on Readiness*. Operations Analysis Division, March 2014. Microsoft PowerPoint. Slide 25
[78] Rook, Capt. Chad, and Jessica Hancock. *Assessment of Marine Non-deployability and the Effects on Readiness*. Operations Analysis Division, March 2014. Microsoft PowerPoint. Slide 16
[79] Allison, Dr. Katelyn F. *USMC GCE-ITF Research, ONR Award #N00014-14-1-0021, Status Report*. University of Pittsburgh, March 2015. Print.
[80] Epstein, Yoram, et al. "Physiological Employment Standards IV: Integration of Women in combat Units Physiological and Medical Considerations." *European Journal of Applied Physiology* 11 (2013): 2673-90. Print.

fractures and other musculoskeletal injuries, which previously had excluded them from most combat duties, have been shown to improve with proper training regimens.[81]

- Given that ITF readiness is largely a function of the injury rate, and considering the effect of MOS, there is a statistically significant difference in the injury rate among the 'Hiking' MOSs (i.e., 0311, 0331, 0341, 0351, 0352, 1371, Provisional Infantry, and Provisional Infantry Machine Gun) and the 'Vehicle' MOSs (i.e., tank, AAV, and Light Armored Vehicle [LAV] crews).[82]
- Using a data set provided by U-Pitt,[83] OAD compared the injury rate for the 'Hiking' MOSs to the injury rate for the 'Vehicle' MOSs. In addition to the descriptive statistics shown below, the OAD analysis determined that the difference in injury rates between the two groups was statistically significant (i.e., it is very unlikely that the observed difference is due to chance or randomness).
    - In the U-Pitt data set, the injury rate for Hiking MOSs is 45.3% (63/139)
    - In the U-Pitt data set, the injury rate for Vehicle MOSs is 11.1% (6/54)
- Considering the effect of gender on ITF readiness, males were available 98.4% of the time while females were available 96.8% of the time. The cause of the lower availability for females was their greater likeliness to be injured (80% of the females and 49% of the males experienced one or more injury). However, the recovery time for males and females were similar, and females were just 13% more likely to miss an experiment day.[84]
- Compared to males, there was a statistically significant difference in the proportion of female Marines who suffered a musculoskeletal injury:[85]
    - 34 out of 84 females (40.5%) suffered a musculoskeletal injury
    - 41 out of 218 males (18.8%) suffered a musculoskeletal injury
- Using a variety of laboratory and field performance tests, U-Pitt collected performance data from the ITF Marines. Analysis of this data shows:[86]
    - On average, male Marines performed significantly better than female Marines did on strength,[87] physiology,[88] and field tests of power and agility

[81] Epstein, Yoram, et al. "Physiological Employment Standards IV: Integration of Women in combat Units Physiological and Medical Considerations." *European Journal of Applied Physiology* 11 (2013): 2673-90. Print.
[82] Moore, Col K. M. "Ground Combat Element Integrated Task Force Experimental Assessment Report." MCOTEA, August 2015. Print. Page O-4 to O-7.
[83] The U-Pitt data includes only Marines from whom they collected physiological data, so it is a sub-set of the entire ITF population.
[84] Moore, Col K. M. "Ground Combat Element Integrated Task Force Experimental Assessment Report." MCOTEA, August 2015. Print. Page 65, O-2 to O-5.
[85] Allison, Dr. Katelyn F. "United States Marine Corps Ground Combat Element Integrated Task Force Research ONR Award #N00014-14-1-0021. Draft Final Report August 14, 2015." University of Pittsburgh, August 2015. Print. Page 44
[86] Allison, Dr. Katelyn F. "United States Marine Corps Ground Combat Element Integrated Task Force Research ONR Award #N00014-14-1-0021. Draft Final Report August 14, 2015." University of Pittsburgh, August 2015. Print. Pages 10-29
[87] In general, the area of overlap between male and female Marines increases as the test moves from the upper extremities to the lower extremities
[88] Body composition, anaerobic power, anaerobic capacity, aerobic capacity

- On average, female Marines performed significantly better than male Marines did on the majority of flexibility variables, balance, and the majority of biomechanical variables
- Male and female Marines performed comparably on the balance scores associated with the NeuroCom Sensory Organization Test and had similar lactate threshold

- In addition to gathering data on the performance of the ITF Marines, U-Pitt collected data on injuries experienced by ITF Marines. Preventable injuries (i.e., injuries that could be reduced through injury prevention programs) and time-loss injuries (i.e., injuries that require an alteration to training activities for at least one day)[89] give insight into the effect gender integration will have on unit readiness.
  - Among female Marines, the lower extremities were the most frequent location of preventable, time-loss injuries, with 19 out of 21 such injuries occurring there.[90]
  - Though 16 of the 21 preventable injuries occurred during ruck marching,[91] only three of the 21 were considered chronic.[92]
- Although females have an initial disadvantage physiologically in comparison to males, the IDF found that policies accounting for, the soldiers' physical abilities enable successful integration of females in combat professions. Similar experiences have been seen in other militaries.[93] However, there are significant differences between the IDF and Marine Corps ground combat units:[94]
  - Currently, female soldiers in the IDF can volunteer to serve in the following specialties that the IDF defines as combat arms: rocket artillery, cannon artillery (Fire Direction Center [FDC] only), combat engineers, combat collection, combat instruction, and light infantry. Of note, light infantry in the IDF is a vehicle-mounted, border-security force. Further, IDF combat instructors are exclusively teachers. They do not join other combat arms units and do not have direct combat experience.
  - Additionally, IDF senior leadership commented on similarities and differences between combat experiences for females in the IDF, and female Marines, indicating that most women in the Marine Corps have more combat experience than the women in combat arms in the IDF.

[89] Allison, Dr. Katelyn F. "United States Marine Corps Ground Combat Element Integrated Task Force Research ONR Award #N00014-14-1-0021. Draft Final Report August 14, 2015." University of Pittsburgh, August 2015. Print. Page 43
[90] Allison, Dr. Katelyn F. "United States Marine Corps Ground Combat Element Integrated Task Force Research ONR Award #N00014-14-1-0021. Draft Final Report August 14, 2015." University of Pittsburgh, August 2015. Print. Page 102, Table 45.
[91] Allison, Dr. Katelyn F. "United States Marine Corps Ground Combat Element Integrated Task Force Research ONR Award #N00014-14-1-0021. Final Report August 14, 2015." University of Pittsburgh, August 2015. Print. Page 103, Table 46.
[92] Allison, Dr. Katelyn F. "United States Marine Corps Ground Combat Element Integrated Task Force Research ONR Award #N00014-14-1-0021. Draft Final Report August 14, 2015." University of Pittsburgh, August 2015. Print. Page 104, Table 49.
[93] Epstein, Yoram, et al. "Physiological Employment Standards IV: Integration of Women in combat Units Physiological and Medical Considerations." *European Journal of Applied Physiology* 11 (2013): 2673-90. Print.
[94] Samarov LtCol Michael, LtCol Benjamin Venning, and Maj Beth Wolny. *Visit to the Israeli Defense Force (IDF) Ground Forces International Talks and the United Kingdom (UK) Ground Close Combat Review Team.* MCFIO, September 2014. Print.

- Most significantly, some aspects of the IDF policy equate to gender normed standards. For example, based on their load carriage index (LCI) for tactical movements, female IDF personnel are limited to 33% of their body weight, while males are limited to 60% of their body weight. Such standards violate the gender neutrality requirement established by the SecDef, and the law prescribed in the NDAA 2014 mandate.

3.2.3 What, if any, effect does gender integration have on discipline rates?

Assessment: Given the existing data on male versus female discipline rates, there are some indications that integration could reduce overall discipline rates in ground combat arms units. However, within the ITF, perceptions of unit discipline varied by gender.

Evidence:

- The 2012 study by OAD on the impact of non-deployability found that administrative holds account for less than 1% of the Marines in a non-deployable status.[95] A later study on unit performance found that male Marines are 1.2 times more likely to receive non-judicial punishments (NJP) than female Marines are.[96] Further, male Marines are 3.2 times more likely to receive a court martial than female Marines are.[97] Finally, compared to a sample of infantry battalions, the rate of disciplinary action is lower in units of the Air Combat Element (ACE) or the Logistics Combat Element (LCE).[98] In summary, gender integrated units in general, and female Marines in particular, have lower incidences of disciplinary actions.
- For a unit, indicators of good discipline include low rates of NJP and desertion. In a similar manner, several factors that predict high rates of enlisted retention also predict low rates of disciplinary action. These factors included more time in the Delayed Entry Program (DEP), a Tier 1 education credential, and higher Armed Forces Qualification Test (AFQT) scores. Among enlistment waiver types, some were consistent predictors of poor conduct, such as "positive drug and alcohol test," "serious misdemeanor," and "adult felony" waivers. Other factors, such as ethnicity and marital status, were less consistent predictors of good conduct.[99]
- In addition to rates of NJP and desertion, the incidence of off-duty injuries can provide insight to the state of the unit's discipline. During the LOE-3 trials, females were more likely to be injured than males. However, the breakout of injury sources reveals that

[95] Rook, Capt Chad, and Jessica Hancock. *Assessment of Marine Non-deployability and the Effects on Readiness*. Operations Analysis Division, March 2014. Microsoft PowerPoint. Slide 14
[96] Grillo, Robert. *Assessing the Effectiveness of the Marine Corps Martial Arts Program on Unit Performance*. Operations Analysis Division, February 2013. Microsoft PowerPoint. Slide 6
[97] Grillo, Robert. *Factors Influencing Disciplinary Actions in the Marine Corps*. Operations Analysis Division, December 2012. Microsoft PowerPoint. Slide 20
[98] Grillo, Robert. *Factors Influencing Disciplinary Actions in the Marine Corps.* Operations Analysis Division, December 2012. Microsoft PowerPoint. Slide 6
[99] Desrosiers, Shannon, and Elizabeth Bradley. *Differences in Male and Female Predictors of Success in the Marine Corps: A Literature Review*. Center for Naval Analyses, February 2015. Print. Page iv

occupational injuries were the greatest source of lost days for females whereas males lost more days due to non-occupational causes.[100]

- Another measure of unit discipline is how Marines in the unit perceive the state of the unit's discipline. Over the lifetime of the GCE-ITF, perceptions of good order and discipline moved from a commonly held opinion to one that varied by gender:
    - At the post-training point (at the conclusion of home-station training at Camp Lejeune), 50% of all Marines reported that unit discipline was good or very good.
    - At the post-assessment point (at the conclusion of testing at the MCAGCC in Twentynine Palms/Mountain Warfare Training Center (MWTC) Bridgeport/Camp Pendleton evolution):
        - 35% of the male Marines and 45% of the female Marines reported that unit discipline was good or very good
        - 35% of the male Marines and 25% of the female Marines reported that discipline was poor [101]

3.2.4 What, if any, effect does gender integration have on unit morale?

Assessment: Based on the experience of the ITF and multiple other sources, gender integration, in and of itself, will not have a significant impact on unit morale. The presence of known cohorts (e.g., other FLC graduates from the same class) can help ease transition into newly integrated units.

Evidence:

- Little policy research has been conducted on the integration of women, making it difficult to reach definitive analytical judgments on the impact on unit morale, cohesion, and readiness.[102] Further, there is scant analysis on the best method for putting gender integration into action. However, based on historical research and the experience of the GCE-ITF, some principles suggest themselves.
- First, it is important to consider what rollout strategy should accompany significant changes in occupation and assignment policies, and to weigh the costs and benefits of a low-key versus high-visibility approach. Second, the presence of men who already know and respect a new female unit member can help to ease the transition of women into formally all-male environments. If the Marine Corps were to open ground combat arms occupations to women, it should consider changes to assignment policies that would promote effective integration. For example, female Marines, after completing a ground

[100] Moore, Col K. M. "Ground Combat Element Integrated Task Force Experimental Assessment Report." MCOTEA. August 2015. Print. Page 65
[101] Dolfini-Reed, Dr. Michelle A., et al. *Survey Support to the Marine Corps Force Integration Plan, Analysis of GCE-ITF Survey Results.* Center for Naval Analyses, 8 July 2015. Microsoft PowerPoint. Slide 14
[102] Rosenau, William and Melissa McAdam. *The Integration of Female Marine Pilots and Naval Flight Officers, 1990-2000*. Center for Naval Analyses, October 2014. Print.

combat arms MOS school, could be assigned to units along with male peers who graduated alongside them.[103]

- Additionally, because gender-related stereotypes tend to be most salient during initial team interactions but have the potential to become less important as initial impressions are replaced with more accurate interpersonal knowledge, it can be expected that time and interaction experience will act as an important moderator of how gender diversity influences team outcomes.[104]
- In addition to the surveys and focus groups conducted by CNA over the life of the GCE-ITF, the Naval Health Research Center (NHRC) used a variety of instruments to monitor and assess the mental health of the Marines in the ITF. Among their many findings, the following support the idea that gender integration, in and of itself, will not have a significant impact on unit morale:
    - The morale profile for male Marines of the ITF is similar to other male Marines of the operating forces.[105]
        - Post-training, 53% of male Marines reported good morale.[106]
        - Post-assessment, 44% of male Marines reported good morale.[107]
    - The morale profile for female Marines of the ITF is higher than the morale profile of other female Marines in the operating forces.[108]
        - Post-training, 61% of female Marines reported good morale.[109]
        - Post-assessment, 47% of female Marines reported good morale.[110]
    - Male and female Marines of the ITF experienced similar rates of anxiety, and these rates are significantly lower than rates experienced in the operating forces.[111]

[103] Rosenau, William and Melissa McAdam. *The Integration of Female Marine Pilots and Naval Flight Officers, 1990-2000.* Center for Naval Analyses, October 2014. Print.
[104] Hollenbeck, Dr. John R. *Project Narrative: Gender Diversity in Traditionally Male-dominated Teams: The Impact of Alternative Compositional Configurations over Time*. Michigan State University, January 2015. Print. Page 2
[105] Beckerley, Dr. Shiloh, et al. *Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS) Report on the GCE-ITF.* Naval Health Research Center, June 2015. Page 5
[106] Dolfini-Reed, Dr. Michelle A., et al. *Survey Support to the Marine Corps Force Integration Plan, Analysis of GCE-ITF Survey Results*. Center for Naval Analyses, 8 July 2015. Microsoft PowerPoint. Slide 13
[107] Dolfini-Reed, et al. *Survey Support to the Marine Corps Force Integration Plan, Analysis of GCE-ITF Survey Results.* Center for Naval Analyses, 8 July 2015. Microsoft PowerPoint. Slide 13
[108] Beckerley, Dr. Shiloh, et al. *Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS) Report on the GCE-ITF.* Naval Health Research Center, June 2015. Page 5
[109] Dolfini-Reed, et al. *Survey Support to the Marine Corps Force Integration Plan, Analysis of GCE-ITF Survey Results*. Center for Naval Analyses, 8 July 2015. Microsoft PowerPoint. Slide 13
[110] Dolfini-Reed, et al. *Survey Support to the Marine Corps Force Integration Plan, Analysis of GCE-ITF Survey Results*. Center for Naval Analyses, 8 July 2015. Microsoft PowerPoint. Slide 13
[111] Beckerley, Dr. Shiloh, et al. *Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS) Report on the GCE-ITF.* Naval Health Research Center, 18 June 2015 (31 July update). Adobe Acrobat. Slide 8

- Male and female Marines of the ITF experienced similar rates of depression, and these rates are significantly lower than rates experienced in the operating forces.[112]
- Possibly as a result of the demands of the research:
  - Male Marines of the ITF reported higher levels of aggression[113] than did female Marines of the ITF. Aggression for both genders increased over time, and the levels of aggression for ITF Marines of both genders were significantly higher than the levels reported by members of the operating forces.[114]
  - Among male and female Marines of the ITF, stress levels (as measured by levels of C-reactive protein levels in saliva samples) increased over time.[115]
- Self-rated resourcefulness was more likely to predict attrition than physical capability.[116]
- Sleep is better in the ITF than in comparison to other gender-integrated Marine units, and sleep problems in the ITF were highly correlated with mental health problems.[117]

3.2.5 What, if any, effect does gender integration have on task or social cohesion?

Assessment: Studies of prior gender integration efforts identify two key points for maintaining and improving task cohesion during integration: (a) gender-neutral standards facilitate task cohesion in integrated units, and (b) regarding readiness, task cohesion is more important than social cohesion. The experience gained by the ITF revalidates both points: showing that the ability to complete the tasks to the same standard, regardless of gender, minimizes the negative effects of gender integration. Social cohesion may follow in time, but this is less important to unit readiness.

Evidence:

- While gender-neutral standards are often pointed to as a barrier to women entering ground combat occupations, analysis suggests that gender-neutral standards will likely facilitate task cohesion in integrated units.[118] When it comes to unit readiness, task

[112] Beckerley, Dr. Shiloh, et al. *Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS) Report on the GCE-ITF.* Naval Health Research Center, 18 June 2015 (31 July update). Adobe Acrobat. Slide 9
[113] For purposes of the NUBHNAS, 'aggression' does not refer to combat; rather, it refers to a desire to lash out or strike at something (i.e., it is a manifestation of feelings of frustration).
[114] Beckerley, Dr. Shiloh, et al. *Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS) Report on the GCE-ITF.* Naval Health Research Center, 18 June 2015 (31 July update). Adobe Acrobat. Slide 11
[115] Beckerley, Dr. Shiloh, et al. *Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS) Report on the GCE-ITF.* Naval Health Research Center, 18 June 2015 (31 July update). Adobe Acrobat. Slide 13
[116] Beckerley, Dr. Shiloh, et al. *Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS) Report on the GCE-ITF.* Naval Health Research Center, 18 June 2015 (31 July update). Adobe Acrobat. Slide 30
[117] Beckerley, Dr. Shiloh, et al. *Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS) Report on the GCE-ITF.* Naval Health Research Center, 18 June 2015 (31 July update). Adobe Acrobat. Slide 27
[118] Schaefer, Agnes G., et al *Implications of Integrating Women into the Marine Corps Infantry:* RAND National Defense Institute February 2015. Print. Page 56

cohesion is more important than social cohesion. And task cohesion is achieved when all members of the team demonstrate the ability to execute their duties to a common standard.[119]

- The impact of gender integration on the cohesion of traditionally male groups depends on the culture of the group—groups more hostile to women experience lower cohesion after gender integration than do groups that are less hostile toward women.[120]Active, dedicated leadership has been crucial to successful integration. However, cultural change has been slow and there are still challenges to overcome (e.g., low numbers, different treatment/failure of acceptance of female soldiers, harassment and sexual assault, etc.).[121]
- An IDF study found no direct evidence that women are likely to have a negative impact on combat effectiveness. The IDF experience suggests that cohesion, an important factor in combat unit effectiveness, is preserved in gender-integrated combat units. Furthermore, attrition rates (excluding medical reasons) in those units are lower for women than men.[122] As noted in the discussion of the effect gender integration has on deployability rates, there are significant differences between the IDF and Marine Corps ground combat units:[123]
    - Females make up approximately 30% of the IDF ground force.
    - Units in the IDF designated light infantry tend to occupy static security positions.
    - Females in the IDF artillery are almost exclusively assigned to rocket firing batteries, or they perform fire direction duties. It would be atypical to find a female IDF soldier in a tubed artillery battery.
- In the ITF, of those Marines who had previous experience in an integrated unit, the general perspective was that women made no difference in factors of teamwork, morale, discipline, performance, and trust (greater than 60% of all respondents to each factor said that the presence of female Marines had no effect). However, at the margins, there was a trend in response by gender.[124]
- When the ITF volunteers were asked about potential outcomes regarding women in ground combat PMOS or unit, the results tended toward more negative outcomes than

[119] Schaefer, Agnes G., et al. *Implications of Integrating Women into the Marine Corps Infantry.* RAND National Defense Institute February 2015. Print. Page ix
[120] Schaefer, Agnes G., et al. *Implications of Integrating Women into the Marine Corps Infantry.* RAND National Defense Institute February 2015. Print. Page xii
[121]Samarov LtCol Michael, et al. *Visit to the Israeli Defense Force (IDF) Ground Forces International Talks and the United Kingdom (UK) Ground Close Combat Review Team*. MCFIO, September 2014. Print.
[122] Epstein, Yoram, et al. "Physiological Employment Standards IV: Integration of Women in combat Units Physiological and Medical Considerations." *European Journal of Applied Physiology* 11 (2013): 2673-90. Print.
[123] Samarov LtCol Michael, et al. *Visit to the Israeli Defense Force (IDF) Ground Forces International Talks and the United Kingdom (UK) Ground Close Combat Review Team*. MCFIO, September 2014. Print.
[124] Dickey, Dr. Bradley, and Dr. Elizabeth Bradley, and Dr. Michelle Dolfini-Reed. *A Quick-Look Analysis of the GCE ITF Baseline Climate Survey*. Center for Naval Analyses, January 2015. Print. Page 24

positive, particularly as it relates to social cohesion, incidents of events requiring disciplinary action, unit readiness, and individual Marine success.[125]

- Improved physical training is one way that the Marine Corps could increase the number of women entering the infantry. Analysis suggests that lowering standards or giving women preferential treatment would be detrimental to cohesion and morale. [126]
- There are no concerns with the morale of women in the ITF, or with their perceptions of unit cohesion or organizational commitment. In fact, in all of these categories, the women of the ITF scored significantly higher than both their male counterparts and the female Marines of the comparison group. [127] Furthermore, the morale of men in the ITF did not suffer from being in a gender-integrated ground combat unit. [128]
    - Both male and female Marines of the ITF feel a strong sense of belonging to the military, even more so when compared to other Marines of the operating forces.
    - Female Marines of the ITF reported extraordinarily high levels of unit cohesion, notably higher than those reported by female Marines of the comparison group.
    - Male Marines of the ITF reported levels of cohesion slightly higher than those reported by male Marines of the comparison group.
- Surveys of the ITF, conducted during the forming period, the training period, and the research period, found that:[129]
    - Volunteers' perceptions regarding the effect of women on combat effectiveness declined over time.
    - Volunteers were divided by gender regarding their support for female Marines in combat roles, with females strongly supporting.
    - Post-training, cohesion levels averaged medium to good across the ITF, with 31% males and 36% females reporting very good cohesion.
    - Post-assessment, the average cohesion levels dropped to medium, trending to poor.

3.2.6 What, if any, effect does gender integration have on rates of sexual harassment and sexual assault?

Assessment: While occurrences of both sexual harassment and assault were reported in the ITF, there is no basis to assume that integration will change the overall rate of these activities in the

[125] Dickey, Dr. Bradley, et al. *A Quick-Look Analysis of the GCE ITF Baseline Climate Survey*. Center for Naval Analyses, January 2015. Print. Page 29

[126] Schaefer, Agnes G., et al *Implications of Integrating Women into the Marine Corps Infantry.* RAND National Defense Institute February 2015. Print. Page viii

[127] NHRC researchers administered the NUBHNAS to a gender-integrated unit in the 1st Marine Logistics Group

[128] Beckerley, Dr. Shiloh, et al. *Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS) Report on the GCE-ITF.* Naval Health Research Center, 18 June 2015 (31 July update). Adobe Acrobat. Slide 5

[129] Dolfini-Reed, Dr. Michelle, et al. *Survey Support to the Marine Corps Force Integration Plan, Analysis of GCE-ITF Survey Results*. Center for Naval Analyses, 8 July 2015. Microsoft PowerPoint. Slides 11, 12

Marine Corps. However, in light of the relationship between sexual harassment and sexual assault, and given the experiences of Marines under the Expanded Unit Assignment (EUA) program, efforts to minimize sexual harassment will facilitate gender integration.

Evidence:

- Starting with the most recently integrated unit, Marines in the ITF report sexual assault histories at levels similar to those in other military populations.[130] Sexual assaults reported during the life of the ITF were at a rate slightly higher than those experienced in other military populations. One sexual assault was formally reported and six sexual assaults were reported anonymously.[131] Of interest, when surveyed about the risks to female security, ITF volunteers' views lessened to nearly the same level post-assessment.[132]
- With regard to the Marine Corps experience at large, there is no historical evidence or information suggesting there would be an increase in criminal activity above the norm. Further, no current data indicates that those units with limited and small ratios of females have higher incidents of sexual assault than do other units.[133] Some facts to bear in mind:
    - 7.9% of female Marines, and 1.1% of male Marines, experienced a sexual assault in the last 12 months.[134]
    - 27% of female Marines and 6% of male Marines experienced sexual harassment in the last 12 months.[135]
- Considering the whole of DoD, of the females who filed a report of sexual assault:[136]
    - 32% perceived professional retaliation.
    - 52% perceived social retaliation.
    - 18% of females and 12% of males who were sexually assaulted in the last 12 months were also subjected to sexual harassment.[137]
- With regard to a small subset of the Marine Corps, the experience of EUA Marines[138] is at odds with the experience of ITF Marines. When asked whether they would stay in the

[130] Beckerley, Dr. Shiloh, et al. *Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS) Report on the GCE-ITF.* Naval Health Research Center, June 2015. Page 1
[131] Beckerley, Dr. Shiloh, et al. *Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS) Report on the GCE-ITF.* Naval Health Research Center, June 2015. Page 3
[132] Dolfini-Reed, et al. *Survey Support to the Marine Corps Force Integration Plan, Analysis of GCE-ITF Survey Results.* Center for Naval Analyses, 8 July 2015. Microsoft PowerPoint. Slide 17
[133] Response from the HQMC Sexual Assault and Prevention Response (SAPR) Office to questions submitted by the CSIS Red Team. Undated document provided by Col Anne Weinberg, Deputy Director MCFIO
[134] Morral, Andrew R. and Kristie Gore. *Sexual Assault and Sexual Harassment in the Military: Findings from the RAND Military Workplace Study*. RAND National Defense Institute, May 2015. Microsoft PowerPoint. Slide 14
[135] Morral, Andrew R. and Kristie Gore. *Sexual Assault and Sexual Harassment in the Military: Findings from the RAND Military Workplace Study*. RAND National Defense Institute, May 2015. Microsoft PowerPoint. Slide 18
[136] Morral, Andrew R. and Kristie Gore. *Sexual Assault and Sexual Harassment in the Military: Findings from the RAND Military Workplace Study*. RAND National Defense Institute, May 2015. Microsoft PowerPoint. Slide 32
[137] Morral, Andrew R. and Kristie Gore. *Sexual Assault and Sexual Harassment in the Military: Findings from the RAND Military Workplace Study*. RAND National Defense Institute, May 2015. Microsoft PowerPoint. Slide 22

Marine Corps, the EUA Marines provided a variety of responses. Many stated they would not want to remain in an integrated unit because of pervasive gender harassment and the stress associated with stigmatization and an overall lack of acceptance and mentoring opportunities. Some indicated a desire to separate from the Marine Corps due to negative experiences. When asked about their experience with sexual harassment, female EUA Marines reported:

- Lack of respect for females when they exercise authority
- Their fellow Marines had a degraded perspective on the ability of female Marines
- The presence of negative stereotypes
- Intimidation
- Constant scrutiny
- Being ostracized from peers

3.3 Individual Marine Success

Finding: Analysis of LOE 2 data showed that in most ground combat arms schools, female students had lower graduation rates in all schools except artillery (when DORs are included). Some physically demanding tasks are not part of the course curricula; however, when these physically demanding tasks are added to the graduation requirements, this could lower female success rates even further. When combat arms MOS skillsets were applied during the ITF live testing (LOE 3), males out-performed females in physically demanding tasks. Performance differences increased as the size and weight of weapon system increased (from the rifle to the various crew-served weapons). In addition, MOSs having team tasks with critical billets identified experienced significantly lower performance when a female Marine occupied the critical billet.

Enlisted female Marine graduation rates in combat arms MOS-producing schools can be significantly improved with tighter screening standards; however, doing so will also decrease the number of potential female Marines in ground combat MOSs and units. Given the more physically demanding standards, producing female infantry officers will be difficult, and the numbers are likely to be very small. To date, no female officers have passed IOC.

Based on numerous foreign and U.S. analyses, females suffer injuries at much higher rates than males. Contributors are not only differences in physiology, but fatigue and susceptibility. LOE 2 and 3 data confirms those findings.

3.3.1 What are the indicators for effective performance at Formal Learning Centers (FLCs)?

Assessment: Female Marines completed Artillery school with rates commensurate to males (when DORs are included); all other schools showed lower graduation rates for females. For some task

[138] Vealey, LCDR Beth-ann. *Marine Corps Force Integration Plan LOE 1 Thematic Research, Final Report*. Operations Analysis Division, November 2014. Print. Table 2-6, page 13 [Note: Thematic research focuses on examining themes within data, and is a method to capture the intricacies of meaning within a data set]

completion rates (that were not graduation requirements), female completion rates were lower than male rates, primarily due to lower performance of physically demanding tasks. Females had significantly lower completion rates for infantry with and without DORs included.

Evidence:

- During LOE 2, female Marines attended ground combat arms producing schools (infantry, artillery, tank, and AAV).[139] Female Marines graduated from Artillery schools with rates commensurate to males, and at lower rates for tank and AAV schools. Female Marines graduated from Infantry schools at a significantly lower rate than male Marines did, both with and without DORs included in analysis. No female volunteers were dropped or recycled due to injury, outside of the infantry course.

Table 3-3: LOE 2 graduation results (DORs included)

MOS	Sample		Graduation Rate	
	Female	Male	Female	Male
03xx (Infantry)	401	1639	35.9%	97.7%
0811 (Artillery)	14	189	85.7%	85.2%
1812 (Tank)	6	23	66.7%	95.7%
1833 (AAV)	7	79	71.4%	96.2%

- As it relates to specific tasks taught at the infantry, artillery, tank, and AAV schools, female Marines had completion rates that were lower than male rates, primarily due to lower performance of physically demanding tasks. Some of these tasks were not necessarily graduation requirements, but were physically demanding nonetheless. When discounting DORs, female task completion rates were lower than males for physically demanding tasks within 0811 Artillery (projectile lift and load) and 1812 Tank (handling and loading of tank ordnance) MOSs.[140] The Artillery tasks are not currently required for graduation, but that may change upon the introduction of MOS-specific physical standards (MSPSs).

Table 3-4: LOE 2 physically demanding MOS school tasks (DORs included)

MOS	Task/Outcome	Sample		Completion (Rate %) on 1st attempt	
		Female	Male	Female	Male
0811 (Artillery)	Artillery projectile lift *	14	189	2 (14.3%)	136 (72.0%)
	Artillery projectile load *	14	189	1 (7.1%)	128 (67.7%)
1812 (Tank)	Ordnance handle and load **	4	23	1 (25.0%)	12 (52.2%)
03xx (Infantry)	PFT/CFT	401		205 (51.1%)	
	Hike	401		199 (49.6%)	

Note: (*) denotes that the task was not a graduation requirement, and (**) denotes the task was a graduation requirement.

[139] Chewning, Laura. "LOE2 EOS Slides V6," TECOM LOE 2 Data Analysis. OAD 14 July, 2015. Slide 2.
[140] Chewning, Laura. "LOE2 EOS Slides V6," TECOM LOE 2 Data Analysis. OAD 14 July, 2015. Slide 2.

Further analysis of the LOE 2 data suggested potential classification standards that could aid in identifying female Marines with the best chance of success at ITB. When discounting DORs, the analysis showed that combinations using CFT components and/or pull-ups as classification standards set at the fifth percentile of all ITB graduates (LOE 2 females and males) would have excluded all 23 female medical drops.[141] What should be noted is that, while additional screening can increase the potential graduation rates, they can also severely decrease the population of female Marines that would receive an 03xx MOS.

Table 3-5: Potential ITB screening criteria (DORs included and based on 60-rep ammo can lift)

Condition	Sample and Completion Rate		
	Female	Male	Female and Male
Overall ITB Completion	34.5% (124/359)[142]	97.7% (1601/1639)	86.3% (1725/1998)
Pull-ups (6 reps)	38.0% (70/184)	97.7% (1583/1620)	91.6% (1653/1804)
Pull-ups (6 reps), Movement to Contact (in 3:20), Ammo Can Lift (60 reps), MANUF (in 3:12)	59.1% (13/27)	97.8% (1548/1584)	97.3% (1541/1584)
Pull-ups (6 reps), Movement to Contact (in 3:20), Ammo Can Lift (60 reps), MANUF (in 3:12), Shipping Height 64+ inches, Shipping Weight 125+ pounds	72.2% (13/18)	98.0% (1480/1510)	97.7% (1493/1528)

- Other attributes that can be used to screen female Marines for ground combat arms MOSs can be identified in DEP and/or recruit training. Female ITB attendees, as compared with female non-attendees, were more physically fit (both in the DEP and at recruit training), more likely to pass male initial strength test (IST) enlistment criteria and the CFT component of the MOS classification standards (the proposed criteria for future entry into closed occupations), and weighed more or were taller at the time of shipping.[143] Among ITB attendees, when we compared female ITB graduates with non-graduates, although they had similar physical fitness levels (as measured by DEP IST and Recruit Training PFT and CFT scores), graduates were, on average, heavier and taller than non-graduates. Female ITB graduates were no more likely to pass male IST enlistment criteria than female non-graduates were.[144,145]
- The physiological traits of the successful females in LOE 2 favored those who would be considered marginal in terms of the current Marine Corps height and weight standards. Given that the Marine Corps has not evaluated height/weight standards since, at best,

[141] Chewning, ibid. Slide 3.
[142] Pull-up data available missing for 42 of 401 Female Marines.
[143] Desrosiers, Shannon, et al. "Accession Characteristics of Women with the Ability or Propensity to Serve in Combat Arms MOSs." CNA, October, 2014. Slides 9, 14.
[144] Although 54 percent of female ITB graduates passed the male IST enlistment criteria, compared to 59 percent of female ITB non-graduates, the difference was not statistically significant.
[145] In previous CNA scientific analyst work, it found that women who were heavier/shorter at shipping completed more pull-ups by the end of Recruit Training, though women who were leaner/shorter at shipping saw bigger pull-up improvements in DEP and completed more pull-ups by the time they shipped to Recruit Training. This suggests that being leaner can help one improve from 0 pull-ups, but being stronger can help one improve beyond 1 pull-up to complete 3 or more pull-ups. Reference: Shannon Desrosiers, "Female pull-up analysis, updated with series 4000 to 4010." CNA, May 21, 2014.

2008[146], this confirms the need to revalidate height/weight standards for women. It also suggests that the recently used criteria for screening women into previously closed occupations may not be effective (since the female Marines who have been successful in ITB to date were no more likely to have met the initial criteria related to the male IST than those who did not graduate). The physiological traits of the successful female Marines in LOE 3 further indicated that the Marine Corps needs to consider reevaluating the BMI standards, since those successful females tended to be heavier than average female Marines found currently in the Operating Forces, and that their heavier weight was correlated to less-likelihood of injury.[147]

3.3.2 What are the indicators for effective performance in a ground combat MOS and unit?

Assessment: Women compare less favorably to men with regard to strength and durability.

Evidence:

- In studies of NATO countries that have integrated women into combat MOSs and units, the consensus is that women compare less favorably to men with regard to strength and durability. The South African Army was able to show that women have typically 60% of lower leg strength and 40% of upper body strength as compared to men.[148] In a different study, the British Army concluded that the male participants were stronger in all the strength measurements of the hand and fingers.[149] While this may not seem relevant, hand strength matters in tasks involving the moving and loading of heavy ammunition of weapons systems such as artillery, mortars, and tanks.
- The NATO observations on physical strength differences is further confirmed in the LOE 3 data, where analysis shows that when combat arms MOS skillsets were evaluated during the ITF experiment, males outperformed females in physically demanding tasks. Performance differences increased as the size and weight of weapon system increased.[150] Also during LOE 3, the University of Pittsburgh was able to show physiological differences in males and females by taking baseline measurements across all body parts prior to the commencement of the GCE-ITF.[151]
- Table 3-6[152] summarizes all physical and physiological tests conducted by the University of Pittsburgh on the baseline population of LOE 3 Marines at the GCE-ITF. As discussed in Section 3.2.2, with the exception of balance and flexibility, nearly all physical and physiological variables tested favored the male Marines.

[146] Coleman, Lt Col Lawrence. "Information Paper: USMC Height and Weight Standards." MCFIO, November 2014.
[147] Allison, Dr. Katelyn F. "United States Marine Corps Ground Combat Element Integrated Task Force Research ONR Award #N00014-14-1-0021. Draft Final Report August 14, 2015.". August 14, 2015. Table 22, Page 86.
[148] Nolte and Bredankamp, "Functional Body Strength: A South African Approach to Gender Differences." ERGOTECH, October, 2008. Page 13.
[149] Nolte and Bredankamp, "Functional Body Strength: A South African Approach to Gender Differences." ERGOTECH, October, 2008. Page 7.
[150] Johnson, Paul C., et al. "GCEITF Experiment Results 3rd Draft." MCOTEA, 16 July 2015. Slide 10.
[151] Allison, Dr. Katelyn F. *USMC GCE-ITF Research, ONR Award #N00014-14-1-0021, Status Report.* University of Pittsburgh, March 2015. Print. Pages 13-25.
[152] Allison, Dr. Katelyn F. "United States Marine Corps Ground Combat Element Integrated Task Force Research ONR Award #N00014-14-1-0021. Draft Final Report August 14, 2015." Print. Page 10.

- More detail on the overlapping nature of data within the male and female Marines can be found in Table 5 in the appendix of the University of Pittsburgh final report.[153]

Table 3-6: U-Pitt musculoskeletal and physiological data

Body Part / Event:	Difference:	Overlap:	Testing Methodology:
Shoulder: Internal Rotation	Females had 30-33% lower strength	Top 10th percentile females overlaps bottom 25th percentile males	Biodex System 3 isokinetic dynamometer, 5 reps
Shoulder: External Rotation	Females had 27-30% lower strength	Top 10th percentile females overlaps bottom 25th percentile males	Biodex System 3 isokinetic dynamometer, 5 reps
Knee Flexion Strength	Females had 13-16% lower strength	Top 10th percentile females overlaps bottom 50th percentile males	Biodex System 3 isokinetic dynamometer, 5 reps
Knee Extension Strength	Females had 11-15% lower strength	Top 10th percentile females overlaps bottom 50th percentile males	Biodex System 3 isokinetic dynamometer, 5 reps
Torso Right and Left Rotation Strength	Females had 21% lower strength	Top 10th percentile females overlaps bottom 50th percentile males	Biodex System 3 isokinetic dynamometer, 5 reps
Torso Flexion and Extension Strength	Females had 15-20% lower strength	Top 10th percentile females overlaps bottom 25th percentile males	Biodex System 3 isokinetic dynamometer, 5 reps
Body Composition	Gender comparison not warranted. Females inherently possess 10% greater body fat than men	n/a	BOD POD body composition tracking system
Anaerobic Power	Females had 15% less power	Top 25th percentile females overlaps bottom 25th percentile males	Velotron cycling ergometer
Anaerobic Capacity	Females had 15% less capacity	None	Velotron cycling ergometer
Aerobic Capacity (VO2max)	Females had 10% lower capacity	Top 10th percentile females overlaps bottom 50th percentile males	Parvo Medics TrueOne 2400 Metabolic Unit
Lactate Threshold	Females were 1% higher	n/a	Arkray Lactate Pro blood lactate test meter
Field Testing: Medicine Ball Toss	Males had 26% longer tosses, on average	None	Medicine ball tossed while Marine is on seated on knees
Field Testing: Broad Jump	Males had 20% longer distances	None	Standing broad jump
Field Testing: Sit and Reach	Females had 30% shorter distance	Top 25th percentile females had greater flexibility than all percentiles males	Sit and reach (reaching toward toes)
Field Testing: Pro-Agility	Males had 10% faster times in both right and left directions	None	Pro-Agility (5-10-5) Drill
Balance: Single-Leg, Eyes Open	Females had 26-30% better bilateral balance	Top 25th percentile males overlaps bottom 25th percentile females	Single-leg balance, eyes open
Balance: Single-Leg, Eyes Closed	Females had 25-32% better bilateral balance	Top 25th percentile males overlaps bottom 25th percentile females, and better left leg balance than the bottom 50th percentile of females	Single-leg balance, eyes closed

[153] Allison, Dr. Katelyn F., ibid, Page 76.

Body Part / Event:	Difference:	Overlap:	Testing Methodology:
Dynamic Jump Landing: Hip	Females had 20-23% greater hip flexion and 18% less right hip abduction	n/a	3D optical capture system
Dynamic Jump Landing: Knee	Females had 22-25% greater bilateral knee flexion at initial contact and 2-5% greater knee flexion angle at maximal flexion	n/a	3D optical capture system
Ground Reaction Forces: Dynamic Jump Landing	Females demonstrated 5-7% lower bilateral landing forces	n/a	Kistler force plates
Shoulder External Rotation, Internal Rotation, and Posterior Shoulder Tightness Flexibility	Females, on average, demonstrated greater shoulder external and internal rotation range of motion compared to males, but comparable posterior shoulder tightness	n/a	Digital inclinometer Average of 3 measurements in (°)
Torso Rotation Flexibility	Females and males, on average, demonstrated similar torso rotation flexibility, and both genders demonstrated greater flexibility towards the right	n/a	Biodex System 3 isokinetic dynamometer, 3 repetitions to right and left maximum rotation Average of 3 joint angles in (°)
Hamstring Flexibility	Females, on average, demonstrated greater bilateral hamstring flexibility	n/a	Saunders Digital Inclinometer 3 measures Passive knee flexion and hamstring Average of 3 joint angles in (°)
Ankle Flexibility	Females, on average, demonstrated greater flexibility	n/a	Saunders Digital Inclinometer 3 measures Active ankle dorsiflexion Average of 3 joint angles in (°)

- The University of Pittsburgh conducted similar research on 101st Airborne Division soldiers.[154, 155] The conclusions reached are comparable to those observed by NATO and at the GCE-ITF. There was a demonstrated significant physical and physiological differences between male and female Soldiers and increased injury rates in female Soldiers, specifically:
    - Female Soldiers have significantly higher body fat percentage and lower lean mass
    - Female Soldiers have significantly lower anaerobic power and capacity, in both absolute terms and when normalized to body weight
    - Female Soldiers have significantly lower aerobic capacity, in both absolute terms and when normalized to body weight
    - Female Soldiers have significantly lower shoulder, knee, torso, and ankle strength, in both absolute terms and when normalized to body weight

[154] Keenan KA, Abt JP, Sell TC, et al. Strength differences between male and female soldiers of the 101st Airborne Division (Air Assault). Paper presented at: National Athletic Trainers' Association Annual Meeting; Jun 19-22, 2011; New Orleans, LA.
[155] Keenan KA, Sell TC, Abt JP, et al. Physiological differences between male and female Army soldiers matched on age and years of service. Paper presented at: American College of Sports Medicine Annual Meeting; May 31-Jun 4, 2011; Denver, CO.

- The UK Ministry of Defense identified 21 factors affecting combat effectiveness in integrated units. The following three were determined unlikely to be mitigated: [156] 1. Morbidity: British women have 15-20% higher rate of disease non-battle injury (DNBI). Women also may sustain higher combat casualty rates due to a lower ratio of explosive power in relation to the combat load carried. 2. Deployability: Women are predisposed to a higher incidence of injury and are 10% less deployable than men are. 3. Survivability / lethality: As women have a lower absolute maximum for carry capacity, they will fatigue sooner than men will. Since strength is relatively lower in women, fatigue will occur sooner and thus combat marksmanship will degrade sooner than men will.
- Additionally, IDF senior leadership commented on similarities and differences between combat experiences for females in the IDF, and female Marines, indicating that most women in the Marine Corps have more combat experience than the women in combat arms in the IDF.
- Most significantly, some aspects of the IDF policy equate to gender-normed standards. For example, based on their load carriage index (LCI) for tactical movements, female IDF personnel are limited to 33% of their body weight, while males are limited to 60% of their body weight. Such standards violate the gender neutrality requirement established by the SecDef and the NDAA 2014 mandate.

3.3.3 What, if any, effect does gender integration have on injury rates?

Assessment: Women sustain injuries at higher rates than do men, with fatigue and susceptibility to stress injuries being major factors.

Evidence:

- In studies of NATO countries that have integrated women into combat MOSs and units, the consensus is that women sustain injuries at higher rates than men do, with fatigue and susceptibility to stress injuries being major factors. The Marine Corps conducted a study that analyzed reasons for non-deployability and found that regardless of gender, the overwhelming cause for non-deployability is for medical reasons.[157]
- LOE live testing confirmed the NATO observation. LOE 3 results showed that female participants in the ITF live testing were more likely to miss training for injury or illness than their male counterparts were.[158] Improved screening can greatly reduce injury rates in FLC. LOE 2 results showed that in ITB, when women were screened out by the three CFT component criteria (see Table 3-2), all medical drops were screened out as well. But even prior to Marines attending an FLC, indicators for success and reduced attrition can be used at DEP. CNA concluded that higher scores on the DEP IST predict lower injury rates for both men and women during recruit training. Females in the top third (IST ≥ 201) have an injury rate of 4.6%, middle third (155 ≤ IST ≤ 200) 5.8%, and bottom third (IST ≤

[156] "Women in Ground Close Combat (GCC) Review Paper." United Kingdom, 2014.
[157] Rook, Capt Chad, and Jessica Hancock. "Assessment of Marine Non-deployability and the Effects on Readiness." Operations Analysis Division, March 2014. Microsoft PowerPoint. Slide 16.
[158] Johnson, Paul C., et al. "GCEITF Experiment Results 3rd Draft." MCOTEA, 16 July, 2015. Slide 8.

154) 7.6%.[159] CNA also found that male and female medical attrition differences narrow considerably when male and female Marine recruits of similar initial physical ability (as measured by gender-neutral IST run times) are compared.[160]

- The University of Pittsburgh showed that fat free mass was correlated to injuries for LOE 3 participants. Marines in LOE 3 who exhibited higher amounts of fat-free mass had lower levels of injury rates.[161]
- Whether or not males and females are trained together or separate makes a difference. When the British Army switched from a gender-normed system (lower entry and exit standard for women) to a gender-neutral system (same male and female standard) in 1998, female recruit overuse injury related discharges increased from 4.6% to 11.1% while male rates remained constant around 1.5%. By reintroducing gender-separated training (extending initial training by 2-3 weeks and separating males and females), the overall medically related attrition for women decreased by 22% and medically related attrition associated with training decreased by 47%.[162] In mixed gender military training, female recruits exert themselves physically and physiologically much more than male recruits. Increased physical activity leads to over training/physical injury.[163] Women are more flexible than men are, but are also more susceptible to joint dislocations and sprains.[164] However, the University of Pittsburgh observed that flexibility not always directly associated with improved performance—rather than a linear relationship, an appropriate range of flexibility is desired for injury prevention and performance (i.e., not too inflexible, but not too flexible).[165]
- A joint study between the U.S. Army and Israel started with the premise that women are two to six times at greater risk for stress fracture than are men undergoing similar training.[166] Using peripheral quantitative computed tomography (pQCT), they analyzed women entering recruit combat training in the IDF and found that women possess disadvantages in bone geometry, strength, and mineralization that may result in greater susceptibility to bone overuse injury relative to their male counterparts. They also found that male recruits had greater bone absorption rates than females over time, which also contributes to female susceptibility to bone injury.

[159] Trost, Robert, Jeff Peterson, Robert Shuford, Aline Quester, and Cathy Hiatt, "Assessing How Delayed Entry Program Physical Fitness is Related to In-Service Attrition, Injuries, and Physical Fitness." CNA, 2014. Page 14.
[160] Hattiangadi, Anita, and David Strauss. "Women in Service Restrictions: Key Issues and Initial Analysis." CNA, April 2012. Page 13.
[161] Allison, Dr. Katelyn F. "USMC GCE-ITF Research." University of Pittsburgh Neuromuscular Research Laboratory, March 30, 2015. Table 22, Page 89.
[162] Izard, "Gender Differences and Temporal Trends in Medical Attrition During British Army Recruit Training." The Army Recruiting and Training Division. United Kingdom, October, 2008. Page 7-4.
[163] Hölzl, et al. "Gender Differences and their Impact on Physical Performance in Soldiers of the Austrian Armed Forces." Austrian Armed Forces, October, 2008. Page 15-3
[164] Hölzl, et al., ibid, Page 15-7.
[165] "US Marine Corps Ground Combat Element Interim Report (GCE-ITF)." University of Pittsburgh, 2015
[166] Evans, "Gender Differences in Parameters of Bone Health in Military Recruits: Beyond Bone Density." October, 2008. Page 21-2.

3.4 Institutional Costs

Finding: Based on results from numerous studies, direct-effect of costs of integration are likely to be one-time and quite low. These will principally apply to modifications to personal protective equipment, modifications to equipment, and modifications to facilities. Indirect costs (e.g., T2P2) will be enduring and higher than direct costs. These will stem from school failures and the subsequent recycling or reclassifying of students. The following result is based on current ITB completion rates (DORs included):

- 35.9% F (144/401) 97.7% M (1601/1639)

Results from the Integrated Task Force show higher injury rates for females—more specifically from ITF Occupational Injuries than from ITF Non-Occupational Injuries:

- ITF Occupational Injuries
    - Females more likely than males by 19%
- ITF Non-Occupational Injuries
    - Males more likely than females by 12%

Additional results show a higher female medical separation rate and non-deployability rate than males:

- Higher medical separation rates
    - 2.4% for females and 1.6% for males
- Higher non-deployability rates (at least one three-month period in a four-year assessed period)
    - 20% for females and 5.4% for males

Assuming voluntary assignments to combat arms, Joint Advertising Market Research and Studies (JAMRS) data indicate that any policy changes are likely to have a neutral to positive effect on recruiting under the all-volunteer force structure. However, CNA survey research identified that mandatory assignments to ground combat arms MOS or units would have a negative impact on recruiting: "The Corps could face larger recruiting challenges if a policy change opens combat arms PMOSs to women or if the Corps makes female ground combat assignments (to PMOSs or GCE units) involuntary."[167]

3.4.1 What, if any, effect does gender integration have were the effects on female attrition rates?

Assessment: A thorough review of various U.S. and NATO studies, together with an exhaustive literature review, found that female integration into ground combat arms MOSs may result in increased female attrition rates at FLCs and costs in reclassification due to lower completion and post-training continuation rates when compared to males.[168] The Tank and AAV ground combat arms MOSs female

[167] Hattiangadi, Anita, and David Strauss. *Women in Service Restrictions: Synopsis of Completed Work and Recommended Next Steps.* CAN, December, 2012. DRM-2012-U-003253-Final

[168] Schaefer, Agnes G., et al. *Implications of Integrating Women into the Marine Corps Infantry.* RAND National Defense Institute May, 2015. Print.

completion rates are lower as compared to the all-male rates today, while Infantry showed much lower rates. Female infantry attrition at ITB could be reduced significantly through better screening, although there will likely remain a significantly higher female attrition rate than male rate, and such screening would substantially cut the quantity of eligible females.

Evidence:

Females and males who entered FLCs in support of LOE 2 experienced the following completion rates: [169]

- ITB completion: 35.9% F (144/401) 97.7% M (1601/1639)
- DORs removed: 46.2% F (144/312) ------- ----------
- Artillery completion: 85.7% F (12/14) 98.7% M (232/235)
- DORs removed: 100% F (12/12) ------- ----------
- Tank completion: 66.7% F (4/6) 100% M (67/67)
- DORs removed: 100% F (4/4) ------- ----------
- AAV completion: 71.4% F (5/7) 98.0% M (99/101)
- DORs removed: 83.3% F (5/6) ------- ----------
- IOC completion: 0% F (0/29) 70.8% M (692/978)

No school attrition due to injury took place during Tank, Artillery, and AAV ground combat arms MOS training.

A solution that could significantly reduce the large disparity of female attrition at ITB would be to develop a better ITB screening tool. The current ITB physical fitness standard is a male third class PFT and CFT; and females are required to meet this same PFT/CFT standard for ITB attendance. However, the current method for screening females into the FLCs—having a minimum of a third-class male PFT and CFT—lets a large percentage of females into these schools who are unable to pass the current standards. While development of a more stringent screen might increase the graduation rate, it would likely reduce the number of female Marines eligible to attend a given FLC.

An alternative screening methodology is developed in section 4 of this document.

Although the artillery projectile lift and load tasks are not graduation requirements, female Marines have a lower first attempt completion rate.

- Artillery projectile lift pass: 16.6% F (2/12) 72.0% M (136/189)
- Artillery projectile load pass: 8.3% F (1/12) 67.7% M (128/189)

On the other hand, the tank ordnance handle and load task is a graduation requirement and shows a lower female first attempt completion rate compared to males.

- Tank ordnance handle and load pass: 25% F (1/4) 52.2% M (12/23)

[169] Data on graduation rates at FLC are taken from tables 4-4, 4-9, 4-14, and 4-19 of this document.

3.4.2 What, if any, effect does gender integration have on T2P2 population?

Assessment: Female integration into ground combat arms MOSs will likely result in an increased number of females in the training and patient categories. However, based on the estimated low numbers of females that will enter the ground combat arms MOSs, this impact is likely to be marginal.

Evidence:

For females and males who entered non-infantry FLCs, both experienced similar completion rates when DORs were removed from the population. However, when DORs are included, the data depicts a lower completion rate.[170] Again, there was no school attrition during Tank, Artillery, and AAV ground combat arms MOS training due to injury.[171] The following school graduation rates include DORs:

- Artillery completion rates: 85.7% F (12/14) 98.7% M (232/235)
- Tank completion rates: 66.7% F (4/6) 100% M (67/67)
- AAV completion rates: 71.4% F (5/7) 98.0% M (99/101)

For ITB, females and males experienced different completion rates based on LOE 2 data. Females experienced lower completion rates than males, with DORs excluded here.[172]

- ITB completion rates: 35.9% F (144/401) 97.7% M (1601/1639)

Common reasons for females not completing ITB include:[173]

- Fractures: 3.99% F (16/401)
- Brachial Plexopathy: 0.75% F (3/401)
- Complex Regional Pain Syndrome: 0.25% F (1/401)
- Torn Ligament: 0.25% F (1/401)
- Heat Injury: 0.25% F (1/401)
- Strains: 0.25% F (1/401)

Additional analysis of U.S. Army school injury rates show a dramatic difference between males and females. Injury rates at four different training locations and across multiple courses showed a female injury rate approximately twice the male rate.[174]

NATO militaries also conducted similar injury research that compared females to males. Their research on workload balance and injury frequency concluded that females exert themselves considerably more than males while conducting typical military tasks.[175] They concluded that a significant

[170] Data on graduation rates at FLC are taken from tables 4-4, 4-9, 4-14, and 4-19 of this document.
[171] Pappa, Leon, et al. "MCFIP LOE2 (Expanded ELT Research Studies) Research Assessment & Findings Report." TECOM 2 July, 2015. Slide 6.
[172] Chewning, Laura. "LOE2 EOS Slides V6," TECOM LOE 2 Data Analysis. OAD 14 July, 2015. Slide 2.
[173] Pappa, Leon, et al. "MCFIP LOE2 (Expanded ELT Research Studies) Research Assessment & Findings Report." TECOM 2 July, 2015. Slide 25-27.
[174] Injury and Prevention Program. "IET Injury and Fitness Surveillance Fiscal Years 2010-2013." U.S. Army Institute of Public Health, 3 July 2014.
[175] Thomas, Hölzl, et al. " Gender Differences and their Impact on Physical Performance in Soldiers of the Austrian Armed Forces" NATO Science and Technology Organization, October, 2008. Page 15-4/RTO-MP-HFM-158

factor of injuries was based on fatigue; thus, women as a whole were more prone to injury than men were.[176]

Based on the above studies, it is expected that the U.S. patient category will likely increase for females due to the likelihood of injury during training. This will result in either additional recuperation time or medical separation.

Female ITF readiness rates were compared to male ITF readiness rates. The list below depicts the result of modeling where gender effects were examined:[177] Females were significantly more likely to incur an illness or live testing injury than male counterparts were:

- Visit Aid Station — F 37% more likely than M
- Experience Lost Training Days — F 18% more likely than M
- Experience Lost Live Testing Days — F 13% more likely than M
- Experience Non-Occupational Injury — F 12% less likely than M
- Experience Occupational Injury — F 19% more likely than M
- Unavailable to Participate in Live Testing — F 25% more likely than M
- Incur an Illness — F 189% more likely than M
- Incur Live Testing Injury — F 208% more likely than M

However, because estimates predict a low number of female accessions into the ground combat arms MOSs, the impact is likely to be marginal. This estimate is based on MCRC's accession data and projected data. MCRC shows historical annual female accessions of 2,800[178] during FY13, approximately 3,100 during FY14, and an estimated 3,500 for FY15. Due to the low proportion of females who will qualify and serve in a particular ground combat arm MOS, the resulting cost of recruiting females into the combat arms is also likely to be low.

For the aggregate Marine Corps population, the magnitude of the impact is likely to be marginal. This conclusion is based on the analysis of the 16-21 year old female population propensity: 29% eligible U.S. females (medical, academic, etc.),[179] followed by an 8% likelihood to serve in the military,[180] and finally a 3% propensity to serve in the Marine Corps.[181]

Additionally, for females who have entered the DEP, propensity estimates show a likelihood to serve in one of the newly opened MOSs (combat support or combat vehicle repair) at 21.4%, and ground

[176] Thomas, Hölzl, et al. "Gender Differences and their Impact on Physical Performance in Soldiers of the Austrian Armed Forces" NATO Science and Technology Organization, October, 2008. Page 15-5/RTO-MP-HFM-158
[177] Johnson, Paul C. et al. "GCEITF Experiment Results 3rd Draft." MCOTEA, 16 July, 2015. Slide 6
[178] Schaefer, Agnes G., et al. "Implications of Integrating Women into the Marine Corps Infantry." RAND, May, 2015. Page 98, PR(L)-1571-2-USMC. "…largest number of women ever to enter the Marine Corps in a single year." (Experienced during FY 2013 with male accessions at 28,312)
[179] Jordan, Miriam. "Recruits' Ineligibility Tests the Military." Wall Street Journal, 27 June, 2014. http://www.wsj.com/articles/recruits-ineligibility-tests-the-military-1403909945
[180] Marine Corps Recruiting Command. "MCFIP Quarterly Update (Jul, Aug, Sept)." JAMRS, 22 October, 2014. Slide 25
[181] Marine Corps Recruiting Command. "MCFIP Quarterly Update (Jul, Aug, Sept)." JAMRS, 22 October, 2014. Slide 27

combat arms MOSs at 10%.[182] The following example depicts this comprehensive female propensity analysis.

Example: (medical, academic, and other qualification requirements estimate the eligible male and female population of 17-to-24-year-olds for military service at approximately 29%)

- Female 18-year-old population on Jan 2014 = 2,063,431
- Military Service 8% = 165,075
- USMC 3% = 4,953
- Eligible to serve 29% = 1,437 (.29 * 4,953)
- Newly Opened MOSs 21.4% = 308 (.214 * 1437)
    - 320/1,497 = 21.4%
- Ground Combat Arms MOSs 10% = 144 (.10 * 1437)
    - 150/1,497 = 10%

3.4.3 What, if any, effect does gender integration have on medical separation rates?

Assessment: Historical data identified that female Marines enter a medical non-deployable state at much higher rates than males, and medically separate at higher rates. Based on the British experience, integrating recruit training caused a significant spike in overuse injuries for females. However, female overuse injuries diminished considerably after re-separation and lengthening of female training.

Evidence:[183]

Females

- 20,937 females analyzed (Sept 08 – Oct 12).
- 4,228 entered a medically non-deployable state (20% of 20,937).
- 1,684 total female separations (40% of 4,228; 8% of 20,937).
- 506 medical separations (30% of 1,684; 2.4% of 20,937)

Males

- 280,279 males analyzed (Sept 08 – Oct 12)
- 15,110 entered a medical non-deployable state (5.4% of 280,279).
- 8,437 male separations (56% of 15,110; 3.01% 280,279)
- 4,493 medical separations (53.25% of 8,437; 1.6% of 280,279)

[182] Marine Corps Recruiting Command. "MCFIP Baseline Analysis, Version 2." MCRC, 28 June, 2014. Slide 5
[183] Rook, Capt. Chad, and Jessica Hancock. *Assessment of Marine Non-deployability and the Effects on Readiness.* Operations Analysis Division, March 2014. Microsoft PowerPoint. Slide 16

Male and female medical attrition differences narrow considerably when male and female Marine recruits of similar initial physical ability are compared.[184] This was measured using gender-neutral IST run times.

Augmenting this data is the British experience highlighting injury rates and medical discharges. One factor that contributed to British Army female recruit overuse injuries and medical discharges was the 1998 recruit training transition to a gender-neutral system from a gender-normed standard. The gender-normed recruit training standards required lower entry and exit standards for females. Female overuse injuries (e.g., stress fracture, back pain, and Achilles tendonitis) all increased with muscle fatigue.[185]

Based on their experience, recruit training integration caused a significant spike in overuse injuries for females. After adopting gender-integrated training, British female recruit overuse injury rates increased from 4.6% to 11.1%, while male recruit rates remained constant around 1.5%. However, this was diminished significantly after re-separation and lengthening of the duration of female training. Extending initial training by 2-3 weeks, in addition to separating males and females, resulted in an overall decrease of female medical attrition by 22% and decreased female medical attrition from training by 47%.[186]

3.4.4 What, if any, effect does gender integration have on equipment costs?

Assessment: If the Marine Corps chooses to better adapt some of its equipment to facilitate female integration, then equipment costs could rise. However, cost estimates are not likely to be substantial. Furthermore, some modified equipment could enhance performance and reduce injury rates for males as well.

Evidence:

The low costs associated with modifications to equipment and facilities would include equipment modifications or redesign to fit the fifth percentile female population through the 95th percentile male population. In general, modifications would need to be made on the inventory of Personal Protective Equipment (PPE) and Load Bearing Equipment (LBE) for female Marines entering the 03xx occupational field. Specific areas identified include modifications to the helmet h-harness ($20.86/unit), protective vest shoulder pads ($25.00/unit), casualty evacuation straps ($70.00/unit), and adjustable pack frame ($270.00/unit). Beyond the above-mentioned items, modifications would also be needed for a greater selection of Small Arms Protective Insert (SAPI) plate sizes for female Marines.[187] Once these modifications are in place, they could also enhance physical performance and reduce injury rates for both male and female Marines.

Additional equipment modifications and adaptations were identified during the assessment of Marines studied during the GCE-ITF. The results showed a justification for various equipment redesign and/or retrofit. Once completed, these would have benefits of lower injury rates for both male and female

[184] Hattiangadi, Anita, and David Strauss. "Women in Service Restrictions: Key Issues and Initial Analysis." CNA, April 2012/DSI-2012-U-000572-Final

[185] Gemmell, Ian M.M. "Injuries among female army recruits: a conflict of legislation." Journal *of the Royal Society of Medicine 95.1 (2002): 23-27.* Specifically, stress fractures are the result of unopposed tensile stress on the bones, due to the lack of musculature compressive force.

[186] Izard, Rachael. "Gender Differences and Temporal Trends in Medical Attrition during British Army Recruit Training." NATO Science and Technology Organization, October, 2008. Page 7-4/RTO-MP-HFM-158.

[187] Jadro, Capt Bryan, Mark Desens, and Mary Bosserman. *Smart Adaptations Study*: Operations Analysis Division, May 2015. Print, page 9.

Marines. Some specific redesign and retrofit recommendations include the LAV-25 Snatch Block (vehicle recovery), M240 Butterfly Trigger, and the M777 Howitzer Step.[188]

3.4.5 What, if any, effect does gender integration have on facility costs?

Assessment: HQMC, I&L LPE estimates that gender integration will require $13–$14 million dollars for facility modifications.[189]

Evidence:

Total initial cost estimates (Doctrine, Organization, Training, Materiel, Leadership & Education, Personnel, and Facilities [DOTMLPF], January 2014) amounted to $12,800,000. Total updated cost estimates (Marine Forces [MARFORs], August 2014) amounted to $13,000,000.[190]

3.4.6 What, if any, effect does gender integration have on recruiting costs?

Assessment: Based on JAMRs data, female integration into ground combat arms MOSs is estimated to have a neutral to positive impact on male and female recruiting.

Evidence:

Based on the 16-to-21-year-old polling, more than 40% of the female respondents indicated that a policy change would have no impact on their likelihood to serve, 30% indicated it made them more likely to serve, and 20% indicated it made them less likely to serve. Of the male respondents, 69% indicated that a policy change would have no impact on their likelihood to serve, with more males indicating that it made them more likely to serve at 17% than not likely at 9%.[191]

Historically, the female populace has shown an 8% propensity to serve in the military; of which, 3% has shown an interest to serve in the Marine Corps.[192] Females in the DEP (1,497) were asked about their interest in the newly opened combat support and combat vehicle repair MOSs; 21.4% responded with interest. The same population was asked about their interest in the currently closed ground combat arms MOSs; 10% responded with interest.[193]

When considering recruiting costs, an important factor will be the current MCRC interview to contract ratios of 9:1 for female recruits and 5:1 for male recruits. Recruiting females into the Marine Corps is more resource intensive.[194]

[188] Jadro, Capt Bryan, Mark Desens, and Mary Bosserman. *Smart Adaptations Study*. Operations Analysis Division, May 2015. Print, page 27. Figures 7 through 11 provide greater detail on select items from table 3. The figures include illustrations of current equipment and the barriers to performance posed by them. As appropriate, commercially available products are depicted that may help reduce those barriers.
[189] HQMC, I&L. "COA 1 Concept of Resource Requirements." LPE preliminary cost estimates, April, 2015.
[190] HQMC, I&L. "COA 1 Concept of Resource Requirements." LPE preliminary cost estimates, April, 2015.
[191] Marine Corps Recruiting Command. "MCFIP Quarterly Update (Jul, Aug, Sept)." JAMRS, 22 October, 2014, slide 24.
[192] Marine Corps Recruiting Command. "MCFIP Quarterly Update (Jul, Aug, Sept)." JAMRS, 22 October, 2014, slide 25 and 27.
[193] Marine Corps Recruiting Command. "MCFIP Baseline Analysis, Version 2." MCRC, 28 June, 2014, slide 5.
[194] Validated with MCRC on 5 Jun 2015, Swope, LtCol Jonathan S., Head, Enlisted Recruiting Operations.

4 Screening

4.1 Introduction

As we have seen in the previous results, the current method for screening females into the FLCs—having a minimum of a third-class male PFT and CFT—lets a large percentage of females into these schools that are unable to pass the current standards. There are also some indications that this may only be exacerbated when the new, MOS-specific standards are put in place. Thus, to mitigate this risk, we explored alternative screening methods that would reduce this risk and increase the likelihood of success for females in combat arms schools and at the same time do no harm to the male graduation rates.

In order to keep the implementation simple and executable under the current system, we explored potential screens for which the Marine Corps already evaluates all Marines and maintains the scoring records necessary to enable such screening methodologies. These include PFT and CFT components, Armed Services Vocational Aptitude Battery (ASVAB) components, and height and weight. Ideally, based on our research, we would have liked to explore lean body mass of the individuals, which would likely be correlated to the ability to hike under load. However, given that those measurements are not currently available and require additional equipment and expertise, we have used height and weight as a surrogate. Finally, our analysis required data on male performance at the various FLC. However, this data was not collected under LOE-2, so we turned to the Marine Corps Training Information Management System (MCTIMS). For that reason, the reader will note differences in the graduation rates of males between this section and previous sections.

The value of screening is twofold, benefitting both the Marine Corps as an institution and the individual Marine. From the institutional perspective, applying appropriate screens can reduce the school failure rates as well as injuries in schools, and this mitigates the impact on T2P2, and associated reclassification activities and turmoil. From the individual Marine perspective, we strive to set all Marines up for success, as failures not only cost the institution but also can affect such areas as future retention. Having large numbers of females failing out of school could have a detrimental effect on not only those female Marines but also others who observe their training outcome.

In the remainder of this section, we will provide some examples and insight into potential screens and how they might affect graduation rates and injury rates. It is not the objective of this report to develop a recommended screening solution for the Marine Corps. Rather, it is simply to provide data on the effects of various screening methods to enable the Marine Corps to make a more informed decision about developing and implementing MOS classification standards.

4.2 Screening Methodology

A multivariate logistic regression model was developed based on the LOE 2 females that attempted ITB and the males that attempted ITB from Charlie Company 4-14 (3 December 2013 ITB pickup date) through Charlie Company 4-15 (2 December 2014 ITB pickup date). We had data for 401 female Marines, who attempted ITB under the auspices of the LOE 2 effort, and 1,639 males from C Co 4-14 to C Co 4-15. The output variable for the regression model was whether or not the Marine graduated ITB and the input variables for the model were:

- Number of final Marine Corps Recruit Depot (MCRD) pull-ups,
- Final MCRD three-mile run time
- Number of final MCRD crunches
- Final MCRD movement to contact (MTC) time
- Number of final MCRD ammo can lifts
- Final MCRD maneuver under fire (MANUF) time
- Shipping height and shipping weight,
- ASVAB component scores, including Clerical (CL), Auto and Shop Information (AS), Electronics Information (EI), Mathematics Knowledge (MK), Word Knowledge (WK), General Technical (GT), General Science (GS), Electronics (EL), Mechanical Comprehension (MC), Arithmetic Reasoning (AR).

The p-values associated with each variable as it relates to graduation are shown in Table 4-1:

Table 4-1: p-values associated with each variable as it relates to graduation

Variable	p-value
Final MCRD Pull-ups	<.0001
Final MCRD MTC Time	<.0001
Final MANUF Time	<.0001
Shipping Height	<.0001
Final MCRD Ammo Can Lift	.0002
Shipping Weight	.0019
Crunches	.1037
WK	.348
Final MCRD Run Time	.3908
AS	.5079
CL	.5273
EI	.6619
MK	.7155
GT	.7363
GS	.7572
EL	.7661
MC	.8140
AR	.9339

The variance inflation factor (VIF) was analyzed to look for collinearity among the input variables, and the VIF was below four for all variables, so it is not a concern for this model. The p-value that we are using for significance is anything below .05. Therefore, we have down-selected the following components for consideration for classification standards for ITB (and other combat arms schools): final MCRD pull-ups, final MCRD MTC time, final MCRD MANUF time, final MCRD ammo can lifts, shipping height, and shipping weight.

Because these standards will be used to classify Marines, the desire is to set the standard at the 95% tolerance limit for 95% of the graduates for each of these variables that were found to be significant in the regression model. The 95% tolerance limit for 95% of the graduates gives us 95% confidence that 95% of the graduates would have a value for each variable that meets or exceeds that value. The 95% tolerance limit for 95% of the graduates is shown in Table 4-2 for each MOS school:

Table 4-2: 95% tolerance limit for 95% of the graduates for each MOS school

Variable	03xx	0811	1812	1833	All LOE 2 Combined
Final MCRD Pull-ups	6	7	7	6	7
Final MCRD MTC Time	3:18	3:24	3:20	3:20	3:18
Final MANUF Time	3:04	3:02	2:56	3:02	3:04
Final MCRD Ammo Can Lifts	68	66	71	71	68
Shipping Height (in)	64	64	63	64	64
Shipping Weight (lbs.)	125	118	124	130	124

4.3 Effects of Screening on Graduation and Injury Rates

Based on the standards developed in Section 4.2, we will apply these standards to the population of LOE 2 females and the males that attended each particular MOS school, to see the effects the suggested standards would have had on the population. An anomaly in the ammo can lift calculations arises because females only need to perform 60 lifts to maximize their score, whereas males need to, and do, go higher. Thus, while we initially calculated the proposed standards based on the strict methodology described earlier, we also looked at the impact of restricting the ammo can lift to 60. The results were that the 60-standard was as good or better in predicting success and reducing failures and injuries, and so the remainder of this section will provide the results for this lower standard.

4.3.1 03xx Screening with 60 Ammo Can Lifts

For the 03xx LOE 2 females and ITB males, we are using the values shown in Table 4-3:

Table 4-3: Proposed standards for the 03xx LOE 2 females and ITB males

Variable	Proposed Standard
Final MCRD Pull-ups	6
Final MCRD MTC Time	3:18
Final MANUF Time	3:04
Final MCRD Ammo Can Lifts	60
Shipping Height (in)	64
Shipping Weight (lbs.)	125

A total of 401 females volunteered for ITB and did not drop on request prior to the start of training. However, we are missing the final MCRD pull-ups for 42 of those females. Because of the missing pull-up data, the analysis of graduation rates to follow will use this sample of 359 for females.

Based on the 359 LOE 2 females and 1639 ITB males for which we have data, the graduation rates at ITB of Marines (screened by third class male PFT and third class male CFT standards out of recruit training) were as follows:

Table 4-4: Graduation rates at ITB of Marines (screened by third class male PFT and CFT standards)

Gender	Graduation %
Female	34.5% (124/359)
Male	97.7% (1601/1639)
Female and Male	86.3% (1725/1998)

If the pull-up standard of six is applied to these Marines' MCRD pull-up scores, and we removed the Marines from the population who have less than six pull-ups, we are left with the following graduation percentages of the population, as shown in Table 4-5:

Table 4-5: Graduation % with six pull-up standard applied

Gender	Graduation % with 6 pull-up standard applied
Female	38.0% (70/184)
Male	97.7% (1583/1620)
Female and Male	91.6% (1653/1804)

Only 184 out of the 359 LOE 2 females for which we have pull-up data had six pull-ups or more at the time they took the final MCRD PFT; of those 184 females, 70 graduated ITB. The male and combined graduation percentages can be interpreted in a similar manner.

Table 4-6 depicts the graduation percentages of the new population that met the requirements if we apply the pull-up standard along with the standards for all three components of the CFT.

Table 4-6: Graduation % with pull-up and CFT standards applied

Gender	Graduation % with pull-up and CFT standards applied
Female	59.1% (13/22)
Male	97.8% (1528/1562)
Female and Male	97.4% (1541/1584)

Table 4-7 shows the graduation percentages of the new population that met the requirements if we apply the pull-up, CFT, and height and weight standards:

Table 4-7: Graduation % with pull-up, CFT, and HT/WT standards applied

Gender	Graduation % with pull-up, CFT and HT/WT standards applied
Female	72.2% (13/18)
Male	98.0% (1480/1510)
Female and Male	97.7% (1493/1528)

Additionally, there were 23 females and six males in the initial sample that were dropped for medical reasons. The standards with pull-ups and CFT components would have excluded all 23 medically-dropped females from starting ITB and would have precluded one of the six male medical drops from starting ITB. If you add the height and weight standards, one additional male medical drop would have been excluded from starting ITB.

4.3.2 0811 Screening with 60 Ammo Can Lifts

For the 0811 LOE 2 females and males, we are using the following values:

Table 4-8: Proposed standard values for 0811 LOE 2 females and ITB males

Variable	Proposed Standard
Final MCRD Pull-ups	7
Final MCRD MTC Time	3:24
Final MANUF Time	3:02
Final MCRD Ammo Can Lifts	60
Shipping Height (in)	64
Shipping Weight (lbs.)	118

There were 14 LOE 2 females, who volunteered for artillery school and did not drop on request prior to the start of training, and 235 males who attended artillery school with those 14 females.

Based on the 14 LOE 2 females and 235 artillery school males, the graduation rates at artillery school of Marines (screened by third class male PFT and third class male CFT standards out of recruit training) were as follows:

Table 4-9: Graduation percentage at artillery school screened by third class male PFT and CFT standards

Gender	Graduation %
Female	85.7% (12/14)
Male	98.7% (232/235)
Female and Male	98.0% (244/249)

If the pull-up standard of seven is applied to these Marines' pull-up scores from MCRD, and we removed the Marines from the population who have less than seven pull-ups, we are left with the following graduation percentages of the population, as shown in Table 4-10:

Table 4-10: Graduation percentage with seven pull-up standard applied

Gender	Graduation % with 7 pull-up standard applied
Female	100% (7/7)
Male	98.7% (228/231)
Female and Male	98.7% (235/238)

Only seven out of the 14 LOE 2 females had seven pull-ups or more at the time they took the final MCRD PFT; all seven of those female Marines graduated artillery school. The male and combined graduation percentages can be interpreted in a similar manner.

If we apply the pull-up standard along with the standards for all three components of the CFT, we are left with the following graduation percentages of the new population who met those standards, as shown in

Table 4-11:

Table 4-11: Graduation percentage with pull-up and CFT standards applied

Gender	Graduation % with pull-up and CFT standards applied
Female	100% (3/3)
Male	98.6% (217/220)
Female and Male	98.7% (220/223)

If we apply the pull-up, CFT, and height and weight standards, we are left with the following graduation percentages of the new population who met those standards, as shown in Table 4-12:

Table 4-12: Graduation % with pull-up, CFT, and HT/WT standards applied

Gender	Graduation % with pull-up, CFT and HT/WT standards applied
Female	(0/0)
Male	98.6% (210/213)
Female and Male	98.6% (210/213)

The table shows that none of the 12 female graduates would have been eligible to start training based on these standards and that the three Males who previously failed were not screened out based on these standards. However, all three of the males dropped from training in this population were dropped due to academic reasons. Additionally, there were no medical drops from this population in artillery school.

4.3.3 1812 screening with 60 Ammo Can Lifts

For the 1812 LOE 2 females and males, we are using the following values:

Table 4-13: Proposed standard for the 1812 LOE 2 females and ITB males

Variable	Proposed Standard
Final MCRD Pull-ups	7
Final MCRD MTC Time	3:20
Final MANUF Time	2:56
Final MCRD Ammo Can Lifts	60
Shipping Height (in)	63
Shipping Weight (lbs.)	124

Six LOE 2 females who volunteered for tank school and did not drop on request prior to the start of training; 67 males attended tank school with those six females.

Based on the six LOE 2 females and 67 tank school males, the tank school graduation rates of Marines screened by third class male PFT and third class male CFT standards out of recruit training were as follows:

Table 4-14: Graduation rates screened by third class male PFT and CFT standards

Gender	Graduation %
Female	66.7% (4/6)
Male	100% (67/67)
Female and Male	97.2% (71/73)

If the pull-up standard of seven is applied to these Marines' pull-up scores from MCRD, and we removed the Marines from the population who have less than seven pull-ups, we get the following graduation percentages of the population, as shown in Table 4-15:

Table 4-15: Graduation percentage with seven pull-up standard applied

Gender	Graduation % with 7 pull-up standard applied
Female	100% (3/3)
Male	100% (66/66)
Female and Male	100% (69/69)

Only three out of the six LOE 2 females had seven pull-ups or more at the time they took the final MCRD PFT and all three of those female Marines graduated tank school. The male and combined graduation percentages can be interpreted in a similar manner.

If we apply the pull-up standard along with the standards for all three components of the CFT, we get the following graduation percentages of the population, as shown in Table 4-16:

Table 4-16: Graduation percentage with pull-up and CFT standards applied

Gender	Graduation % with pull-up and CFT standards applied
Female	(0/0)
Male	100% (65/65)
Female and Male	100% (65/65)

As depicted in Table 4-16, none of the females who volunteered for tank school would have met the standards based on adding the CFT standards even though four out of six of the females graduated from the school.

If we apply the pull-up, CFT, and height and weight standards, we get the following graduation percentages of the population, as shown in Table 4-17:

Table 4-17: Graduation percentage with pull-up, CFT, and HT/WT standards applied

Gender	Graduation % with pull-up, CFT and HT/WT standards applied
Female	(0/0)
Male	100% (64/64)
Female and Male	100% (64/64)

Adding the height and weight standards to the pull-up and CFT standards would have screened out one additional male who attended tank school during this time.

There were no medical drops from this population in tank school.

4.3.4 1833 Screening with 60 Ammo Can Lifts

For the 1833 LOE 2 females and males, we are using the following values:

Table 4-18: Proposed standard for the 1833 LOE 2 females and ITB males

Variable	Proposed Standard
Final MCRD Pull-ups	6
Final MCRD MTC Time	3:20
Final MANUF Time	3:02
Final MCRD Ammo Can Lifts	60
Shipping Height (in)	64
Shipping Weight (lbs.)	130

There were seven LOE 2 females who volunteered for AAV school and did not drop on request prior to the start of training and 101 males who attended AAV school with those seven females.

Based on the seven LOE 2 females and 101 AAV school males, the graduation rates at AAV school of Marines screened by third class male PFT and third class male CFT standards out of recruit training were as follows:

Table 4-19: Graduation rates at AAV school of Marines screened by third class male PFT and CFT standards

Gender	Graduation %
Female	71.4% (5/7)
Male	98.0% (99/101)
Female and Male	96.3% (108/112)

If the pull-up standard of six is applied to these Marines' pull-up scores from MCRD, and we removed the Marines from the population that have less than six pull-ups, we get the graduation percentages of the population shown in Table 4-20:

Table 4-20: Graduation percentage with six pull-up standard applied

Gender	Graduation % with 6 pull-up standard applied
Female	100% (3/3)
Male	98.0% (98/100)
Female and Male	98.1% (101/103)

Only three out of the seven LOE 2 females had six pull-ups or more at the time they took the final MCRD PFT and all three of those female Marines graduated AAV school. The male and combined graduation percentages can be interpreted in a similar manner.

If we apply the pull-up standard along with the standards for all three components of the CFT, the result are the graduation percentages of the new population who met those standards, shown in

Table 4-21:

Table 4-21: Graduation percentage with pull-up and CFT standards applied

Gender	Graduation % with pull-up and CFT standards applied
Female	100% (1/1)
Male	98.0% (96/98)
Female and Male	98.0% (97/99)

As depicted in

Table 4-21, none of the females who volunteered for AAV school would have met the standards based on adding the CFT standards even though five out of seven of the females graduated from the school.

If we apply the pull-up, CFT, and height and weight standards, we get the following graduation percentages of the population, as shown in Table 4-22:

Table 4-22: Graduation percentage with pull-up, CFT, and HT/WT standards applied

Gender	Graduation % with pull-up, CFT and HT/WT standards applied
Female	100% (1/1)
Male	97.9% (94/96)
Female and Male	97.9% (95/97)

Adding the height and weight standards to the pull-up and CFT standards would have screened out two additional males who attended AAV school during this time, but none of the male failures. However, both of the male failures were the result of poor academic performance.

There were no medical drops from this population in AAV school.

4.3.5 Combined Screening with 60 Ammo Can Lifts

Combining all LOE 2 females (03xx, 0811, 1812, and 1833) and their male counterparts, we developed standards based on the 95% tolerance limit for 95% of the graduates (with the exception of ammo can lift), as shown in Table 4-23:

Table 4-23: Proposed standards based on the 95% tolerance limit for 95% of the graduates

Variable	Proposed Standard
Final MCRD Pull-ups	7
Final MCRD MTC Time	3:18
Final MANUF Time	3:04
Final MCRD Ammo Can Lifts	60
Shipping Height (in)	64
Shipping Weight (lbs.)	125

There were 428 females who volunteered for LOE 2 and did not drop on request prior to the start of training. However, we are missing the final MCRD pull-ups for 42 of the 03xx females. The analysis of graduation rates to follow will use a denominator of 386 for females because of the missing pull-up data.

Based on data we have for the 386 LOE 2 females and 2046 males that attended ELT with these females, the graduation rates for the combined LOE 2 data set (screened by third class male PFT and third class male CFT standards out of recruit training) were as follows:

Table 4-24: Graduation percentage based on the 386 LOE 2 females and 2046 males that attended ELT

Gender	Graduation %
Female	37.6% (145/386)
Male	97.9% (2003/2046)
Female and Male	88.3% (2148/2432)

If the pull-up standard of seven is applied to these Marines' pull-up scores from MCRD, and if we removed the Marines from the population who have less than seven pull-ups, we are left with the following graduation percentages of the population, as shown in Table 4-25:

Table 4-25: Graduation percentage with seven pull-up standard applied

Gender	Graduation % with 7 pull-up standard applied
Female	43.3% (68/157)
Male	97.9% (1965/2007)
Female and Male	93.9% (2033/2164)

Based on the pull-up data we have, only 157 out of the 386 LOE 2 females had seven pull-ups or more at the time they took the final MCRD PFT, and 68 of those 157 females graduated ITB or one of the Combat Arms ELT schools. The male and combined graduation percentages can be interpreted in a similar manner.

If we apply the pull-up standard along with the standards for all three components of the CFT, the graduation percentages of the new population who met those standards is found in Table 4-26:

Table 4-26: Graduation percentage with pull-up and CFT standards applied

Gender	Graduation % with pull-up and CFT standards applied
Female	60.9% (14/23)
Male	98.0% (1894/1933)
Female and Male	97.7% (1908/1956)

If we apply the pull-up, CFT, and height and weight standards, we get the following graduation percentages of the new population who met those standards:

Table 4-27: Graduation percentage with pull-up, CFT, and HT/WT standards applied

Gender	Graduation % with pull-up, CFT and HT/WT standards applied
Female	61.5% (8/13)
Male	98.1% (1825/1860)
Female and Male	97.9% (1833/1873)

Additionally, there were 23 females and six males in this population that were dropped for medical reasons. The standards with pull-ups and CFT components would have excluded all 23 medically dropped females from starting ITB and precluded one of the six male medical drops from starting ELT. If you add the height and weight standards, one additional male medical drop would have been excluded from starting ELT.

4.3.6 Additional potential Height and Weight Standards

Other potential height and weight standards are shown in Table 4-28. These values are the 2.5 percentile and 5th percentile of the current active duty E-2 through E-4 population by occupation field/MOS. This data was pulled from the commander's profile database.

Table 4-28: Additional potential height and weight standards

	03xx (n=20,664)		08xx (n=2,584)		1812 (n=416)		1833 (n=1,021)		Combined MOS (n=24,865)	
	2.5%ile	5th %ile	2.5%ile	5th %ile	2.5%ile	5th %ile	2.5%ile	5th %ile	2.5%ile	5th %ile
HT	64	65	64	65	64	64	64	65	64	65
WT	129	135	126	132	127	134	128	135	129	135

4.4 Standards applied to LOE 3 Females

4.4.2 Standards applied to LOE 3 Females with 60 Ammo Can Lifts

For the 03xx population, we use the 95% tolerance limit for 95% of the graduates to propose the following standards (with the exception of ammo can lifts):

Table 4-29: Proposed standard for the 03xx population

Variable	Proposed Standard
Final MCRD Pull-ups	6
Final MCRD MTC Time	3:18
Final MANUF Time	3:04
Final MCRD Ammo Can Lifts	60
Shipping Height (in)	64
Shipping Weight (lbs.)	125

We then applied these standards to the Marines who attended ITB with the purpose of participating in the GCE-ITF. These female Marines are distinct from the LOE 2 females because they were recruited from the current active duty Marine Corps and were an older, more experienced group of females. We are using their final MCRD CFT data, shipping height and weight, and their self-reported pull-up scores they gave to the GCE-ITF because many of them have flexed arm hang data from their final MCRD PFT.

There were 61 females who volunteered for the GCE-ITF, attended ITB, and did not drop on request prior to the start of training.

The graduation rates for the 61 LOE 3 Marines were as follows:

Table 4-30: Graduation rates for the 61 LOE 3 Marines

Gender	Graduation %
LOE 3 Females	54.1% (33/61)

If the pull-up standard of six is applied to these Marines' self-reported pull-up scores, and if we removed the Marines from the population that have less than six pull-ups, the following graduation percentages of the population is the result:

Table 4-31: Graduation percentage with six pull-up standard applied

Gender	Graduation % with 6 pull-up standard applied
LOE 3 Females	64.4% (29/45)

Only 45 out of the 61 LOE 3 females reported six pull-ups or more to the GCE-ITF and 29 of those 45 females graduated ITB.

If we apply the pull-up standard along with the standards for all three components of the CFT, we get the following graduation percentages of the new population who met those standards:

Table 4-32: Graduation percentage with pull-up and CFT standards applied

Gender	Graduation % with pull-up and CFT standards applied
LOE 3 Females	80.0% (12/15)

If we apply the pull-up, CFT and height and weight standards, we get the following graduation percentages of the new population who met those standards:

Table 4-33: Graduation percentage with pull-up, CFT, and HT/WT standards applied

Gender	Graduation % with pull-up, CFT and HT/WT standards applied
LOE 3 Females	100% (7/7)

Additionally, there was one LOE 3 female who was dropped for medical reasons. The standards with pull-ups and CFT components would have excluded her from starting ITB. The only standard she did not meet was the MTC time.

4.5 Standards applied to current Active Duty Marines

4.5.2 Standards applied to current Active Duty Marines with 60 Ammo Can Lifts

Table 4-34 provides the 95% tolerance limit for 95% of the graduates for each previously described LOE 2 ELT data set. The only exception to that are the ammo can lifts, which we set at 60 as before.

Table 4-34: The 95% tolerance limit for 95% of the graduates for each MOS school

Variable	03xx	0811	1812	1833	All LOE 2 Combined
Final MCRD Pull-ups	6	7	7	6	7
Final MCRD MTC Time	3:18	3:24	3:20	3:20	3:18
Final MANUF Time	3:04	3:02	2:56	3:02	3:04
Final MCRD Ammo Can Lifts	60	60	60	60	60
Shipping Height (in)	64	64	63	64	64
Shipping Weight (lbs.)	125	118	124	130	124

We will now apply these standards to the current active duty Marine Corps population that holds each particular MOS. We are applying these standards to the active duty Marine Corps' final MCRD PFT and CFT performance, in addition to shipping height and weight, since this is where we are suggesting these standards be applied in order to classify Marines out of MCRD into a particular MOS.

Table 4-35 shows the number and percentage of the current population of each particular MOS that would not have been eligible for their current MOS based on the number of their final MCRD pull-ups.

Table 4-35: Current MOS Marines that would have been screened out based on their final MCRD pull-ups

	03xx	0811	1812	1833	All LOE 2 Combined
Current MOS Marines that would have been screened out based on their final MCRD pull-ups	0.8% (157/19,795)	2.5% (65/2,642)	1.2% (5/416)	1.0% (10/1,037)	1.6% (381/23,890)

If we apply the pull-up standard along with the standards for all three components of the CFT, we get the number and percentages of the current population of each particular MOS that did not meet those standards at their final MCRD PFT and CFT, as seen in Table 4-36:

Table 4-36: Current MOS Marines that would have been screened out based on their pull-ups and CFT component MCRD scores

	03xx	0811	1812	1833	All LOE 2 Combined
Current MOS Marines that would have been screened out based on their final PFT/CFT MCRD scores	7.0% (1,381/19,795)	9.2% (244/2,642)	8.4% (35/416)	9.0% (93/1,037)	8.1% (1,933/23,890)

If we apply the pull-up, CFT, and shipping height and weight standards, we get the number and percentages of the current population of each particular MOS that did not meet those standards at their final MCRD PFT and CFT, as shown in Table 4-37:

Table 4-37: Current MOS Marines that would have been screened out based on their PFT/CFT MCRD scores and HT/WT

	03xx	0811	1812	1833	All LOE 2 Combined
Current MOS Marines that would have been screened out based on their final PFT/CFT MCRD scores and HT/WT	9.5% (1,881/19,795)	11.4% (301/2,642)	12.5% (52/416)	14.2% (147/1,037)	10.8% (2,577/23,890)

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5 Summary and Conclusions

In order to support the Commandant's recommendation about the integration of females into combat arms MOSs and units, we researched the potential impacts of integration in the four areas described in Section 3: Combat Effectiveness, Unit Readiness, Individual Marine Success, and Institutional Costs. The objective of this research was to identify positive implications, as well as risks/downsides, of integration. For those areas of risk, where possible and supported by research, we also provide potential mitigating factors to help reduce those areas of risk.

The objective of this report is not to provide a particular recommendation to open or close combat arms MOSs or units, but rather to assess the relative levels of risk and mitigation in doing so. In the end, the recommendation of the Commandant will have to be based on best military judgment, as there cannot be a definitive correct answer, but simply one that is best supported by empirical evidence, and formulated with the needs of the Marine Corps in mind.

As a general comment, we see very little data that distinguishes the effects of integration within the non-infantry combat arms MOSs (08xx, 1371, 18xx). Within the infantry occupational field, a portion of the data (such as FLC attrition, injuries, etc.) does not distinguish individual MOSs. However, performance results from the GCE-ITF indicate integration of the crew-served weapons MOSs (0331/41/52) may impose a greater risk on infantry battalions compared to the integration of 0311s, because of the larger potential impact on combat effectiveness. Further, we have very little data to distinguish between opening an MOS versus opening an associated unit to assignment for female non-combat arms MOSs (e.g., 0311s and infantry battalions). What we do have on these categories comes from the Provisional Infantry in the GCE-ITF research, which does not shed clear light on distinguishing between those two. Thus, for the remainder of this section, the only distinctions we will make are those between infantryman and crew-served infantry MOSs and units, as well as the overall infantry occupational field compared to non-infantry, combat arms MOSs and units. Any further distinctions would not be supported by analysis.

One byproduct of this entire gender integration discussion is the development of gender-neutral standards, MOS school classification standards, and MOS-specific performance standards to augment/replace the current Training & Readiness (T&R) Manual standards, which are currently not fully adequate. Regardless of the way ahead on female integration, all of the aforementioned standards should strengthen the current Marine Corps' processes for selection to an MOS and training, and continuation in an MOS, and may ultimately improve such intangible factors such as unit morale and task cohesion.

Before getting into some of the detailed discussions of the potential positive and negative aspects of integration, it is worthwhile to point out that some of the initial negative impacts are likely to diminish over time. Based on Marine Corps' experiences with previous integration efforts (such as aviation and logistics), as well as the experiences of foreign militaries, we can expect gradual improvements in certain areas over time. For example, the initial numbers of females integrated into these units are likely to be very small, but can be expected increase gradually over time. However, based on the experience in other nations, it is likely the ultimate numbers in the combat arms will never reach the current 7% figure for females in the Marine Corps today. Similarly, while we might initially expect higher (both EAS and non-EAS) female attrition rates when compared to male attrition rates, these are also likely to diminish over

time. Further, any initial detrimental effects on cohesion can eventually be mitigated with good training and solid leadership.

5.1 Positive implications of Integration

Further integration of females into the combat arms brings with it many of the general benefits of diversity that we experience across the spectrum of the workforce, both within the military as well as the private sector. This was perhaps best illustrated in a decision-making study that we ran in which all-male and integrated groups attempted to solve challenging field problems. Each of the problems involved varying levels of both physical and cognitive difficulty. For those more cognitively challenging problems, the female integrated teams (with one female, and three to four males), performed as well or better than the all-male teams.

We also see benefits to integrated units in areas in which females traditionally have better outcomes than males, e.g., incidents pertaining to disciplinary issues. Integration of females is likely to lower the instance of disciplinary action, and this has been shown in general across the Marine Corps, as well as in the comparison of integrated (e.g., ACE, LCE) to non-integrated units.

From a recruiting and propensity perspective, the opening up of these formerly closed MOSs/units would likely have a neutral to positive effect, based on survey data. However, this presumes a voluntary assignment process; if females were to be involuntarily ordered into combat arms units, this could actually lower propensity and female enlistments.

We also identified some physiological characteristics (e.g., lactate threshold and flexibility), and a few performance tasks (e.g., .50 caliber marksmanship), in which females, or female-integrated groups, excelled. However, none of these formed strong predictors of overall improved mission performance or reduced injuries.

5.2 Negative implications of Integration

Throughout the research effort, there were numerous indications of lower performance levels from combat arms females, or female-integrated groups. The most direct results come from the GCE-ITF, in which, of the 134 observed tasks, 93 showed statistically significant differences when comparing the all-male control group and at least one of the integrated groups (low and/or high density). Of these 93, the all-male control group performed statistically better than at least one of the integrated groups in 88 of the tasks. Moreover, at least one of the integrated groups performed statistically better than the all-male control group in 5 of the tasks. Furthermore, of the 134 tasks and within the 93 that showed statistical differences, 30 tasks showed statistical significance of a 30% or greater difference. Of these 30, the all-male control group performed 30% better than at least one of the integrated groups in 28 of the tasks. Also, at least one of the integrated groups performed 30% better than the all-male control group in 2 of the tasks (both were employment of the M2 machine gun). Of the group of 30 tasks with operationally relevant differences, the majority occurred in the infantry and Provisional Infantry, again with the all-male teams typically performing better.

In addition to the strict performance data from the GCE-ITF, we have also qualitative/subjective observations that have further discerned differences. These are important because a live test that measures team performance can mask individual differences. We have seen numerous cases of

compensation during physically demanding tasks, in which males have shifted positions to take over certain aspects of the tasks from females, such as loading ammo into trucks or heaving loaded packs on top of a wall.

Earlier indicators of differences can be observed in the performance at the formal learning centers. While the ability to DOR for the female volunteers confounds the statistical analysis of the school graduation rate analysis, the differences are large enough to draw conclusions about the relative ability of females versus males at these schools. The difference is most stark for the infantry. At ITB, the graduation rates for females range from 36% (including DORs) to 46% (excluding DORs), compared to the male graduation rate of about 98%. For the other combat arms schools (e.g., artillery, tanks, AAVs), graduation rates range from approximately the same (excluding DORs), to somewhat lower for females (with DORs). Further, a more careful examination of some of the physically demanding tasks, such as artillery projectile lift/load and tank ordnance handle/load, showed significantly higher initial completion rates by males. Some of these tasks were not even graduation requirements, although that may change shortly with the development of the MOS-specific performance standards. Furthermore, the success rate for female Marine officers at IOC, albeit based on a small sample, is 0%. Thus, integration of females into the infantry runs the risk of having very few officer role models for these new infantry females.

In addition to performance, we see significant evidence of higher injury rates for females when compared to males. The aforementioned upper- and lower-body strength and higher fatigue levels lead to greater incidents of overuse injuries, such as stress fractures. This leads to significantly higher levels of non-deployable status for females, of which, medical non-deployability comprises the largest fraction. We have seen this not only for ITF and ITB females, but also for female Marines in general, and for females throughout foreign militaries that were studied. Further, for all GCE-ITF volunteers, we saw higher levels of injuries within the 'hiking' MOSs (03xx less 0313, 1371) compared to the 'riding' ones (08xx, 18xx, and 0313).

When we examine the institutional costs of integrating females into the combat arms, it helps to divide this into the direct and indirect costs. The direct costs, such as modifications to equipment and facilities, are likely to be relatively small. The indirect costs, such as increased T2P2, medical separations, non-deployability rates, attrition, and recycling or reclassification, will be more significant.

5.3 Mitigation to risks

Along with the negative implications of integration, we have learned that there are many actions the Marine Corps could take to mitigate the risks of those implications. While most of these would not likely eliminate entire shortfalls, they could certainly lessen the risks. These typically fall in the areas of screening and standards, and training and education.

While we have seen FLC graduation rates that range from comparable to considerably lower for females, when compared to males, by better screening students before entry, we can substantially improve female graduation rates (the example for ITB showed the potential to improve the graduation rate from 35% to approximately 64%).[195] The downside of such screening is that we would drastically reduce the number of females eligible for these schools; as a result, leadership must weigh this against the improved graduation rates. We would also slightly reduce the number of males eligible; however, this may

[195] These numbers exclude those females lacking pull-up data; hence, they display a slight difference from the previously stated statistics.

also serve to cull the lower-performing male combat arms Marines. Screening has also been shown to reduce the numbers of injuries in these schools. Similar screening techniques could also be used to determine eligibility for non-combat arms Marines (both male and female), who are eligible for assignment to combat arms units, to better ensure success in those units. Useful screening measures include pull-ups, components of the CFT, and lean body mass (LBM) (because LBM is not readily available, we use height and weight as a surrogate). Interestingly, LBM was also a good predictor of injuries in LOE 3 – the higher the LBM, the lower the injury rate.

In addition to screening at the end of recruit training for ultimate eligibility for combat arms FLCs, we could also develop initial screening tests for the recruiters to better assign program enlisted for (PEF) codes to Marine poolees. This action could effectively reduce the likelihood of PEF reclassification at the end of recruit training. The Marine Corps can develop and refine occupational field standards to ensure trained Marines can continue to satisfactorily perform the tasks necessary for their MOSs.

When we looked into height and weight standards as possible screening criteria, we also uncovered a discrepancy in these standards between male and female Marines, with a stricter resultant body mass index (BMI) standards for females (25) than for males (27.5).[196] This appears to be counterproductive, especially for enabling females to enter physically demanding MOSs, as the higher BMI female Marines may actually be more successful in these MOSs than lower-weight Marines who currently meet the current standards.

Numerous studies and live tests have indicated that physical training regimens are critical to success in preparing service men and women for entering physically demanding MOSs. Experience in separated training at Marine recruit training, along with the recent UK experience of moving to integrated, and then back to separated initial training, indicated that initial training can be better tailored when men and women are separated early on. However, even with gender-separated initial training, the Marine Corps should look for integrated training opportunities in order to prepare these young men and women to serve together in the near future. Beyond initial training, we have seen tremendous value in assigning physical trainers to units at the battalion level to help tailor physical training, identify sources of injury, and to help commanders and staffs construct training regimens to support training objectives while minimizing injuries.

In addition to physical training, the Marine Corps should provide training in other aspects of integrating units, ranging from sexual harassment, common obstacles in integration, and general respect for others, to best ensure success, especially during the early years of integration. The ground combat units have many years of historical bias, much of which will take time to eliminate.

While we described the potential negative implications to readiness earlier, predominantly from medical issues, our analysis has showed that the number of females entering these combat arms MOSs and units likely will be a very small percentage—significantly lower than the current 7% female Marine Corps population overall. Thus, the overall impact on unit readiness will be buffered by the dominant numbers of male Marines, and should not show a significant difference.

[196] Coleman, LtCol Lawrence. *USMC Height and Weight Standards*. August 2015. Print.

5.4 Conclusions

Based on the body of evidence developed in support of this research, as well as existing related research, the integration of females into the combat arms MOSs and units will add a level of risk in performance/effectiveness and cost. While this risk can be mitigated by various methods to address failure rates, injuries, and ability to perform the mission, the bottom line is that the physiological differences between males and females will likely always be evident to some extent.

The decision to recommend the opening of an MOS and unit will never be a black and white one; it is not simply a matter of setting standards and letting any Marine into the MOS or unit who passes those standards. There are costs to the institution to be considered in the final recommendation. Setting standards too high will preclude many qualified Marines from serving, while setting them too low will introduce high levels of risk for attrition, injury, and degradation of unit performance. The data in this report indicates that even striking what appears to be a balance for setting standards will likely introduce some level of risk across all of these factors. That level of risk is highest for infantry MOSs and units, and within the infantry, highest for the crew-served weapons MOSs. The risks appear to be significantly lower for the non-infantry combat arms.

The recommendation to open or to request an exception to policy for any MOS or unit will depend on the Marine Corps' tolerance for the level of risk that such a change would impose. This report can help quantify those risks, and the effects of certain mitigation efforts, but it cannot analytically provide a definitive answer to the level of risk tolerable by the Marine Corps—that is a decision that can only be made by senior Marine Corps leadership. This decision will clearly be influenced by the levels of risk described, and the ability to mitigate those risks, balanced against the beneficial aspects of integration. Many of the mitigation efforts identified in this report would serve the Marine Corps well and would help strengthen performance and reduce risks for both male and female Marines, regardless of the recommendation pertaining to integration.

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Appendix A – Research Integration Framework

A.1 Background & Purpose

The Research Integration Framework (RIF), an Excel-based tool for organizing and synchronizing all of the research conducted, was built by OAD to support MCFIO and the associated researchers. During execution of the MCFIP Campaign Plan, OAD used the RIF for problem framing, organizing the research plan, synchronizing the research efforts, and integrating the research findings. This appendix contains information on:

- The origins of the RIF
- The contents of the RIF
- The relationship between the RIF and the EEA

A.2 Origins: Planning and Organizing the Research Effort

While developing the analytical approach for supporting execution of the MCFIP Campaign Plan, it became clear that the framework for supporting the Commandant's decision would be quite complex. Given the importance of the decision, the large number of factors that might inform the decision, and the wide scope of planned research, the planners developed a number of methods for visualizing the connections between research and desired end state. One of these visualizations is shown below, using the familiar fishbone (i.e., cause-effect) diagram. In this presentation of the decision support framework, the CJCS principles are affected by the several elements of planned research.

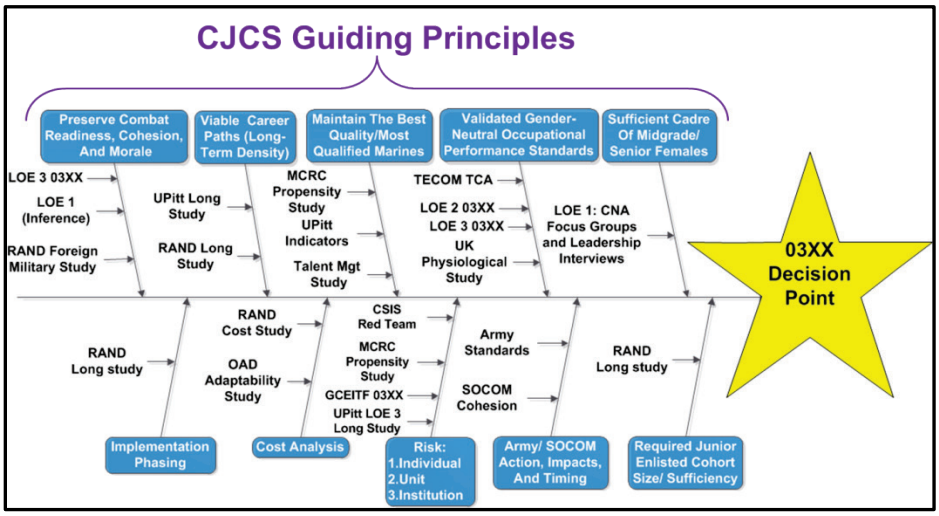

Figure A-1: Decision Support Framework

While the above visualization aids in understanding the connections among the research efforts, it reflects neither the strength of the connection, nor the requirements of the connection. For example,

under the CJCS principle of 'Preserve Combat Readiness, Cohesion, and Morale' three (3) research efforts are shown, indicating some connection between the research and the end state. But this presents at least two analytic challenges:

- What information is required to judge that 'Preserve combat power…' has been met?
- What information will each of the three efforts generate?

In a series of whiteboard sessions, the analysis team developed questions designed to address the above challenges simultaneously. These questions evolved through an iterative process, involving researchers, analysts, planners, and other stakeholders. With the question set finalized, development of an Excel-based tool began. This tool, which came to be known as the Research Integration Framework, cross-referenced the questions with known information requirements. The RIF was used in the several research workshops held during the latter half of 2014. Personnel from OAD, MCFIO, MCOTEA, and the research organizations (e.g., RAND, CNA, U-Pitt, NHRC) used the RIF to guide workshop discussions.

A.3 Contents: Questions and Attributes

The RIF contained a total of 33 questions, divided into three (3) groups:

- Table 1 Questions that Inform the Commandant's Decision
- Table 2 Questions that Inform Implementation
- Table 3 Overarching Research Questions

Table A-1: Questions that Inform the Commandant's Decision

Research Questions that Inform the Commandant's Decision
Does gender integration affect unit readiness?
Does gender integration affect mission effectiveness at the tactical level under LOE 3?
What are the physiological indicators for effective performance in a ground combat MOS and unit?
What are the physiological indicators for effective performance at Formal Learning Centers (FLCs)?
What are the quantifiable Occupational physical performance standards for physically demanding MOSs and how do we best evaluate them using MOS Specific Physical Standards (MSPS)?
What are the non-physiological indicators for effective performance in a ground combat MOS and unit?
What are the non-physiological indicators for effective performance at Formal Learning Centers (FLCs)?
Does gender and other characteristics affect team decision making?

Table A-2: Questions that Inform Implementation

Research Questions that Inform Implementation
Do female attrition rates in previously closed MOSs or units differ from female attrition rates in open MOSs?
Do attrition rates among male and female Marines in previously closed MOSs or units differ?
Identify viable courses of action for assignment policies and practices; assess the assignment policies and practices on population density and deployability rates.
Does a change in the level of gender integration affect unit outcomes (SAPR, retention, awards, etc)?
What are the lessons learned from previous integration efforts of the aviation, logistics, EOD and Combat Engineer MOSs?
What are the effects on inventory due to the implementation of MOS-specific physical assessments during the screening, qualification and sustainment phases?
Does gender integration affect cohesion and morale?
What are the Marine Corps policies that promote long-term success of gender integration?
What are the causes, contributing events or conditions for Marine attrition in previously closed MOSs or units by gender?
What material adaptations are available to support gender integration?
What non-material adaptations are available to support gender integration?
Does gender integration affect discipline rates?
Does gender integration have an effect on sexual assault rates?
Does gender integration have an impact on T2P2?
Does gender integration affect deployability rates?
Does gender integration affect female Marine selection to key billets?
Does gender integration affect promotion rates?
Does gender integration affect retention?
What are female Marine entry rates for previously closed MOSs?
Does gender integration affect PEF (program enlisted for) rates?
Does gender integration affect recruiting (propensity)?
Identify paths that lead to equitable career opportunity for each MOS, regardless of gender.

Table A-3: Overarching Research Questions

Overarching Research Questions
What factors contribute to successful gender integration of a unit?
What are the potential risks of gender integration and corresponding mitigation strategies (wargame strategies for viability)?
What are the comprehensive costs (e.g. facilities, analytical support, injury, MOS reclassification) associated with gender integration?

Questions from the first two tables were then mapped to each of several information requirements (i.e., the attributes for each question):

- Whether the question would be answered in the short term or in the long term

- Whether the question touched on one or more of the CJCS principles
- Whether the question touched on one or more of the LOE
- Whether the question would be answered by a primary or secondary research source
- The organization responsible for answering the question
- Whether the question touched on one or more specified criteria:
    - Mission Accomplishment
    - Man, Train & Equip
    - Troop Welfare
    - Cost

A.4 Relationship: From RIF to EEA

Section 2 of the main body describes the methodology used the research integration team. As noted, the EEA played a critical role in the method used, and the careful reader will have observed similarities between the EEA and the questions in the first two tables of this appendix. As personnel from OAD and MCFIO developed the methodology for integrating the completed research, the content and structure of the RIF was heavily leveraged. In some cases, RIF questions can be found, unchanged, in the EEA. In other cases, the content of a RIF question might be spread across one or more EEA. And there is a strong correspondence between the specified criteria and the four FA:

- Mission Accomplishment ➔ Combat Effectiveness
- Man, Train & Equip ➔ Unit Readiness
- Troop Welfare ➔ Individual Marine Success
- Cost ➔ Institutional Costs

Appendix B – Sources

B.1 Primary Sources

Title: A Quick-Look Analysis of the GCE-ITF Baseline Climate Survey

Date: January 2015

Research Performer: Center for Naval Analyses (CNA)

Summary: The Commandant of the Marine Corps has tasked the Ground Combat Element (GCE) Integrated Task Force (ITF) to train and operate as an integrated combat arms unit. Dedicated research teams are observing the unit's performance in an operational environment, conducting physiological testing, and collecting survey data on Marine volunteers' experiences and opinions regarding morale, readiness, and unit cohesion. The combined results of these separate research efforts will provide information to Marine Corps leadership to inform gender integration policy decisions. This quick-look analysis provides CNA's initial analysis of the GCE-ITF Baseline Climate Survey fielded in November 2014. The survey informs a variety of issues, with a particular interest in intangibles that cannot be measured in other ways. Intangibles include motivations to join the Marine Corps and to volunteer for the GCE-ITF, and Marines' attitudes and opinions regarding integrated units, especially with regard to morale, readiness, and unit cohesion.

Title: An Analysis of Female Representation and Marines' Performance in Aviation and Logistics Occupations

Date: April 2015

Research Performer: Center for Naval Analyses (CNA)

Summary: This report is in support of the Marine Corps Force Innovation Office, which is charged with implementing the Marine Corps Force Integration Plan to integrate ground combat occupations and units. CNA examine female representation and performance in aviation (60xx–75xx) and logistics (04xx) primary military occupational specialties (PMOSs) since FY 1987. Female representation, as a percentage, has increased in these occupational fields over the past three decades, but women tend to leave the Marine Corps at higher rates than men. CNA also find, however, that female officers are selected for promotion at the same rates as male officers and enlisted women are promoted faster than enlisted men. These findings suggest that women who entered previously closed PMOSs have performed comparably to men and that separation rates differ by occupation suggesting the need to factor in PMOS specific trends into manpower plans and to learn more about factors motivating separation decisions.

Title: Assessing How Delayed Entry Program Physical Fitness is Related to In-Service Attrition, Injuries, and Physical Fitness

Date: September 2014

Research Performer: Center for Naval Analyses (CNA)

Summary: CNA examined the relationship between the Initial Strength Test (IST) given to recruits at the time of enlistment and early attrition, recruit training injury rates, scores on the Physical Fitness Test (PFT), and scores on the Combat Fitness Test (CFT); and how these relationships vary by gender. This paper presents the results of this examination. CNA found that the IST score is a good predictor of attrition, injury rates, and PFT and CFT scores, with a higher IST score leading both to lower attrition and injury rates and to higher PFT and CFT scores. They also found, however, that a significant share of men and women who score well on the IST end up scoring

poorly on the PFT and CFT; conversely, a significant share who score poorly on the IST, score well on the PFT and CFT. This latter finding suggests that any classification policies for physically-demanding MOSs that are based on IST scores should include provisions to reconsider the MOS classification if recruit training PFT and CFT scores differ significantly from the IST score.

Title: Changes in Combat Task Performance under Increasing Loads in Active Duty Marines

Date: March 2015

Research Performer: Naval Health Research Center (NHRC)

Summary: U.S. Marines perform mission tasks under heavy loads which may compromise performance of combat tasks. However, data supporting this performance decrement are limited. The aim of this study was to determine the effects of load on performance of combat-related tasks. This study found that short aerobic performance is significantly impacted by increasing loads. Marksmanship is compromised as a function of fatigue and load. These data suggest that loads of 45% body weight increase time to cover distance and reduce the ability to precisely hit a target.

Title: Ground Combat Element Integrated Task Force Research ONR Award #N00014-14-1-0021: Interim Report

Date: March 2015

Research Performer: University Of Pittsburgh, Neuromuscular Research Laboratory, Department of Sports Medicine and Nutrition

Summary: The final documents research performed by the University of Pittsburgh to complement the ongoing activities of the GCE-ITF. A multi-aim approach was implemented to meet objectives and provide the deliverables necessary for the GCE-ITF to meet its established deadline for recommendations to the Commandant of the Marine Corps.

Title: Ground Combat Element Integrated Task Force Research ONR Award #N00014-14-1-0021: Final Report

Date: August 2015

Research Performer: University Of Pittsburgh, Neuromuscular Research Laboratory, Department of Sports Medicine and Nutrition

Summary: This interim report summarizes the pre-GCE-ITF baseline testing and interval testing of male and female Marines. The report is organized to provide an overview of program development and implementation, selected descriptive baseline laboratory data results for female and male GCE-ITF volunteers tested prior to unit integration and female and male GCE-ITF volunteers tested during interval testing. This report also provides a preliminary injury epidemiology analysis as well as outlines completed and future task and demand analyses.

Title: Impacts of Gender Differences on Conducting Operational Activities

Date: October 2008

Research Performer: North Atlantic Treaty Organization (NATO)

Summary: This report addressed issues related to the growing involvement of women in NATO military forces. This integration of female soldiers affects all military operations since most, if not all, military jobs are open to women. All dimensions of women's integration were considered: physiology, anthropometry, pathology, training, psychology, sociology.

Title: Implications of Integrating Women into the Marine Corps Infantry

Date: February 2015

Research Performer: RAND

Summary: In this study, RAND's National Defense Research Institute (RAND NDRI) identifies the issues that may arise if women are integrated into the Marine Corps infantry, describes efforts that have been successful in addressing these issues in the past, and estimates the potential costs associated with integration.

Title: Injuries Among Female Army Recruits: A Conflict of Legislation

Date: January 2002

Research Performer: UK Royal Medicine

Summary: In the final decade of the 20th century, the British Armed Forces came under intense pressure to open up traditionally male roles to female recruits. Report studies the effects of a "gender free policy" whereby identical physical fitness tests were used for selection of male and female recruits and the training program made no allowances for gender differences. This study confirms and quantifies the excess risk for women when they undertake the same arduous training as male recruits, and highlights the conflict between health and safety legislation and equal opportunities legislation.

Title: IOC Study (LOE 2)

Date: June 2105

Research Performer: Training and Education Command (TECOM)

Summary: The performance of female Marine Officer volunteers assigned to Infantry Officer Course (IOC) was assessed. The propensity, performance, and injury data were collected in order to inform policy decisions on the assignment of women to the infantry occupational field.

Title: ITB Study (LOE 2)

Date: June 2015

Research Performer: Training and Education Command (TECOM)

Summary: The performance of enlisted female Marine volunteers assigned to Infantry Training Battalion (ITB) was assessed. The propensity, performance, and injury data were collected in order to inform policy decisions on the assignment of women to the infantry occupational field.

Title: LOE 1 Thematic Research

Date: November 2014

Research Performer: Operations Analysis Division

Summary: The purpose of this study was to analyze and better understand the integration of females into Expanded Unit Assignments (EUA) so the Marine Corps can consider ways to improve the successful integration of females into previously closed combat arms units.

Title: MCOTEA (LOE 3): GCE-ITF

Date: July 2015

Research Performer: Marine Corps Operational Test and Evaluation Activity (MCOTEA)

Summary: MCOTEA was responsible for planning and executing all of the LOE 3 research. Following the completion of live testing by all elements of the Ground Combat Element Integrated Task Force (GCE-ITF), MCOTEA analyzed the data to determine if differences existed between baseline (all-male) and gender-integrated units.

Title: Optimizing Operational Physical Fitness

Date: January 2009

Research Performer: North Atlantic Treaty Organization (NATO)

Summary: The Research and Technical Organization recognizes the need to address issues in light of the wide range of missions and increased deployment of NATO personnel on operations since 1997. The revised spectrum of NATO missions requires a new approach to operational physical fitness. Specifically, a new necessity to define, assess, evaluate and optimize physical capability by setting appropriate criteria and methodology was identified by an exploratory team that met in Spain in 2002. As a result of the exploratory meeting, Task Group 019 on Optimizing Operational Physical Fitness was established to determine the requirement for physical fitness for military personnel in order to prepare military personnel for physical task requirements, to prevent physical overburdening, and to reduce injuries.

Title: Other FLC Study (LOE 2- Armor, Artillery, AAVs)

Date: June 2015

Research Performer: Training and Education Command (TECOM)

Summary: The performance of enlisted female Marine volunteers assigned to one of the Non-infantry Ground Combat Arms Schools (0811 - Cannon Crewman Course / 1812 - Armor Crewman Course / 1833 - AAV Crewman Course) was assessed. The propensity, performance, and injury data were collected in order to inform policy decisions on the assignment of women to the non-infantry ground combat arms occupational fields.

Title: Why Can't Anything Be Done? Measuring Physical Readiness of Women for Military Occupations

Date: October 2011

Research Performer: U.S. Army

Summary: This study looked at what data is available and found significant differences in ability of female and male recruits to meet the military's physical performance standards. The data showed a large gap between the physical strength, aerobic capacity, and size of Army men and women. Training men and women correctly improved the performance of both groups but it also widened the gap in performance.

Title: Women in Ground Close Combat (WGCC) Review Paper

Date: December 2014

Research Performer: UK Armed Forces

Summary: Assessments of the factors that may affect Combat Effectiveness (CE) have been analyzed by a panel of military, physiological, psychological experts. The panel concluded that three factors (morbidity, deployability, and survivability/lethality) are likely to have a negative effect on CE if women were to be allowed to conduct Ground

Close Combat (GCC) roles. These factors are distinctly difficult to militate against and if measures were identified they may require a significant review or alteration of current policy or standards.

B.2 Secondary Sources

Title: Gender Diversity in Male-dominated Teams: The Impact of Compositional Configurations over Time

Date: June 2015

Research Performer: Michigan State University

Summary: Michigan State University researchers sought to test the degree to which gender diversity in teams affects: tactical decision-making outcomes, team decision-making processes, critical team emergent states, and Individual team member experiences. Researchers used the Military Operations in Urban Terrain (MOUT) facility aboard Camp Lejeune to create a tasked based leadership reaction course, focusing on how gender diversity affects small unit performance and decision making.

Title: OAD Analysis of GCE-ITF volunteers

Date: July 2015

Research Performer: Operations Analysis Division (OAD)

Summary: This was an informal analysis conducted by OAD that looked into the body composition of all GCE-ITF volunteers. The analysis focused on determining the lean body mass and body fat for each individual and then related that information to various pack load weights (fighting load, assault load, approach load, and sustainment load). The analysis also determined basic statistics like the average male and female body fat, average weight, and average lean body mass.

Title: Accession Characteristics of Women with the Ability or Propensity to Serve in Combat Arms MOSs

Date: October 2014

Research Performer: Center for Naval Analyses (CNA)

Summary: This study attempted to establish a connection between female accession characteristics and females most likely to express an interest in a ground combat MOS, as well as the ability to complete the training. CNA was able to identify characteristics of female graduate from ITB using LOE 2 data.

Title: Analysis in Support of the Women in Service Restriction Review Study

Date: January 2014

Research Performer: NHRC and TECOM

Summary: The focus of this early effort was to identify physical ability tests that might be used, and how effective they might be, for estimating physical preparedness for combat. Specifically, the Physical Fitness Test (PFT) and Combat Fitness Test (CFT) were identified as candidate predictors of physical combat readiness. The information gathered for this effort was also used to identify performance discrepancies between men and women, thus helping to identify specific problem areas for women. This information was then used to recommend minimum combat readiness standards for each selection test.

Title: Assessing the Effectiveness of the Marine Corps Martial Arts Program on Unit Performance

Date: February 2013

Research Performer: Operations Analysis Division

Summary: Using data collected from the Marine Corps Total Force System (MCTFS), the Operational Data Store Enterprise (ODSE), and fitness reports, analysis was undertaken to evaluate the effectiveness of the Marine Corps Martial Arts Program (MCMAP). In addition, the influence of various factors on disciplinary actions was also analyzed.

Title: Assessment of Marine Non-Deployability and the Effects on Readiness

Date: March 2014

Research Performer: Operations Analysis Division

Summary: This study, which has been approved by the ADC M&RA, directly supports the Commandant's Planning Guidance, Marine Corps Service Campaign Plan, and the Executive Force Preservation Board tasking by analyzing non-deployability for female and male Marines. The report displays results, by MOS and rank, for periods of non-deployability for medical, legal, and administrative reasons or training status.

Title: Differences in Male and Female Predictors of Success in the Marine Corps: A Literature Review

Date: February 2015

Research Performer: Center for Naval Analyses (CNA)

Summary: As part of the Marine Corps Force Integration Plan considering female integration into previously closed Military Occupational Specialties and units, CNA was asked to support the Marine Corps Recruiting Command's research needs. This research memorandum, which reviews the literature on predictors of male and female Marine performance over the last 25 years, will inform CNA's work examining the impact of previous female integration as well as future trend analysis. Performance measures include attrition and promotion at different milestones. CAN reviewed studies of Marine Corps performance for enlisted personnel and officers. Some enlisted equations were separately estimated for men and women, but officer equations were not. CNA found that some factors are solid predictors of lower Marine Corps enlisted attrition for both men and women, such as time in the Delayed Entry Program, Armed Forces Qualification Test score, education, race/ethnicity, enlistment waivers, and being recruited as a high school senior. Other predictors of enlisted attrition, such as age, vary by gender.

Title: DOD Report to Congress on Women in Service Review (WISR)

Date: August 2013

Research Performer: N/A

Summary: This report addresses Congress' inquiry into the implementation of the policy changes announced in the February 2012 report to Congress on the review of laws, policies, and regulations restricting the service of female members in the armed forces; the feasibility of incorporating gender-neutral occupational standards for military occupational specialties closed to female members of the armed forces; additional options to increase service and career opportunities for women; and the Department and Services' practices with regard to recognizing, recording, and characterizing combat-related service by female Service members.

Title: Factors Influencing Disciplinary Actions in the Marine Corps

Date: December 2012

Research Performer: Operations Analysis Division

Summary: Using data collected from the Marine Corps Total Force System (MCTFS), analysis was undertaken to explore the influence of various factors on disciplinary actions in the Marine Corps.

Title: Female Pull-up Analysis

Date: May 2014

Research Performer: Center for Naval Analyses (CNA)

Summary: In previous scientific analyst work, CNA found that women who were heavier/shorter at shipping completed more pull-ups by the end of boot camp, though women who were leaner/shorter at shipping saw bigger pull-up improvements in DEP and completed more pull-ups by the time they shipped to boot camp. This suggests that being leaner can help one improve from 0 pull-ups, but being stronger can help one improve beyond 1 pull-up to complete 3 or more pull-ups.

Title: IET Injury and Fitness Surveillance

Date: July 2014

Research Performer: U.S. Army Institute of Public Health

Summary: This study compared various injury incidences by gender from FY 10 through FY 13 at Fort Leonard Wood, Fort Benning, Fort Sill, and Fort Jackson. Training is conducted during Basic Combat Training (BCT) and (One Station Unit Training). Additionally, male and female comparisons were completed for the Army Physical Fitness Test (APFT).

Title: Joint Chiefs of Staff (CJCS) Women in Service Review (WISR) Implementation Plan Memo

Date: January 2014

Research Performer: N/A

Summary: This information memo from the CJCS to the Secretary of Defense describes guiding principles, goals and milestones for the Women in the Service Implementation Plan.

Title: Less Body Fat Improves Physical and Physiological Performance in Army Soldiers

Date: January 2011

Research Performer: Military Medicine

Summary: The purpose of this study was to compare physical and physiological fitness test performance between Soldiers meeting the Department of Defense (DoD) body fat standard (< or = 18%) and those exceeding the standard (> 18%). Ninety-nine male 101st Airborne (Air Assault) Soldiers were assigned to group 1: < or = 18% body fat (BF) or group 2: > 18% BE. Groups 1 and 2 had similar amounts of fat-free mass (FFM) (66.8 +/- 8.2 vs. 64.6 +/- 8.0, p = 177). Each subject performed a Wingate cycle protocol to test anaerobic power and capacity, an incremental treadmill maximal oxygen uptake test for aerobic capacity, isokinetic tests for knee flexion/extension and shoulder internal/external rotation strength, and the Army Physical Fitness Test. Results showed group 1: < 18% BF performed significantly better on 7 of the 10 fitness tests. In Soldiers with similar amounts of FFM, Soldiers with less body fat had improved aerobic and anaerobic capacity and increased muscular strength.

Title: MCRC (Quarterly) Baseline Propensity

Date: October 2014

Research Performer: Marine Corps Recruiting Command (MCRC)

Summary: The motivation for the study was to identify the accession characteristics of women with the propensity or physical ability to serve in combat arms military occupational specialties (MOSs). The approach was to determine the number of female interviews and applications necessary for a contract (in any program enlisted for [PEF]). More specifically, to identify the accession characteristics of women: (1) Who are interested in combat arms MOSs, (2) Able to pass PEF enlistment criteria, (3) Able to pass the Physical Screening Test (PST), (4) Who attended the Infantry Training Battalion (ITB) or (5)Who graduated from ITB.

Title: Naval Unit Behavioral Health Needs Assessment Survey (NUBHNAS): Ground Combat Element Integrated Task Force

Date: June 2015

Research Performer: Naval Health Research Center (NHRC), NUBHNAS Team

Summary: Using anonymous assessment of behavioral health (e.g., PTSD, suicidal thoughts, sexual assault, anxiety, depression, sleep disturbances, mental health stigma), as well as assessment of biomarkers related to stress and immune function, the team evaluated the impact on behavioral health of integrating women into USMC ground combat units. In addition, the team looked at the effect gender integration had on morale and unit cohesion.

Title: Physiological Employment Standards IV: Integration of Women in combat Units Physiological and Medical Considerations

Date: November 2013

Research Performer: Yoram Epstein, Ran Yanovich, Daniel S. Moran, Yuval Heled, European Journal of Applied Physiology

Summary: Anthropometric and physiological factors place the average female soldier at a disadvantage relative to male soldiers in most aspects of physical performance. Aerobic and anaerobic fitness levels are lower in women than in men. Thus, women have a lower overall work capacity and must therefore exert themselves more than men to achieve the same output. The lower weight and fat-free mass and the higher body fat of women are associated with lower muscle strength and endurance, placing them at disadvantage compared with men in carrying out military tasks such as lifting and carrying weights or marching with a load. Working at a higher percentage of their maximal capacity to achieve the same performance levels as men, women tire earlier and are at increased risk of overuse injuries. Their smaller size, different bone geometry and lower bone strength also predispose women to a higher incidence of stress fractures. Although training in gender-integrated groups narrows the gaps in fitness, significant differences between the genders after basic training still remain. Nevertheless, integration of women into military combat professions is feasible in many cases. Some 'close combat roles' will still be an exception, mainly because of the extreme physical demands that are required in those units that are beyond the physiological adaptability capacities of an average female. There is no direct evidence that women have a negative impact on combat effectiveness. Once the gender differences are acknowledged and operational doctrines adjusted accordingly, female soldiers in mixed-gender units can meet the physical standards for the assigned missions.

Title: Project Narrative: Gender Diversity in Traditionally Male-dominated Teams: The Impact of Alternative Compositional Configurations over Time

Date: January 2015

Research Performer: John Hollenbeck, Michigan State University

Summary: This document provides an overview of current thinking regarding the study of decision making by small teams. It provides context for the study proposed by MSU and forwards their theory about a model for gender integration of small teams

Title: Recruits' Ineligibility Tests the Military

Date: June 2014

Research Performer: Miriam Jordan, Wall Street Journal

Summary: More than two-thirds of America's youth would fail to qualify for military service because of physical, behavioral or educational shortcomings, posing challenges to building the next generation of soldiers even as the U.S. draws down troops from conflict zones. The Defense Department estimates 71% of the roughly 34 million 17- to 24-year-olds in the U.S. would fail to qualify to enlist in the military if they tried.

Title: Response from the HQMC Sexual Assault and Prevention Response (SAPR) Office

Date: June 2015

Research Performer: HQMC SAPR Office

Summary: This document was drafted by the HQMC SAPR Office in response to a series of questions posed by the CSIS Red Team. These questions dealt with expectations regarding the rate of sexual assault and sexual harassment within ground combat units following gender integration.

Title: Sexual Assault and Sexual Harassment in the Military: Findings from the RAND Military Workplace Study

Date: May 2015

Research Performer: RAND

Summary: This brief presents major conclusions for Department of Defense service members from the 2014 RAND Military Workplace Study, an independent assessment of the rates of sexual assault, sexual harassment, and gender discrimination in the U.S. military.

Title: Smart Adaptations Study

Date: July 2015

Research Performer: ManTech

Summary: The study examined the Marine Corps requirements generation and equipment fielding systems with a focus on the human systems integration aspects of those systems. The study team also consulted with GCE advocates and acquisition professionals, visited several FLCs, engaged with Marines from the GCE-ITF, and reviewed a broad spectrum of equipment for potential adaptation.

Title: Survey Support to the Marine Corps Force Integration Plan, Analysis of GCE-ITF Survey Results

Date: July 2015

Research Performer: Center for Naval Analyses (CNA)

Summary: CNA researchers surveyed members of the GCE-ITF at three points in the unit's life-cycle (i.e., at forming, after completing initial training at Camp Lejeune, after completing the live testing at Twentynine Palms). This brief provided MCFIO leadership with insight into: (1) The initial attitudes and perceptions of the volunteers regarding gender integration, (2) Whether the attitudes and perceptions of the volunteers regarding gender integration change of the course of the GCE-ITF, and (3) How gender integration affected unit cohesion, teamwork, and discipline, and how these factors might have changed over time.

Title: The Integration of Female Marine Pilots and Naval Flight Officers, 1990-2000

Date: October 2014

Research Performer: Center for Naval Analyses (CNA)

Summary: As part of a broader research project, CNA studied the integration of female Marine aviators during the 1990-2000 period. Using archival and other primary sources, CNA identified key themes that are likely to be relevant as the service considers opening formerly closed occupations and units to women. The history of integration highlights the important role of male peers. If combat arms occupations are eventually opened to women, the Marine Corps should look closely at its assignment policies. For example, a female Marine, upon completion of a combat arms primary military occupational specialty, could be assigned with one or more male peers with whom she graduated.

Title: Marine Corps Force Innovation Office (MCFIO) Visit to the Israeli Defense Force (IDF) Ground Forces International Talks and the United Kingdom (UK) Ground Close Combat Review Team

Date: September 2014

Research Performer: MCFIO personnel

Summary: This document summarizes the results of travel to the United Kingdom and Israel. During this visit MCFIO personnel exchanged information on gender integration of ground combat units with two key allies.

Title: USMC Height and Weight Standards

Date: November 2014

Research Performer: LtCol Lawrence Coleman, HQMC MCFIO

Summary: The purpose of this paper is to establish the date of validation for the current height and weight standards. The paper points out that these standards are based on Body Mass Index (BMI), that the services are not authorized to set a more stringent standard , and that the current male standard is 27.5 and the current female standard is 25.

Title: Marine Corps Force Innovation Office (MCFIO) Visit to the Australian Army

Date: February 2015

Research Performer: MCFIO personnel

Summary: This document summarizes the results of travel to Australia. During this visit, MCFIO personnel exchanged information on gender integration of ground combat units with a key ally.

Title: Marine Corps Force Innovation Office (MCFIO) Visit to the Canadian Armed Forces (CAF)

Date: November 2014

Research Performer: MCFIO personnel

Summary: This document summarizes the results of travel to Canada. During this visit, MCFIO personnel exchanged information on gender integration of ground combat units with a key ally.

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Appendix C – Acronyms

Acronym	Definition
AAV	Amphibious Assault Vehicle
ACE	Aviation Combat Element
AFQT	Armed Forces Qualification Test
AR	Arithmetic Reasoning
AS	Auto and Shop Information
ASVAB	Armed Services Vocational Aptitude Battery
BMI	body mass index
CASEVAC	casualty evacuation
CFT	Combat Fitness Test
CJCS	Chairman of the Joint Chiefs of Staff
CL	Clerical
CMC	Commandant of the Marine Corps
CNA	Center for Naval Analyses
CSIS	Center for Strategic and International Studies
DEP	Delayed Entry Program
DGCDAR	Direct Ground Combat Definition and Assignment Rule
DNBI	disease non-battle injury
DoD	Department of Defense
DOR	drop on request
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership & Education, Personnel, and Facilities
DRRS	Defense Readiness Reporting System
EAS	end of active service
EEA	Essential Elements of Analysis
EI	Electronics Information
EL	Electronics
ELT	Entry Level Training
EUA	Expanded Unit Assignments
FA	focus areas
FAR	Flight Aptitude Rating
FDC	Fire Direction Center
FLC	Formal Learning Center
FY	fiscal year
GCE-ITF	Ground Combat Element-Integrated Task Force
GMU	George Mason University
GS	General Science
GT	General Technical
I&L	Installation and Logistics
IDF	Israeli Defense Forces
IOC	Infantry Officer Course
IRB	Institutional Review Board
IST	initial strength test
ITB	Infantry Training Battalion

Acronym	Definition
LAV	Light Armored Vehicle
LBE	Load Bearing Equipment
LBM	lean body mass
LCE	Logistics Combat Element
LCI	load carriage index
LOE	lines of effort
M&RA	Manpower and Reserve Affairs
MANUF	maneuver under fire
MARFOR	Marine Forces
MC	Mechanical Comprehension
MCAGCC	Marine Corps Air Ground Combat Center
MCB	Marine Corps Base
MCFIO	Marine Corps Force Innovation Office
MCFIP	Marine Corps Force Integration Plan
MCMAP	Marine Corps Martial Arts Program
MCOTEA	Marine Corps Operational Test and Evaluation Activity
MCRC	Marine Corps Recruiting Command
MCRD	Marine Corps Recruit Depot
MG	Machine Gun
MK	Mathematics Knowledge
MLDC	Military Leadership Diversity Commission
MND	medically non-deployable
MOS	military occupational specialties MOS
MSPS	MOS-specific physical standard
MSU	Michigan State University
MTC	movement to contact
MWTC	Mountain Warfare Training Center
NATO	North Atlantic Treaty Organization
NCO	noncommissioned officers
NDAA	National Defense Authorization Act
NFO	naval flight officer
NHRC	Naval Health Research Center
NJP	non-judicial punishment
NUBHNAS	Naval Unit Behavioral Health Needs Assessment Survey
OAD	Operations Analysis Division
OPT	operational planning team
P&R	Programs & Resources
PEF	program enlisted for
PFT	physical fitness test
POI	program of instruction
PPE	Personal Protective Equipment
pQCT	peripheral quantitative computed tomography
Q	quarter
RAND	Research and Development Corporation
RIF	Research Integration Framework

Acronym	Definition
ROTC	Reserve Officers' Training Corps
SAPI	Small Arms Protective Insert
SecDef	Secretary of Defense
SNCO	staff noncommissioned officer
STARS	Study of Talent, Attrition, Retention, and Success
T&R	Training & Readiness
T2P2	training, transient, prisoner, and patient
TECOM	Training and Education Command
TEEP	training, exercise, and employment plan
UK	United Kingdom
U-Pitt	University of Pittsburgh
VIF	variance inflation factor
WISRR	Women In Service Restrictions Review
WK	Word Knowledge