**Vol. 3, No. 1 (Summer 2009)**: Using the TNDM for the Battles of Singapore; Analysis of the Historical Effectiveness of Different Counterinsurgency Tactics and Strategies; Chemical Weapons and Iranian Casualties in the Iran-Iraq War: A Further Note and Update; Comparing Force Ratios to Casualty Exchange Ratios; An Analysis of the Morale Table in the TNDM. 

**Vol. 3, No. 2 (Winter 2010)**: Summation of QJM/TNDM Validation Efforts; Validation of the TNDM to Corps-level Combat; Validation of the TNDM to Division-level Combat; Iranian Casualties in the Iran-Iraq WAr: A 2010 Update, Comparing the RAND Version of the #:1 Rule to the Real-World Data; Correction Made for Version 2.07 of the TNDM. 

Volume 3, Number 1 Summer 2009

# THE INTERNATIONAL TNDM NEWSLETTER

## Using the TNDM for


# THE BATTLE OF SINGAPORE

# INTRODUCTION

In tribute to what Trevor Dupuy pioneered and in an effort to pursue what he wanted to achieve, TDI continues to amass historical data and strives to refine the combat variables which go into the TNDM. In this issue of our newsletter Christopher Lawrence, Alex Dinsmoor, and Bill Beuttel continue to provide information on these efforts.

As you, our readers, survey the pages of this issue, you may be curious about the total scope of work of TDI. The paragraphs below outline what is missing in applied military history and what TDI is doing to shore up that deficiency. In other words, here is *our core capability*:

1. TDI provides independent, objective, historically–based analyses of modern military campaigns. Operations research, as developed during and right after World War II, was based on recorded, detailed data from battles. It is now nearly extinct. It has been supplanted by weapons and systems effects and performance analyses totally devoid of human factors considerations. As a result the Services, particularly the Army, have only partial answers for the development of operational concepts, battle doctrine, weapons requirements, and organizations. Similarly, because they were not historically validated, the Service models and simulations are skewed. Striving for only measured weapons effects and technical systems capabilities, they miss (or significantly distort) the impact of leadership, training, organization, and psychological factors (such as fear of death) on military units in contact.

2. Over the years, TDI, a successor organization to the Historical Evaluation and Research Organization (HERO), both founded by the late Col. Trevor N. Dupuy, has compiled a large database from modern military campaigns and battles. Using Colonel Dupuy's methodologies and some new techniques, TDI has developed the following capabilities:

a. Comparison of fighting capabilities of opposing forces (systemic strengths and weaknesses) based on:
(1) Command and organizational arrangements, leadership, force structure, intelligence, and logistics;
(2) Training, cultural and psychological profiles, and flow of information;
(3) Doctrinal flexibility or constraints in utilizing new weapons and technologies.

b. Validation of models or simulations and of scenarios for field exercises. Validation is a process, based on historical data and trends, that assists in determining whether a scenario, model, or simulation is an accurate representation of the real world. TDI has the capability to do this independently or to provide primary source historical data for agency in–house validations.

c. Estimating casualties for combat or other operations.

d. Providing lessons learned from studies of cause and effect chains among responsible players at the political, theater, operational, and tactical levels.

e. Analysis of group behavior (impact of various combat activities on units) and other human factors (historically–based aggregate measure of leadership, training, morale, organizational capacity, and cultural characteristics) in modern battles.

f. Studies, based on historic trends and experiential data, of the specific impact on combat caused by new technology and the improvement in weapons. This enables projections of ways in which future wars should be fought and understanding of what elements constitute "force multipliers."

3. The capabilities listed above merge operations research with historical trends, actual combat data, and real world perspectives creating applied military history in its most useful sense.

# CONTENTS



In honor of the memory of the late

**Trevor N. Dupuy**
Col., USA

**International TNDM Newsletter**

# From the Editor...



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The last issue of The International TNDM Newsletter was published in December 1998. The ten-year gap in publication was because of relatively limited work on the model during most of that period. Still, not all was quiet here at The Dupuy Institute (TDI) during that period.

This newsletter has come about due to TDI having made a sale recently in Asia, and this generated a desire by us to make some additional changes to the model. During the ten-year publication gap, we sold a copy of the model, without a support contract, to a country in Europe. We also performed two major contractual efforts that used the TNDM. First, we prepared an extensive report for the Army Medical Department in 2005 that compared the TNDM to five other casualty-estimation methodologies, reviewed the bases for various casualty estimation methodologies and models, and prepared a computerized catalog of over 150 combat models and casualty-estimation methodologies. Part of that report will be presented in this newsletter. The article "Comparing Force Ratios to Casualty Exchange Ratios" is an appendix from that report.

The other major effort was the use of the TNDM in 2006 to analyze the potential effectiveness of a projected combat system as compared to historical data. In this case, we ran a series of corps-level and division-level engagements from the Battle of Kursk (July 1943) using the TNDM. The results of these runs, which basically serve as an independent and separate corps- and division-level validation of the model, will be published in our next newsletter.

So, there has been some use of the model in the decade since our last publication. On the other hand, since 2004, most our work at the Institute has been focused on insurgencies. While this is not related in any manner to our TNDM work (although this was not entirely the case for the Bosnia estimate done in 1995), it is work that we feel is of interest to many of our readers. Therefore, I have included a copy of an article called "The Analysis of the Historical Effectiveness of Different Counterinsurgency Tactics and Strategies." This was work drawn from an effort we completed last year and was presented for us in 2008 by Gene Visco at the Cornwallis Group. As such, this same article appears in the Proceedings of the 2008 Cornwallis Group that is expected to be published this spring.

The lead article in this newsletter comes from a sample use of the model that we recently did in preparation for our sale of the TNDM in Asia. The article on the analysis of the morale table in the TNDM was also prepared in response to questions from our new customer. They were both written by one of our junior researchers, Alexander Dinsmoor, who is profiled in the "Who is TDI" section.

The remaining article is the third and second-to-last installment in the series of articles by H. W. Beuttel on the Iran-Iraq War. The first two articles appeared in Volume II, Numbers 3 and 4 of the newsletter. This article on chemical warfare has been sitting in our files for a decade, awaiting publication. It was time to complete that, and Bill Beuttel graciously took the time to update the article before we published it here. The next issue will present his revised summation of casualties in the Iran-Iraq War.

This completes the return of The International TNDM Newsletter. We intend to publish quarterly over the next year and already have enough material assembled to cover the next year. If we decide to talk insurgencies, which have been the primary focus of our work for the last four-and-and-a-half years, then we can certainly fill many more newsletters.

The TNDM is currently being reviewed, and we expect soon to complete another round of revisions, creating version 2.07. This will include fixing some minor computer bugs and clean-up. We then intend to revise the model to better address the effects of fighting in urban terrain, based upon the work we did in our three urban warfare studies.

Anyhow, it's good to be back and good to bring the newsletter back to life.

# Using the TNDM for the Battles of Singapore

Alexander Dinsmoor

## Introduction

On December 8, 1941, forces of imperial Japan attacked British forces on the northeastern coast of the Malayan Peninsula at Kota Bharu. Additional Japanese forces landed in Thailand and proceeded overland into western Malaya. The British forces in Malaya were undermanned and under-trained and quickly fell back. The Japanese forces advanced down the coasts and the central trunk road toward Singapore Island.

The British pursued both a land- and sea-based defensive strategy. The land forces deployed throughout the Malaya Peninsula were too few to cover the whole peninsula and too dispersed to support each other. The naval strategy was based on a deterrent force consisting of the battle cruiser HMS Repulse, the battleship HMS Prince of Wales, and four destroyers. It was thought that the two capital ships would be a powerful disincentive to any Japanese attack. Both strategies failed. The Japanese were able to land on the peninsula without difficulty and sank both capital ships with aircraft attacks on December 10, 1941. By early February 1942, the British had been pushed all the way back to Singapore. The only barrier between the Japanese and Singapore was the Jahore Strait, separating Malaya from Singapore Island. The Japanese possessed air superiority from the beginning of the campaign through its conclusion with the fall of Singapore.

This article describes the Japanese assault crossing of the strait – the Battle of Sarimbun Beach – as analyzed using the TNDM.

## Japanese Forces

The Japanese deployed their 25th Army, under the command of Gen. Tomoyuki Yamashita, to Malaya. The 25th Army was composed of the 5th Division, the 18th Division and the Imperial Guards Division. All three divisions were veteran, having had combat experience in China. Additionally, prior to crossing the Jahore Strait, the Japanese occupied overwatch positions in Jahore, giving them an excellent view of the strait.

After pushing the British out of Malaya, the three divisions lined up along the shore of the Jahore Strait opposite Singapore. The 5th and 18th divisions deployed in the west, facing to the southeast, with the 5th on the right and the 18th on the left. The Imperial Guards Division was in position along the coast to the east of the 5th and 18th divisions, covering most of the strait from just west of the causeway to opposite Palau Ubin. The Japanese forces had sufficient boats to transport their forces across the strait and into Singapore. Furthermore, the Japanese had either practiced with boats or had river-crossing experience during operations in China.

For the TNDM analysis, we have given the Japanese 13 infantry battalions and 2 divisional artillery support units. Japanese reports indicate that they had a total of 13 battalions available for the attack, with 5 in reserve. The opposing Australians estimated that as many as 12 battalions could have crossed the strait by noon on February 9.

## British Empire Forces

Lt. Gen. Arthur Earnest Percival was the General Officer Commanding (GOC) of the Malaya Command, which was responsible for defending the Malayan Peninsula and Singapore. The Malaya Command's principal formation was the Indian III Corps, which consisted of the 9th Indian and 11th Indian divisions and the 8th Australian Division, with the 28th Indian Brigade in reserve. By the time these forces had withdrawn to Singapore Island, they had been reduced in numbers and capability. The forces remaining intact for the defense of Singapore included: the 11th Indian Division, the 8th Australian Division, the newly-arrived 18th British Division, several surviving Indian brigades, 2 Malaya brigades, the Straits Settlements Volunteer Force (brigade-sized), and several smaller locally-raised militias. Most of these forces were depleted in strength, although several of them had just received replacements.

Singapore Island was home to a major Royal Navy base at Sembawang. Batteries of coastal defense guns were placed around the island to defend the base from a

naval attack. Contrary to popular belief, the guns were capable of aiming landward; however, their armament consisted almost entirely of armor piercing shells intended for use against ships. Much of the base infrastructure had been destroyed prior to the Japanese attack on Singapore Island.

Singapore Island contained several airfields. The most significant was Tengah airfield, which was the Japanese objective on the first day of the attack. After the British withdrawal to Singapore Island, Tengah airfield was in range of Japanese artillery, causing the British aircraft to be relocated to Kallang airfield. After the initial landing on the night of February 8th, the surviving aircraft withdrew to Sumatra. Close to the end of the Malaya campaign, the defending Brewster Buffalos, which had proven no match for the Japanese aircraft, were reinforced by Hurricanes.

After withdrawing across the Jahore Strait, the British forces redeployed to defend Singapore Island. The northern coast was divided into eastern and western defense areas. The 8th Australian Division was given responsibility for the western defense area, which ran up the west coast to just east of the causeway. The Indian III Corps, then consisting of the 11th Indian Division and the 18th British Division, was given the responsibility for the eastern defense area, which started just east of the causeway and ran along the entire northeastern coast. The two Malay brigades, the Straits Settlements Volunteer Force and some Indian units were in reserve along the southern coast and in the city of Singapore.

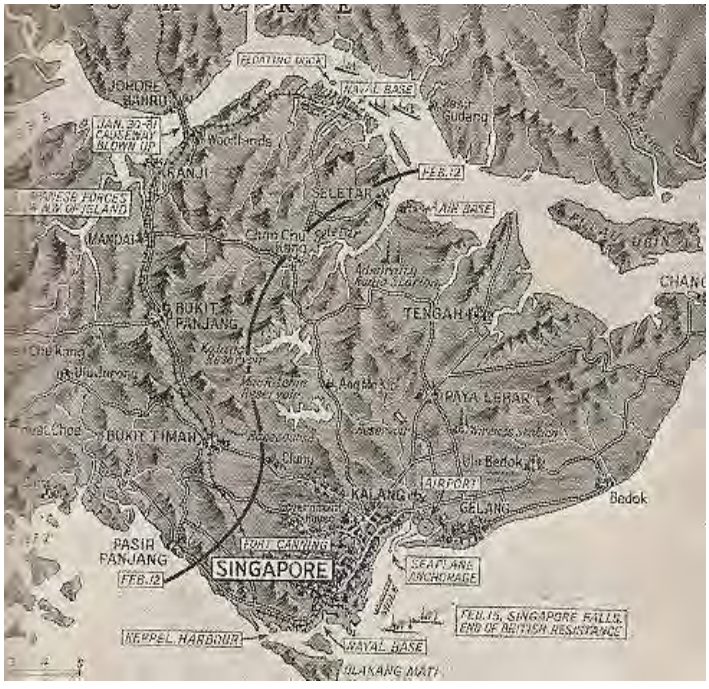
The Sarimbun Beach area, where the Japanese were planning their main effort, was defended by the Australian 22nd Brigade, facing northwest, under the command of Brig. Harold B. Taylor. The Australian 27th Brigade was on the 22nd Brigade's right flank in Kranji. The 44th Indian Brigade was on the 22nd Brigade's left, south of the Choa Chu Kang road. The 22nd Brigade had received replacements after suffering casualties during the fighting in Malaya, but they were poorly trained. The 22nd Brigade was responsible for covering almost 8 km of coastline against 2 veteran Japanese divisions.

The 22nd Brigade deployed with the 2/19 Battalion on the left, the 2/18 Battalion in the center and the 2/20 Battalion on the right. The 22nd Brigade was supported by D Company of the 2/4 Machine Gun Battalion, the 2/15 Field Regiment (minus 1 battery), G Troop (a provisional artillery unit) and 100 men from Dalforce, a Malay militia unit armed with rifles. The forward posts were equipped with searchlights, which, with a single exception, were not used during the battle, and Very lights (flare guns) to signal their supporting artillery.

The engagement ended at 0630 hrs on February 9th, when the 2/29th Battalion (27th Brigade) arrived in the vicinity of Tengah Airfield. The 2/29th Battalion had been ordered into the 22nd Brigade's zone but took several hours to concentrate its forces before moving west. If the engagement were to be continued beyond this point, other reinforcing units, which began showing up on the morning of February 9th, would have to be added.

**The Battle of Sarimbun Beach**

Following an artillery bombardment, the first wave of Japanese assault troops crossed the Jahore strait at approximately 2230 hrs. February 8, 1942. Col. Arthur Varley, commander of the 2/18 Battalion, had ordered his troops to be prepared for a night attack, as had been Japanese custom throughout the Malaya campaign. The Japanese crossed the straits in small boats, each carrying 20-25 men. Where the boats ran into defending forces they were shot-up, but the defenders were spread thinly over their 8 km front, allowing many boats to land unopposed. The Japanese mounted machine guns



and mortars on barges that followed the attacking force to provide close support.

Once ashore the Japanese force utilized the infiltration tactics they had used so effectively on the peninsula. When they encountered an opposing force, they would pin it with a small detachment and send most of their troops on a flanking maneuver. These tactics were particularly effective at night, when visibility was low. The Japanese preparatory bombardment had not caused many casualties but had damaged the communications lines. Most of the Australian forces lacked radios, as they had been turned over for maintenance after the retreat from Malaya and had not been properly redistributed. It is not clear if the supporting artillery units were able to see the Very lights that the front line troops had been equipped with for signaling. The Very lights were, however, visible to troops in the neighboring 27th Brigade.

The Japanese attack fell most heavily on the 2/18th Battalion in the center of the 22nd Brigade's line. On the 2/18th's right, "A" Company, and on the left, "C" Company, were the targets of landings. The Japanese forces worked their way up the Sungei Sarimbun and the Sungei Murai, (both small rivers) on the right and left flanks of the 2/18th Battalion. Many of the Australian units that were not surrounded or dispersed put up a fight until 0100 or 0200 hrs, when they began to run low on ammunition. By 0130 on the 9th, Varley requested approval for a withdrawal to Ama Keng. One of the Australian's fall-back plans had been to establish a defensive line from the village of Ama Keng to the Sungei Berih, however, no work was ever done on the position. Under the weight of continuing Japanese attacks, the Australian line was never reestablished. Communications quickly broke down during the retreat, and scattered Australian forces withdrew towards Tengah. The British forces never recovered, and Percival, facing a shortage of water, supplies and ammunition, surrendered to Yamashita on February 15, 1942, days after the battle of Sarimbun Beach.

**Running the Battle in the TNDM**

In order to run the battle in the TNDM we created a Japanese battalion based on a TO&E from a World War II US government information packet. Each battalion had 1,100 troops. We gave each battalion 2 70mm bn guns, 36 Type 11 LMGs, 12 Type 92 HMGs, 12 50mm "Knee Mortars," 2 90mm mortars and 1,036 Arisaka rifles. The Japanese were given 13 of these battalions for this engagement. The Japanese were also given two 2,300-man divisional artillery support units. These units represent the artillery support that would be provided by the 5th and 18th divisions' supporting artillery. Each supporting artillery unit was given 36 75mm field guns, 12 75mm mountain guns and 12 32mm AT Guns. Based on the superior leadership, training, experience and morale that the Japanese forces had exhibited during the Malaya campaign, they were given a CEV of 2.

The same procedure was used for creating the Australian forces in the TNDM. An Australian infantry battalion, with a strength of 860 men, represents the 2/18, 2/19, and 2/20 battalions of the 22nd Brigade. The Australian forces were armed based on a TO&E of early-war Australian forces and from the Australian War Memorial's narrative of the engagement. The Australian battalion was given 36 Bren guns, 6 3-in mortars and 818 Lee-Enfield rifles. The Australians were given the 12 motorcycles and 8 trucks they were assigned. The actual number may have been lower. Australian infantry battalions usually had 19 universal carriers; however, in light of a general lack of materiel, the total number of universal carriers assigned to all Australian forces in the battle has been reduced to 20. D Company of the 2/4 Machine Gun Battalion was assigned to support the 22nd Brigade's three battalions. D Company's strength was estimated at 235, and it was given 16 Vickers MMGs and 216 Lee Enfields. The 2/15 Field Regiment was assigned to provide artillery support to the 22nd Brigade. The 2/15 Field Regiment's strength was estimated at 400. The 2/15 Field Regiment was down one battery and only had 16 Ordnance QF 25-pounders. G Troop was a provisional artillery support unit. G Troop's strength was estimated at 400, and it was armed with 6 4.5-in. howitzers. Both artillery units were given trucks. The final unit in the 22nd Brigade's sector was a 100-man detachment from Dalforce, a locally-raised Malay militia unit armed with rifles.

Since the Japanese were crossing the Jahore Strait, shoreline vulnerability was applied. This likely impacted the TNDM run, as the strait was not only not fordable but also is the largest size category of river or water short of an amphibious landing. Where the 5th and 18th divisions crossed, the strait was over 500 meters wide. Also, since the Japanese crossed the river in small boats were not able to bring any mechanized transport,

they have had their trucks removed. The road quality has been given as poor, and the road density has been given as sparse. This decision was based narratives of the battle and a look at maps of the area.

**Results from the TNDM**

The TNDM clearly has no difficulty identifying the winner when two Japanese divisions attack one Australian brigade. On the whole the losses given (about 330 for the Japanese and about 400 for the Australians) seem within the range of possibility. We do not have good casualty data for this engagement at this time.

The TNDM had difficulty accurately predicting the advance rate of the Japanese forces. In the TNDM the Japanese advance 0.817km for the engagement. Historically, they advanced at least 5 km by 0630 to near the northern edge of the Tengah airfield. Also, historically, the Japanese advanced and captured the Tengah airfield, which is approximately 6 km from the coast, within 24 hours of the landing. A number of different variables were adjusted in the TNDM for the sake of seeing whether the Japanese advance rate could reach its historical level. The two key issues are the river crossing and the lack of trucks, both of which slow the advance rate in the model. Throughout the Malaya campaign the Japanese forces had trucks. However, as previously mentioned, during the Battle of Sarimbun Beach, the Japanese were conducting a river crossing in small boats and barges and would not have been able to use their trucks. Japanese wheeled and tracked vehicles were not brought across the Jahore Strait until the next day, when the Imperial Guard Division secured the causeway. Trucks and other vehicles significantly affect advance rates in the TNDM.

The TNDM had difficulty predicting artillery losses for the engagement. Japanese artillery losses for the engagement are unknown, and the TNDM did not predict any losses for the Japanese towed artillery. The TNDM predicted that the Australian's would lose one gun. However, the 2/15 Field Regiment's 29th Battery lost seven of its guns when the unit became bogged down during its withdrawal. Since the TNDM-predicted penetration of the Japanese was less than one kilometer, the model could not have predicted the abandonment of guns during the historical deep penetration. Concerning other materiel losses, the model predicted that the Australians would only lose three trucks; they probably lost more.

Concerning other operational or environmental factors, the fighting occurred at night during and after the initial crossing. We have the engagement ending at 0630 on the 9th, when the 2/29th Battalion (historically) arrived in the vicinity of the airfield. Neither side has been given the advantage of surprise; not only was there a preparatory bombardment before the attack started, but Colonel Varley, commander of the 2/18th Battalion ordered his troops to be prepared for a night crossing. The weather and climate have been adjusted for the fact that Singapore is 85 miles north of the equator. Terrain is a matter of contention; in the end rolling-gentle-mixed was used.

Weapons system totals for each side:

| **Australia** | **Japan** |
|---|---|
| 3,715 personnel | 18,900 personnel |
| 2,773 Lee-Enfield rifles | 13,468 Ariska rifles |
| 108 Bren guns | 468 Type 11 LMG |
| 16 Vickers MMG | 156 Type 92 HMG |
| 18 3-inch mortars | 156 50mm mortars |
| 20 Bren carriers | 26 90mm mortars |
| 6 4.5-inch howitzers | 12 32mm AT guns |
| 16 QF 25-pounders | 26 70mm battalion guns |
| 26 motorcycles | 24 75mm mountain guns |
| 50 trucks | 72 75mm field guns |

The TNDM report is reprinted on the following pages.

TACTICAL NUMERICAL DETERMINISTIC MODEL (TNDM)
Compiled 20 Jan 1998
Version: 2.04 Copyright (c) 1994 T. N. Dupuy
All rights reserved
03/05/2009

ENGAGEMENT FILENAME: SARIMBUN ANALYST: AWD
ENGAGEMENT DESCRIPTION: Battle of Sarimbun Beach
STARTING DATE OF ENGAGEMENT: 02/08/1942
STARTING TIME OF ENGAGEMENT: 2230
ATTACKER: Japan
DEFENDER: Australia
ATTACKER'S STARTING POINT (X, Y): 0.00, 0.00
ATTACKER'S OBJECTIVE (X, Y): 0.00, 6.00

RESULTS SUMMARY

| | ATTACKER | DEFENDER |
|---|---|---|
| COMBAT POWER RATIO | 3.684 | 0.271 |
| WINNER | XXXXXX | |
| DISTANCE ADVANCE | 0.817 | |
| ADVANCE RATE (KM/DAY) | 2.452 | |
| CASUALTIES | 334.817 | 397.914 |
| % CASUALTIES/DAY | 5.315 | 32.133 |
| TANK LOSSES | 0.000 | 20.000 |
| % TANK LOSSES/DAY | 0.000 | 300.000 |

PROGRAM-CONTROL VARIABLES
TIME STEP FOR ATTRITION CALCULATION: 8.0000 HOURS
TIME STEP FOR PRINT OUT OF RESULTS: 8.0000 HOURS MAXIMUM
ELAPSED TIME FOR SIMULATED COMBAT ENGAGEMENT: 8.0000 HOURS
INTERMEDIATE RESULTS WILL NOT BE PRINTED OUT
INPUT DATA

ENVIRONMENTAL VARIABLES
LIGHTING LEVEL: MIXED DAY AND NIGHT, HALF DAY
TERRAIN TYPE: ROLLING-GENTLE-MIXED
WEATHER CONDITION: DRY-SUNSHINE-EXTREME HEAT
CLIMATE/SEASON OF YEAR: SEMI-TROPICAL
ROAD QUALITY: POOR ROADS
ROAD DENSITY: SPARSE

OPERATIONAL VARIABLES
ATTACKER'S MISSION: ATTACK (MAIN EFFORT)
DEFENDER'S MISSION: HASTY DEFENSE
ATTACKER'S WEAPONS SOPHISTICATION: UNKNOWN
DEFENDER'S WEAPONS SOPHISTICATION: UNKNOWN
FORCE TYPE: INFANTRY
ATTACKER HAS AIR SUPERIORITY
SURPRISE LEVEL: NO SURPRISE

PRIOR DAYS OF COMBAT - ATTACKER: 0.00
PRIOR DAYS OF COMBAT - DEFENDER: 0.00

SHORELINE VULNERABILITY

WATER/BEACH OBSTACLE: ACROSS MAJOR UNFORDABLE RIVER
FRIENDLY TROOPS DISTANCE FROM SHORE: Less than 1,000m (small arms fire)
WIDTH OF UNFORDABLE RIVER/STREAM: 5 = 500 METERS OR MORE
ATTACKER CEV: 2.000

| EQUATION MODIFIERS | ATTACKER | DEFENDER |
|---|---|---|
| COMBAT POWER: | 1.000 | 1.000 |
| ATTRITION RATE: | 1.000 | 1.000 |
| TOWED ARTILLERY RATE: | 1.000 | 1.000 |
| SP ARTILLERY RATE: | 1.000 | 1.000 |
| ADVANCE RATE: | 1.000 | |
| SET PIECE FACTORS: | 1.000 | 1.000 |
| Original Dispersion Factors | 3000.000 | 3000.000 |
| New Dispersion Factors: | 3000.000 | 3000.000 |

ATTACKER'S ORDER OF BATTLE

13.000 Infantry Battalion of JAPAN
2.000 Divisional Artillery of JAPAN

DEFENDER'S ORDER OF BATTLE

3.000 Infantry Battalion of AUSTRLIA
1.000 D Coy 2/4 Machine Gun BN of AUSTRALIA
1.000 2/15 Field Regiment (-1 Bty) of AUSTRALIA
1.000 G Troop Provisional of AUSTRALIA
1.000 Dalforce of AUSTRALIA

FORCE & EQUIPMENT INVENTORY

| | ATTACKER | DEFENDER |
|---|---|---|
| NUMBER OF PERSONNEL | 18900 | 3715 |

NUMBERS OF COMBAT SYSTEMS

| | ATTACKER | DEFENDER | SCORES | |
|---|---|---|---|---|
| Armor | 0 | 20 | 0.000 | 3.200 |
| Infantry | 14274 | 2915 | 9765.028 | 2016.229 |
| Anti-Tank | 24 | 0 | 696.000 | 0.000 |
| Towed Artillery | 122 | 22 | 10616.000 | 654.000 |
| SP Artillery | 0 | 0 | 0.000 | 0.000 |
| Anti-Air | 0 | 0 | 0.000 | 0.000 |
| Fixed-Wing Aircraft | 0 | 0 | 0.000 | 0.000 |
| Rotary-Wing Aircraft | 0 | 0 | 0.000 | 0.000 |

| | | |
|---|---|---|
| TOTAL OLI | 21077 | 5673 |
| NUMBERS OF MOBILITY ELEMENTS | | |
| Trucks | 0 | 50 |
| Tracked Vehicles | 0 | 0 |
| Fixed-Wing Aircraft | 0 | 0 |
| Rotary-Wing Aircraft | 0 | 0 |
| Motorcycles | 0 | 36 |

SNAPSHOT OF BATTLEFIELD OUTCOME AFTER 8.000 HOURS OF COMBAT
( 1 TIME STEP OF CALCULATION)

| | | |
|---|---|---|
| FORCE STRENGTHS | | |
| FORCE STRENGTHS | 21690.934 | 4941.714 |
| FORCE RATIO | 4.389 | 0.228 |
| POWER POTENTIAL | | |
| COMBAT POWER (P) | 25722.951 | 5317.492 |
| P/P RATIO | 4.837 | 0.207 |
| P'/P' IMBALANCE | 3.684 | 0.271 |
| TIME AND SPACE | | |
| ADVANCE RATE (km/day): | 2.452 | |
| LOCATION (x, y): | 0.000 | 0.817 |
| TOTAL DISTANCE (km): | 0.817 | |

FINAL INVENTORY

| | ATTACKER | DEFENDER |
|---|---|---|
| NUMBER OF PERSONNEL | 18565 | 3317 |

NUMBERS OF COMBAT SYSTEMS

| | ATTACKER | DEFENDER | SCORES | |
|---|---|---|---|---|
| Armor | 0 | 0 | 0.000 | 0.000 |
| Infantry | 14021 | 2603 | 9592.039 | 1800.271 |
| Anti-Tank | 24 | 0 | 683.670 | 0.000 |
| Towed Artillery | 122 | 21 | 10578.118 | 3531.896 |
| SP Artillery | 0 | 0 | 0.000 | 0.000 |
| Anti-Air | 0 | 0 | 0.000 | 0.000 |
| Fixed-Wing Aircraft | 0 | 0 | 0.000 | 0.000 |
| Rotary-Wing Aircraft | 0 | 0 | 0.000 | 0.000 |
| TOTAL OLI | | | 20854 | 5332 |

NUMBERS OF MOBILITY ELEMENTS

| | | |
|---|---|---|
| Trucks | 0 | 47 |
| Tracked Vehicles | 0 | 0 |
| Fixed-Wing Aircraft | 0 | 0 |
| Rotary-Wing Aircraft | 0 | 0 |
| Motorcycles | 0 | 34 |

# Analysis of the Historical Effectiveness of Different Counterinsurgency Tactics and Strategies

Christopher A. Lawrence

## Background

In 1990, Trevor N. Dupuy, using his combat model, the TNDM (Tactical Numerical Deterministic Model) made casualty predictions about the upcoming Gulf War, both in congressional testimony and in a book published just before the shooting started in Kuwait in 1991. His estimate was the lowest public estimate presented and, therefore, more accurate than the much higher estimates provided by the US defense community.

Subsequently, in 1995, The Dupuy Institute assembled an estimate of casualties for the chairman of the Joint Staff before the US decision to deploy into Bosnia. This was the first systematic attempt we are aware of to provide a casualty estimate for what was then called Operations Other than War (OOTW—a term no longer employed). The estimate was derived from analysis of a database of 90 peacekeeping operations, insurgencies and interventions that we had assembled. It provided an accurate prediction and, in this case, became part of the decision-making process.

In late 2004, The Dupuy Institute provided projections of casualties, duration and several other factors for the developing insurgency in Iraq. This was the first systematic attempt we are aware of to provide casualty and duration estimates for an insurgency. It was derived from a database of 28 post-World War II insurgencies that we had assembled. Like the Bosnia estimate, it was accurate in its predictions of casualties, and provided predictions on duration, US force size, insurgent force size and other factors. As such, it stands today, four years later, without change.

## Counterinsurgency Tactics and Strategy Study

This study was a direct consequence and partial continuation of the Casualty Estimate for the Insurgency in Iraq study done by The Dupuy Institute in 2004.[1] With a more extensive database of 83 insurgences, interventions and peacekeeping operations, we began systematically to test the theories of various counterinsurgency experts. The effort included an examination of the works of nine experts: Clutterbuck, Galula, Joes, Kitson, Fall, Manwaring, O'Neill, Trinquier and a 1984 BDM report.

As part of this study, we systematically examined the published works of these nine theorists and summarized their conclusions. We then compared the results of the analysis of our database to these theorists' conclusions to see if the data supported or contradicted their hypotheses. In those areas where we were able to test their ideas (and there were limitations), we were only able to find support for about half of what they had hypothesized, with the exception of David Galula and Bernard Fall, for whom we found broad support.

This effort included a broad range of findings based upon a statistically measurable and significant number of cases from our database of 83 post-WWII cases. The analysis of these issues and the data used in the analysis are included in a series of detailed appendices to the full report, or as separate referenced reports, but are not included in this brief summary of our work. Our findings addressed:

- Terrain
- Rules of Engagement and Degrees of Brutality
- Nature of Insurgencies
- Force Ratios
- Measurements of Burden
- Operational Details - Active Sanctuaries, Border Controls and Population Resettlement
- Indigenous Government Type and Elections
- Force Ratio versus Cause

## Conclusions

Our principal conclusion from this exercise is that Force Ratios and Insurgent Cause are extremely significant factors. We can build a model based on these two fac-

[1] The Dupuy Institute, *Casualty Estimate for the Insurgency in Iraq - Draft*. Annandale, VA: The Dupuy Institute, 2005. This was presented as a series of briefings given between December 2004 and March 2005 and included an undistributed draft paper.

tors alone that will explain the outcome of 80% of the 83 cases we examined. This is quantitative analysis of the largest and most detailed insurgency database that we are aware of. This does not mean we are convinced that it is entirely correct, but we will argue that it has at least as much support as any other suggestions made and more support than most. Still, it is clear that more work needs to be done.

In general, Galula and Fall provide the two theoretical constructs we examined that we believe have a sound basis.

We also conclude that:

1) There is a strong need for further study of these issues.
2) There is a considerable danger of negative learning.
3) There is not a strong basis for developing any model of insurgency before further study is conducted.
4) There are sometimes limitations with developing theories based primarily upon personal experience.

**The Big Picture**

1) Force ratios, within reason, are not an issue when facing regional or factional insurgencies.

2) When facing insurgencies that have a broad base of support, one needs at least a 5-to-1 force ratio and preferably a 10-to-1 force ratio.

3) It appears that the two most important factors in determining the outcome of an insurgency are the force ratio and the nature of the cause of the insurgency.

**Other Factors Tested**

A number of factors were tested in this effort and in our work for the Center for Army Analysis. A listing of the important ones, but of lesser importance than force ratio and cause of insurgency, are provided below. Once the two most important factors are addressed, then other lower order factors come into play. The lower order factors include:

1) Rules of Engagement and Rectitude
2) Terrain
3) Burden [2]

Factors that may be important are the Insurgent Strategy and the impact of local government types and elections.

Then there are those elements of an insurgency that so far have not shown to be as important as those above, relatively. This does not mean that they are not important; it just means that their impact appears to be of a lower order in the overall picture. These include:

1) Structure of Insurgencies
2) Specific Government Reforms
3) Degree of Outside Support
4) Sanctuary
5) Barrier Systems
6) Population Resettlement
7) Government Type
8) Staying the Course

**Recommendations**

1. Future analysis should be focused to address one of three distinct time frames:

a. Before an insurgency starts (pre-insurgency)

b. The early stages of an insurgency (proto-insurgency)

c. An insurgency that has clearly developed (developed insurgency)

Our current work addresses primarily developed insurgencies.

2. The intelligence community needs three sets of quantitative predictive tools. These are not intended to replace current approaches but to supplement them. The three sets of tools are:

a. A model that predicts the chances of political violence across all nations. This is, in effect, readdressing the Gurr and Feierabend & Feierabend work and would be extended to address all the data that has accumulated in the 40 years since they did their analysis. This is not a small effort (pre-insurgency model).

[2] Burden in this case refers to the cost of the war, measured as either a percent of losses compared to home population (what we label intensity), or a percent of forces committed compared to the home population (what we label commitment).

b. A model or set of procedures that predicts the chances of and analyzes the nature of insurgencies in their early stages (proto-insurgency model).

c. A model or set of procedures that predicts the chances of and analyzes the nature of insurgencies that are clearly developing. This is effectively what our Iraq casualty estimate did in January 2005 (developed insurgency model).

3. Training tools need to be revamped to consider current understandings and to remove past biases.

a. The political concept, motivation and causes of insurgencies need to be seriously addressed.

b. The structure of the insurgency needs to be addressed. The current material appears to be overly influenced by the US experience in Vietnam.

c. The issue of outside support needs to be addressed. The current material appears to be overly influenced by the US experience in Vietnam.

4. Analysis needs somehow to be able to parse the study of insurgencies to their appropriate levels, from strategic concerns (most important), to operational concerns to tactics. Each level needs to be studied separately and then at some point, interrelated.

5. Related to the above points, databases need to be constructed for analytical uses that address the appropriate levels and the appropriate time frames.

6. Time series analysis looking at the changes in violence and actions over time and the events that might drive those changes needs to be done.

7. There needs to be an examination of the how to measure the degree of population control based upon real-world examples.

There are 38 additional recommendations provided in the full report of the study.

**An Example**

The foregoing is drawn from our reports. Below we provide the solid base of data from which this is developed.
Two of our earliest and more influential findings were that we were able to see a difference in outcomes depending on the nature of the cause of the insurgency. Those insurgencies based upon a limited developed political thought, basically a regional or factional insurgency, resulted in insurgent victories (red victories) in just 23% of our cases, while those based upon a central political idea (like nationalism or anti-colonialism) resulted in insurgent victories in 64% of our cases. The third category we worked with applied to those based upon an overarching concept, which in all of our cases was communism, but could represent any overarching ideological or religious construct.

| Outcome by Type of Political Concept | | | | | |
|---|---|---|---|---|---|
| **Outcome** | **Limited** | **Central** | **Overarching** | **Not Applicable** | **Total** |
| Blue | 24 | 8 | 8 | 2 | 42 |
| Gray | 7 | 2 | 2 | 0 | 11 |
| Red | 9 | 18 | 3 | 0 | 30 |
| Total | 40 | 28 | 13 | 2 | 83 |

Two-sided p-value from Fisher's exact test excluding the not applicable cases: 0.0077

Two-sided p-value Fisher's exact test excluding the not applicable and gray cases: 0.0031[3]

[3] Basically, these Fisher Exact Tests establish that the results do not come about by chance (less than 1% chance that they did). They do not establish cause and effect.

| Name | Force Ratio | Peak Insurgent Strength | Years | Winner | Classification |
|---|---|---|---|---|---|
| 63. Peacekeeping in Liberia (1990-1997) | 0.38 | 31,000 | 7.11 | Insurgents | INS/I |
| 70. First Chechen War (1994-1996) | 0.61 | 62,000 | 1.73 | Insurgents | CONV/INS becomes INS/NI |
| 48. Operation Tacaud (1978-1980) | 0.75 | 19,400 | 2.21 | Insurgents | INS/I |
| 49. Tanzania in Uganda (1978-1980) | 1.07 | 26,200 | 2.01 | Intervening Force | CONV/INS becomes INS/I |
| 23. Katanga Wars (1961-1963) | 1.09 | 12,400 | 1.36 | Intervening Force | CONV |
| 67. UN Mission to Somalia (1992-1995) | 1.09 | 32,000 | 2.47 | Insurgents | VIOLENCE |
| 2. Ukraine (1944-1957) | 1.12 | 40,000 | 10.24 | Government | INS/NI |
| 26. Borneo (1963-1966) | 1.25 | 22,000 | 3.34 | Intervening Force | GUERINV |
| 75. UN PK in Congo (2000-present) | 1.28 | 89,250 | 7.85 | Intervening Force | PEACE |
| 78. PK Ivory Coast (2002-present) | 1.28 | 52,564 | 5.28 | Intervening Force | PEACE |
| 80. Second PK in Liberia (2003-present) | 1.52 | 42,604 | 4.41 | Intervening Force | PEACE |
| 24. Yemen (1962-1970) | 1.55 | 40,000 | 7.55 | Intervening Force | INS/I |
| 66. UN PK in Yugoslavia (1992-present) | 1.57 | 219,000 | 15.87 | Intervening Force | PEACE |
| 33. Chad Civil War (1965-1969) | 1.60 | 5,000 | 3.42 | Insurgents | INS/NI |
| 64. PK in Lebanon (1990-present) | 2.09 | 37,700 | 17.22 | Ongoing | PEACE |
| 40. French in Chad (1969-1971) | 2.30 | 5,000 | 2.21 | Intervening Force | INS/I |
| 69. UN PK in Rwanda (1993-1996) | 2.37 | 20,000 | 2.43 | Insurgents | PEACE |
| 60. UN PK in Angola (1988-1999) | 2.45 | 65,600 | 10.19 | Intervening Force | INS/I |
| 44. Angola Civil War (1975-1991) | 2.56 | 68,550 | 13.87 | Intervening Force | INS/I |
| 73. PK in Sierra Leone (1997-2005) | 2.71 | 21,000 | 8.61 | Intervening Force | CONV/INS becomes INS/I |
| 16. Oman (1957-1959) | 3.14 | 630 | 1.54 | Intervening Force | INS/I |
| 19. UN PK in Congo (1960-1964) | 3.18 | 17,244 | 3.96 | Intervening Force | PEACE |
| 52. Uganda Civil War (1979-1986) | 3.73 | 11,000 | 6.80 | Insurgents | INS/NI |
| 47. Mozambique Civil War (1976-1992) | 4.08 | 20,000 | 16.60 | Government | INS/I |
| 77. US in Afghanistan (2001-present) | 4.68 | 25,000 | 6.13 | Ongoing | INS/I |
| 45. Lebanon (1975-1990) | 5.67 | 28,000 | 15.52 | Intervening Force | INS/I |
| 55. Contras in Nicaragua (1982-1990) | 6.38 | 12,000 | 8.41 | Government | INS/NI |

| | | | | | |
|---|---|---|---|---|---|
| 51. El Salvador (1979-1992) | 6.39 | 9,000 | 13.04 | Government | INS/NI |
| 18. La Menos Violencia (1958-1964) | 8.32 | 8,100 | 6.29 | Draw | VIOLENCE |
| 13. Tibetan Revolt (1956 – 1964) | 10.47 | 21,006 | 18.59 | Intervening Force | INS/I |
| 6. La Violencia (1948-1958) | 11.23 | 6,000 | 9.85 | Draw | VIOLENCE |
| 68. UN PK in Mozambique (1992-1994) | 11.79 | 20,538 | 1.98 | Intervening Force | PEACE |
| 79. Iraq (2003 - present) | 15.39 | 27,000 | 4.79 | Ongoing | CONV/INS becomes INS/I |
| 56. Tamil Insurgency (1983-2002) | 16.40 | 7,500 | 18.60 | Government | INS/NI |
| 81. UN PK in Burundi (2004-2006) | 18.69 | 3,000 | 2.62 | Intervening Force | PEACE |
| 59. Kashmir (1988 - present) | 40.00 | 10,000 | 19.43 | Government | INS/NI |

It is clear from a cursory glance, that there is not a good track record when engaged in operations against insurgent forces that outnumber you (the three cases this was tried resulted in insurgent victories). For those operations where the force ratio is between 1-to-1 and 4-to-1 the counterinsurgent usually, but not always wins. For those operations where the force ratio is above 4-to-1, there are no insurgent victories. Note: the "Peace" in the last column means peacekeeping operations, with "INS" means an insurgency of some type.

On the other hand, the picture is radically different for insurgencies based upon a central political idea: (see table, next page)

**Central Idea (like nationalism)**

| Name | Force Ratio | Peak Insurgent Strength | Years | Winner | Classification |
|---|---|---|---|---|---|
| 3. Indonesia (1945-1949) | 1.13 | 160,000 | 4.33 | Insurgents | INS/C |
| 5. Indochina War (1946-1954) | 1.28 | 350,000 | 7.67 | Insurgents | INS/C |
| 42. Rhodesia II (1972-1979) | 1.34 | 33,500 | 7.01 | Insurgents | INS/I |
| 1. UK in Palestine (1944-48) | 1.58 | 55,500 | 4.29 | Insurgents | INS/C |
| 12. Cameroun (1955-1960) | 1.82 | 3,000 | 4.48 | Insurgents | INS/C |
| 53. USSR in Afghanistan (1979-1989) | 2.28 | 110,000 | 9.15 | Insurgents | INS/I |
| 35. Namibia (1966-1989) | 2.84 | 14,000 | 22.68 | Insurgents | INS/C |
| 25. Portuguese Guinea (1963-1974) | 3.35 | 9,560 | 11.26 | Insurgents | INS/C |
| 17. Vietnam I (1957-1960) | 3.52 | 75,017 | 3.40 | Insurgents | INS/NI |
| 50. Cambodia (1978-1989) | 4.06 | 64,000 | 10.78 | Insurgents | CONV/INS becomes INS/I |
| 37. Sandinistas (1967-1979) | 4.18 | 4,000 | 12.50 | Insurgents | INS/NI |
| 22. Angola (1961-1974) | 4.89 | 13,900 | 13.23 | Insurgents | INS/C |
| 43. Polisario Rebellion (1973-1991) | 5.71 | 21,000 | 18.34 | Intervening Force | INS/I |
| 9. Mau Mau Revolt (1952-1956) | 5.97 | 12,000 | 3.44 | Intervening Force | SUP/INS becomes INS/C |
| 28. Aden (1963-1967) | 6.75 | 4,000 | 3.98 | Insurgents | INS/C |
| 30. Mozambique (1964-1974) | 7.00 | 10,000 | 9.87 | Insurgents | INS/C |
| 29. Colombian Civil War (1964-present) | 8.03 | 38,100 | 43.62 | Government | INS/NI |
| 14. Soviet Intervention in Hungary (1956) | 8.90 | 15,000 | 0.05 | Intervening Force | SUP |
| 83. Hezbollah War (2006) | 10.00 | 3,000 | 0.09 | Insurgents | GUERINV |
| 46. Indonesia in Timor (1975-1999) | 10.20 | 3,000 | 24.03 | Insurgents | CONV/INS becomes INS/I |
| 10. Algerian War (1954-1962) | 10.28 | 61,100 | 7.67 | Insurgents | INS/C |
| 8. Puerto Rico (1950-1954) | 10.67 | 402 | 3.34 | Government | SUP/INS becomes INS/NI |
| 58. First Intifada (1987-1993) | 12.95 | 14,050 | 5.77 | Insurgents | INS/NI |
| 34. Rhodesia I (1966-1972) | 15.96 | 1,360 | 6.72 | Government | INS/I |
| 76. Second Intifada (2000-2005) | 22.85 | 7,900 | 4.36 | Draw? | INS/NI |
| 39. Northern Ireland (1968-1998) | 24.56 | 1,500 | 29.53 | Intervening Force | INS/NI |
| 11. Cyprus (1955-1959) | 162.73 | 273 | 3.89 | Intervening Force | INS/C |

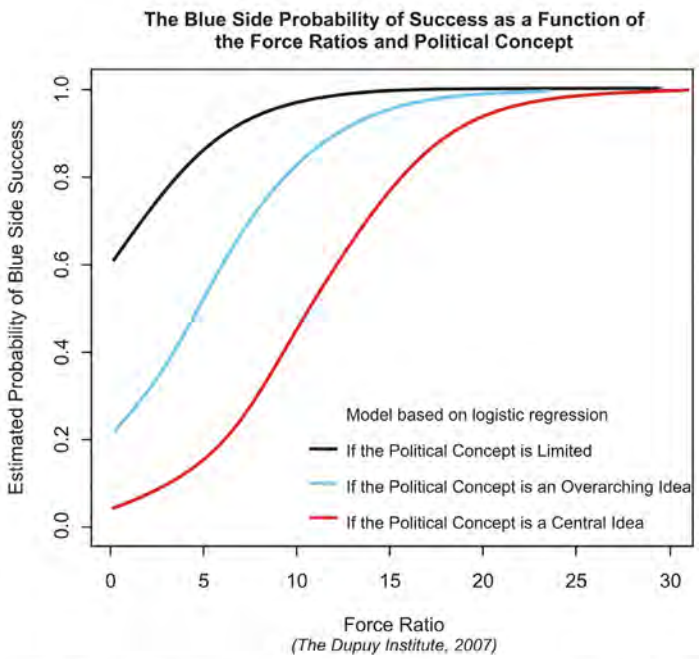
Note that in each case in which the counterinsurgents outnumbered the insurgents less than 5-to-1, the insurgents won. Counterinsurgent success improves somewhat at force ratios between 5-to-1 and 10-to-1, but only above 10-to-1 do we see a significant shift in favor of the counterinsurgent. These two charts clearly establish that both cause and size (force ratios) matter. The final chart reinforces these observations.

**Overarching Idea (like communism)**

| Name | Force Ratio | Peak Insurgent Strength | Years | Winner | Classification |
|---|---|---|---|---|---|
| 65. UN PK in Cambodia (1991-1993) | 0.70 | 27,000 | 2.08 | Intervening Force | PEACE |
| 21. Vietnam II (1961-1964) | 2.26 | 261,710 | 4.00 | Insurgents | INS/I |
| 31. Vietnam War (1965-1973) | 4.32 | 376,000 | 8.08 | Insurgents | INS/I |
| 27. Tupamaru Insurgency (1963-1973) | 6.67 | 4,200 | 9.92 | New Government | INS/NI |
| 32. Dhofar Rebellion (1965-1976) | 6.75 | 2,000 | 10.90 | Intervening Force | INS/I |
| 4. Greek Civil War (1946-1949) | 8.97 | 25,700 | 3.55 | Government | INS/NI |
| 20. Guatemala (1960-1996) | 9.28 | 6,000 | 36.15 | Government | INS/NI |
| 15. Cuban Revolution (1956-1959) | 10.00 | 3,000 | 2.09 | Insurgents | INS/NI |
| 7. Malaya (1948-1960) | 12.91 | 8,200 | 12.13 | Intervening Force | INS/I |
| 41. Argentina (1969-1983) | 22.81 | 5,700 | 14.53 | New Government | INS/NI |
| 54. Shining Path in Peru (1980-1999) | 29.50 | 6,000 | 19.17 | Government | INS/NI |
| 36. Guevara Guerilla Campaign (1966-1967) | 37.41 | 54 | 0.92 | Government | INS/NI |
| 38. Cabanas Insurgency (1967-1974) | 105.89 | 350 | 7.55 | Government | INS/NI |

## A Logistic Regression Model

This data can be used to develop a logistic regression model as displayed below:




$$\log\left(\frac{\pi_i}{1-\pi_i}\right) = -1.34 + 0.29(ForceRatios) + 1.47(Limited) - 1.76(Central)$$

| | | | | |
|---|---|---|---|---|
| s.errors | (1.06) | (0.11) | (1.04) | (1.00) |
| p-values | (0.1996) | (0.0068) | (0.0935) | (0.0799) |

Similar work was done for the other factors we examined, including the effects of terrain, rules of engagement, levels of brutality and many others. Our work produced 10 analytical reports that totaled over a thousand pages, based upon analysis of 83 insurgencies, interventions and peacekeeping operations.

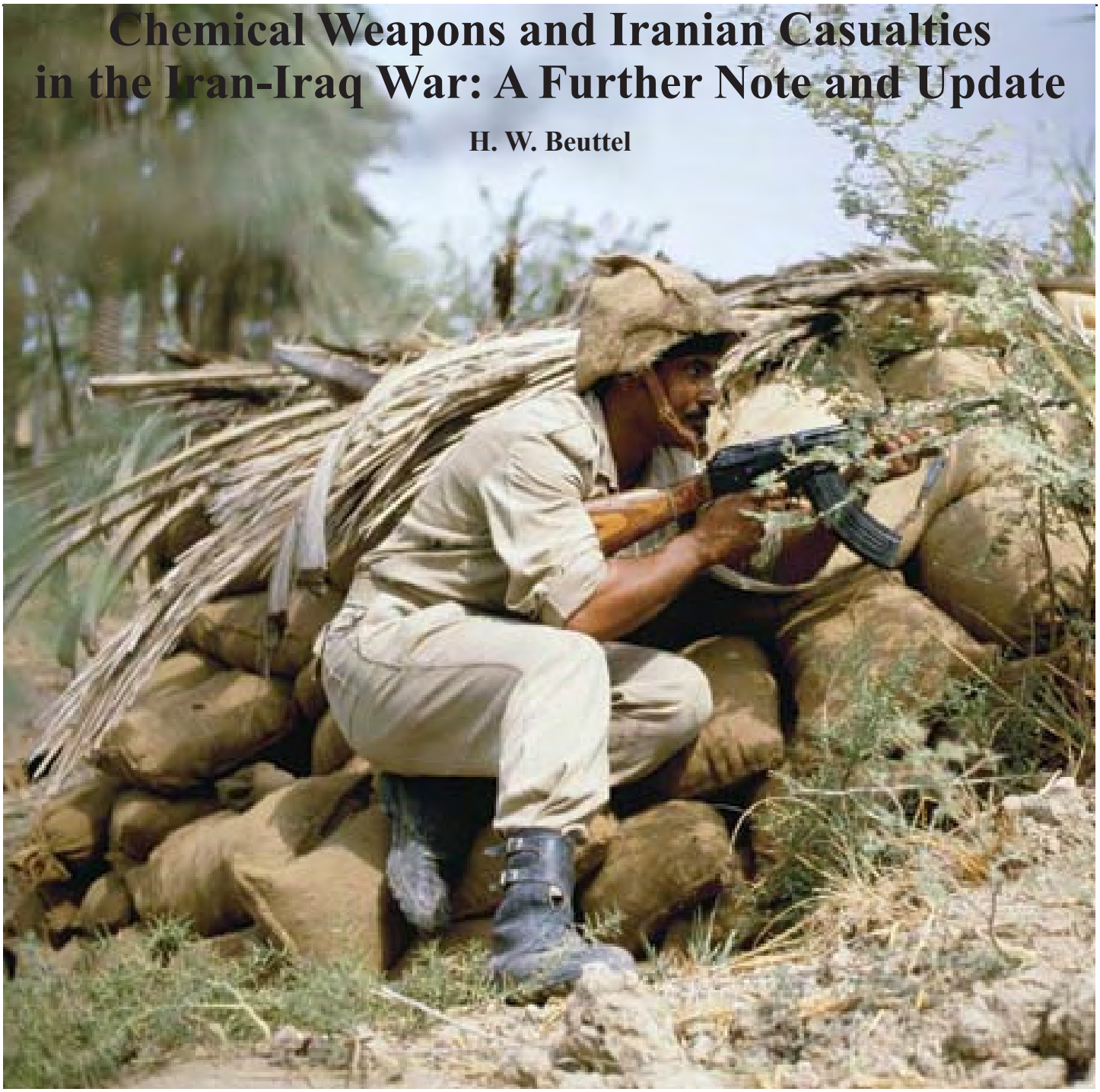
Due to other priorities, the work on this effort has shifted from the big-picture analysis, and currently, no further effort is being done to refine or develop this work. We feel that this is unfortunate. We were developing useful findings that we felt had universal application across a range of irregular warfare conflicts. More work clearly is needed.

The attendees of Cornwallis should note that some of our results look similar to those presented at an earlier Cornwallis by Andrew Hossack of the UK. In fact, Mr. Hossack's and our own research and work were developed independently. We became aware of Mr. Hossack's work later due to Cornwallis and Gene Visco. The fact that many of our conclusions are similar to his, simply serves to demonstrate what can be done with a little solid historical research and analysis developed from that. In the UK, they actually now label what we do as a separate discipline of Operations Research, called Historical Analysis.

The scope of this work is beyond the reach of any single individual. In our case, it was conducted by a team of a dozen researchers, historians, analysts and statisticians over the course of more than a year. We wish to thank all of our various sponsors for giving us a chance to develop the work to this extent.

# Chemical Weapons and Iranian Casualties in the Iran-Iraq War: A Further Note and Update

**H. W. Beuttel**



Twelve years ago, in 1997, the controversy over Iraqi weapons of mass destruction led to the release of additional data on Iraqi use of chemical weapons in the Iran-Iraq War (1980-1988). This, as well as new data released by the Iranian government, has shed better light on aspects of chemical casualties experienced by Iranian forces during that conflict which were discussed in a previous article on overall Iranian casualties in the Iran-Iraq War and causal proportions of those casualties. Significant data was compiled and released by the United Nations Special Commission (UNSCOM) pursuant to UN Resolution 687 in a report dated 6 October 1997.[1] Other sources were a US Government White Paper released 13 February 1998 and a "Q&A" sheet issued by the United States Information Agency on 19 February 1998.[2] Additional data came directly from the Iranian Foundation for the Disabled and Oppressed and other Iranian sources. The original version of this ar-

[1] *Report of the Secretary General on the Activities of the Special Commission Established by the Secretary General Pursuant to Paragraph 9 (b) (i) of Resolution 687 (1991)*. S/1997/774, 6 October 1997. Hereafter cited as *UNSCOM*.

[2] "Iraq Weapons of Mass Destruction Program," US Government White Paper (13 February 1998); "Crisis with Iraq: Q&A," USIA (19 February 1998). Hereafter cited as White Paper and USIA.

ticle was written in 1998 and not published. It has now been revised and updated to include data and information released in the last twelve years.

The UNSCOM report traced the inventory of Iraqi chemical agents and munitions before, during, and after both the Iran-Iraq and Desert Storm Wars. It was based on Iraqi-provided data, much of which may be inaccurate, or deliberately false or misleading, but it provides the only quantified data base regarding these weapons as a point of departure. Among the data are interesting statistics about the amount of agent and number of munitions expended against Iranian forces. According to Iraqi figures, some 2,870 tons of chemical warfare agents were consumed from 1981 to 1988.[3] Further, this tonnage was employed in 101,080 munitions expended.[4] Throughout the war, Iraq employed chemical weapons against Iranian forces at least 195 times although as many as 300 and even 400 attacks have been claimed.[5] In 2002, Iran insisted some 6,000 tons were actually employed.[6] Later Iranian claims in 2008 refer to 2.5 million kilograms of chemical agents, or 2,500 tons which is more in line with Iraqi statements.[7] It seems that mustard agents—particularly the infamous and effective Iraqi "dusty" mustard—caused the majority of chemical casualties in the war judging by post-war Iranian medical literature, where populations of gassed soldiers studied are as high as 1,500.[8] Some 3,000 men were exposed to mustard gas from Fars Province alone.[9] The Iranian Revolutionary Guard Corps or *Pasdaran* maintains its own medical school, the Baqiatollah Medical University. Enrollment was 2,000 in 1998. One of its tasks is to compile and maintain a data base on Iranian chemical wounded from the War of Sacred Defense.[10]

The types of munitions employed were not enumerated. However, corollary data indicates that, prior to the Desert Storm War, Iraq had the following inventory of munitions dedicated to chemical agent delivery:

- Rockets ~ 100,000
- Artillery Shells ~ 30,000
- Aerial Bombs ~ 10,000[11]

At first, it seemed likely the Iraqi inventory in the Iran-Iraq War was similar. If so, rockets accounted for 72%, artillery shells for 21%, and bombs 7% of the total inventory of chemical munitions. However, the munitions expended divided into the amount of agent consumed (2,870,000 kg/101,080) indicated ”average” munitions must have had a 28 kg fill. This corresponds exactly to a KhAB-100 class aerial bomb (100 kg with 28 kg fill of mustard).[12] This suggests the majority of agent was delivered by aerial bombing. The usual Iraqi aerial chemical strike was five MiG-23 or MiG-27 aircraft each carrying 4-6 250 kg chemical bombs (KhAB-250) with a 49 kg chemical fill. Such a strike could deliver 980 to 1,470 kg of agent. However, oftentimes up to 50% of these bombs failed to detonate. Iraq also used flights of 2-3 helicopters to drop 220 liter containers which detonated on ground contact.[13]

Artillery shells, mortars and small caliber rockets deliver only 5-8 kg of chemical agent on the average. Artillery shells are the least efficient, with 5% of their weight as agent fill. Mortars are better at 10%. Tactical rockets can deliver about 15% of their weight as agent. Best of all are large rocket or missile warheads which contain 30-50% of their overall weight as agent fill. The R-72 Luna-M (FROG-7) 960 kg warhead has 475 kg of agent, while an R-300 Zemlya ( SS-1c Scud-B) chemical warhead packs 555 kg from a total weight of 985 kg.[14] None of the latter are known to have been used. Iraq often used massed mortars for chemical delivery, as they delivered the “best bang for the buck.” A 60mm

[3] *UNSCOM*, 11.

[4] *UNSCOM*, 12

[5] “Curing the Victims of Chemical Weapons; From Rumor to Reality,” *Iran Daily* (9 May 2002); “Iraq Chemically Attacked Iran 196 Times,” *Etemaad Daily* (3 February 2003); “2,000 Iranian Chemical Victims Sue German Companies,” *Sharq Daily* (4 July 2004).

[6] “Iran Insists Iraq Had Used 6,000 Tons of Chemical Weapons,” *IRNA* (25 December 2002).

[7] “Iran, Major Victim of Weapons of Mass Destruction: Envoy,” *IRNA* (10 May 2008).

[8] “Abstracts Obtained from Iran on Medical Research Conducted After the 1980-1988 Iran-Iraq War,” www.chronicillnet.org/PGWS/tuite/IRMED/IRANTOC.html.

[9] M. Zakerina, et al. “Development of Hematologic Malignancies and Aplastic Anemia Following Exposure to Mustard Gas,” Department of Internal Medicine, Shiraz University of Medical Science and the Fars Chemical Warfare Victims Center.

[10] “Baseej to Hold Maneuvers, 500,000 to Participate,” *IRNA* (18 November 1998)

[11] *White Paper*, Appendix B

[12] T.J.. Gander, “Soviet Air Launched Chemical Munitions,” *Jane’s Soviet Intelligence Review* (June 1989), pp. 256-257.

[13] “CW Use in Iran-Iraq War,” 062596_cia_66846_01.txt

[14] Martin S. Navias, *Going Ballistic: The Build-Up of Missiles in the Middle East* (London: Brassey’s, 1993), p.100.

mortar round could contaminate 50 cubic meters; an 82mm round 200, and a 120mm round 1,000.[15]

If we fill all the pre-Desert Storm munitions (5 kg per artillery shell, 8 kg per rocket and 49 kg per bomb) the total munitions fill is 1,440 tons. This is exactly half of the claimed Iraqi agent consumption. This taken alone suggests that the Iraqis fired twice the amount of chemical munitions (280,000) against Iran, than they had on hand to combat coalition forces. However, the number of munitions expended is only listed as 101,080 - only 36% of the theoretical total. This again suggests that the munitions proportion in the Iran-Iraq War was different, with many more large capacity aerial bombs.

The 195 known Iraqi chemical attacks must have averaged about 518 munitions per attack (101,808/195). This is roughly what two 6-launcher batteries of BM-21 class multiple-rocket launchers could accomplish in under 30 seconds. Conversely, it would take three artillery battalions of 18 guns firing four rounds sustained about 2.5 minutes. However, each attack would also average 14,504 kg of delivered agent (2,870,00/195). This would then require either 296 KhAB-250 class bombs, 1,813 122mm class rockets, or 2,900 152/155mm artillery shells. Also complicating any definitive calculation is that the 195 known "attacks" may be a seriously incomplete count or a highly-aggregated figure useful only in the most general sense. Iranian figures claim 242 attacks by March 1988.[16]

The problem may be simplified in that, despite its later inventory before the Desert Storm War, Iraq does not seem to have used rockets to deliver gas in the Iran-Iraq War. A quick review of Cordesman's accounts of chemical incidents and delivery means indicates air delivery by fighter or helicopter was the most common method. Artillery and mortars participated in delivery 58%; aircraft or helicopters 79%; and both 42% of the time. Only in 16% of incidents did artillery act alone, but in 32% aircraft acted alone.[17] There is no definite mention or suggestion of rockets except for the allegation that air-to-ground rockets with chemical submunition warheads were used in 1984.[18] This is a novel delivery means of high sophistication unknown in the arsenals of any other nation. It is probably the misidentification of an incendiary or smoke weapon.

It is reported that Iraqi *Luna*-M (NATO: FROG-7) heavy battlefield rockets were fired with chemical warheads filled with HD (distilled mustard) against Iranian rear areas during the Iran-Iraq War.[19] These could not have been many as only about seventy *Luna* are known to have been fired in the whole war, and none after 1984. Iran reported no mustard gas casualties until 1982. On 27 October 1982, near Musain, four Iranian soldiers died from toxic chemical exposure, probably mustard gas. There were only 29 total gas casualties reported for that year. In mid-August 1983, Iran suffered 318 casualties from mustard and arsenic agents. On November 7, 9, and 13 1983, Iraq used mustard in the Panjwin area. Four seriously wounded Iranian soldiers later died in European hospitals.[20] The final total gassed in 1983 was 564.[21] Only about five *Luna* were fired in these two years, all at Dezful. Additionally, Iraq declared to UNSCOM that it had only experimented with a chemical warhead for the *Luna* series in 1988 without success.[22]

Given this simplification we can algebraically calculate the number of 152/155mm artillery shell and 250 kg bomb equivalents used to deliver the 101,080 expended munitions and 2,870,000 kg of agent.

Let x = number of artillery rounds
Let y = number of bombs
Let 5 kg = average fill for artillery shell
Let 50 kg = average fill for bomb

Our system of linear equations in two unknowns is:

(1) $x + y = 101,080$
(2) $5x + 50y = 2,870,000$

Collecting terms and canceling in equation 2 results

[15] "CW Use in Iran-Iraq War," 062596_cia_66846_01.txt

[16] James Smith, "Chemical Weapons Proliferation," *Jane's Soviet Intelligence Review* (May 1991), 194-198.

[17] Anthony Cordesman, *The Iran-Iraq War* (Boulder, Colo: Westview Press, 1990), 508-509.

[18] Julian Robinson and Jozef Goldblat, "Chemical Warfare in the Iran-Iraq War," *SIPRI Fact Sheet* (May 1984).

[19] "Free Rocket Over Ground (FROG) Artillery Rocket System," *Jane's Armor and Artillery 1997-98* (London: Jane's Information Group, 1997), 794.

[20] Cordesman, 188n23, 513-518.

[21] James Smith, "Chemical Weapons Proliferation," *Jane's Soviet Intelligence Review* (May 1991), 194-198.

[22] *UNSCOM Report to the Security Council - 25 January 1999: Annex A*, 9.

in

$$x + y = 101{,}080$$
$$x + 10\,y = 574{,}000$$

Subtracting equation 1 from equation 2 leaves:

$$x + y = 101{,}080$$
$$9y = 472{,}920$$

Again collecting terms and canceling in equation 2 we arrive at:

$$x + y = 101{,}080$$
$$y = 52{,}545$$

Subtracting equation 2 from equation 1 results in:

$$x = 48{,}535$$
$$y = 52,\ 545$$

From this we can conclude that 48% of the munitions were artillery and mortar shells, and 52% were aerial bombs. Given an average chemical bomb load of five 250 kg equivalents the Iraqi air force carried out something like 10,500 (52,545/5) chemical sorties, or roughly 5% of its total sorties against Iranian ground forces. The air force also delivered 92% of all agent, with 8% delivered by Iraqi ground forces artillery. In World War I chemical artillery rounds made up 5% of all artillery shells fired and 90% of all chemical agents delivered.[23] We see the exact opposite in the Iran-Iraq War where air force delivery of agent exceeded artillery by a factor of twelve.

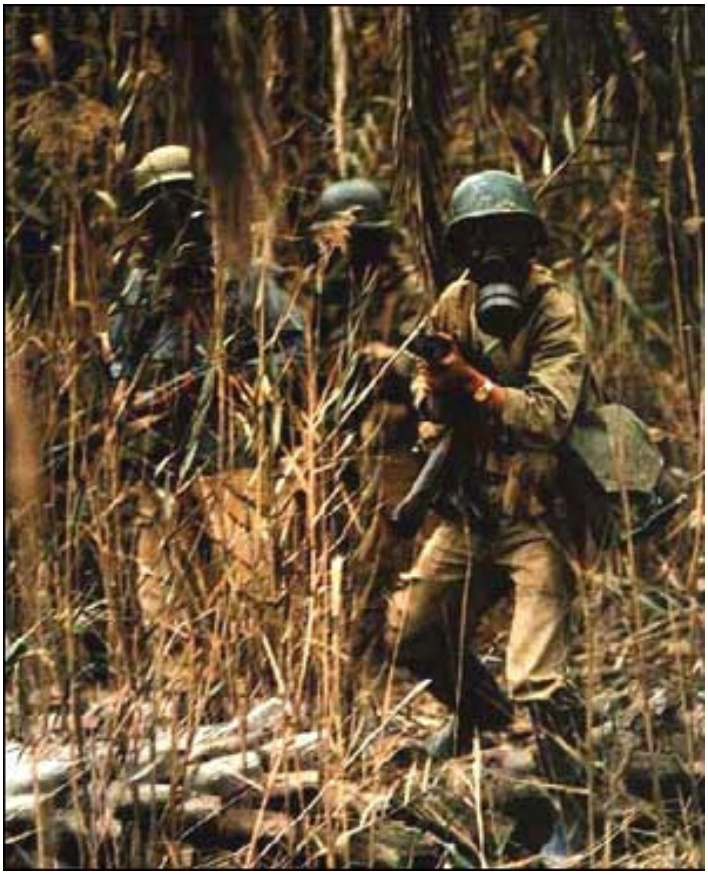
The number of munitions claimed expended by Iraq is paltry contrasted to WWI standards. At Riga on 1 September 1917, the Germans fired 116,400 chemical shells at a rate of 388 a minute into Russian forces causing 1,000 casualties. In the first German spring of-

[23] John Terraine, *White Heat: The New Warfare 1914-1918* (London: Sidgwick & Jackson, 1982), 160-161.

fensive of March 1918 German forces fired two million gas shells inflicting 14,860 casualties.[24] 7,000 of these were suffered by the BEF 2nd and 63rd Divisions, which were on the receiving end of 120,000 gas shells over a three-day period.[25] The amount of agent expended in this eight-year conflict is also small contrasted to the Great War. At least 100,000 tons of chemical agent were expended in WWI.[26] The British Special Brigade alone discharged some 5,700 tons in just less than three years from September 1915 to August 1918 in some 378 distinct gas attacks.[27] Iraqi usage is only 2-3% that of WWI. In WWII, the US had 32,000 tons of agent earmarked for the invasion of Japan.[28] This is over eleven times Iraqi expenditure. The number of attacks—242 according to Iranian data—is also minuscule contrasted to World War I. Given that the average WWI gas attack against a specific target involved about 300 shells, something like 22,000 "attacks" occurred in the War to End All Wars.

After the publication of my original article I discovered an interesting and detailed listing of Iranian chemical casualties. Iran first claimed Iraqi use of chemicals in an air attack on Susangerd in November 1980. By 16 February 1984, Iran alleged 49 instances of Iraqi chemical weapons employment in which 109 were killed and "hundreds" wounded.[29] Iran claimed the following chemical casualties year by year during the war in 242 overall Iraqi gas attacks.[30]

- 1981: 11
- 1982: 29
- 1983: 564
- 1984: 2,237



- 1985: 3,267
- 1986: 11,141
- 1987: 13,496
- 1988 (Jan-Mar): 13,300

Total: 44,050

This listing is at odds with other Iranian statements that in all they had suffered 25,600 gas casualties by April 1988, of which 260 (sic 2,600 ?) died.[31] It is some 72% larger.

New data on Iranian chemical casualties was released in 1998 by the Iranian government in conjunction with the tenth anniversary of the Hajabla incident, much covered by the world press.[32] In March 1998, Farzad Panahi, Deputy Director of the Foundation for the Disabled for health and medical treatment, said that 60,000 Iranian soldiers had been wounded by chemical weapons *during* the imposed war with Iraq. According to his data, 50-60% suffer from pulmonary diseases, 30% have ocular disorders and the rest have skin diseases.[33] The main treatment center for chemically

[24] Ian V. Hogg, *Gas* (New York: Ballantine Books, 1975), 120, 125.

[25] Terraine, *Op. cit.*

[26] Donovan Webster, *Aftermath: The Remnants of War* (New York: Vintage Books, 1996), 24-25. WWI shells, many still cast iron, had poor capacity for agent fill. 4" Stokes mortars were very efficient with about a 4 kg fill, while the Livens projector delivered almost 14 kg of agent. Howitzer artillery shell might carry as little as 1.5 kg, but usually not more than 3 kg from weapons as large as 150mm. A modern 152/155mm howitzer has about a 5 kg fill.

[27] Donald Richter, *Chemical Soldiers: British Gas Warfare in World War I* (Lawrence, KS: University of Kansas Press, 1992), 228.

[28] Thomas B. Allen and Norman Polmar, *Codename Downfall: The Secret Plan to Invade Japan - and Why Truman Dropped the Bomb* (New York: Simon and Schuster, 1995), 179.

[29] Julian Robinson and Jozef Goldblat, "Chemical Warfare in the Iraq-Iran War," *SIPRI Fact Sheet* (May 1984).

[30] James Smith, "Chemical Weapons Proliferation," *Jane's Soviet Intelligence Review* (May 1991), 194-198.

[31] Cordesman, 516-517.

[32] See for instance, Christine Gosden, "Why I Went, What I Saw," *Washington Post* (11 March 1998) and the "60 Minutes" documentary segment broadcast on 1 March 1998 on CBS.

[33] "60,000 Chemically Wounded Iranians Under Treatment," *IRNA* (12

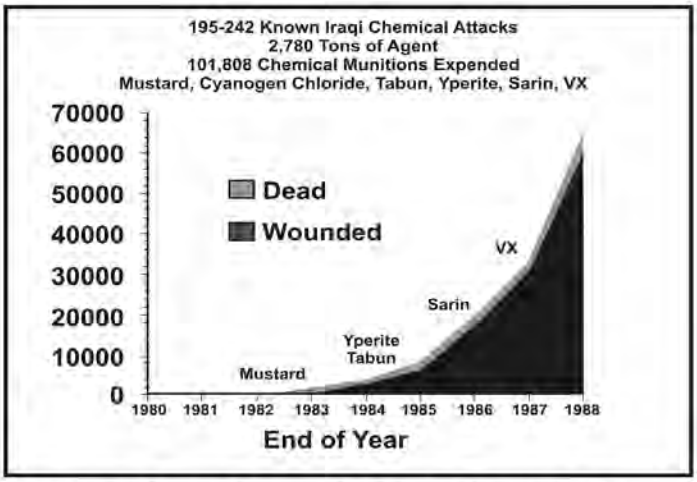
wounded persons is the *Isar* Center in Sari, Mazandaran Province.[34] In 2006, a new nationwide plan was implemented to assess war veterans' suffering from chemical exposure. Mostafa Qanei, Director of the Center Dealing with Chemical Victims, said that of 40,000 chemical victims in Iran, 100 were in very critical condition. Overall 15% of war veterans with chemical wounds are in serious condition. Iranian research indicates it takes 15-20 years for a chemical injury related disorder to advance from a mild to a moderate or serious stage.[35]

This data now indicates that chemical weapons accounted for about 6% of Iranian battle casualties, rather than the 4% proposed in my earlier article when Iran admitted only 30,000 chemical injured. It also indicates that the Iranian chemical casualties in the last five months of the war amounted to about 16,000, if we accept the 44,000 figure by March 1988. This seems more reasonable than 25,600 (misprint for 45,600?), which would require another 34,400 casualties in the same five months to reach the total of 60,000. The pattern though is the same: Iranian chemical casualties doubled in the last year of the war.

In August 1998 Mohammed Baqer Nik-Khah, deputy head of the Foundation for Preservation of the Documents and Values of the Sacred Defense and himself a chemical warfare victim, stated that the death toll from Iraqi chemical agents "surpassed 10,000," and these weapons injured 50,000.[36] In November 2000, Abbas Kani, head of the Legal Office for War Veterans, stated that some 15,000 had died *since* the end of the war due to chemical injuries.[37] This also indicates that the Iranians over time counted post-war dead as war dead and subtracted from their "injured" totals as required. The figures (2001) seem to suggest: 65,000 total casualties of which 5,000 are battlefield dead, 15,000 post war died of wounds and 45,000 still living wounded. Some 45,000 civilians were also affected by chemical weapons.[38] Many of these were women. A seminar entitled "The Patient Defenders" was held on 30 September 1999 in Tehran to examine the impact of chemical weapons specifically on women disabled by toxic agents during the imposed war with Iraq.[39]

On the tenth anniversary of the Halabja incident the US Department of State claimed 20,000 Iranian soldiers had been killed by Iraqi chemical agents.[40] This figure may be correct but 75% of them are post-war deaths. If this is true, it indicates a 25% latent death rate for the 60,000 estimated chemical wounded.

As such, this new data causes a modification in the chemical casualty graph presented in my original article. The graph now should read:




**Iranian Chemical Warfare Casualties**
**War of Sacred Defense 1980-1988**

Chemically wounded in the war continue to die. In December 1998, Brigadier General Mohammed Farivar Khomani died. As a division commander, he was gassed in 1986 during the Beit ol Moqaddas offensive near Fakkeh. He had been under constant medical care since that time.[41] In spring 2000, more chemical wounded were reported dying. Amir Hossein Pourguneh of Shirvan, Khorrassan Province, succumbed to wounds received in 1987 on 31 May 2000. On 7 June 2000, Brig. Gen. Abdul Reza Muzeh died of chemical injuries resulting in prolonged systemic infection. On 10 June 2000, Abbas Hassani likewise passed away as a direct result of

March 1998).

[34] "Iran Supports Convention On Prohibition of Chemical Weapons," *IRNA* (20 May 1999).

[35] "40,000 Victims of Chemical Weapons in Iran," *IranMania* (21 May 2007).

[36] "Litigations to Accentuate Sufferings of Iranian Nation During War," *IRNA* (8 August 1998).

[37] "Over 15,000 War Veterans Died of Chemical Weapons Syndrome," *IRNA* (13 November 2000).

[38] "Official Says Germany, US and Britain were Main Suppliers of Chemicals to Iraq," *IRNA* (1 December 1996).

[39] "'Patient Defenders' Seminar to Study the Impacxt of Chemical Warfare," *Iran News* (28 September 1999).

[40] "Anniversary of the Halabja Massacre," Press Statement by James P. Rubin, US State Department (16 March 1998).

[41] "Chemically Wounded Veteran Army Officer Attains Martyrdom," *Tehran Times* (28 December 1998).

being gassed in the war. All deaths were reported to the UN offices in Tehran by the Society Supporting War Veterans Wounded by Chemical Weapons, according to executive secretary Mohammed Hassan Maleki.[42] Another Baseej chemically-wounded, Yousef Khorshidi, died in Karaj on 2 July 2000.[43] Two days later two more veterans—Gholamreza Madani of Tehran and Khodadad Najafi of Fars province—both succumbed to their wartime chemical injuries.[44] At the end of the month yet another chemically-injured—Golamhossein Rezaie of Isfahan—died.[45] Two more—Amir Hossein Kambuzia and Hassan Qadamqahi—passed away in early August 2000.[46] In late August, Fazollah Geryan died of his chemical injuries.[47] In mid-September, yet another two chemically-wounded from 1985 and 1987—Faraj Yahya-Ee and Haj Saeed Pour Jafari—died. This brought the total to more than 20 over the year.[48] Two more—Kamran Jheddi Nejad and Mohammed Etemadi—died in early October 2000.[49] In November 2000, Avbbas Kani, head of the Legal Office for War Veterans, stated that some 15,000 have died since the end of the war due to chemical injuries.[50]

In all of the year 2000, some 20 chemical casualties died, making about 1,400 since 1981. Some 2,000 others were in critical condition.[51] In July 2001, Col. Ali Hussein Abadi died of his injuries. By then over 300 wounded had died since the war's end.[52] These last two numbers are, of course, far fewer than the 15,000 post-war deaths reported elsewhere. They must refer to deaths in a particular city or perhaps major hospital complex, the detail of which was lost in the editing of the particular obituaries. In August, Alireza Nazari, gassed at Halabja in 1988, died.[53] Brig. Gen. Taqi Raee Dehnaqi, chemically wounded in 1987, died in September.[54] Ayyoub Bolandi died in October, chemically wounded over 75% of his body in March 1981.[55] Hossein Safei, General Manager of the War-Disabled Veterans Affairs Office in Khorasan Province, said that 40 war veterans were in critical condition and that 4,000 others in Khorassan were not responding to treatment. Some 67 war veterans from Khorassan injured by chemical weapons had died.[56] Another side effect was infertility among gassed soldiers. Out of 81 mustard gas patents, 34 had no sperm and 47 had reduced sperm counts. Some 44 were categorized as severely injured, 20 moderately injured, and 17 mildly injured.[57] Typical of survivors is Rezai Mohammed. In 2002, he was a permanent patient at Tehran's Sasan Hospital on oxygen due to severe respiratory problems from mustard gas exposure in 1985. He also suffered from chronic skin boils. Akbar Salimi, another patent, had undergone three operations to stop intestinal bleeding from mustard gas exposure in 1987.[58]

In 2002, IRGC Col. Mohammed Akbari was still suffering from his mustard gas exposure in 1985, and his son, born in 1993, has been diagnosed with a nervous disorder related to the exposure.[59] At Baqiatallah Hospital in 2002 in Tehran, Jalal Taqvi, gassed at Abadan in 1987, suffered from numbness of his right side and was partially paralyzed.[60] In the same year, at the Sassan Hospital (also in Tehran), the beds reserved to treat chemical warfare victims were often 60% filled, ac-

[42] "Iranian Veteran of Iraqi Chemical Warfare Dies," *IRNA* (31 May 2000); "War Veteran General Muzeh Dies from Chemical Warfare Injuries," *IRNA* (7 June 2000); "War Veteran Abbas Hassani Dies of Iraqi Chemical Warfare Infection," *IRNA* (10 June 2000).

[43] "Chemical War Veteran Martyred in Karaj," *Tehran Times* (3 July 2000).

[44] "Two Iranian War Veterans Die of Iraqi Chemical Warfare Syndrome," *IRNA* (4 July 2000).

[45] "Iranian Combatant Dies of His Iraqi Inflicted Chemical Wounds," *IRNA* (22 July 2000).

[46] "Two More War Veterans Inflicted By Iraqi Chemical Attack Martyred," *IRNA* (6 August 2000).

[47] "Another War Veteran Inflicted By Iraqi Chemical Warfare Martyred," *IRNA* (4 September 2000).

[48] "UN Chief Urged To Heed Chemical Warfare Victims," *IRNA* (16 September 2000); "Another Iranian Victim of Iraq's Chemical War Succumbs to His Injuries," *IRNA* (17 September 2000).

[49] "Two More Chemically Wounded War Veterans Attain Martyrdom," *IRNA* (14 October 2000).

[50] "Over 15,000 War Veterans Died of Chemical Weapons Syndrome," *IRNA* (13 November 2000).

[51] "Chemically Wounded War Veteran Dies of His War Injuries," *Tehran Times* (12 July 2001).

[52] "War Veteran Martyred Suffering From Chemical Weapons," *Tehran Times* (21 July 2001).

[53] "Iranian War Veteran Injured By Chemical Weapons Attains Martyrdom," *Tehran Times* (14 August 2001).

[54] "Who Is Responsible?" *Tehran Times* (11 September 2001).

[55] "Chemically Wounded War Veteran Attains Martyrdom, *Tehran Times* (2 October 2001).

[56] "40 War Veterans Injured By Chemical Weapons in Critical Condition," *Tehran Times* (17 October 2001).

[57] "Chemical Warfare Agent May Cause Infertility," Reuters, 13 August 2001.

[58] "Iranian Soldiers Offer Grim Glimpse," AP (8 October 2001).

[59] Scott Peterson, "Lessons From Iran On Facing Chemical Warfare," *The Christian Science Monitor* (19 November 2002).

[60] Brian Murphy, "Iranian War Victims Still Suffering," AP (15 October 2002).

cording to chief physician Hamid Jamali.[61] In January 2002, Davoud Tarkhani, father of six, died of chemical wounds received at Fao in 1985.[62] Raim Moradi died in February after suffering 70% disability from chemical injuries.[63] Azizullah Zamir died in April from chemical wounds sustained in Fao in 1986.[64] Alizeza Bayat, injured in the 1985 Badr operation, died in June. During this eight-day operation Iraq drpopped 77 chemical bombs and fired 23 chemical rockets and 639 chemical shells into advancing Iranian formations. This resulted in 32 Iranian chemical deaths and 2,231 chemically wounded.[65] The same month, Kazem Kiyan Pisheh also passed away from his wounds sustained during the Wal Fajir 8 operation. And, ten days later, Mohammed Reza Hashemi, injured in the Beit ol Moqaddas operation in 1988 and 70% disabled, succumbed.[66] In the first week of July six veterans died, including Brig. Gen. Mohammed Ali Ameri Mazaher Aghajanlou who was wounded in the 1987 Nasr operation; Gholam Reza Javad Pour Samak, who was also an ex-PoW. Others were Ali Asghar Hashemi, Seifallah Gholami, and Amrallah Nadderan.[67] Later, in July, Mohammed Ali Boulaki, wounded in the chemical bombardment of Majnoon Island in 1988, died.[68]

In 2002, statistics indicated 100,000 military personnel and civilians had been exposed to chemical agents during the war. Of these 40,000 were affected enough to require treatment. About 90,000 were military, of which 70,000 were referred to healthcare programs. About 35,000-40,000 qualify as chemical casualties. Of 6,000 civilians, 3,500 are under medical care. One group of 4,300 was referred to the Chemical Patients Committee of the Janbazan Foundation. Of these, 586 had 70% or greater disability, and 3,264 had 50% or less disability.[69] By January 2003, 5,000 to 6,000 chemically wounded were still under treatment, and 1,000 of these were moderately to critically ill. Esmail Khoshnevisan, gassed ferrying wounded soldiers in southwestern Khuzistan, had chronic breathing problems and had lost all his teeth due to degeneration of his gums. Mohammed Reza Bajelan inhaled mustard gas when his gas mask valve jammed in 1985 and coughed up blood chronically. Mohammed Reza Abbasi was a fifteen year old Baseej clearing minefields when he was mustard gassed. All three were patients at the Sassan Hospital in Tehran in 2003.[70] In February 2003, Mohammed Hossein Hosseinabadi died from chemical wounds.[71] Mohammed Reza Yazdani Vafa was gassed five times during the war beginning in the Majnoon offensive of 1982. He survived the Iraqi attack on Halabja in 1988. His main injury was loss of sight in his left eye and diminished vision in the other, as well as swelling and blistering on his skin. He received 1.5 million rials (about $180) a month for his pension.[72] In June 2004, Dr Mostapha Qanei published A Guide to the Health of Chemically Injured War Veterans intended for patients suffering from chemical exposure. The book was free from the Research Office of the Chemically Wounded Veterans Committee. It prescribes health tips to avoid aggravating the condition of the wounded.[73] In September 2004, Davood Karimi died in Sasan Hospital of chemical wounds.[74] By 2004, Iranian figures claimed 120,000 veterans chemically injured. Of these 45,000 including 7,000 civilians were monitored by the Janbazan Foundation. Some 11,348 suffered from skin lesions, 15,562 from ocular injuries, and 17,750 from pulmonary damage. At least 126 had died in the previous 20 years from cancers caused by exposure to HN or sulphuric mustard gas.[75]

In March 2005, Brig. Gen. Mohammed Noureddin

[61] Farnaz Fassihi, "In Iran, Grim Reminders of Saddam's Arsenal," *New Jersey Star-Ledger* (9 December 2002).

[62] "Another Chemically Disabled War Veteran Succumbs to His Injuries," *IRNA* (12 January 2002).

[63] "War Veteran Succumbs to Injuries," *IRNA* (3 February 2002).

[64] "Chemically Injured War Veteran Attains Martydom," *Tehran Times* (10 April 2002).

[65] "March 10, 1985, is the Anniversary of the Military Operation 'Badr'." www.chemicalvictims.com/DesktopModules/News/NewsViewsPrintable.aspx?TabID

[66] "Chemically Disabled War Veteran Succumbs to Injuries," *IRNA* (6 June 2002); "Funeral Ceremony for War Victim of Chemical Weapons," *Tehran Times* (12 June 2002); "Disabled War Veteran Succumbs to Injuries," *IRNA* (22 June 2002).

[67] "Another Chemically Disabled Veteran Dies," *IRNA* (9 July 2002).

[68] "War Veteran Succumbs to Chemical Injuries," *IRNA* (25 July 2002).

[69] "Curing the Victims of Chemical Weapons; From Rumor to Reality," *Iran Daily* (9 May 2002).

[70] "Saddam's Chemical Victims Still Suffering in Iran," Reuters (20 January 2003).

[71] "Chemically Injured War Veteran Succumbs to Injuries," *Tehran Times* (5 February 2003).

[72] "Forgotten Victims of Iraq's Chemical Weapons," AFP (19 March 2003).

[73] "40,000 Chemically Wounded Veterans in Iran: Professor," *Tehran Times* (28 June 2004).

[74] "Chemically-Wounded War Veteran Succumbs to His Injuries," *Tehran Times* (7 September 2004).

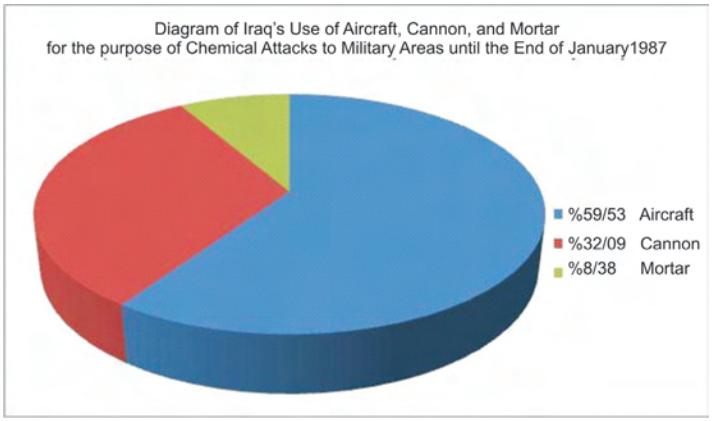
[75] "2,000 Iranian Chemical Victims Sue German Companies," *Sharq Daily* (4 July 2004).

Enshaie died of chemical wounds received in the war.[76] In November 2006, Mehdi Vahidi Asl died in Sassan hospital from gas exposure in 1986.[77] In August 2007, Col. Javad Soheill died of chemical wounds received in 1988.[78] In October 2007, war veteran Abdollah Abdollah-Pour, wounded by the chemical bombardment of Sardasht in 1987, died.[79] In July 2008, Ramezan Safidgari who had taken part in operations Fath ol Mobin, Beit ol Moqqadas, Kheiber, Val Fajr Moghademati, Wal Fajir 8 and Wal Fajir 10, died of chemical wounds.[80]

In 2008 the following chemical wounded statistics for 2006 were released: [81]

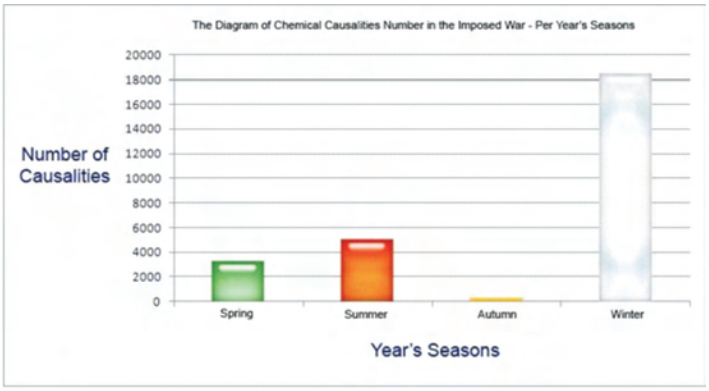
| Severity | Lung | Eye | Skin | Total |
|---|---|---|---|---|
| Mild | 14,580 | 12,900 | 25,670 | 37,300 |
| Moderate | 3,530 | 2,224 | 1,510 | 7,264 |
| Severe | 640 | 438 | 18 | 1,096 |

Other interesting graphs were also presented.




This graph indicates most chemical munitions were delivered by aerial bomb. This is consistent with Iraqi statements after Desert Storm about expenditures of their chemical stockpiles in the War of Sacred Defense. This is consistent with the algebraic evaluation originally done in 1998 for this article.

Another graph of interest displays proportions of chemical casualties by season of year.




The graph indicates about 27,000 total casualties and obviously does not reflect total gas casualties, but some representative population of a particular war year—most likely 1987-88. Some two-thirds, or 66%, of all casualties were suffered in winter. This might be expected, as cooler winter temperatures made chemical agents less volatile and more persistent, leading to longer casualty-producing periods of contamination. Summer saw about 18% of casualties and spring 11%. Autumn, interestingly, only indicates about 1-2% of all casualties, showing use of chemical weapons was unfavorable or highly ineffective in this season.

For 65,000 estimated Iranian military chemical casualties (includes 5,000 estimated maximum killed), the amount of ordnance delivered was very efficient. It inflicted roughly one military casualty per 1.56 munitions expended (65,000/101,080 = 0.64). This is much better than WWI, in which 66 million chemical artillery rounds inflicted 965,140 casualties, or one casualty per 68 shells.[82] The Iranian ground forces were generally ill-prepared for chemical defense. During the course of the War of Sacred Defense, much NBC defense gear was purchased from the UK, Germany and Czechoslovakia, but there was never enough and NBC defense training was insufficient. Many Iranian soldiers became gas casualties because they did not shave often enough to allow their protective masks to make a tight seal.[83] In 1984, Iran bought gas masks from the Republic of Korea and East Germany. The RoK masks were too small for Iranian faces, and the filters were only good for fifteen minutes. The 5,000 East German masks ended up being used as goggles for spray-painting crews. Not until February 1988 did Iran produce its own two-piece chemical protective suit, the Derkash-6. Only in

[76] "Another Iranian War Veteran Dies," *IranMania* (15 March 2005).

[77] "Memorial Service Held for War Veteran Suffering from Chemical Attack," *IRNA* (6 November 2006).

[78] "Another Chemical Attack Victim Succumbs to Injuries," *IRNA* (5 August 2007).

[79] "War Veteran Abdollah-Pour Succumbs to Chemical Wounds," *IRNA* (6 October 2007).

[80] "Another Iranian Chemically Injured Patient Was Martyred," *IRNA* (21 July 2008).

[81] "Iranian Chemical Victims According to the Type of Chemical Agent and Extent of Injury," chemical-victims.com/DesktopModules/Articles/ArticlesViewPrintable.aspx"?TabID

[82] Hogg, 136. The residual 25% of WWI gas casualties were victims of cloud attacks.

[83] Cordesman, 2: 516.

April 1988 did they begin domestic production of gas masks.[84] Despite these improvements one out of every ten severely gassed Iranian soldiers died before receiving any treatment.[85] Only a third of Iranian troops had anything like even partial NBC defensive kit. Many units went into combat without even protective masks. Most pictures show usual Iranian NBC defensive gear as no more than a mask, and occasionally a pair of rubber gloves. In July 1998 it was confirmed that on 17 and 18 April 1988 Iraq introduced VX nerve gas delivered by artillery shell and aircraft bombs during the Fao Peninsula offensive. This new agent inspired panic among *Pasdaran* formations.[86] Without even the protection of a WWI class army, it is a miracle that chemical weapons inflicted only 6% of overall Iranian casualties. At the munitions to casualty ratio of the Iran-Iraq War, WWI's 66 million gas shells would have caused 42 million military casualties!

From the same Iraqi data we learn 44 kg of delivered agent was necessary to inflict a military casualty. WWI data, depending on circumstance of use and agent, indicates anywhere from 50-250 kg were required to produce a casualty, although it must be borne in mind that only cloud or projector attacks used this measure of merit.[87] Using our 5 kg standard for artillery, WWI's 66 million shells amounted to 350 kg per casualty. Again at the Iran-Iraq War ratio, they would have inflicted 7.5 million casualties!

If we consider the civilian chemical casualties together with military (roughly 100,000), then Iraqi chemical munitions had a one-for-one (0.99) casualty ratio; agent amount per casualty is 28.7 kg.

The only other more specific data we have consists of a couple of points. On 17 March 1984, four Iraqi aircraft each carrying eight 100 kg chemical bombs loaded with about 28 kg of Tabun nerve agent attacked an Iranian position. About 400 troops "were affected."[88] This translates to 12.5 casualties per munition and one casualty per 2.24 kg of agent delivered. However, only 40 casualties were observed hospitalized. In the Wal Fajir 8 fighting in February 1986, Iraqi forces reportedly fired 7,000 chemical artillery and mortar rounds on Iranian positions and dropped 1,000 chemical bombs over the operational theater.[89] This resulted in approximately 8,500 Iranian casualties. This translates to a rate of 1.06 casualty per munition. Using our agent fill standards, it represents one casualty per 10 kg of agent employed.

Other strange chemical episodes were also reported. In March 1984 near Guziel, groups of Iranian corpses were found bearing no external trace of injury. The victims appeared to be asleep.[90] This was assumed to be some novel chemical agent. The report bears a strong similarity to contemporary reports from Afghanistan. Nicknamed "The Flash," this agent was purportedly used on one occasion in Afghanistan, inducing instantaneous death with no chemical poisoning symptoms. Afghan Mujahadeen fighters were reportedly found stone dead in their foxholes still aiming their weapons.[91] Although not a chemical agent, Iran also claimed use of "microbic" and "bacteriological" weapons by 1984. Israeli reports claimed anthrax had been diagnosed in some hospitalized Iranian troops.[92] This was neither specifically claimed by Iran nor proved by UN inspectors.

This data would suggest munitions-to-casualty ratio has decreased over 44 (68/1.56) times since WWI, and agent-amount-to-casualty ratio has decreased by a factor of at least eight. On average, chemical weapons should have been about five times "better" in the Iran-Iraq War in their casualty-causing potential than in WWI. Yet, overall casualty patterns and proportions compared are almost exactly the same in both conflicts! This suggests that chemical weapons have become more *efficient*, but overall battlefield *effectiveness* (in terms of inflicting a greater proportion of casualties) has not changed since the Great War.

The only other body of historical-empirical chemical lethality data comes from chemical agent use by the Imperial Japanese Army in the China War (1937-1945). During this conflict, Japanese forces employed

[84] Jean Pascal Zanders, "Iranian Use of Chemical Weapons: A Critical Analysis of Past Allegations," SIPRI Chemical and Biological Warfare Project (7 March 2001).

[85] Saddam's Chemical Victims Still Suffering in Iran," Reuters (20 January 2003).

[86] "Iraq Reportedly Used VX Gas in Iran-Iraq War," Reuters (3 July 1998).

[87] Hogg.

[88] Robinson and Goldblat.

[89] "Violation of International Rules by Iraq," Sacred Defense Epic, *IRNA* (23 September 1998).

[90] Robinson and Goldblat.

[91] David C. Isby, *Weapons and Tactics of the Soviet Army* (2d ed.; London: Jane's, 1988), 301.

[92] Robinson and Goldblat.

chemical weapons at least 1,688 times and perhaps over 2,000 times. Mustard and Lewisite were used at least 1,000 times.[93] Other agents included Phosgene, Blue Cross (Diphenylchloroarsine), Hydrocyanic Acid, and Chloroacetophenone. The Chinese have two sets of conflicting casualty data. For 1,688 attacks, one claim is 6,000 killed and 41,000 wounded. This translates to a 13% lethality rate and a wounded-to- killed ratio of 6.8:1. Casualties per attack are only 28.[94] A second set of figures claims 200,000 total casualties in 2,000 attacks with 40,000 fatalities. This is a 20% lethality with a wounded-to-killed ratio of 5:1. Casualties per attack are 100.[95] A third set claims 80,000 total casualties with 10,000 deaths, but no attack count.[96] This gives 13% lethality with a 7:1 wounded-to-killed ratio. The first set is probably the more correct as it was compiled by the Engineering Academy of the Chinese Army Chemical Defense Command. Some 2,000,000 rounds filled with chemical agents abandoned by Japanese forces are scattered throughout China, and some 2,000 persons have become casualties since the war due to these ex-Japanese gas caches.[97] Even the larger set of figures, if true, represents only a trivial fraction of the Chinese deaths and injuries in the China War (3,311,419 military casualties; perhaps 35,000,000 total civilian and military casualties, with 15,000,000 civilians dead -- nobody really knows).[98] The Nanking Massacre of 1937 alone took 260,000-355,000 lives in just six weeks by bullet, bayonet, sword and assorted other cruel devices, but no gas.[99]

If we accept that 50% of the chemical bombs failed to detonate and ignore them and their agent fill, we get even more outrageous ratio figures per military casualty (1.2 per munition and 24 kg of agent required). It would also mean that there were something like 25,000 unexploded chemical bombs in southeastern Iraq and southwestern Iran at war's end. Yet Iranian combat engineers had only discovered and neutralized 100 unexploded Iraqi chemical munitions of all types as of 1991.[100] As of 1996, 5,207,600 pieces of unexploded ordnance (not including mines) had been neutralized.[101] By way of contrast, the French *Département du Deminage* neutralizes about 900 tons of unexploded ordnance a year (80% of it from WWI). Of this number, 30 tons are chemical rounds (3% overall, 4% of WWI munitions).[102] The latter figure matches almost exactly the percentage of chemical rounds fired in the Great War (5%).

A final note: In the 1997 crisis we again saw exaggerated, almost hysterical, accounts of Iraqi chemical weapons' lethality in the Iran-Iraq War. A paper published by the American Enterprise Institute in February 1998 claimed "Postwar analysis showed that they [chemical agents] were far more effective than conventional weapons and warfare."[103] I do not believe a careful analysis of the facts supports this assertion. As far as I know there is no body of "postwar analysis" data readily available outside of what this article and its predecessor have cited.

USIA's "Q&A" paper says that "16,000 Iranians were reported killed by toxic blister agent mustard gas between August 1983 and February 1986."[104] Once again, a government agency cannot distinguish between killed and overall casualties. Iran's military chemical deaths were probably no more than 5,000 (at most 10,000) in the entire war and in the time period cited amounted to 1,200-2,500 (1,800 is a good guess). From Iran's own figures, we know there were a total of 6,108 chemical casualties by the end of 1985. At the end of 1986 there were 17,249. A bad year to be sure, but the wounded far outnumbered the dead.

Gas hysteria in the press is nothing new. In the first German gas attack on 22 April 1915 against the French 45th and 87th divisions, results were disappointing. The Germans estimated it had only caused about 200

[93] Sheldon H. Harris, *Factories of Death: Japanese Biological Warfare, 1932-45, and the American Cover-Up* (New York: Random House, 1994), 73.

[94] *Kyodo* (13 August 1992).

[95] *Xinhua* (18 September 1995).

[96] Hongmei Deng and Peter Evans, "Social and Environmental Aspects of Abandoned Chemical Weapons in China," *The Nonproliferation Review* (Spring-Summer 1997).

[97] Harris, 67, 235-238; Deng and Evans.

[98] "Estimated Chinese Armies Casualties, 1937-1945," *RoK Department of Defense Official Report*, www.edu.cn.history/www.arts.chuk.hk/NanjingMassacre/NMchron.html

[99] Iris Chang, *The Rape of Nanking: The Forgotten Holocaust of World War II* (New York: Basic Books, 1997), 99-104.

[100] "IIR 2 762 0059 92 Iranian Analysis of Iraqi Chemical Ordnance Used During Iran/Iraq War."

[101] "Iran—Armed Forces Commander Interviewed on Security," *USNI Daily Defense News Capsules* (11 October 1996).

[102] Webster, 24-25.

[103] Anthony E. Mitchell, "Is a Second Iran-Iraq War on the Horizon?" *AEI On the Issues* (February 1998).

[104] USIA, 1.

French casualties. The French army calculated the casualties at 625. However, the French press reported *5,000 killed!* [105]

Further, as regards the lethality of mustard gas in particular, deaths per wounded soldier in WWI were about 2%. If 16,000 were indeed killed by mustard, then this would suggest Iran's chemical wounded from mustard alone were on the order of 800,000 or eight times the highest total Iranian acknowledged chemical casualties! However, if you *are* going to die from any chemical agent, mustard is a good bet. Of 1,221 hospital deaths from chemical agents experienced by the AEF in WWI, 600 (50%) were due to mustard. By contrast, the arsenic-based German "Blue Cross" (diphenyl chloroarsine) produced only 3 deaths in the AEF out of 580 total casualties from this agent (0.5% lethality)![106] There are other reports of as many as 5,000 Iranian chemical deaths from mustard gas, and the vast majority of post war chemical injured are mustard casualties. According to the CIA, Iraqi forces used an unidentified silica compound impregnated by mustard gas against Iranian forces. This substance was delivered in White Phosphorus shells. The silica compound reduced the amount of mustard gas the shell could carry, but actually decreased the dose rate required to produce a casualty, resulting in effectiveness five times the standard shell. It apparently helped the agent create a vapor rather than a contact hazard among those exposed. It was noted that Iranian soldiers exposed to mustard gas had unusually high amounts of respiratory injuries as opposed to the more common skin blistering.[107] The higher proportion of lung injuries among Iranian soldiers would increase the agent's overall lethality.

According to some reports, not all Iranian chemical deaths were battle-related. One story tells of ten Iranian PoWs taken to the Saudi border, tied to posts and then exposed to anthrax from a bomb detonated fifteen yards away. Other anthrax tests were conducted on Iranian PoWs at an underground facility at Salman Pak. In June 1994, UN inspectors found a mass grave near Salman Pak which was suspected of containing victims of Iraqi bio-chemical weapons' research.[108] In July 1998, Iran claimed it had information that some 1,000 Iranian and Kuwaiti PoWs had been subjects of Iraqi chemical agent tests. Another 170 Iranian PoWs have reportedly been summarily executed or died under torture in recent years.[109]

The historical record suggests gas is a case of threat versus anxiety, provoking a "gut" rather than a "logical" reaction to its use as a weapon. Yet threat often must be evaluated on an individual basis, as well as statistical. It's one thing to dispassionately calculate these numbers thousands of miles distant from and years later than the chemical battlefields of World War I or the Iran-Iraq War. It is quite another to be one of 400 surviving (as of 1990) UK soldiers of WWI forever blinded by mustard gas or of the 30,000-60,000 Iranian veterans living with post-exposure disorders due to chemical weapons—much less poor, martyred Baseej fighter Magid Azam who ended his life coughing up his lungs in a Tehran hospital.[110]

*Mr Beuttel, a former US Army intelligence officer, is employed as a senior military analyst by Boeing Research and Technology, located in Seattle, Washington. The views and opinions expressed in this article do not necessarily reflect those of The Boeing Company.*

[105] Holger H. Herwig, *The First World War: Germany and Austria-Hungary, 1914-1918* (New York: St. Martin's Press, 1997), 168.

[106] Hogg, 82-86; William Blewett, "Tactical Weapons: Is Mustard Still King?" *NBC Defense & Technology International* (June 1986), 64-66.

[107] "Mustard Gas Used By Iraq in War with Iran," cia_62648_61898_01.txt

[108] "Iraq Used Anthrax on PoWs, Paper Says," *Seattle Times* (19 January 1998), A10; "Iraq 'Used Iranian and Kurdish Prisoners as Human Guinea Pigs'," *Iran News* (19 January 1998); "In Iraq, Hints of Biological Atrocities," *US News & World Report* (26 January 1998).

[109] "Hundreds of Iranian PoWs Still in Iraq," *IRNA* (6 July 1998).

[110] Denis Winter, *Death's Men: Soldiers of the Great War* (London: Penguin Books, 1978), p.124.

# Comparing Force Ratios to Casualty Exchange Ratios

**Christopher A. Lawrence**

There are three versions of force ratio versus casualty exchange ratio rules, such as the three-to-one rule (3-to-1 rule), as it applies to casualties. The earliest version of the rule as it relates to casualties that we have been able to find comes from the 1958 version of the US Army *Maneuver Control* manual, which states:

*"When opposing forces are in contact, casualties are assessed in inverse ratio to combat power. For friendly forces advancing with a combat power superiority of 5 to 1, losses to friendly forces will be about 1/5 of those suffered by the opposing force."*[1]

The RAND version of the rule (1992) states that *"... the famous '3:1 rule', according to which the attacker and defender suffer equal fractional loss rates at a 3:1 force ratio if the battle is in mixed terrain and the defender enjoys 'prepared' defenses..."*[2]

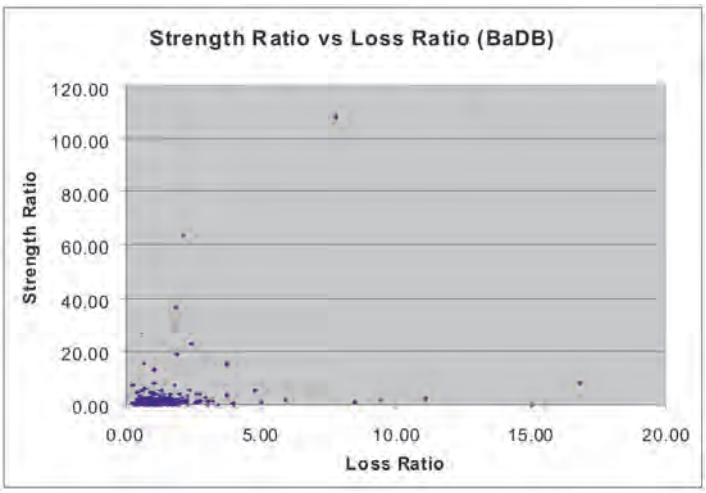
Finally, there is a version of the rule that dates from the 1967 *Maneuver Control* manual that only applies to armor that shows:

| Combat Ratio | | Tank Losses (per platoon of 5 tanks) per Hour | |
|---|---|---|---|
| Attacker | Defender | Attacker | Defender |
| 1 | 1 | 2 | 1 |
| 2 | 1 | 2 | 1 |
| 3 | 1 | 1 | 1 |
| 4 | 1 | 1 | 2 |
| 5 | 1 | 1 | 3 |

As the RAND construct also applies to equipment losses, then this formulation is directly comparable to the RAND construct.

Therefore, we have three basic versions of the 3-to-1 rule as it applies to casualties and/or equipment losses. First, there is a rule that states that there is an even fractional loss ratio at 3-to-1 (the RAND version), Second, there is a rule that states that at 3-to-1, the attacker will suffer one-third the losses of the defender. And third, there is a rule that states that at 3-to-1, the attacker and defender will suffer the same losses as the defender. Furthermore, these examples are highly contradictory, with either the attacker suffering three times the losses of the defender, the attacker suffering the same losses as the defender, or the attacker suffering 1/3 the losses of the defender.

Therefore, what we will examine here is the relationship between force ratios and exchange ratios. In this case, we will first look at *The Dupuy Institute's* Battles Database (BaDB), which covers 243 battles from 1600 to 1900. We will chart on the y-axis the force ratio as measured by a count of the number of people on each side of the forces deployed for battle. The force ratio is the number of attackers divided by the number of defenders. On the x-axis is the exchange ratio, which is a measured by a count of the number of people on each side who were killed, wounded, missing or captured during that battle. It does not include disease and non-battle injuries. Again, it is calculated by dividing the total attacker casualties by the total defender casualties. The results are provided below:

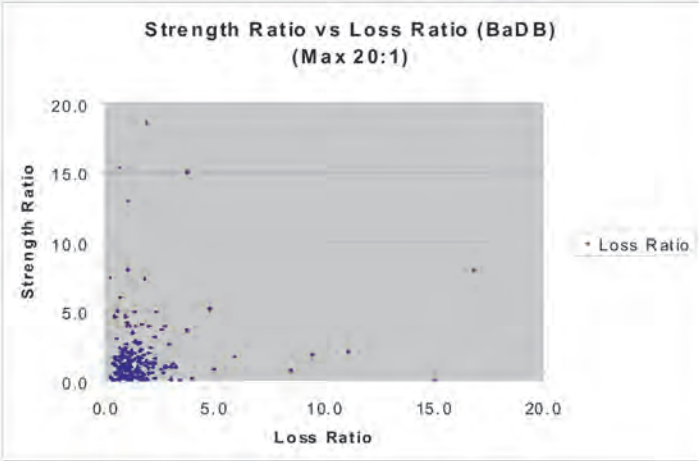



As can be seen, there are a few extreme outliers among these 243 data points. The most extreme, the Battle of Tippermuir (1 Sep 1644), in which an English Royalist force under Montrose routed an attack by Scottish Covenanter militia, causing about 3,000 casualties to the Scots in exchange for a single (allegedly self-inflicted) casualty to the Royalists, was removed

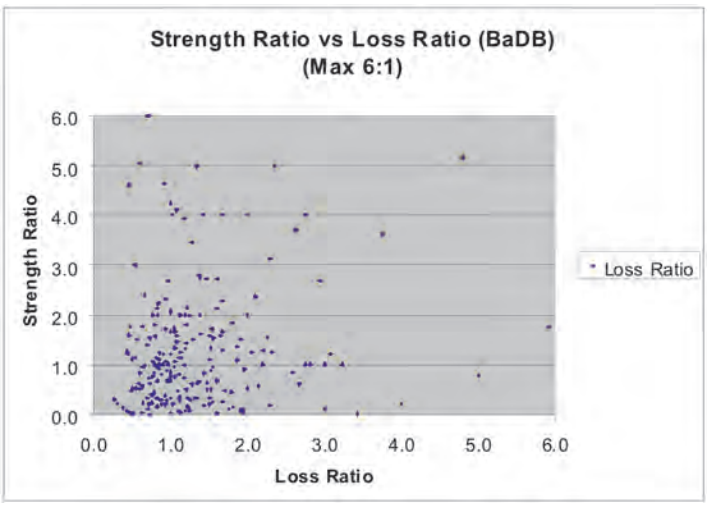
[1] FM 105-5, *Maneuver Control* (1958), 80.

[2] Patrick Allen, *Situational Force Scoring: Accounting for Combined Arms Effects in Aggregate Combat Models* (N-3423-NA, RAND, Santa Monica, Calif., 1992), 20.

from the chart. This 3,000-to-1 loss ratio was deemed too great an outlier to be of value in the analysis.




As it is, the vast majority of cases are clumped down into the corner of the graph with only a few scattered data points outside of that clumping. If one did try to establish some form of curvilinear relationship, one would end up drawing a hyperbola. It is worthwhile to look inside that clump of data to see what it shows. Therefore, we will look at the graph truncated so as to show only force ratios at or below 20-to-1 and exchange rations at or below 20-to-1.



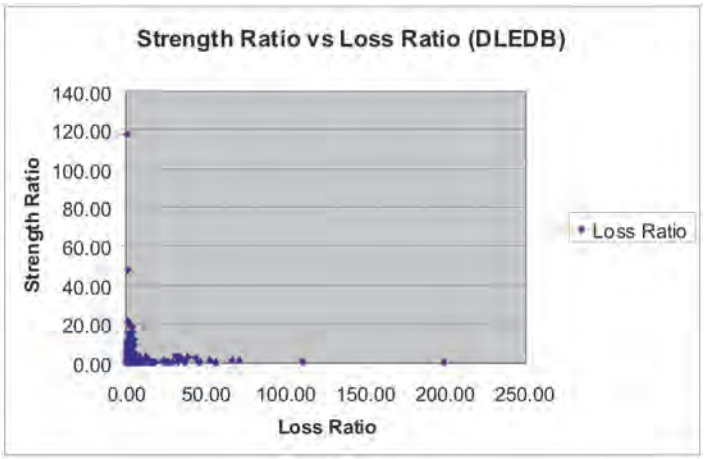

Again, the data remains clustered in one corner with the outlying data points again pointing to a hyperbola as the only real fitting curvilinear relationship. Let's look at little deeper into the data by truncating the data on 6-to-1 for both force ratios and exchange ratios.

As can be seen, if the RAND version of the 3-to-1 rule is correct, then the data should show at 3-to-1 force ratio a 3-to-1 casualty exchange ratio. There is only one data point that comes close to this out of the 243 points we examined.

If the FM 105-5 version of the rule as it applies to armor is correct, then the data should show that at 3-to-1 force ratio there is a 1-to-1 casualty exchange ratio, at a 4-to-1 force ratio a 1-to-2 casualty exchange ratio, and at a 5-to-1 force ratio a 1-to-3 casualty exchange ratio. Of course, there is no armor in these pre-WWI engagements, but again no such exchange pattern does appear.

If the 1958 version of the FM 105-5 rule as it applies to casualties is correct, then the data should show that at a 3-to-1 force ratio there is 0.33-to-1 casualty exchange ratio, at a 4-to-1 force ratio a .25-to-1 casualty exchange ratio, and at a 5-to-1 force ratio a 0.20-to-5 casualty exchange ratio. As can be seen, there is not much indication of this pattern, or for that matter any of the three patterns.

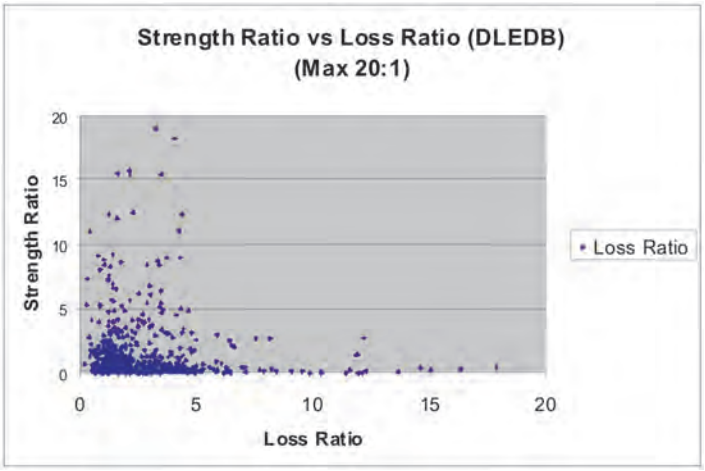
Still, such a construct may not be relevant to data before 1900. For example, Lanchester claimed in 1914 in Chapter V, "The Principal of Concentration," of his book *Aircraft in Warfare*, that there is greater advantage to be gained in modern warfare from concentration of fire.[3] Therefore, we will tap our more modern Division-Level Engagement Database (DLEDB) of 675 engagements, of which 628 have force ratios and exchange ratios calculated for them. These 628 cases are then placed on a scattergram to see if we can detect any similar patterns.



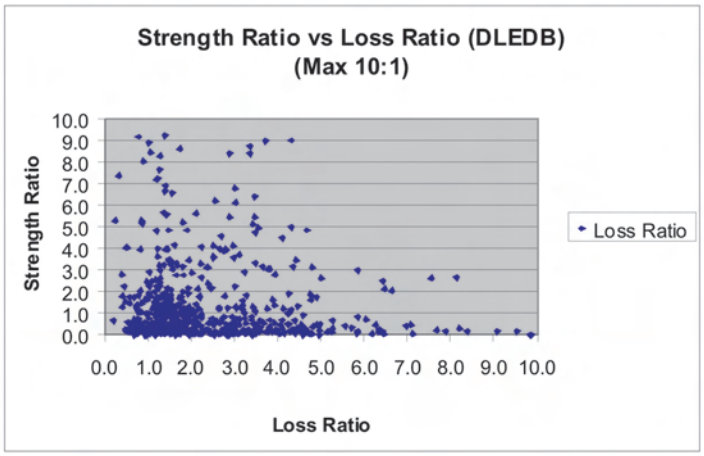

Even though this data covers from 1904 to 1991, with the vast majority of the data coming from engagements after 1940, one again sees the same pattern as with the data from 1600-1900. If there is a curvilinear relationship, it is again a hyperbola. As before, it is useful to look into the mass of data clustered into the

[3] F. W. Lanchester, *Aircraft in Warfare: The Dawn of the Fourth Arm* (Lanchester Press Incorporated, Sunnyvale, Calif., 1995), 46-60. One notes that Lanchester provided no data to support these claims, but relied upon an intellectual argument based upon a gross misunderstanding of ancient warfare.

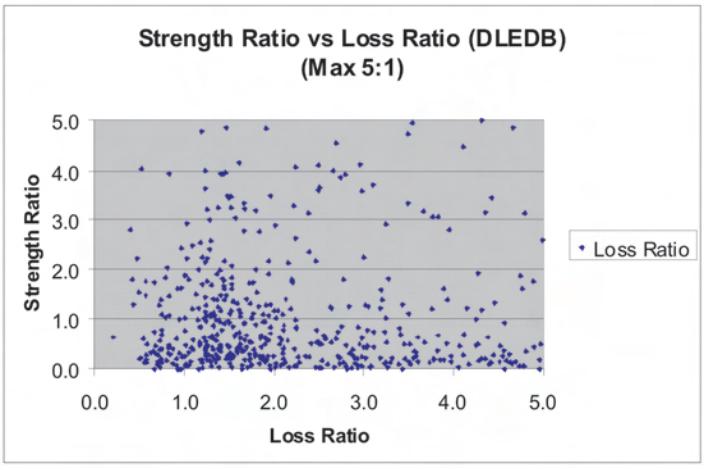
corner by truncating the force and exchange ratios at 20-to-1. This produces the following:




Again, one sees the data clustered in the corner, with any curvilinear relationship again being a hyperbola. A look at the data further truncated to a 10-to-1 force or exchange ratio does not yield anything more revealing.




And, if this data is truncated to show only 5-to-1 force ratio and exchange ratios, one again sees:




Again, this data appears to be mostly just noise, with no clear patterns here that support any of the three constructs. In the case of the RAND version of the 3-to-1 rule, there is again only one data point (out of 628) that is anywhere close to the crossover point (even fractional exchange rate) that RAND postulates. In fact, it almost looks like the data conspires to make sure it leaves a noticeable "hole" at that point. The other postulated versions of the 3-to-1 rules are also given no support in these charts.

Also of note, that the relationship between force ratios and exchange ratios does not appear to significantly change for combat during 1600-1900 when compared to the data from combat from 1904-1991. This does not provide much support for the intellectual construct developed by Lanchester to argue for his N-square law.

While we can attempt to torture the data to find a better fit, or can try to argue that the patterns are obscured by various factors that have not been considered, we do not believe that such a clear pattern and relationship exists. More advanced mathematical methods may show such a pattern, but to date such attempts have not ferreted out these alleged patterns. For example, we refer the reader to Janice Fain's article on Lanchester equations, *The Dupuy Institute's Capture Rate Study, Phase I & II*, or any number of other studies that have looked at Lanchester.[4]

The fundamental problem is that there does not appear to be a direct cause and effect between force ratios and exchange ratios. It appears to be an indirect relationship in the sense that force ratios is one of several independent variables that determine the outcome of an engagement, and the nature of that outcome helps determines the casualties. As such, there is a more complex set of interrelationships that have not yet been fully explored in any study that we know of, although it is briefly addressed in our *Capture Rate Study, Phase I & II*.

[4] In particular, see page 73 of Janice B. Fain, "The Lanchester Equations and Historical Warfare: An Analysis of Sixty World War II Land Engagements" *Combat Data Subscription Service* (HERO, Arlington, Va., Spring 1975).

## An Analysis of the
# Morale Table in the TNDM

**Alexander Dinsmoor and Christopher A. Lawrence**

According to the *TNDM Manual of Rules and Procedures*, the Combat Effectiveness Value (CEV) of a unit includes leadership, training, experience, logistics effectiveness, technology, morale, and luck and chance. Yet, within the TNDM and the older QJM, there has always been a separate morale table. This raises the question as to when to use this value and whether to use it in conjunction with CEV?

Col. Trevor N. Dupuy suggested settings for morale in his description of the QJM in *Numbers, Predictions and War*. The same chart was reproduced in the appendix of the *TNDM Manual*. Neither *Numbers, Predictions and War* nor the *TNDM Manual* give instructions for adjusting morale in the QJM or TNDM. Descriptions, or even the existence of a morale parameter separate from the combat effectiveness value (CEV), are absent from the *TNDM User's Guide* (including its non-inclusion in a screenshot of the Rate Modifiers and Set Piece Factors menu on page 37, which was from an earlier version of the TNDM). The TNDM includes an option to adjust the morale of the attacker's or defender's forces on the Rate Modifiers and Set Piece Factors menu in version 2.06 of the TNDM.

This chart appears as table 12 in Appendix B-14 in the *TNDM Manual* and on page 231 in *Numbers, Predictions and War*:

| **Morale Level** | **Morale Factor** |
|---|---|
| Excellent | 1.0 |
| Good | 0.9 |
| Fair | 0.8 |
| Poor | 0.7 |
| Panic | 0.2 |

Morale acts upon the model the same way that CEV does, which is entirely logical as Morale is a component of CEV. As there is no detailed description in the *TNDM Manual*, we decided to test the results of adjusting morale on the results of the Battle of Sarimbun Beach, part of the Malaya campaign in World War II. Initially, both sides' morale was lowered the same amount; this lowered each side's p-values equally and, therefore, did not change the results. For the next test, the Japanese morale was kept at 1 and the Australians' morale was lowered to each of the levels suggested in the *TNDM Manual*. Morale again acted as a divisor on the p-value of the side that was adjusted. Therefore, lowering the Australians' morale from 1.0 to 0.9 causes them to lose the 10% of their p-value. This indicates that the morale factor operates like the CEV, adjusting the total p-value. This was confirmed when the CEV was adjusted in place of morale. Lowering CEV from 1.0 to 0.9 caused a 10% loss of p-value. Therefore, setting one side's CEV to 1.43 has the same effect as lowering its opposition's morale to poor (0.7), and morale value of panic (0.2) has the same effect as setting one side's CEV to 5. Like the CEV, morale can be adjusted to any value, not just the values suggested in Numbers, Predications and War and table 12 of the TNDM manual.

It appears that morale remains in the TNDM primarily as a legacy table. As morale is a component of CEV, we strongly recommend using CEV instead of morale. The results of the tests suggest that adjusting morale, particularly in a drastic fashion, without good reason, can significantly affect results. In fact, lowering the Japanese morale to 0.2 produced the only outcome we tested in which the Australians won the Battle of Sarimbun Beach.

We suspect this table was developed in part because Colonel Dupuy was trying to establish values for each independent component of CEV. As there was no clear way of doing so, this effort was abandoned, and he instead focused on CEV and the value to best work with. In the eight years I worked with Trevor Dupuy (from 1987-1995), I do not recall a single case of someone using the morale factor in model runs.

Probably the only time we would advise using the morale function is if there were a situation in which the morale had clearly changed (declined) for one side since the initial engagements had been modeled (assuming one was doing a series of engagements) or was starting to collapse. Adjusting morale might be applicable in cases where one side's morale completely collapsed—for example, the Iraqi forces in the 1991 Gulf War. In this case, you are adding in a morale factor to reflect a change above and beyond the morale that was originally reflected in the CEV differences. There, it can be used with judiciousness in certain cases, but it is not recommended for use with most analysis.

## TDI Profile
# Alexander Dinsmoor

Alexander Dinsmoor graduated from Goucher College with a BA in Political Science in 2005. During his course of studies, Mr. Dinsmoor had the opportunity to intern in the US House of Representatives on Capitol Hill and in the British Parliament's House of Commons. During a study abroad at the London School of Economics, Mr. Dinsmoor authored a thesis on the future of the UK's nuclear deterrent.

Mr. Dinsmoor is originally from Boston, MA, but moved to Washington DC in the winter of 2005 to pursue a job in a political science- or history-related field. After working with organizations as diverse as union groups and the Heritage Foundation, Mr. Dinsmoor joined *The Dupuy Institute* in November 2006.

Mr. Dinsmoor's first project with *The Dupuy Institute* was the Modern Insurgency Spreadsheets (MISS) database of insurgencies, where he focused on African insurgencies.He was also tasked with editing the final versions of the Phase IV reports. In the past year, Mr. Dinsmoor has worked on transitioning the MISS sheets into the ACID database. Most recently Mr. Dinsmoor was involved in demonstrating the TNDM's capabilities as part of our training course for the TNDM.

Mr. Dinsmoor lives in College Park, Maryland. He enjoys reading history, foreign films and his vegetable garden.

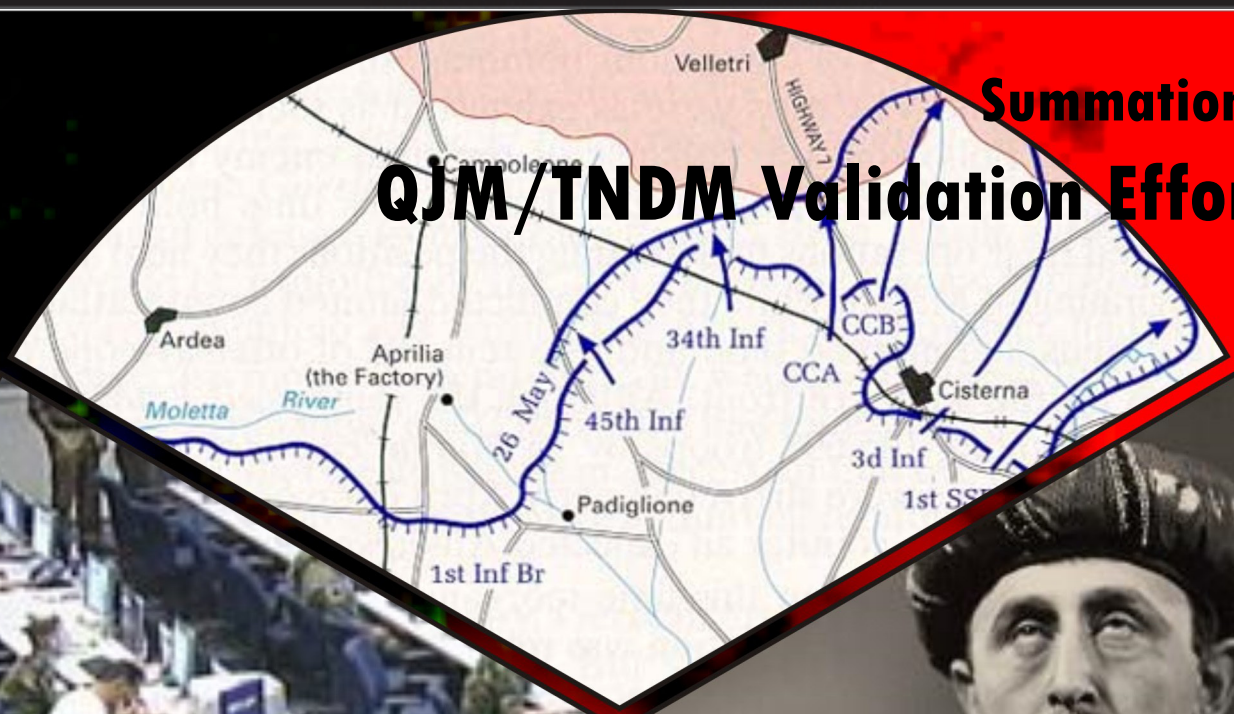
INSULTING A SCOTCHMAN.

Boy. "HERE YOU AIR, SIR! THREE PAIR O' TROWSER STRAPS FOR SIXPENCE."

Volume 3, Number 2 Winter 2010

# THE INTERNATIONAL TNDM NEWSLETTER

## Summation of QJM/TNDM Validation Efforts




Also in this issue:

- Validation of the TNDM to Corps-Level Combat
- Validation of the TNDM to Division-Level Combat
- Iranian Casualties in the Iran-Iraq War: A 2010 Update
- Comparing the RAND Version of the 3:1 Rule to Real-World Data
- Corrections Made for Version 2.07 of the TNDM

# INTRODUCTION

In tribute to what Trevor Dupuy pioneered and in an effort to pursue what he wanted to achieve, TDI continues to amass historical data and strives to refine the combat variables which go into the TNDM. In this issue of our newsletter Christopher Lawrence, Alex Dinsmoor, and Bill Beuttel continue to provide information on these efforts.

As you, our readers, survey the pages of this issue, you may be curious about the total scope of work of TDI. The paragraphs below outline what is missing in applied military history and what TDI is doing to shore up that deficiency. In other words, here is *our core capability*:

1. TDI provides independent, objective, historically–based analyses of modern military campaigns. Operations research, as developed during and right after World War II, was based on recorded, detailed data from battles. It is now nearly extinct. It has been supplanted by weapons and systems effects and performance analyses totally devoid of human factors considerations. As a result the Services, particularly the Army, have only partial answers for the development of operational concepts, battle doctrine, weapons requirements, and organizations. Similarly, because they were not historically validated, the Service models and simulations are skewed. Striving for only measured weapons effects and technical systems capabilities, they miss (or significantly distort) the impact of leadership, training, organization, and psychological factors (such as fear of death) on military units in contact.

2. Over the years, TDI, a successor organization to the Historical Evaluation and Research Organization (HERO), both founded by the late Col. Trevor N. Dupuy, has compiled a large database from modern military campaigns and battles. Using Colonel Dupuy's methodologies and some new techniques, TDI has developed the following capabilities:

a. Comparison of fighting capabilities of opposing forces (systemic strengths and weaknesses) based on:
(1) Command and organizational arrangements, leadership, force structure, intelligence, and logistics;
(2) Training, cultural and psychological profiles, and flow of information;
(3) Doctrinal flexibility or constraints in utilizing new weapons and technologies.

b. Validation of models or simulations and of scenarios for field exercises. Validation is a process, based on historical data and trends, that assists in determining whether a scenario, model, or simulation is an accurate representation of the real world. TDI has the capability to do this independently or to provide primary source historical data for agency in–house validations.

c. Estimating casualties for combat or other operations.

d. Providing lessons learned from studies of cause and effect chains among responsible players at the political, theater, operational, and tactical levels.

e. Analysis of group behavior (impact of various combat activities on units) and other human factors (historically–based aggregate measure of leadership, training, morale, organizational capacity, and cultural characteristics) in modern battles.

f. Studies, based on historic trends and experiential data, of the specific impact on combat caused by new technology and the improvement in weapons. This enables projections of ways in which future wars should be fought and understanding of what elements constitute "force multipliers."

3. The capabilities listed above merge operations research with historical trends, actual combat data, and real world perspectives creating applied military history in its most useful sense.

# CONTENTS



In honor of the memory of the late

**Trevor N. Dupuy**
Col., USA

**International TNDM Newsletter**

# From the Editor...



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This issue of The International TNDM Newsletter is focused primarily on the various validation efforts that have been undertaken for the QJM and the TNDM over the years. This is certainly the most extensively validated model of which we are aware.

The first two articles are on the validation of the TNDM to corps-level and division-level combat. This was done as part of our 2006 effort to analyze the potential effectiveness of a projected combat system as compared to historical data. In this case, we ran a series of corps-level and division-level engagements from the Battle of Kursk (July 1943) using the TNDM. The results of these runs, which effectively serve as an independent and separate corps- and division-level validation of the model, are published here.

Next, we present the final installment in the series of articles by H. W. Beuttel on the Iran-Iraq War. This is Bill Beuttel's revised summation of Iranian casualties in that war. It incorporates the data he has collected since the articles that appeared in this newsletter over a decade ago.

Following that is an article titled, "Comparing the RAND Version of the 3:1 Rule to Real-World Data." This article comes directly from an appendix to our report for the Army Medical Department in 2005 that compared the TNDM to five other casualty-estimation methodologies, reviewed the bases for various casualty estimation methodologies and models, and included a computerized catalog of over 150 combat models and casualty-estimation methodologies.

In creating version 2.07 of the TNDM, we made some minor corrections to the model. These revisions have been distributed to our customers. In this issue we provide a brief description of the changes.

The featured article in this newsletter summarizes the validation efforts applied to the QJM and TNDM over the years. The model has been validated six times, from battalion- to corps-level. The more recent validations have been completely disseminated.

Finally, I profile myself in the "Who is TDI" section. Over the years, we have profiled ten people who were either part of TDI or who contributed to the newsletter. We never got around to profiling me, until now.

This completes the winter issue of The International TNDM Newsletter. We have decided, due to manpower and time limitations, to publish the newsletter semiannually for now.

The next planned revision of the TNDM is to revise the model to better reflect the effects of fighting in urban terrain. This will be based on the work we did in our three urban warfare studies. We will probably address this in the next newsletter.

Anyhow, we trust everyone had a good holiday season and hope you enjoy the newsletter.

# Validation of the TNDM to Corps-Level Combat

Christopher A. Lawrence

The Dupuy Institute had a contract in 2006 to test some modern weapons systems using the TNDM. As part of that test, we decided to baseline our model runs to historical data, and used the data from the Battle of Kursk.

The data from the Battle of Kursk came from the DLEDB (Division-Level Engagement Data Base) Kursk engagements. The DLEDB is a data base we have created of 752 division-level engagements from 1904 through 1991. They are mostly a single day in length but can range from a fraction of a day to five days in length, depending on the battle and the records.[1] This powerful database has been used for a range of studies, including the Capture Rates studies, the Situational Awareness study, and our three Urban Warfare studies.[2] The Kursk engagements in our database came from the updated version of the Kursk Data Base and from the unpublished manuscript Kursk: The Battle of Prokhorovka. Most of the data was derived from the unit records of both sides.

As part of our contracted work, we first baselined (or validated) the model to two divisions. One was the Leibstandarte SS Adolf Hitler Panzer Grenadier Division. This SS Division was developed from Adolf Hitler's bodyguard and was part of the SS Panzer Corps at Kursk. We recommended to our customer that he do a second, similar, but non-SS division, just to be balanced and avoid criticism. This expanded the test to include the Gross Deutschland Panzer Grenadier Division from the neighboring 48th Panzer Corps at Kursk. We then tested each of these divisions using the TNDM for the 12 days they were on the offensive (4th July through the 15th of July, 1943). In the case of the Gross Deutschland Division, it had two separate engagements on the 6th of July caused by its penetration of the first Soviet defensive lines and its lateral movement before attacking the next Soviet defensive position.

After a review of that work, our customer asked us to go back and repeat the comparison, except using corps. In this case, we stayed in the same area and timeframe and then did the validation using the 48th Panzer Corps and its neighboring SS Panzer Corps. This was done for each day of the battle for each corps.

In both cases, the opposing Soviet forces were identified as those that primarily opposed them on that day and their data assembled for that day.

This effort effectively generated two separate validations: one of 24 days of combat at corps level and one of 25 cases (23 of them for one day) of combat at the division level.

We believe that all validations should be independent, but we were not able to do that primarily because we were the only ones intimately familiar with the data and the model. Therefore, we separated the work, with me providing the orders of battle for each engagement, including the air support. The actual engagements were set up and run by Richard Anderson. The analysis of the results of the engagements was done by Victoria Plamadeala. This was done in part to make sure that no systematic or personal bias is introduced into the validation.

We assigned the Germans a combat effectiveness value of three for these engagements. This was based in part by our experience in our work for AMEDD (Army Medical Department), in which we used a CEV (Combat Effectiveness Value) of 2.5, based upon Trevor Dupuy's work, for the Soviet Army.[3] In this case, we used 3, which seemed to work better. Needless to say, the results would have been very different if we gave both sides equal combat capabilities, but as it is well understood that this was not the case, there was no reason to test it as such.

[1] There are ten engagements from six to eight days in length.

[2] Not all of these studies have been posted to our website yet.

[3] Combat Effectiveness Value (CEV) is a figure used to adjust the relative combat value of one side. It represents the difference in morale, training, experience, and other intangible factors that exist in warfare. In effect, it tries to assign a value to human factors in combat. It is usually a value that you have to assign to one side, based upon an understanding of these factors and their influence. Assigning a value of 1 means that both sides are at equal levels of competence in these areas, which the historical record clearly indicates is not the case.

## So, How Did It Do?

Having assembled the data (which was a pretty painstaking process), run the engagements (which was not near as labor intensive as assembling the data), and analyzed the results, how did the TNDM do?

We decided to measure its performance in six areas:

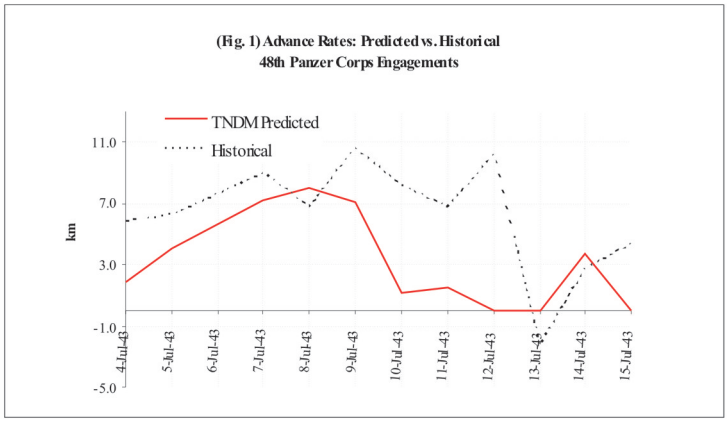
1. Win/Lose
2. Advance rates
3. German casualty rates
4. Soviet casualty rates
5. German armor loss rates
6. Soviet armor loss rates

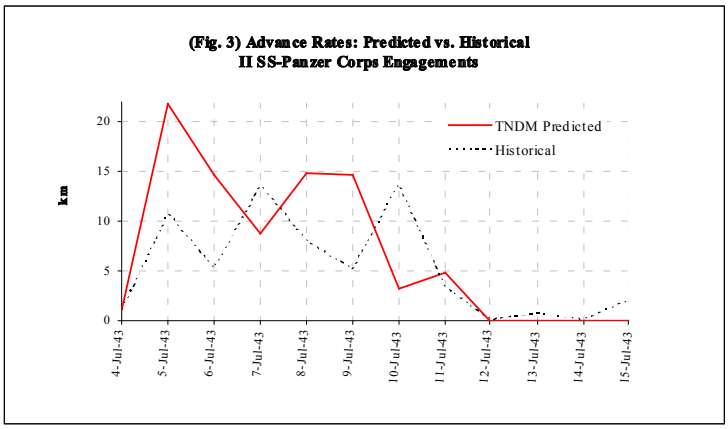
1. Win/Lose

In the case of predicting the winner or the loser, the TNDM predicted the correct outcome in 21 of 24 cases. Now, in the DLEDB, there is a filled-in field that determines the winner of engagement. These were filled in by me before the analysis began, and in many cases (over half the cases in the division-level engagements), it was filled in years before we had this contract. The results could be attacker win, draw, or defender win. The TNDM predicted draws for the SS Panzer Corps for the 13th and 15th when they were in fact marginal wins. The model predicted draws for the 48th Panzer Corps for the 15th when it was a marginal win (the Soviets withdrew during the night). In all reality, considering the nature of the engagements on the 13th and 15th, one could argue whether they were a draw or a German win. The model never completely mis-predicted the outcome (i.e. declared one side won when the other side did). Overall, this is a stellar performance on the part of the TNDM.

## 2. Advance Rates

In the case of opposed advance rates, we track them for each day in our engagements. Therefore it was a simple matter to compare the historical advance rates with what the combat model generated. This comparison is shown below for each of the German Corps: [4]




As can be seen, the model sort of did a good job of matching the historical rates. In the case of SS Panzer Corps is was close overall, with several days being under or overestimated by a factor of two. Still, this appears to be a pretty good fit, and we doubt that there are any combat models out there that would do better. The 48th Panzer Corps does well through the 9th and then from the 10th through the 12th, the model simply did much worse than what they historically did.

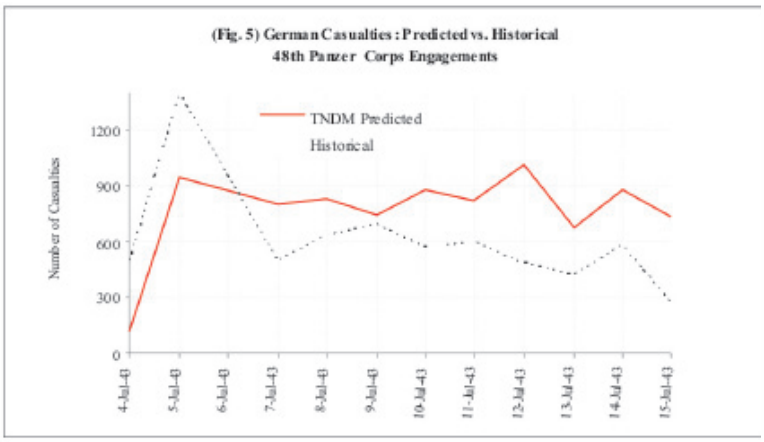
This was probably caused in part by the 48th Panzer Corps on the afternoon of the 9th turning two of its armored division to the west and exploiting the gaps in the Soviet defenses there. As such, the corps was advancing to the west, perpendicular to its original line of advance. The historical advance rate shows this push to the west, while the push to north historically came to a halt.

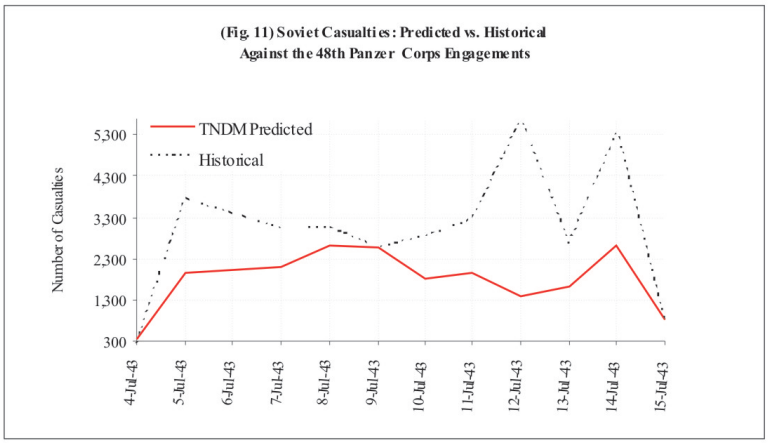
## 3. German Casualty Rates

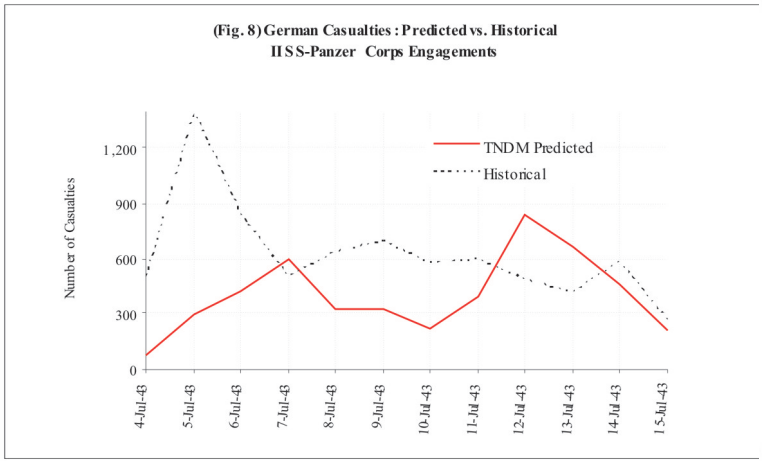
Again, it was a simple comparison by day for the each corps of the number of historical German combat losses (killed, wounded, and missing) compared to the model prediction. For most of the time we had good daily reports of losses by each German division in each

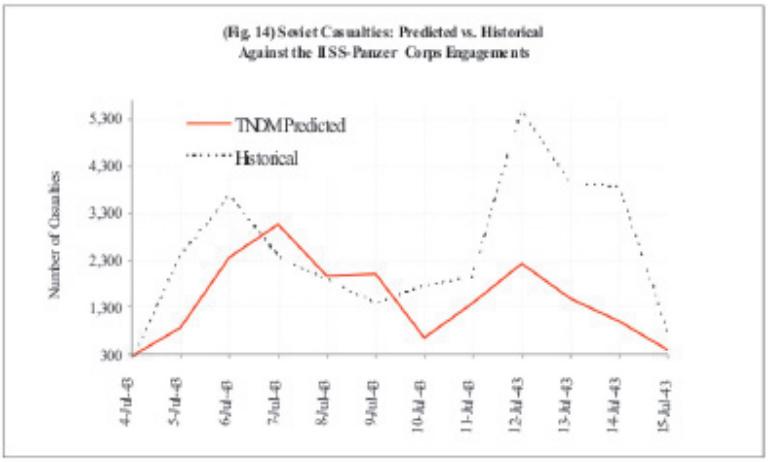
[4] These charts are from our original report and the figure numbers are in accordance with that report.

corps. So the daily historical data is pretty accurate in this case.




In this case the 48th Panzer Corps predicted losses couldn't have been much more on target. The SS Panzer Corps historical losses are in many cases much higher than what the model would predict. This is hard to explain without speculating as to the nature of the how the SS fought, or their competency relative to the regular German Army (the Wehrmacht).

## 4. Soviet Casualty Rates

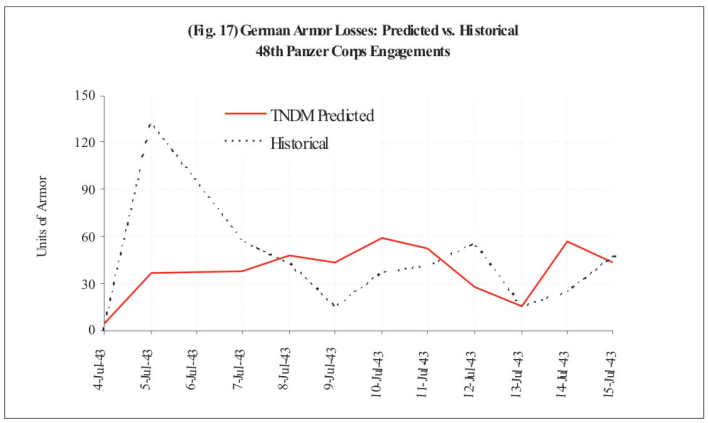
Here again, we did a simple comparison by day for each corps of the number of Soviet combat losses (killed, wounded and missing) historical compared to the model prediction. These are the losses from the Soviet units that faced the German corps in question. In many cases, it consisted of units from several corps or even more than one army. The Soviet losses come from Soviet unit records, but they did not always provided us with a daily loss report. So, in some cases, Soviet losses for that day are derived for some of the units from a periodic report. So not perfect daily historical data but in aggregate it is accurate.

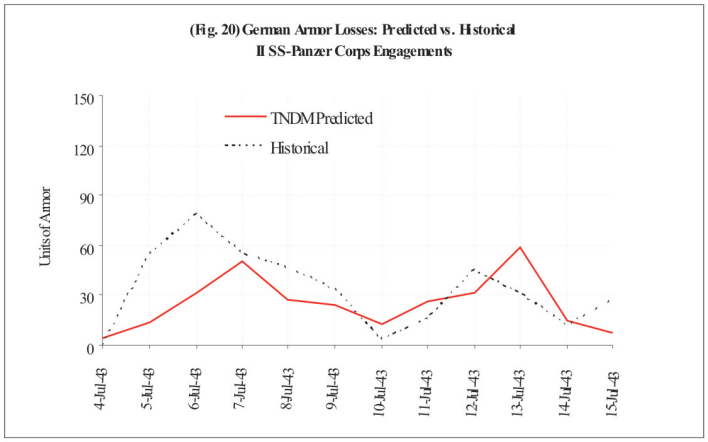
In this case, it is hard for the model to do as bad as the Soviets did historically. We had noted this tendency in previous validations and discussed the problem to some extent in our battalion-level validations. Still, this constantly shows up with the Soviet forces losing more people than the model predicts. In the case of the 12th of July, the date of the famous Battle of Prokhorovka, the Soviets attacked across a broad front with very limited success. This certainly drove up their losses.

## 5. German Armor Loss Rates

We continue the pattern of doing a simple comparison of the number of tanks lost each day (damaged, destroyed or abandoned, with most being damaged) historically with the number of armored vehicles predicted by the model as being lost. This case is complicated in that our loss figures include tanks that broke down. This is caused by the nature of the historical data, where we usually have daily ready for action reports for each type of tank, but no systematic loss reports. Therefore,

we can only determine how many fewer tanks were not available the following day, and do not know how many of the missing tanks were broken down versus damaged, nor how many repaired tanks showed up with the unit that day. Still, the figures close to accurate and are the best that can be obtained.

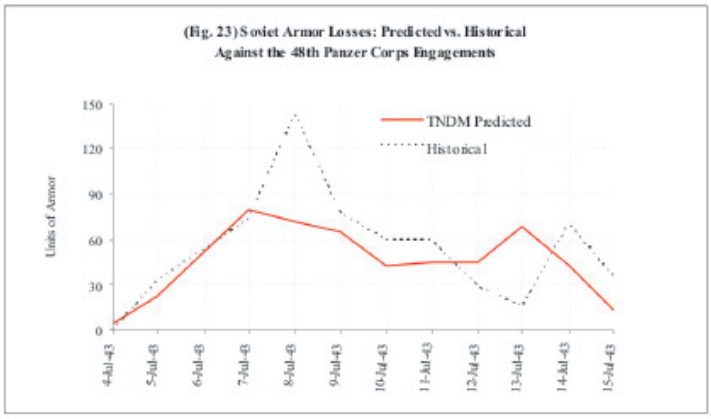


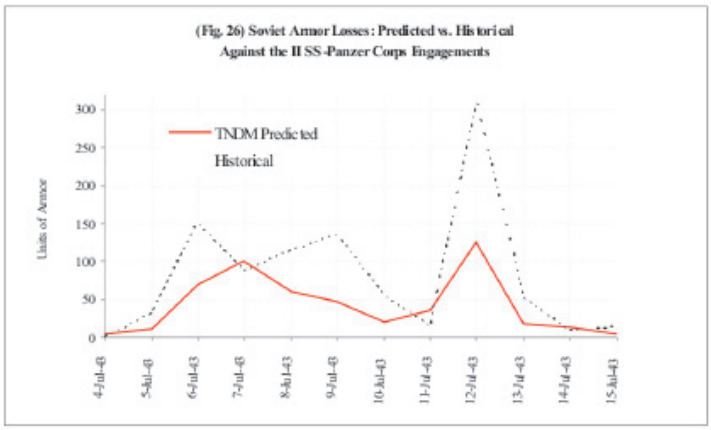




In this case, the Germans armored losses were under-predicted for the 5th and 6th but were otherwise accurate. There are two reasons for this. First the Germans were fighting through an extensive minefield and field fortifications. While the model does address these, the nature and extent of the ones used at Kursk were unique. Second, the German historical data includes broken down tanks. In the case of the 48th Panzer Corps, they have a unit of 200 new Panther tanks assigned to them that had not been properly tested before being released for use. As such, they had a considerable number break down in the first couple of days, an estimated 120 tanks! The German historical figures above reflect this. If these are removed, then historical losses are very much in line with the TNDM predicted losses. Overall, the model did a good job here.

## 6. Soviet Armor Loss Rates

Finally, there is a comparison of the opposing Soviet armor losses. These again, have the same problems of the German armor, in that we do not know how many were damaged versus broken down (the Soviets had a much higher percent of destroyed tanks compared to their total number of tanks lost when compared to the Germans). We do not think that the Soviets repaired as many tanks during the battle as the Germans. We also have a problem, similar to their casualty reports, in that we do not always have the armor losses for each day, but only have it for some units in aggregate reports covering several days. Still, the data we have is a reasonable representation of the real situation and in aggregate is correct.




Still, one will note that Soviet armor losses facing the 48th Panzer Corps is pretty much dead on except for two days. The SS Panzer Corps has a little more of a problem, especially when it comes to the famous Battle of Prokhorovka (12 July), but still the predicted results are only notably off for three days. In general, the predictions on the Soviet armor losses were pretty good and better than for the Soviet casualties.

**Summation (Historical Result vs Model Run)**

So, overall, I think we are comfortable stating that the TNDM was a good predictor of the outcome, advance rates, German casualty rates, German armor loss rates and Soviet armor loss rates for both corps tested. It tended to under-predict Soviet casualty rates.

In aggregate the statistics are (the historical figure is listed first followed by the predicted result):

| | **24 Corps Engagements** |
|---|---|
| 1. Win/Lose | 21 correct (88%) |
| 2. Advance Rates (in km) | |
| Wehrmacht | 80.5 vs 37.99 (47%) |
| SS | 63.3 vs 83.3 (132%) |
| 3. German casualty rates | |
| Wehrmacht | 7,491 vs 9,607 (128%) |
| SS | 7,899 vs 4,812 (61%) |
| 4. Soviet casualty rates | |
| Versus Wehrmacht | 35,702 vs 22,504 (63%) |
| Versus SS | 29,311 vs 17,602 (60%) |
| 5. German armor loss rates | |
| Wehrmacht | 470 vs 463 (99%)* |
| SS | 403 vs 305 (76%) |
| 6. Soviet armor loss rates | |
| Versus Wehrmacht | 621 vs 544 (78%) |
| Versus SS | 964 vs 507 (53%) |

* Less the 120 Panthers that broke down

# Validation of the TNDM to
# Division-Level Combat

Christopher A. Lawrence

This article discusses the original validation effort that was done looking at the Gross Deutschland and the Leibstandarte SS Adolf Hitler (LSSAH) Panzer Grenadier divisions at Kursk, from 4 to 15 July 1943. The background to this is discussed in the previous article. These engagements were run in the TNDM for each day, except for the Gross Deutschland Division having two engagements on the 6th of July. This provides for a validation test of 25 division-level engagements.

The two divisions were very similar in structure, with SS Panzer Grenadier divisions having been patterned on the Gross Deutschland Division. There were minor differences in the mix and number of armor vehicles, mix and number of guns, but otherwise, they were parallel organizations of similar structure and size. They were larger than the standard German panzer division. The main difference between these two units was that the Gross Deutschland Division had attached to it the 39th Panzer Regiment, which had around 200 Panthers. These were extremely unreliable and within a few days, it is estimated that about 120 of these had broken down in addition to about 40 being lost in combat. The remaining Panthers were effectively integrated into the Gross Deutshland's Panzer Regiment on the 6th, and thereafter, the division was effectively the same as the SS divisions in structure.

## So, How Did It Do?

Again, we assembled the data, ran the engagements, and analyzed the results. We decided to measure performance in six areas:

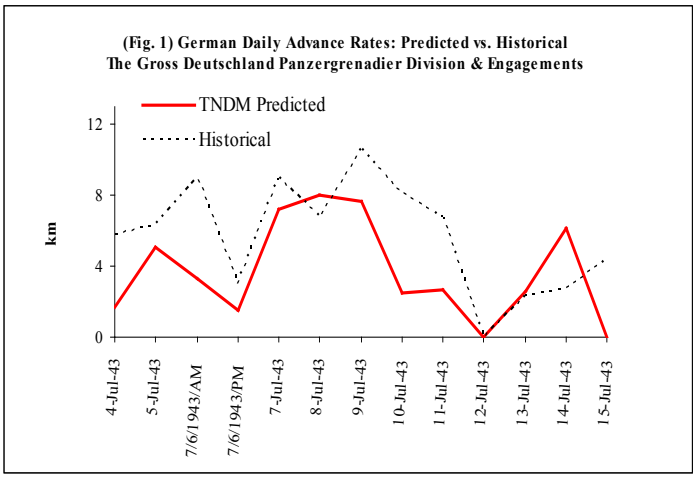
1. Win/Lose
2. Advance rates
3. German casualty rates
4. Soviet casualty rates
5. German armor loss rates
6. Soviet armor loss rates

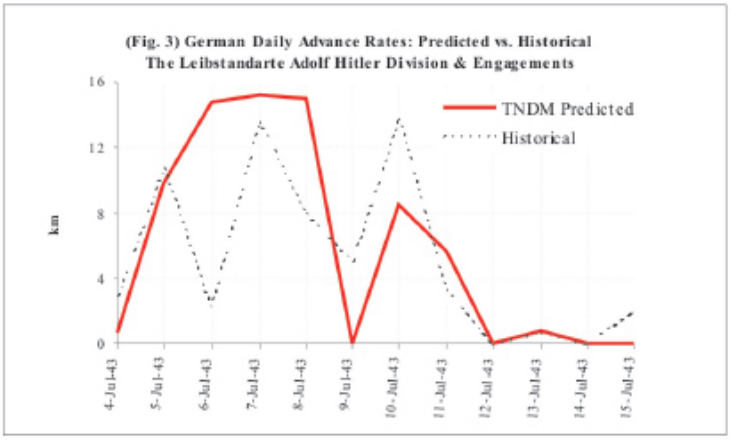
## 1. Win/Lose

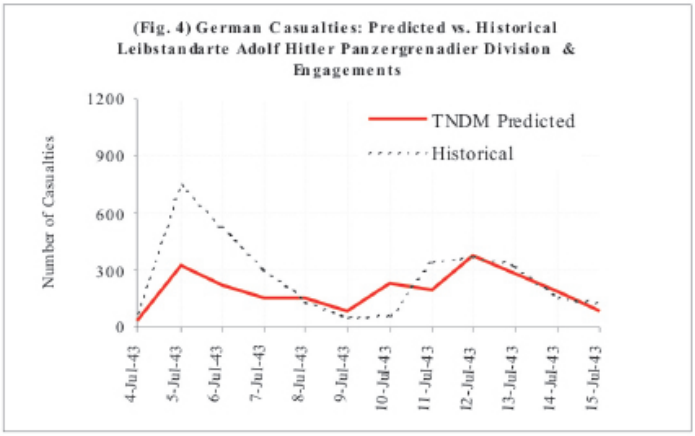
For the division-level engagements, the TNDM correctly predicted outcome in 24 of 25 cases. The model predicted the correct winner in all but one case. That was the Gross Deutschland attack on 15 July, where the attacker won, but the model predicted the defender won. This is an understandable case, and may be easily explained since the main defending unit, the V Guards Tank Corps, had withdrawn from Tolstoye Woods during the night of 14 and 15 July. The Germans were able to then successfully clear the woods in the morning but made no attempt to carry the attack into the V Guards Tank Corps' new position. As a result the Germans were able to successfully attack and advance a substantial distance without significant casualties being incurred by either themselves or the Soviets, a situation that is difficult to model. Overall, we consider this to be a very good performance by the model, being able to correctly predict the winner in 96 percent of the cases. This is in line with what we see with the corps-level engagements but better.

## 2. Advance Rates

In the case of opposed advance rates, we track them for each day in our engagements. Therefore, it was a simple matter to compare the historical advance rates with what the combat model generated. This comparison is shown below for each of the German divisions:



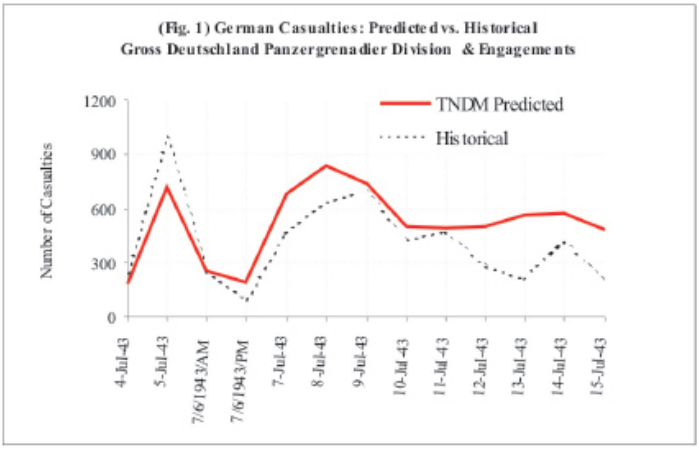



In general, this is a very good performance by the model in both cases. There are about four days across both cases where it is really off, but the TNDM predictions otherwise track closely with the historical data. The three cases that are really off are those for the Gross Deutschland Division for 6 July AM, 10 July and 11 July. In all three of those cases, the Gross Deutschland was making a lateral move across the battlefield against an out of position opponent. The historical advance rates for these divisions were determined years before we ever started this analysis and are part of the Kursk data base.

### 3. German Casualty Rates

Again, it was a simple comparison by day for the each division of the number of German combat losses (killed, wounded and missing) historical compared to the model prediction. For most of the time we had good daily reports of losses by each German division and in the case of the Gross Deutschland Division, had revised and corrected daily loss figures assembled several months after the battle. So the historical data is very accurate in this case.

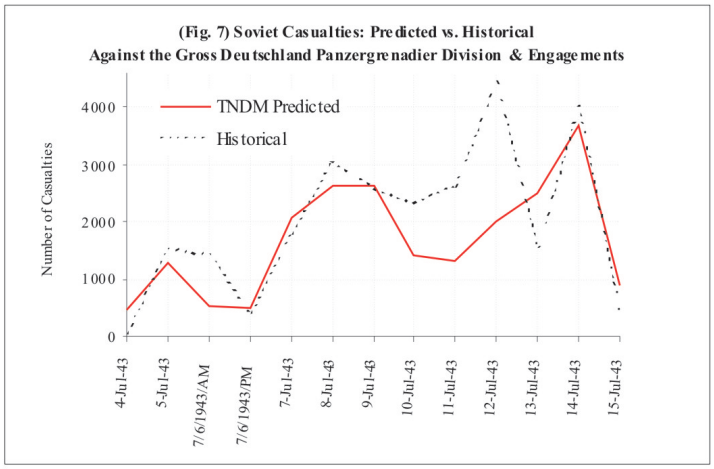


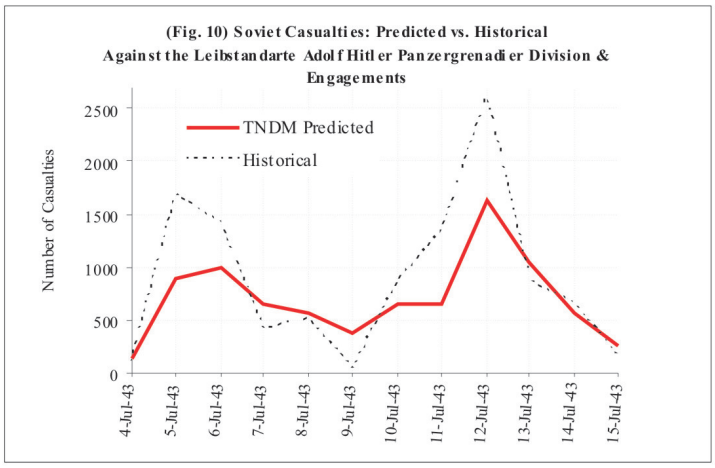

If I ever want to use a single chart to show the power of the TNDM, the Gross Deutschland Division's casualty chart is the one I would use. Casualty prediction doesn't get much better than this. In this case, the daily casualty data that we have from Gross Deutschland we know is accurate, and it is revised data assembled well after the battle.

In the case of the LSSAH Division, we have a couple of days where the predicted casualties are low (the 5th and 6th of July), but otherwise, the TNDM is doing a good job of predicting German division-level losses.

### 4. Soviet Casualty Rates

Here again, we did a simple comparison by day for each division of the number of Soviet combat losses (killed, wounded, and missing), historical compared to the model prediction. These are the losses from the Soviet units that faced the German divisions in question. In many cases, these consisted of units from several divisions or even more than one corps. The Soviet losses come from Soviet unit records, but these did not always provide us with a daily loss report. So, in some cases, Soviet losses for that day are derived for some of the units from a periodic report. So, not perfect daily historical data, but in aggregate, it is accurate.

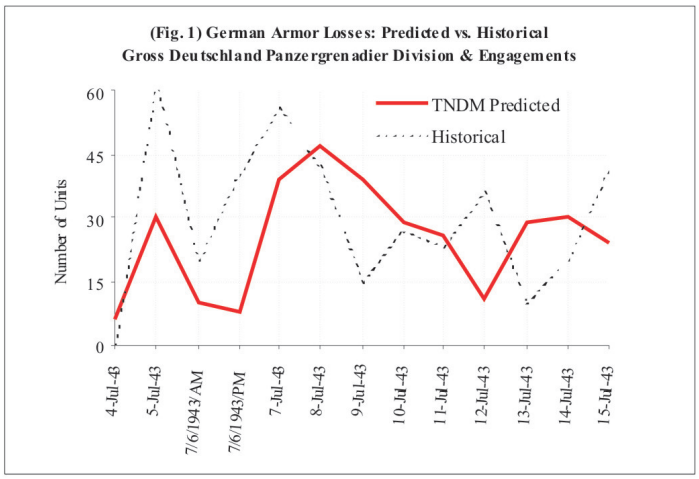


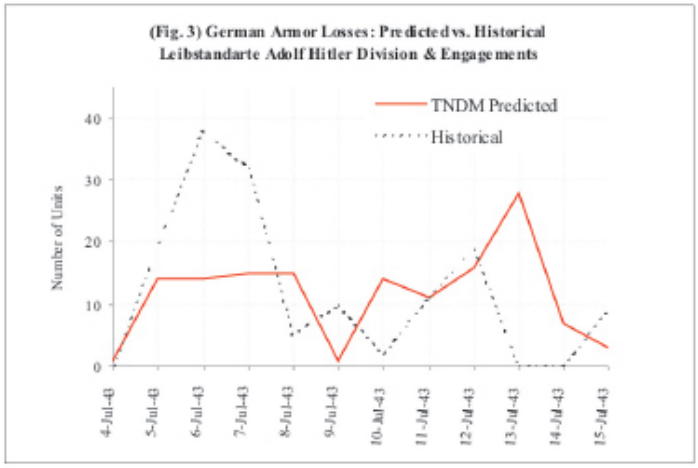




Again, facing the Gross Deutschland, the Soviet losses are very accurate, with them only being noticeably off on one day, the 12th of July, the day of the infamous bloody Soviet counterattack. For the LSSAH Division zone, it is also very good. Overall, for these two divisions, the TNDM did a much better job of predicting the Soviet casualty rates compared to what was done for the two corps.

## 5. German Armor Loss Rates

We continue the pattern of doing a simple comparison of the number of tanks lost each day (damaged, destroyed or abandoned, with most being damaged) historically with the number of armored vehicles predicted by the model as being lost. This case is complicated in that our loss figures include tanks that break down. This is caused by the nature of the historical data, where we usually have daily ready for action reports for each type of tank, but no systematic loss reports. Therefore, we can only determine how many fewer tanks were not available the following day, and do not know how many of the missing tanks were broken down versus damaged, nor how many repaired tanks showed up with the unit that day. Still, the figures are close to accurate and are the best that can be obtained.



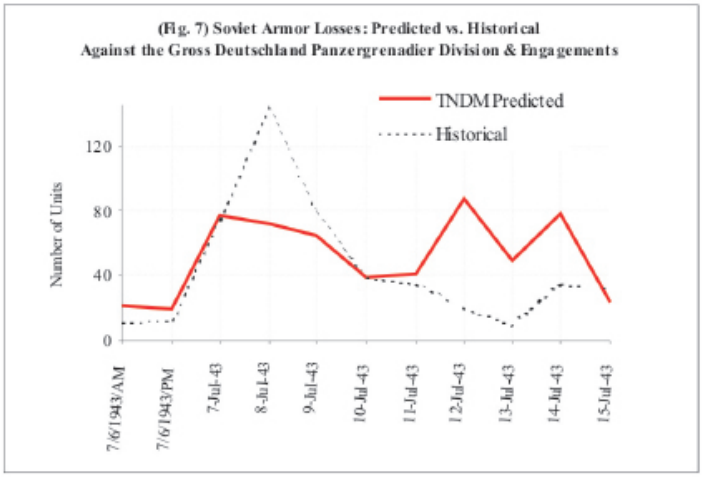



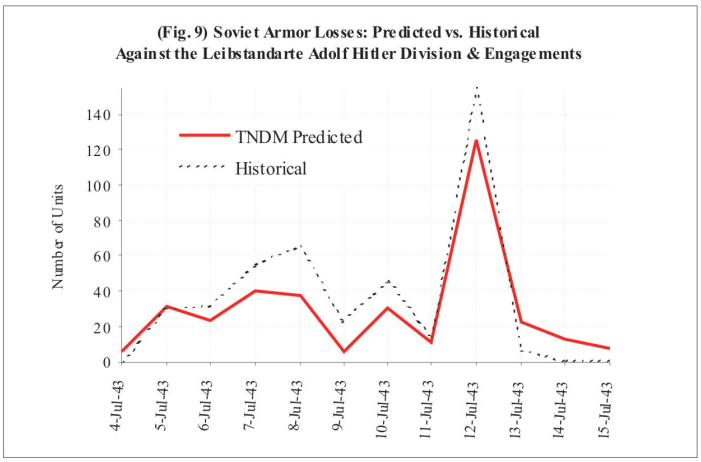

Of course, the Gross Deutschland figures are heavily influenced by the large number of Panthers which broke down during the first couple of day of the offensive (probably around 120). After that, the predicted line does a fairly good job of following historical armor losses except for the 12th and the 13th. The TNDM predictions for the LSSAH Division losses are clearly astray for the 6th and 7th of July, and we have no real explanation for this. On the 13th, the division did not really attack, so the high predicted losses there may be indicative of the way we chose to run that engagement.

## 6. Soviet Armor Loss Rates

Finally, there is a comparison of the opposing Soviet armor losses. These again, have the same problems of the German armor, in that we do not know how many were damaged versus broken down (the Soviet had a much higher percent of destroyed tanks compared to

their total number of tanks lost when compared to the Germans). We do not think that the Soviets repaired as many tanks during the battle as did the Germans. We also have a problem, similar to their casualty reports, in that we do not always have the armor losses for each day, but only have it for some units in aggregate reports covering several days. Still, the data we have is a reasonable representation of the real situation and in aggregate is correct.




The Soviet armor losses against the Gross Deutschland Division are not always well predicted here. There were no Soviet armor losses recorded against this division for the 4th or the 5th (there was little armor in the area). The model under-predicted for the 8th and over-predicted for the 12th through the 14th. Considering how complex the fighting was on those days, this is not all that surprising (the division was restoring a position that had been penetrated by Soviet armor).

On the other hand, if I wanted a single chart to show the power of the TNDM, the LSSAH Division's Soviet armor loss chart certainly does the trick. It is hard to expect a model to perform better than this.

**Summation (Historical Result vs. Model Run)**

Overall, I think we are comfortable stating that the TNDM was a good predictor of the outcome, advance rates, German casualty rates, Soviet casualty rates, German armor loss rates and Soviet armor loss rates for both divisions tested.

In aggregate the statistics for the corps (reprinted) and division-level validation are (the historical figure is listed first followed by the predicted result):

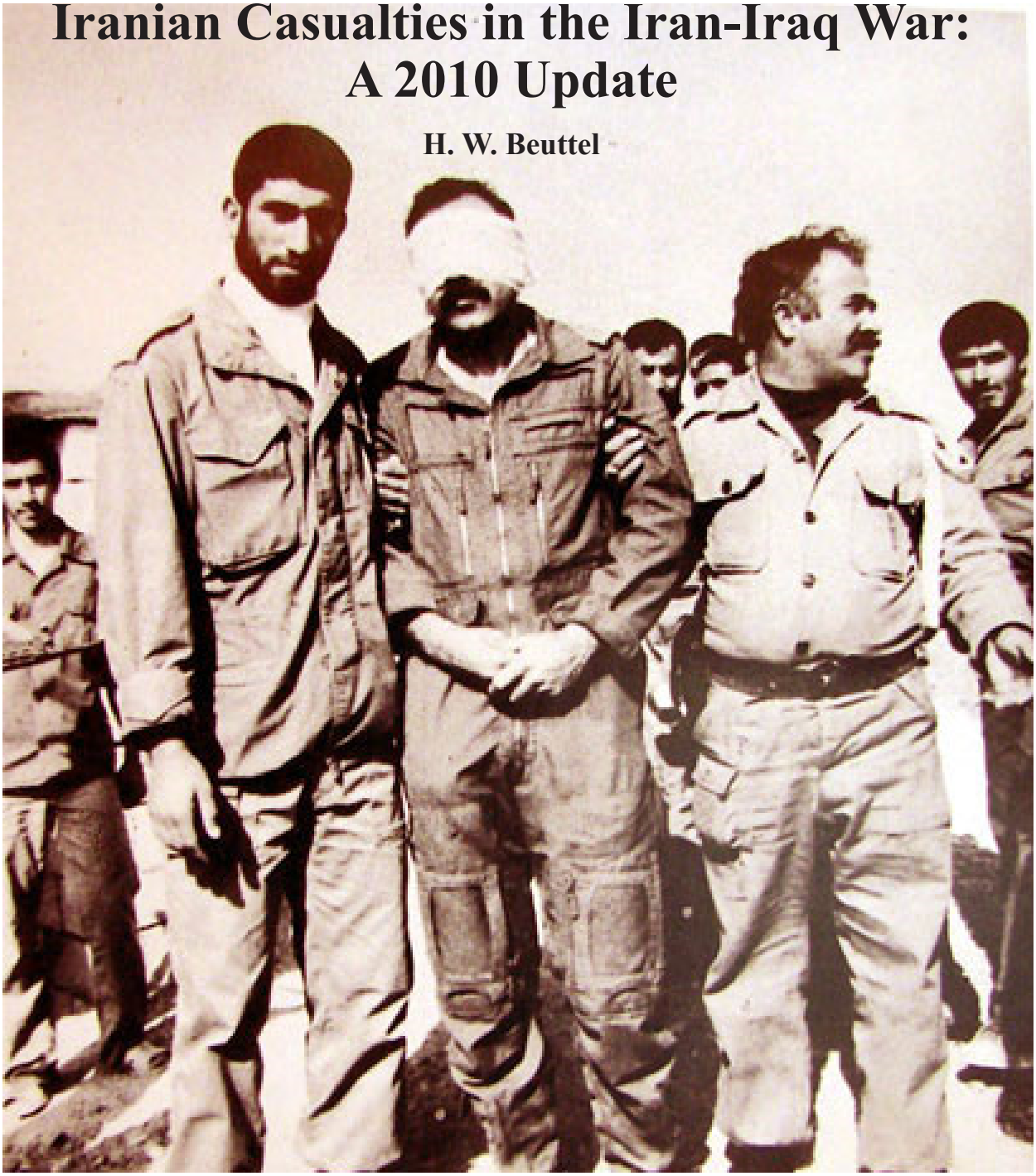
| | 24 Corps Engagements | 25 Division Engagements |
|---|---|---|
| 1. Win/Lose | 21 correct (88%) | 24 correct (96%) |
| 2. Advance Rates (in km)<br>Wehrmacht<br>SS | <br>80.5 vs 37.99 (47%)<br>63.3 vs 83.3 (132%) | <br>74.9 km vs 48.3 (64%)<br>62.4 km vs 70.4 (113%) |
| 3. German casualty rates<br>Wehrmacht<br>SS | <br>7,491 vs 9,607 (128%)<br>7,899 vs 4,812 (61%) | <br>5,386 vs 6,718 (125%)<br>3,204 vs 2,318 (72%) |
| 4. Soviet casualty rates<br>versus Wehrmacht<br>versus SS | <br>35,702 vs 22,504 (63%)<br>29,311 vs 17,602 (60%) | <br>26,348 vs 21,890 (83%)<br>10,705 vs 8,365 (78%) |
| 5. German armor loss rates<br>Wehrmacht<br>SS | <br>470 vs 463 (99%)*<br>403 vs 305 (76%) | <br>390 vs 328 (84%)*<br>146 vs 139 (95%) |
| 6. Soviet armor loss rates<br>versus Wehrmacht<br>versus SS | <br>621 vs 544 (78%)<br>964 vs 507 (53%) | <br>488 vs 571 (117%)<br>430 vs 357 (83%) |

* Less the 120 Panthers that broke down

Overall, I believe these two validations clearly establish that the model is a good predictor of corps- and division-level combat. Furthermore, as the use of the CEV was essential in getting the results that we did, it clearly showed the importance of considering human factors when analyzing warfare between different armed forces.

# Iranian Casualties in the Iran-Iraq War: A 2010 Update

**H. W. Beuttel**



Over the last thirteen years since the publication of my "Iranian Casualties in the Iran-Iraq War: A Reappraisal" by The Dupuy Institute in the December 1997 issue of The International TNDM Newsletter, the Iranian government has released new data which not only generally confirms, but also corrects and expands on this subject. Generally, these tend to confirm my earlier calculations and provide poignant additional detail.

On 14 March 1998, the Iranian Foundation for the Martyrs released their official figures for war dead. A total of 213,000 "martyrs" died during the Islamic Revolution, the War of Sacred Defense or fell victim to political assassinations. Of these, 85% (181,050) died in the war (which I take to be active combatants killed in action).[1] While this is in line with my general thesis, I was surprised it was in the lower bounds of my estimate. If anything I expected it to be somewhat higher. Equally interesting is that 31,950 "martyrs" died in the Islamic Revolution -- a figure that is counted from 15 Khordad 1342 (5 June 1963). This figure does not count those of the Shah's faction or other opposition (not "martyrs") who also perished. The much publicized wrap figure of 50,000 dead in the Revolution may be correct. In 2008 the total war dead was revised to about 199,000, almost

[1] "Iran Counts 213,000 'Martyrs'," Iran News, 14 March 1998.

20,000 more.[2]

Among the other poignant statistics released are the following:[3]

• 75% of the dead were between 14 and 24 years of age
• Their average age was 23.
• Some 44% were between 16 and 20 years old;
• 30% were 21 to 25;
• 8% were 26 to 30 and the remainder older.
• Some 36,000 were under eighteen.[4]
• 7,000 (4%) were *under 14*.
• Fifty-five of every 1,000 clerics were killed in action; 14 times more than lay persons
• Twenty four of every 1,000 clerics lost a son in the war; 6.5 times more than the average family.
• Over 93,000 *Baseej* fighters were killed in action.[5] Of these, 3,500 "University" *Baseej* fighters were killed in action.[6] Not all *Baseej* were illiterate peasants. A substantial number were recruited for temporary service from Iran's best and brightest at university.
• Female *Baseej* martyrs numbered 4,470.[7]
• Of Iran's 320,000 permanently disabled from the War of Sacred Defense, 45,000 (14%) are combat stress casualties. Of these 12,000 (27%) are in "critical condition."[8]

**Killed in Action**

In an address to the Imam Ali Officers' College in Tehran on 14 April 1998, regular ground forces commander Brigadier General Pourshab cited figures of 50,000 regular army personnel killed in action and 120,000 disabled in the War of Sacred Defense.[9]

During the Ettehad ("Unity") naval maneuver of 12-21 April 1998, spokesman Capt. Abdollah Manavi cited 48,000 regular forces servicemen including 3,000 navy personnel as killed in action during the imposed war with Iraq.[10]

Readers of my original article may recall that outgoing *Pasdaran* commander Maj. Gen. Moshen Rezai claimed 150,000 *Pasdaran* (and *Baseej*) KIA ("martyrs") in the War of Sacred Defense. I will reproduce for the benefit of those who may not have access to the original article, my comments on this statement at the time:

*The Moshen Rezai Excursion*

In September of 1997, outgoing commander of the *Pasdaran*, Maj. Gen. Moshen Rezai, cited some compelling statistics on Iranian casualties in the War of Sacred Defense. Speaking of the IRGC, he claimed some 2,000,000 *Pasdaran* served in combat over the course of the war. Of these, 150,000 were martyred, 200,000 permanently disabled.[11] Taken at face value, these figures suggest KIA totals far higher than released in 1988. The *Pasdaran* are cited as taking some 90% more KIA than disclosed at war's end. If the proportion is the same for the regular army, then it must have suffered some 66,000 KIA, and paramilitary deaths were on the order of 16,000. The total KIA would stand at 232,000. Another question is whether Rezai counted the MIAs, and if so, how many were *Pasdaran* (and *Baseej*)? If he did, and the proportion is constant (69%), then some 23,000 of 33,000 cases recovered or settled were *Pasdaran* (or *Baseej*). This in turn boosts the count by at least 11,000 (counting regular army and paramilitary recovered MIAs) to about 243,000. As there are at least 39,000 still missing (and presumed dead), the final tally would be on the order of 282,000 military and paramilitary dead.

On the other hand Major General Rezai may have been speaking somewhat loosely to exaggerate his component's contribution. He has been known to exaggerate before. The number of 150,000 KIA matches the sum of the announced dead (123,220) at war's end, plus officially announced recovered MIA *bodies*—27,000 as of June 1997 (remember: 6,000 MIAs have been simply *declared* dead at family request). 123,220 + 27,000 = 150,220. The remaining estimated 39,000 residual MIAs would bring the total count of military combat dead to 189,000 - in line with above estimates.[12]

[2] "Iranians Count Cost of War, Two Decades On," Payvand, 9 June 2008.
[3] "Iran Counts 213,000 'Martyrs'," Iran News, 14 March 1998; "Safavi: Weak Revolutionary, Legal Institutions Make US Happy," IRNA, 28 May 1998.
[4] "Iranians Count Cost of War, Two Decades On," Payvand, 9 June 2008.
[5] "Baseej Instrumental in Both War and Peace Times," IRNA, 7 February 1999.
[6] "Safavi Condemns Physical Face-Off at Universities," IRNA, 5 January 1998.
[7] "Women In The Iranian Armed Forces," RFE/RL Iran Report, 12 February 2001.
[8] "Safavi: Iran Shoulders Great Responsibility Toward War Disabled," Tehran Times, 6 May 1999.
[9] "Iran Army, One of the Strongest in World," Tehran Times, 14 April 1998.
[10] "Iranian Naval Forces Ready to Defend Country, Its Territory," IRNA, 16 April 1998.
[11] "Rezai Speaks Out About His New Appointment, IRGC," Iran News, 13 September 1997.
[12] H.W. Beuttel, "Iranian Casualties in the Iran-Iraq War: A Reappraisal," The International TNDM Newsletter, December 1997, 10-11.

It now appears that my argument was superfluous, although an interesting coincidence. The *Pasdaran* (and *Baseej*) contrasted to regular forces may have indeed suffered not 90% more killed (extrapolated from 1988 Iranian data), but 300% more combat deaths. They often had less training and tactical competency than regular forces and were famous (or infamous) for their so-called "human wave" assaults. Baseej commander Brig. Gen. Mohammed Hejazi revealed in February 1999 that over 93,000 Baseej were killed in action.[13] This represents some 62% of overall Pasdaran killed and as much as 47% of overall combat dead.

In any event, combining the Pasdaran figures of General Rezai and the statements of General Pourshab, total KIA still stand at no more than 200,000. This is in perfect accord with the figure of 199,000 released in June 2008.

And why does the Foundation for the Martyrs list only 181,050 KIA? If we take the average of the two sums (200,000 and 181,050), we arrive at 190,052 KIA. This is still in line with my original calculation. Figures of the Foundation and the services may vary without being actually contradictory. The Foundation's "martyrdom" is an official status that entitles surviving relatives to certain benefits. Those of the services are based upon unit returns.

But what of the MIAs? Are they included in this count? It seems reasonable at this point to conclude that they are. Total KIA and MIA counts originally were 123,220 (1988) and 72,753 (1995), which equals 195,973 or very close to the service figures of 200,000. As of April 1998, 39,320 Iranian MIA bodies had been recovered.[14] This would leave an MIA residual of 33,433. By 2002, this stood at 48,000, with another 10,000 still listed as missing.[15] Combining 48,000 with 93,000 and 58,000, we arrive at exactly 199,000 dead. This number seems fairly firm now, as the much publicized release of 322 Iranian "PoWs" in April 1998 by Iraq yielded only 3 that were of war vintage—all the others being civilian internees since the 1991 Desert Storm War.[16] In July 1998, Iran claimed to have information that "hundreds" (no longer thousands) of Iranian PoWs from the war were still being held in Abu Ghraib prison outside Baghdad. Before the 1990 invasion of Kuwait, Iraq had hundreds of Iranian PoWs transferred to secret locations.[17] As this information comes from the Iraqi opposition, its veracity may be suspect.[18] Many, if not all, of these were probably Iranian nationals arrested for criminal offenses. There are probably no more true Iranian PoWs from the War of Sacred Defense still held in Iraq at this time.

This may explain Iranian PoW Commission chief Brig. Gen. Abdollah Najafi's somewhat veiled remark in July 1998 in which he stated that the names of those listed as PoWs by both Iran and Iraq had become "clear." He also mentioned that total releases up to that time numbered 39,364 Iranian and 54,776 Iraqi PoWs.[19] He stated that Iraq had clarified the fate of 10% of Iranian PoWs still in Iraq, that some had died and others were unwilling to return home. The number of unresolved cases numbered 3,738.[20] This number corresponds more or less to the sum of the 3,000 deserters/defectors during the imposed war and 400 Iranian ex-PoWs unwilling to return home. This leaves a residual of 378, which in fairness could be described as "hundreds" still in captivity as in the resistance report. Whether they are truly "PoWs" of the war era or other types of prisoners and internees remains to be seen.

As there may have been as many as 3,000 defectors in this MIA total, and the Iraqi one-time claim that 400 Iranian PoWs refused repatriation, the resid-

[13] "Baseej Instrumental in Both War and Peace Times," IRNA, 7 February 1999.

[14] "Search for War Martyrs Causes Almost 50 More Deaths on Iran-Iraq Border," Iran News, 23 April 1998.

[15] "Funeral for 225 Martyrs of Iraqi Imposed War to Be Held Wednesday," IRNA, 5 January 2002.

[16] "268 Iranian PoWs to Be Swapped for 3,791 Iraqi War Prisoners," Tehran Times, 5 April 1998;"23 More Iranian PoWs Exchanged for 500 Iraqi PoWs," IRNA, 6 April 1998; "Head of Commission on PoWs: PoWs Issue to Be solved This Year," IRNA, 13 April 1998; "Iran-Iraq PoW Committee to Meet in Baghdad," Iran News, 13 April 1998; "Leader Receives Former PoWs," IRNA, 8 April 1998; "Iran Releases 5,584 Iraqi POWs Including Army Generals," Associated Press, 7 April 1998; "Iraq Releases Iranian Pilot," Associated Press, 7 April 1998; "268 Iranian PoWs to Be Swapped for 3,791 Iraqi War Prisoners," Tehran Times, 5 April 1998; "23 More Iranian PoWs Exchanged for 500 Iraqi PoWs," IRNA, 6 April 1998; "Iran Says All Prisoners to be Swapped with Iraq," Associated Press, 6 April 1998; "3rd Batch of PoWs Swapped, 1 Iraqi Dies of Heart Attack," IRNA, 5 April 1998.

[17] "Iranian PoWs Still Kept in Iraq, Iraqi Opposition Says," IRNA, 29 July 1998.

[18] "Hundreds of Iranian PoWs Still in Iraq, Says Opposition Radio," IRNA, 6 July 1998.

[19] "Iran's PoW Commission Head: Talks with Iraqis Positive," IRNA, 17 July 1998.

[20] "Fate of 3,738 Iranian PoWs Still Unknown," IRNA, 21 July 1998.

ual may be closer to 30,000.[21] If we deduct these from the 1988 and 1995 KIA and MIA numbers, it equals 192,573. Reconciling the figures of Pourshab (50,000) and Manavi (48,000) for regular forces KIA, it seems reasonable that the former rounded up and the latter is closer to the true figure. We can forgive General Pourshab for inflating the count by 4%. If we theorize that perhaps General Rezai also rounded up by no more than 4%, then his real figure would be about 144,000 (150,00 * .96). This now yields a total of 192,000 (48,000 + 144,000). This is within 2% of my original calculation. It also indicates that the difference between the figures of the services and the Foundation for the Martyrs is only about 11,000 or about 6%. It suggests that Iran has realized its MIAs are, in fact, dead. The only question is formal "martyr" status.

I conclude that Iranian KIA in the War of Sacred Defense was at least 192,000, or some 2% higher than I calculated in the original version of this article written in 1997. If the 199,000 is accepted, then about 5% higher.

**Disabled and Severely Wounded**

The numbers of disabled or severely wounded must also be revised. I took the 200,000 cited by General Rezai to be a combined figure for both Pasdaran/ Baseej and regular forces. Brig. Gen. Mohammed Hejazi, commander of *Baseej*, stated in February 1999 that the *Baseej* suffered 42,000 disabled in the war.[22] *Baseej* fighters represent 21% of overall *Pasdaran* disabled. However, General Pourshab's figures for regular forces alone indicate 120,000 disabled.[23] Together, these equal 320,000 severely wounded. Even accounting for a 4% round up, the number is still 307,000. It is likely no rounding has occurred as in the case of killed and missing. Figures from the Foundation for the Disabled are probably quite accurate. This would indicate the distribution of killed to severely wounded to other wounded was 17%, 28%, 55%. The proportion of severely wounded is now almost double that of T.N. Dupuy's historically-derived distribution of 20% killed, 15% severely wounded and 65% other wounded.[24]

On an aside, Iranian categorization of degree of disability is very different from that of the West. Iranian reports often cite a range of 50-70% "disabled." These reports usually refer to individuals who were blinded, lost one or more limbs, confined to wheelchairs or even quadriplegic. I seem to remember an instance of 90% disability, but I cannot recall what this poor soul must have been enduring. My own father, a WWII combat infantry officer, was grievously wounded in the European Theater in 1944. Despite spending several years in and out of military hospitals and being categorized as "100% disabled," he still had his sight, use of all his limbs (aside from a fused left wrist) and generally good health until his death in 2003. It would seem that in the Iranian scale "100% disabled" equals "dead."

**Casualty Patterns in Iranian Forces**

The patterns of disabled to killed (using the larger numbers) overall are 1.60:1. Among regulars, it was 2.4:1, and among Pasdaran overall it was 1.33:1. If we decompose *Pasdaran* into *Pasdaran* and *Baseej*, the ratios of disabled to killed is: *Pasdaran* 1.46:1; *Baseej* 0.45:1.

The differing ratios between components may be accounted for by the probability of many more direct, frontal attacks by *Pasdaran* in which more severe wounds were encountered from mines and small arms. Another contributing factor may be the overall Iranian tendency not to shut down an operation until having suffered 30% casualties. Finally, the excellent medical support Iranian forces enjoyed (perhaps more so by regulars) saved the lives of those gravely injured who would have otherwise died of wounds.[25] This is particularly noticeable in the *Baseej* disabled to killed ratio. The *Baseej* were the least trained, least supported component. Those who were not killed outright more frequently died of wounds than other components. Hence

[21] "Iranians Against the Ayatollah," Special Forces, April 1988, p.2.; "War in the Gulf: Chronology of Events," FYEO, No. 267, 10 June 1991, p. 267-2; "War in the Gulf: Chronology of Events," FYEO, No. 277, 28 October 1991, p. 277-4. Iran may have experience as many as 25,000 known deserters during the war. Of these only about 3,000 joined armed opposition groups in Iraq. Between September 1984 and March 1985 Iran executed 168 soldiers for "spying or counter-revolutionary activities." See Edgar O'Ballance, The Gulf War (London: Brassey's, 1988), 169.

[22] "Baseej Instrumental in Both War and Peace Times," IRNA, 7 February 1999.

[23] "Iran Army, One of Strongest in World," Tehran Times, 14 April 1998.

[24] T.N. Dupuy, Attrition: Forecasting Battle Casualties and Equipment Losses in Modern War (Fairfax, Va.: HERO Books, 1990), 165-167.

[25] H.W. Beuttel, "Iranian Casualties in the Iran-Iraq War: A Reappraisal," The International TNDM Newsletter, December 1997, 12.

their surviving disabled, representing the living fraction of severely wounded, was three to five times less.

The percentage of killed and disabled by total service combatants is:

*Pasdaran* ~
Killed: 3%
Disabled: 8%
*Baseej* ~
Killed ~ 5%
Disabled ~ 2%
Regulars ~
Killed: 5%
Disabled: 12%

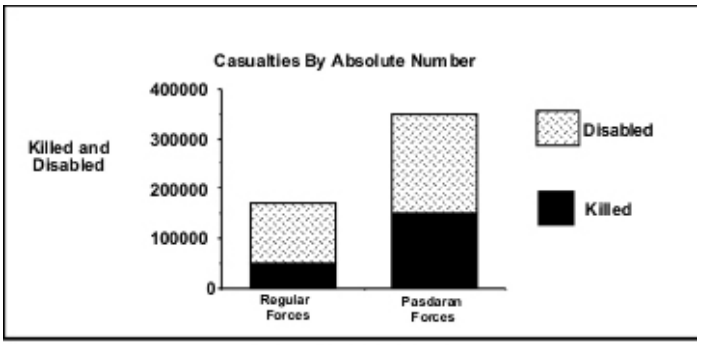
*Pasdaran* to *Baseej* to Regular KIA:
1.0: 1.78 : 0.93

*Pasdaran* to *Baseej* to Regular Disabled:
1.0 : 0.27 : 0.78

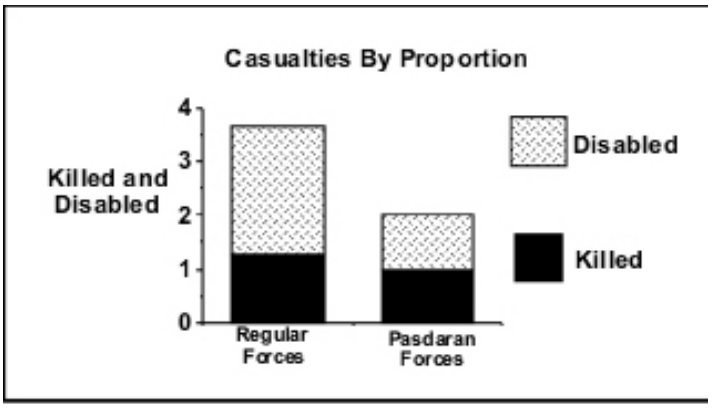
*Pasdaran* to *Baseej* to Regular Killed + Disabled:
1.0 : 0.65 : 0.80

Thus the *Pasdaran* (counting *Baseej*), a force four times as large as the regular army, suffered 300% more killed and 67% more disabled. Overall, it suffered 206% more lethal or disabling casualties. However, the regular army suffered 25% more killed proportional to its size than the *Pasdaran*, and 240% more disabled. Proportionate to its size, regular forces' overall lethal and disabling casualties were 189% larger than the Pasdaran. This suggests regular troops fought even more and harder than *Pasdaran* formations. The *Baseej*, proportionate to their size, suffered 182% more dead than the *Pasdaran*, but only 27% of disabling wounds. Contrasted to the regular Army their killed were equivalent, but they suffered six times fewer disabling wounds proportionately.

An interesting note on casualty distribution by rank was revealed in a speech by Maj. Gen. Rahim Safavi, CinC *Pasdaran*, to a gathering of IRGC officers and NCOs during *Pasdaran* Week in November 1999. In the speech he remarked that nearly 30,000 IRGC personnel were martyred in the course of the War of Sacred Defense.[26] This low number can be explained, given his audience, as probably the number of IRGC officers and NCOs killed in action. If so, then officers and NCOs accounted for 20% of all IRGC personnel killed.




Casualty Pattern:
Regular Forces Vs Pasdaran




Casualty Pattern:
Regular Forces Vs Pasdaran

**Total Casualties**

Some 1997 articles related to the Iran-Iraq War have cited "official statistics"—without identifying the source—that the war claimed 300,000 Iranian lives, and 500,000 were wounded.[27] I do not take these references as definitive or precise as regards military battle casualties. They appear to be more general numbers for the revolution and the war, counting all military and civilian dead, both combat and non-combat deaths. If we add the 32,000 martyrs of the revolution to the 273,000 deaths due to the imposed war with Iraq that I calculated in my previous article, the sum is 305,000.

These articles also cite 500,000 wounded in the war. This would give a wounded to killed ratio of 1.67:1. This is suspect compared to historical casualty trends. At best 500,000 might represent "other wounded," as distinct from 320,000 disabled or severely wounded, yielding a total military wounded of 820,000. If actual

[26] "IRGC Safavi," IRNA, 12 November 1999.

[27] "Leader Attends Funeral for 1,500 Martyrs," Iran News, 2 Mat 1998; "Tehran's Vast Monument to a Deadly Conflict," Agence France Presse, 15 December 1997.

combat deaths were 199,000, then the wounded to killed ratio in this case is 4.12:1, a much more believable figure.

Our revised casualty figures and percentages for Iranian forces are now:

Total Battle Casualties: 1,137,000
Total Killed in Action: 192-199,000 (17-18%)
Total Severely Wounded: 320,000 (28%)
Total Other Wounded: 638,000 (55%)

Of 5,000,000 estimated Iranian combatants:

4% were killed in action
6% were severely wounded/disabled (up 2 percentiles)
13% were wounded

**Naval Casualties**

Captain Manavi indicated that of the 48-50,000 regulars killed in action, 3,000 were naval personnel.[28] This is roughly 6% of regular KIA. It is a large number for a war in which there were only a few naval engagements and those primarily against US forces in April 1988. Most of these sailors probably died supporting the great amphibious and littoral operations such as *Kheiber* and *Wal Fajir*-8.

**Casualties Due to Air and Missile Strikes**

In my original article I calculated that Iraqi air strikes may have killed as many as 24,000 Iranian soldiers and wounded another 86,000. I indicated this was probably inflated. It was. According to official statistics released in 2000, some 171,235 troops actually fell at the front, while 16,780 died in Iraqi air and missile strikes.[29] These latter are technically described as in "residential areas" and may not include troops killed by air at the front. Nevertheless, the number indicates how ineffective Iraqi air power actually was. Consequently, we may conclude that 16,780 were killed by air, and thus about 59,493 may have been wounded by air power. This results in air accounting for about 8% of all killed and only 6% of all wounded.

**Combat Stress Casualties**

It comes as no surprise that in fighting the longest war of the 20th Century, Iranian forces suffered combat stress casualties, and these psychological casualties have been acknowledged. At one Tehran center in 1998, 76 veterans were permanently hospitalized for "nervous and psychological disorders." Thirty six were listed with over 50% disability.[30] Of Iran's 320,000 permanently disabled from the War of Sacred Defense, 45,000 (14%) were combat stress casualties according to Pasdaran Commander in Chief, Maj. Gen. Rahim Safavi speaking in 1999. Of these, 12,000 (27%) required immediate hospital care.[31] This indicates an instance of one serious combat stress casualty per twenty five other battle casualties or a rate of 9 per 1,000 combat veterans (given 5,000,000 saw combat) and 2.4 severe cases per 1,000 veterans.

In the 23 years of the Napoleonic Wars a soldier might expect to fight in sixty battles and see some 400 other lesser actions. A total of some 644 major combat actions also occurred during the period.[32] Combat stress casualties were almost unknown.[33] Combat stress was first formally diagnosed in the US Civil War, and it was called "Soldier's Heart." The intensity and frequency of the fighting—some 10,455 combat actions in just four years, fifteen times that of the Napoleonic Wars—caused this casualty-producing effect of battle to become noticeable. Battles themselves had lengthened from an average of 1.6 days in the Napoleonic Wars to 2.6 days fifty years later.[34] There were no less than 2,261 recognized major actions, 3.5 times that of the sum of major actions in the Napoleonic Wars.[35] It was diagnosed as "nostalgia" in the first year of the war with a recorded 5,213 cases. The rate then was about 2.34 - 3.3 per 1,000 soldiers annually.[36]

[28] "Iranian Naval Forces Ready to Defend Country, Its Territory," IRNA, 16 April 1998.
[29] "Iran Lost 188,015 Forces During 8 Year War," IRNA, 23 September 2000.
[30] "President Visits Rehabilitation Center for War Disabled," Iran News, 3 January 1998.
[31] "Safavi: Iran Shoulders Great Responsibility Toward War Disabled," Tehran Times, 6 May 1999.
[32] Gunther E. Rothenburg, The Art of War in the Age of Napoleon (Bloomington: Indiana University Press, 1980), 228, 246.
[33] Rory Muir, Tactics and the Experience of Battle in the Age of Napoleon (New Haven, Conn.: Yale University Press, 1991), 194-195.
[34] Paddy Griffith, Battle Tactics of the Civil War (New Haven, Conn.: Yale University Press, 1989), 197.
[35] Frederick Phisterer, Statistical Record: A Treasury of Information About the US Civil War (Carlisle, Pa.: John Kallmann Publishers, reprint of 1883 ed.), 83ff.
[36] Anthony Babington, Shell Shock: A History of the Changing Attitudes to War Neurosis (London: Leo Cooper, 1997), 13-20.

In WWI the British Army listed 28,533 shell shock wounded cases by December 1917. The British, however, distinguished between shell shock "wounded" (about 40%) and shell shock "sick" (about 60%), so actual numbers were higher. By 1921, 65,000 UK veterans were drawing pensions for neuropsychiatric disorders, with 14,771 (23%) of them confined to hospital. This was only about 3% of Britain's 2,090,212 military wounded. By 1922 that number of pensioners had fallen to 50,000, but there were now 16,771 (34%) hospitalized. Also in WWI, a total of 69,394 US soldiers of the AEF suffered from neuropsychiatric disorders. This was about 34% of total AEF ground combat forces wounded of 203,183 (193,663 Army, 9,520 USMC), but it is not clear if all these were counted in casualty statistics, as most men recovered. Of these, only 4,039 cases (6%) had to be evacuated to the US, and 7,804 (11%) had to be confined to hospital after the war. This represented 27% of overall disabled wounded being so treated in 1921. It also represents about 4% of total wounded—in line with UK experience.[37]

In WWII the US had three combat stress casualties for every two wounded and 125 for every 100 killed. The German army had only 13 for every 100 wounded.[38] In the North African campaign prior to Kasserine, psychiatric casualties were responsible for 20% of all battlefield evacuations and sometimes ran as high as 34%. During 1943 almost 40% of the Southwest Pacific Area's evacuations to Hawaii or the US were loosely classed as mental. In Normandy 11,000 were treated for combat exhaustion with 75% returned to duty.[39] Overall, the annual rate for the US Army in WWII was between 28 and 101 per 1,000 engaged troops. In Korea during 1950-52, 37 of every 1,000 US servicemen were treated for psychiatric wounds each year. Only 6% of these were severe and required evacuation.[40]

If Iranian serious combat stress casualties (45,000) accounted for, say, 4% of all wounded then we arrive at a figure of about 1,125,000 total combat wounded. This is closer to the total battle casualty figure of 1,137,000 cited above. It would suggest to some that Iranian forces had far less of a problem with combat stress casualties than other 20th Century armies fighting sustained general wars. This may be due not only to a culturally superior psychological fortitude of the Iranian soldier or even the probable strengthening effect of a deep belief in Islam, but also to the simple fact there were only about 400 days of heavy combat in the eight years of the war. Additionally, the frequency of all combat actions was about that of the US Civil War, but the Iranian combat stress rate per thousand per year was three times higher.

**Conclusion**

Despite the fact that these figures debunk the western myth that hundreds of thousands or millions died in the War of Sacred Defense, we must not forget the tragedy that these lethal and disabling casualties represent. The war caused not only the casualties themselves, but also the heartbreak of their loved ones and friends and imposed an obligatory burden on the nation. "Every single one of the 34 tiny alleyways around my home is named after a martyr. In some alleyways there were three or four martyrs," said Tehran resident Mohammed Ibrahim, a veteran of the 1985 battles. The mother of 17-year-old Pasdaran martyr Ali Reza Mirzai literally lived at her son's grave at the Behest e Zahra for 13 years after his 1985 death in action, until ill health forced her to come only once a week. She cooked simple meals at his graveside to feed veterans visiting the cemetery as a way to honor her son's memory.[41]

In 1989, 2.7 million persons—the wives, parents, and children—of men killed and disabled in the war were receiving government benefits. By 1996 this figure had risen 170% to 4.6 million as disabled veterans struggled to attain and maintain a normal life with families.[42]

**Excursion: PoW/MIA Update**

In November 1997, Iran approved the release of another 496 Iraqi PoWs.[43] This brought the total to 49,196 since the end of the imposed war; 10,000 were

[37] Ibid. 107, 121-122.
[38] James F. Dunnigan, How to Make War, 3d ed. (New York: William Morrow and Co., 1993), 480.
[39] Albert E. Cowdrey, Fighting For Life: US Military Medicine in World War II (New York; The Free Press, 1994), 135-152, 256-257.
[40] Babington, op. cit., 164.
[41] "Tehran's Vast Monument to a Deadly Conflict," Agence France Presse, 15 December 1997.
[42] "President Rafsanjani's Grand Achievements in Two Terms," Iran Exports, 47 (May-June 1997).
[43] "Iran to Unilaterally Release 500 Iraqi PoWs," IRNA, 26 November 1997; "Leader Approves Release of Iraqi PoWs," IRNA, 26 November 1997.

unilateral Iranian actions.[44] In response Iraq released two Iranian civilians arrested for border crossing in 1991.[45] In December 1997, Iran released two Jordanian PoWs captured during the *Fatah ol Mobin* offensive in 1982.[46] In January 1998, two Sudanese PoWs captured during the war were likewise released.[47] Later in May 1998, Iran released four Palestinian PoWs who had fought for Iraq.[48]

In April 1998, a sudden change occurred in the POW situation. Iraq agreed to release 380 Iranian PoWs in exchange for the release of 5,592 Iraqi prisoners. On 3 April, 61 or 62 Iranians were exchanged for 800 Iraqis at the Khosravi border post.[49] Still, hope for a full accounting of Iranian PoWs is unlikely. In October 1991, Iraq stated it had 400 Iranians who refused repatriation.[50] During the 1991-92 time frame, another 64 Iranian soldiers became POWs during fighting with the NLA and Kurdish groups supported by Iraq.[51] These individuals probably were the ones being released or compelled to return. The exchange began on 2 April when 112 Iranians and 1,801 Iraqi PoWs were released. A further 89 Iranians and 1,500 Iraqis were exchanged on 5 April. On 6 April, 23 Iranians and 500 Iraqis went home, bringing the total to 4,058 (258 Iranian and 3,800 Iraqi). The final exchange took place on 7 April, when 50 Iranians were freed, and the total Iraqi repatriates numbered 5,584 of the original 5,592 promised (one Iraqi PoW who died of a heart attack during the swap; seven other Iraqi PoWs in the group elected to stay in Iran). This brought the grand total for the aftermath of the Iran-Iraq War to 29,157 Iranian and 50,993 Iraqi PoWs released in 94 bilateral exchanges, plus 28 unilateral releases by Iran according to Brig. Gen. Abdollah Najafi, head of the Iranian PoW Commission speaking on 5 April. This was contradicted by commission statistics released the next day, which listed 39,269 Iranian and 52,993 Iraqi PoWs swapped since 1981.[52] In July 1998, these figures were revised again by General Najafi to 39,364 Iranian and 54,778 Iraqi PoWs exchanged.[53]

Of the 319 (322?) Iranians actually released in April 1998, 316 were civilian internees seized during the unrest in southern Iraq following the end of the Desert Storm War. Among the few actual PoWs of the War of Sacred Defense was Hussein Raza Lashgari, the Iranian pilot shot down in 1981, coming home after 18 years. Also released were pilot Mohammed Amini and Arsalan Sharifii. Ayatollah Khameini personally greeted these three returnees, promoting the first two to the rank of brigadier general and the third to major.[54]

[44] "Iran Unilaterally Releases 500 Iraqi PoWs," Tehran Times, 29 November 1997.

[45] "Iraq Releases Two Iranians Jailed Since 1991, Reuters, 5 December 1997; the ICRC lists these two as Iranian servicemen captured in 1991. See "Iran/Iraq: New Hopes for Repatriations," ICRC News 97/49, 11 December 1997.

[46] "Iran Releases Two Jordanian PoWs," IRNA, 11 December 1997.

[47] "Iran Frees Two Sudanese Held since War with Iraq," Iran News, 21 January 1998.

[48] "Four Palestinian PoWs Freed at Request of Hamas Leader," IRNA, 4 May 1998.

[49] "Iran, Iraq Begin Exchange of PoWs," IRNA, 3 April 1998;"Iran-Iraq Release PoWs," BBC News, 3 April 1998; "Iran - PoW Exchange, 5.600 Iraqis to Be Released," USNI Daily Defense News Capsules, 3 April 1998.

[50] "War in the Gulf: Chronology of Events," FYEO, No. 267, 10 June 1991, p. 267-2; "War in the Gulf: Chronology of Events," FYEO, No. 277, 28 October 1991, p. 277-4.

[51] "Iran and Iraq," ICRC Annual Report 1996, 1 June 1997.

[52] "268 Iranian PoWs to Be Swapped for 3,791 Iraqi War Prisoners," Tehran Times, 5 April 1998;"23 More Iranian PoWs Exchanged for 500 Iraqi PoWs," IRNA, 6 April 1998; "Head of Commission on PoWs: PoWs Issue to Be solved This Year," IRNA, 13 April 1998; "Iran-Iraq PoW Committee to Meet in Baghdad," Iran News, 13 April 1998.

[53] "Iran's PoW Commission Head: Talks with Iraqis Positive," IRNA, 17 July 1998.

[54] "Leader Receives Former PoWs," IRNA, 8 April 1998; "Iran eleases 5,584 Iraqi POWs Including Army Generals," Associated Press, 7 April 1998; "Iraq Releases Iranian Pilot," Associated Press, 7 April 1998; "268 Iranian PoWs to Be Swapped for 3,791 Iraqi War Prisoners," Tehran Times, 5 April 1998; "23 More Ira-

Generals Lashgari and Amini led the Army Day Parade on 18 April 1998 in Tehran's Azadi Square, where they were personally greeted by President Khatami.[55]

In July 1998 Iran claimed it had information that "hundreds" of Iranian PoWs were still being held in Abu Ghraib prison outside Baghdad.[56] Before the 1990 invasion of Kuwait, Iraq had hundreds of Iranian PoWs transferred to secret locations.[57] However, General Najafi stated that the names of those listed as PoWs by both Iran and Iraq had become "clear."[58] He stated that Iraq had clarified the fate of 10% of Iranian PoWs still in Iraq, that some had died and others were unwilling to come home. The number of unresolved cases numbered 3,738.[59]

In December 1998, another release of Iraqi PoWs was announced. On 17 December, 375 Iraqi PoWs were handed over at Khosrawi border point. This raised the overall numbers of Iraqis released to 55,150 according to Seyyed Ahmad Safavi, an official in charge of the provincial foreign nationals department.[60] A further release of 376 Iraqi PoWs was announced in January 1998.[61] On 16 March 1999, Iran released another 449 Iraqi PoWs in return for fifty three Iranian civilians jailed in Iraq. This raised the Iranian PoW and other returnee count to 39,417 and that of Iraq to 55,438. Iran still holds 8,718 Iraqis registered with the Red Cross, but the actual residual was closer to 18,000.[62] In April 1999, Brig. Gen. Mohammed Balar, spokesman of Iran's PoW Commission, said that there were no actual Iraqi PoWs left in Iran. All of the residuals had chosen to stay in Iran and did not wish repatriation.[63] In August 1998, Iran arranged a meeting of the ICRC with 3,479 Iraqi PoWs. In March 1999, only 6 of 108 interviewed indicated they desired repatriation.[64] In all, 3,587 Iraqi PoWs have told the ICRC they did not wish to return to Iraq. Iran also examined the official Iraqi list of 9,162 names and found many of them repetitive, already released, under refugee status or completely unknown. In all, Iran clarified the status of some 18,995 alleged Iraqi PoWs in 1998. At the same time Iran called on Iraq to provide more information on the fate of 2,806 Iranian PoWs.[65]

In August 1999, the PoW issue became active again. Ten days of talks in Baghdad beginning 24 July eventually broke down. The Iraqis presented a list of 2,952 (or 2,525) Iraqis still held by Iran. Iran countered by providing a list of 2,923 Iranian PoWs. Iraq claimed it held only 64 Iranian criminals captured during the Shiite rebellion of 1991 in the aftermath of the Desert Storm War. According to Iranian figures, Iran had released 55,438 Iraqi PoWs on 103 occasions since 1981, while Iraq had released 39,417 Iranian PoWs on 70 occasions.[66] Eventually, about 400 Iraqi PoWs were released in exchange for 50 Iranian detainees.[67] On 29 September 1999, Iran unilaterally released 276 Iraqi PoWs in conjunction with the 100th birth anniversary of Imam Khomeini. It reiterated that 2,806 Iranian PoWs were still being held by Iraq.[68] Brig. Gen. Mohammed Balar, public affairs chief of the Iranian POW Commission, noted that 6,018 Iraqi PoWs had been unilaterally released by Iran to Iraq's zero.[69]

In April 2000, Iran announced it would unilaterally release 2,000 Iraq PoWs.[70] The first group of 500 was released on 9 April 2000.[71] Three more releases in

nian PoWs Exchanged for 500 Iraqi PoWs," IRNA, 6 April 1998; "Iran Says All Prisoners to be Swapped with Iraq," Associated Press, 6 April 1998; "3rd Batch of PoWs Swapped, 1 Iraqi Dies of Heart Attack," IRNA, 5 April 1998;

[55] "Iran Displays Its Armed Forces Might, Potentials," IRNA, 18 April 1998.

[56] "Hundreds of Iranian PoWs Still in Iraq," IRNA, 6 July 1998.

[57] "Iranian PoWs Still Kept in Iraq, Iraqi Opposition Says," IRNA, 29 July 1998.

[58] "Iran's PoW Commission Head: Talks with Iraqis Positive," IRNA, 17 July 1998.

[59] "Fate of 3,738 Iranian PoWs Still Unknown," IRNA, 21 July 1998.

[60] "Some More Iraq PoWs to Be Released," IRNA, 15 December 1998; "Iran Releases 375 More Iraqi PoWs," IRNA, 17 December 1998.

[61] "Iran to Release Iraqi PoWs," BBC News, 3 January 1998.

[62] "Iran and Iraq Exchange Prisoners," CNN, 16 March 1999; "Iraq, Iran Exchange PoWs," IRNA, 17 March 1999; "Iran Releases 450 Iraqi PoWs," IRNA, 18 March 1999.

[63] "Iran Has No More Iraqi PoWs," Iran News, 24 April 1999.

[64] "Head of Iranian PoWs Commission On Outcome of Talks with Iraqis," IRNA, 24 May 1999.

[65] "Iran Requests Iraq to Clarify 2,806 Iranian PoWs," IRNA, 25 April 1999.

[66] "55,438 Iraqi PoWs Relased By Iran since 1981," Tehran Times, 11 August 1999; "Iran Blames Iraq for PoW Talks Breakdown as War of Words," Agence France Presse, 10 August 1999.

[67] "Iran, Iraq Exchange Bodies," BBC News, 2 September 1999

[68] "Iran Frees 276 Iraqi PoWs," IRNA, 29 September 1999; "Iran Releases 276 Iraqi PoWs Unilaterally," IRNA, 29 September 1999.

[69] "Iraq PoWs to be Releaserd Unilaterally by Iran," IRNA, 28 September 1999.

[70] "Iran to Unilaterally Release 2,000 Iraqi PoWs Next Week," IRNA, 6 April 2000.

[71] "Iraqi PoWs Freed 12 Years after War with Iran," Reuters, 9

the next few days brought the total to 1,999.[72] On 23 April 2000, Iran claimed their latest figures indicated Iraq held 3,206 Iranian PoWs; Iran had freed 57,712 Iraqi PoWs since the war, while 39,417 Iranian PoWs had been released by Iraq. Some 9,000 Iraqi PoWs had sought asylum in Iran, and 4,600 of these had been formally interviewed by the ICRC and their requests officially submitted.[73] On 6 May 2000, Brig. Gen, Mohammed Balar, head of the POW Commission, announced Iran had unilaterally released another 480 Iraqi PoWs at the Iraqi Munthiriya border post. Other sources indicated Iran would release yet another 2,000 in the next few weeks.[74] The next release was announced for 23 May 2000, when 460 Iraqi PoWs would be set free. Some 6,743 Iraqi PoWs had been interviewed at this time by the ICRC and indicated they did not want to return home. Since 1995 Iran claimed to have clarified the fate of some 17,275 Iraqi captives and freed 10,514 of them, bringing the total to 50,019 released in 106 transfers since the war. In return Iraq had released 39,417 Iranian PoWs in 70 transfers.[75] Another 460 were released on 25 May 2000. Since April 1998 Iran had released 9,451 PoWs, while Iraq had released just 3 POWs and some 369 civilian internees.[76] On 29 June 2000, another 450 Iraqi PoWs were released, bringing the total to 3,389 in 2000.[77] On 10 and 11 August 2000, 728 Iraqi PoWs, the only remaining POWs held against their will, were released to Iraq. Some 7,307 Iraqi former POWs have elected to remain in Iran with formal petitions to the ICRC, while over 8,000 total have chosen to do so. Since 1995, 12,145 Iraqi PoWs have been repatriated according to Brig. Gen. Abdullah Najafi, Chief of the Iranian PoW Commission. In all, Iran had released 59,830 Iraqi PoWs to Iraq's 39,417 Iranians.[78] The Iranian number claimed seems to include Iraqi PoWs choosing to remain in Iran. In December 2000, Iran still claimed Iraq held 3,206 POWs, while Iraq insisted Iran held 29,000 of theirs.[79] Reports in early 2002 indicate that Iraq, if not holding actual POWs, was holding up to 2,000 Iranian civilian internees at its Ramadiyah camp.[80] Similarly, Iran released another 682 Iraqi PoWs in January 2002.[81] Of these, 507 were PoWs from the War of Sacred Defense, and the other 188 were PoWs captured after the First Gulf War fleeing coalition forces. In return, the Iraqis released 46 Iranian prisoners it claimed were not PoWs but rather were illegal border crossers. This amounted to the release of a total of 99,766 PoWs of both nations since the end of the war.[82] Iran continued to insist Iraq still held 2,806 Iranian PoWs. By April 2002, this claim fell to 900.[83] In November Iran freed 20 more Iraqi PoWs, but Iraq had no more Iranians to set free.[84]

In the run up to the US 2003 invasion of Iraq, more prisoner exchanges were arranged. On 18-19 March, Iran and Iraq exchanged 1,239 POWs—888 Iraqi and 351 Iranians. The Iranians were not POWs but civilian detainees.[85] In May the ICRC brokered the release of 59 Iraqi PoWs from Iran which it stated were

April 2000.

[72] "Iran Sets Free More Iraqi PoWs," Reuters, 10 April 2000; "Najafi: ICRC to Decide Fate of Iranian PoWs within a Month," IRNA, 14 April 2000.

[73] "Official: Iraq Still Holds 3,206 Iranian PoWs," IRNA, 23 April 2000.

[74] "Iran to Free 480 Iraqi PoWs," IRNA, 28 April 2000; "Iran Frees 480 Iraqi PoWs," IRNA, 6 May 2000; "480 Iraqi PoWs Home 12 Years After Iran War," Reuters, 4 May 2000.

[75] "Iran Will Unilaterally Free 460 Iraqi PoWs on 23 May," IRNA, 17 May 2000.

[76] "Iran Frees 460 Iraqi PoW," The News International Pakistan, 25 May 2000.

[77] "450 Iraqi PoWs Freed by Iran," IRNA, 29 June 2000; "Iraqi PoWs Return Home, Praise Iran's Hospitality," IRNA, 29 June 2000.

[78] "Najafi: Iranian PoWs Fate to be Clarified Soon," IRNA, 6 August 2000; "Iran To Hand Over 721 Iraqi PoWs to ICRC," IRNA, 6 August 2000; "Iran to Release All Remaining Iraqi PoWs Soon," IRNA, 5 August 2000; "Iran Releases 728 Remaining Iraqi PoWs," IRNA, 9 August 2000; "Remaining Iraqi PoWs Released By Iran Unilaterally," IRNA, 9 August 2000; "Iran Holds No More Iraqi PoWs-Official," IRNA, 13 August 2000; "Iran-Iraq-PoWs," IRNA, 10 September 2000; Iran-PoWs-ICRC," IRNA, 12 September 2000; "Iraq Has Given No Explanation on 3,000 PoWs," IRNA, 27 September 2001.

[79] "Iran-Iraq-Prisoners," IRNA, 16 December 2000.

[80] "The War's Not Over," RFE/RL Iran Report, 22 January 2001.

[81] "In Brief – Iran Releases 682 Iraqi PoWs," JDW, 6 February 2002.

[82] "Iraq Hopes Iran Ends Human File," Iraqi News Agency, 24 January 2002; "Iran to Free 697 Iraqi PoWs within 72 Hours: Ministry," AFP, 20 January 2002; "Iran Frees Hundreds of Iraqi Prisoners of War," Reuters, 23 January 2002; "Iran Releases Iraqi PoWs," BBC News, 21 January 2002; "Red Cross Oversees POW Handover," AP, 23 Janmuary 2002; "Iran Releases 682 Iraqi PoWs," IRNA, 23 January 2002.

[83] "Iran and Iraq Have Exchanged 98% of PoWs: Press," IRNA, 10 April 2002; "900 Iranian PoWs Remain in Captivity of Iraqi Regime," IRNA, 21 July 2002.

84 "Iran Frees 20 Iraqi Prisoners of War," AFP, 20 November 2002.

[85] "351 Iranian Prisoners Released By Iraq," IRNA, 18 March 2003;"Release of Iranian Prisoners by Iraq Not Entire Demands of Iran," IRNA, 19 March 2003;"Iran and Iraq Exchange 1,200 Prisoners," AFP, 19 March 2003; "FM Spokesman: Remaining PoWs to be Exchanged Next Week," IRNA, 13 March 2003; "Exchange of Iranian Prisoners, Iraqi PoWs Ends," IRNA, 19 March 2003.

the last held in Iran involuntarily.[86] In August, Brig. Gen. Abdollah Najasfi, head of the Iranian POW Commission, stated 7,228 Iraqi PoWs had chosen to stay in Iran and that Iran had released 61,482 Iraqi PoWs in total. Further 38,993 Iranian PoWs had been returned by Iraq, and 570 had died in Iraqi custody.[87]

Like their US counterparts, many Iranian *azadegan* (ex-PoWs) suffer from post-traumatic stress disorders and chronic physical ailments associated with their captivity. The conditions of their confinement by the Iraqis were horrendous, involving starvation rations, beatings, sexual abuse, disease and indifferent medical attention, claustrophobic mass internment living accommodations, and often ten years or more captivity. Azizollah Farokhi is typical. Captured in 1983 when just 20 years old, he spent eight years in captivity until released in the buildup to the Desert Storm War. Wounded when captured, he suffers 60% disability. Like their US counterparts in Vietnam, despite threats and abuse, he and other Iranian PoWs refused to collaborate with the enemy, maintaining complete loyalty to their nation and faith. Such was the strength of their moral resistance that one Iraqi guard told them: "We are *your* prisoners."[88]

The quality and amount of aid ex-PoWs and other wounded veterans have received from the Iranian government has been widely criticized.[89] "For people who gave so much, the government does not do enough. The Americans who fought in Vietnam are treated better than us" is the bitter opinion of Gholam Ali, a typical Iranian war veteran.[90] This was the subject of an award-winning Iranian film—"The Glass Agency"—in the 1997 Fajr Film Festival. The movie centers on a war veteran who takes hostages at a travel agency to obtain a free plane ticket and money to take his friend, a war disabled *Baseej*, to London for surgery. The film won eight prizes for best picture, actor, actress, supporting actor, director, script, editing and soundtrack.[91]

On the other hand, there are veterans who have continued their military careers and are not bitter about the war. One such is Ali Zakani, now a senior *Baseej* official at Tehran University. "We did not enter the battlefield to become martyrs, only to defend Islam and the revolution. But we knew if we died, we were going to be martyrs, and that was important to us ... so we would have victory either way." Zakani enlisted in the *Baseej* at age 15, fought in 15 major campaigns and as wounded an incredible 10 times. He recalled how during the *Wal Fajir-8* operation Iranian frogmen di-

[86] "Iraqis Said To Be Last PoWs Return from Iran," Reuters, 5 May 2003.
[87] "Head of PoW Committee: No More Iraqi PoWs in Iran," IRNA, 17 August 2003.
[88] "Iranian PoWs in Iraq Witness Iraqi's Weakness," Tehran Times, 18 August 1998.
[89] "Our Boy; Their Prisoner of War," The Iranian, December 1995.
[90] "Tehran's Vast Monument to a Deadly Conflict," Agence France Presse, 15 December 1997.
[91] "War Movie Given Top Honors at Iran Festival," AFP, 11 February 1998.

rected his unit's assault boats to an Iraqi position on the Majnoon islands. After hours of deadly close combat, 20 Iraqi soldiers surrendered to his unit. The Iranian troops tended to the Iraqi wounded and shared their rations of "good bread" made from milk and wheat with their malnourished prisoners. One of the Iraqis was so overwhelmed by Iranian kindness and honor in the midst of such carnage that he blurted out: "Now I know what is Islam." He was then allowed to go back into the marshes and retrieve other surrendering Iraqi soldiers and bring them to safety.[92]

In December 1991, a forensic team with Human Rights Watch and Physicians for Human Rights uncovered the graves of 19 Iranian soldiers on the grounds of the Sardaw military base near Sulaimaniyya. After examining the remains, the forensic experts found several skulls with evidence of single gunshot wounds. In spring 1985, two years before the base was built, a group of Kurdish secondary students found the bodies exposed on the slopes of Saywan Hill. Some of them were still in uniform. The students notified local residents, who called the municipality, which, in turn, dispatched a local gravedigger, Sadiq 'Issa, to dispose of the bodies. 'Issa told the forensic team that many of the bodies had intravenous needles in their forearms. He speculated that they were captured Iranian soldiers who had been hospitalized by the Iraqis and then later executed in retaliation for an Iranian attack, which was a common practice during the Iraq-Iranian War. "I could see some of them had been shot in the head," he said. "And on some of them I found identification papers and even photographs of their families. I placed these things in glass jars and, as I buried them, I placed the jars between their legs." The International Committee of the Red Cross turned over the remains of the Iranian soldiers to the Iranian authorities in 1992.[93]

"Martyr" is not an exclusively Muslim status. In conjunction with Christmas 1998 the Foundation for the Martyrs commemorated the Iranian Christian "martyrs" who "were active in safeguarding divine values."[94]

In 2008, Mohammed Taghi Khademi, a senior official with Iran's Foundation for Preservation of the Relics and Values of Sacred Defense, said 50,000 MIA bodies had been recovered and of these 10% had not been identified.[95] The standard practice seems to be determination of the operation in which they were martyred and the provincial origins of units in that engagement. Of the 1,500 buried in May 1998, 99% were identified by their dog tags.[96] In search operations along the Iran-Iraq border between 1990 and 1998, 50 were

[93] See Eric Stover, "Unquiet Graves: The Search for the Disappeared in Iraqi Kurdistan," Middle East Watch, a division of Human Rights Watch, and Physicians for Human Rights, March 1992.

[94] "Martyrs Foundation Congratulates Birth Anniversary of Christ," IRNA, 23 December 1998.

[95] "7,000 Iranian MIAs from War," PressTV, 14 November 2008.

[96] "Iran Holds Funeral for Victims of War with Iraq," Reuters, 2 May 1998.

killed and 80 wounded by mines.[97] Among these victims was noted Iranian war documentary director Morteza Avini. He was killed by a mine on 8 April 1993, while making a documentary about Iranian MIAs.[98] In July 1999, the new Iranian-designed mine clearance vehicle *Taftan*-1 was put into trials with an MIA recovery team working in minefields.[99]

In May 1998, 1,500 martyrs were buried, including 315 or 319 from Tehran Province.[100] On 4 September 1998, ceremonies were held in Tehran for another 700 MIAs.[101] These had been recovered in the preceding four months in the Salamech region along with those of 300 Iraqi soldiers, according to Brig. Gen. Mir Faisal Baqerzadeh, head of the MIA commission.[102] In May 2001, a funeral was held for 1,000 martyrs from 20 different provinces in Azadi Square in Tehran.[103] Some 225 were eulogized in 45 cities in January 2002, all of them unknowns.[104] In July, the remains of 570 deceased PoW-MIAs were interred, 120 of them unknown.[105] Another 300 MIAs were buried in Tehran in November.[106] In April 2003, a funeral was held for 90 martyrs throughout Iran. All unknowns, 8 were buried in Mashad, 6 in Meshkan, 6 at the University of Khorassegan, 5 at Azad University, 5 in Taftan Park in Khash, 5 at Basij base east of Tehran and 20 in Isfahan.[107] In July, 300 martyrs were laid to rest in the Behest e Zahra cemetery and elsewhere.[108] In early August, 25 more were buried in Tehran, 5 at the Qamar e Bani Hashem Mosque and 5 at the Malek Ashtar Barracks of the *Baseej*.[109] Later that month, another 225 were buried at 40 locations throughout Iran. MIA Committee chief Mir Feizal Bagherzadeh said there were still 8,700 Iranian soldiers buried in Iraq.[110] In June 2008, the remains of seven unknowns were buried on the grounds of the Majlis in Tehran.[111] Unrecovered Iranian MIAs are carried as active soldiers on their unit personnel rolls with their current status listed simply as "still at the front."

In June 1997, the remains of 20, and in August those of 15 more Iranian MIAs were returned by Iraq.[112] In September 1997, another 15 Iranian MIAs came home, exchanged for 16 Iraqi dead. During the

[97] "Search for War Martyrs Causes Almost 50 More Deaths on Iran-Iraq Border," Iran News, 23 April 1998.

[98] "Iranian and French Scholars to Review War Films in Tehran," Tehran Times, 7 April 2008.

[99] "Iran's Defense Industrial Complex Produces Mine Mopper," IRNA, 29 July 1999.

[100] "Leader Leads Funeral Procession in Tehran," IRNA, 21 July 1995; "Rowhani Pays Tribute to Martyrs of Sacred Defense," IRNA, 27 July 1995;"Funeral Procession War Martyrs," IRNA, 7 July 1997; "The Remains of 750 Iranian Soldiers...", Al Akhbar Muslim World News, 15 October 1996; "Funeral Service to be Held Nationwide for 1,233 War Martyrs," IRNA, 1 October 1997; "Funeral Service for War Martyrs," Iran Daily, 7 October 1997; "Martyr Funeral Procession in Presence of Leader," IRNA, 1 May 1998; "Leader Attends Funeral for 1,500 Martyrs," Iran News, 2 May 1998; "Iran Holds Funeral for Victims of War with Iraq," Reuters, 2 May 1998; "900 Iranian PoWs Remain in Captivity in Iraq," IRNA, 21 July 2002.

[101] "Iran - Funeral Ceremony," IRNA, 4 September 1998.

[102] "Thousands Attend Mass Funeral for Iranian Soldiers Killed in Iraq War," Iran News, 5 September 1998.

[103] "Funeral Service for 1,000 War Martyrs to be Held," IRNA, 24 April 2001; "People Invited to Participate in Funeral for War Martyrs," IRNA, 8 May 2001.

[104] "Funeral for 225 Martyrs of Iraqi Imposed War to be Held Wednesday," IRNA, 5 January 2002; "Iran Buries Unknown Martys of Iraqi Imposed War," IRNA, 9 January 2002; "Funeral Services Held for 10 Unknown Martyrs," IRNA, 9 January 2002; "Supreme Leader Visits Graves of Unknown Martyrs," IRNA, 12 January 2002; "National Heroes Seen Off to Paradise," Tehran Times, 10 January 2002; "Martyrs to be Buried in 40 Cities Next Week," Tehran Times, 2 January 2002.

[105] "Funeral Procession Held for Bodies of PoWs," IRNA, 24 July 2002; "Bodies of Five Unidentified Soldiers Laid to Rest," IRNA, 25 July 2002.

[106] "Iran to Hold Funeral for 300 Martyrs," IRNA, 21 November 2002.

[107] "Remains of Unknown Martyrs of War with Iraq Buried Throughout Iran," IRNA, 24 April 2003; "Iran to Hold Funerals for 90 Martyrs of War with Iraq," IRNA, 19 April 2003.

[108] "Mass Funeral Services Held for 300 War Martyrs, " IRNA, 13 July 2003.

[109] "Burial Ceremony Held for 25 Unknown Martyrs in Tehran Province," IRNA, 2 August 2003.

[110] "State Funerals for 225 Martyrs in Iran-Iraq War," AFP, 2 August 2003.

[111] "President Participates in Mass Funeral for 7 Unknown War Martyrs," IRNA, 27 June 2008.

[112] "Remains of Twenty Martyrs of Imposed War Handed Over to Iran, IRNA, 1 June 1997; "Iran, Iraq Swap Bodies of Soldiers," Tehran Times, 6 August 1997.

exchange ceremony at Shalamcheh border point General Baqerzadeh, head of Iranian MIA retrieval operations, approached his Iraqi counterpart with a proposal to swap Iraqi PoWs for Iranian MIA corpses.[113] As of September 1997, the total number of MIA bodies recovered stood at over 37,000 according to General Baqerzadeh.[114] In December 1997, Iraq exchanged the bodies of 7 Iranian MIAs for those of 37 of their own.[115] By April 1998, a total of 39,230 Iranian MIAs had been recovered, 1,500 since October 1997.[116] In May 1998, Iran and Iraq reached an accord for joint search operations. According to General Baqerzadeh, the first effort would be to recover MIAs of the *Karbala*-5 offensive by a ten-man Iranian team in the Shalamcheh region of Iraq. At the same time an Iraqi team would search for their MIAs on Iranian territory.[117] The team entered Iraq on 11 May 1998, and by September had recovered 111 MIAs, 77 of whom could be identified. These men had been lost in the *Karbala*-5 and *Beit ol Moqqadas*-7 operations. The Iraqi team in Iran located 117 of their own MIAs. The remains were exchanged on 29 September at Salamcheh. After a funeral service in Susanagerd, the bodies were transferred to Tehran.[118] On 9 June 1998, the remains of 53 other Iranian MIAs were returned at Salamcheh crossing point, while those of 134 Iraqi MIAs were likewise handed over in return.[119] On 28 July 1998, the remains of another 100 Iranian and 83 Iraqi MIAs were exchanged at Salamchech.[120] According to General Baqerzadeh, the next search area would be in the Sumar and Mandali areas.[121]

On 8 December 1998, Iran received the remains of 121 of its MIAs killed in the Basra, Al Fao and Al Amara areas in exchange for 213 Iraqi bodies. Discussions were held on a boat in the Arvandrud River by General Baqerzadeh on means to search for the MIAs of the *Karbala*-4 and *Wal Fajir*-8 offensives.[122]

The US attacks on Iraq in December 1998 caused suspension of MIA retrieval operations and evacuation of Iranian search teams in Iraq. They were scheduled to resume as soon as possible.[123] A funeral service for 440 MIAs was held in Tehran on 8 January 1998. The remains of 219 MIAs found in the Shalamcheh region have not yet been identified. All told, the remains of 43,512 martyrs had been recovered by then. General Baqerzadeh said the remains of another 10,000-12,000 MIAs still lay in Iraq.[124] Similar funeral ceremonies for 34 MIAs in Khuzistan, 12 in Kohkiloyeh-Boyerahmad and 2 in Kashan were held on 15 January 1999.[125]

In April 1999, Iraq and Iran held talks on release of further Iraqi PoWs and the continued search for MIAs. A swap of 221 Iraqi and 166 Iranian MIAs was scheduled for 17 April at the al-Mundhiriya border post.[126] The swap occurred on schedule, but only 164 Iranian bodies were actually delivered.[127] Of these, 161 were as yet unidentified.[128] On 7 June 1999, a funeral ceremony was held for some 600 MIAs recovered in the previous 6 months. This raised the recovered MIA total to 43,672, according to General Baqerzadeh.[129] At the same time, another body exchange was being arranged with Iraq.[130] This occurred on 8 June 1999, when the remains of 47 Iranian MIAs were traded for those of 59 Iraqis.[131] On 30 July 1999, a funeral procession was held for 72 MIAs killed during operations

[113] "Bodies of 15 Iranian Martyrs Exchanged with Corpses of Iraqis," IRNA, 15 September 1997.
[114] "Funeral Service to be Held Nationwide for 1,233 War Martyrs," IRNA, 1 October 1997.
[115] "Remains of Seven Iranian Martyrs Exchanged with Those of Iraq," IRNA, 22 December 1997.
[116] "Search for War Martyrs Causes Almost 50 More Deaths on Iran-Iraq Border," Iran News, 23 April 1998.
[117] "Search Operation to Locate MIAs Starts," IRNA, 11 May 1998.
[118] "Funeral Procession to be Held for 111 War Martyrs," IRNA, 29 September 1998; "Remains of 111 Martyrs of Sacred Defense Returned Home," Iran News, 30 September 1998.
[119] "Iraq Hands Over Bodies of 53 Martyrs to Iran," IRNA, 9 June 1998.
[120] "Iran-Iraq Exchange Remains of Soldiers," IRNA, 28 July 1998.
[121] "Iran Offers Joint Cooperation with Iraq to Find Remains of Dead," IRNA, 9 June 1998.
[122] "Iran Receives More Bodies of War Martyrs," IRNA, 8 December 1998; Iran, Iraq to Expand Cooperation on Fate of MIAs," IRNA, 8 December 1998.
[123] "Joint Search Operations to Find Bodies of War Martyrs Halt," IRNA, 22 December 1998.
[124] "Funeral Service To Be Held for 440 War Martyrs," IRNA, 4 January 1998.
[125] "Funeral Processions for War Martyrs on Last Friday of Ramadan," IRNA, 15 January 1999.
[126] "Iranian Visits Baghdad to Discuss PoWs Issue," Reuters, 15 April 1999; "Iran and Iraq to Swap War Dead," AFP, 15 April 1999.
[127] Bodies of 164 Martyrs of Sacred Defense Returned to Country," IRNA, 17 April 1999.
[128] "Funeral Procession Held for 161 Martyrs in Abadan," IRNA, 19 April 1999.
[129] "Funeral Procession to be Held for 600 Martyrs of Imposed War," IRNA, 6 June 1999.
[130] "Iran, Iraq to Exchange Remains of War Veterans, Tehran Times, 6 June 1999.
[131] "Bodies of Iranian and Iraqis Exchanged Tuesday, IRNA, 8 June 1999.

*Ramadan*, *Kheiber*, *Wal Fajir*-3, *Karbala*-4, *Beit ol Moqqadas*-7 and the Iraqi attack on Shalamcheh. This ceremony brought the number of Iranian MIAs recovered to 43,744 and the number of Iraqi MIAs returned to 6,000.[132] Another exchange occurred on 2 September with Iran receiving 164 sets of remains and returning those of 221 Iraqi soldiers.[133]

On 20 January 2000, Iran held memorial services for the remains of 342 MIAs at Qom. This brought the total remains recovered to 44,086. Iraq still held another 64 not yet handed over, according to General Baqerzadeh.[134] Eventually, four funeral caravans—dubbed "Faith," "Jihad," "Martyrdom," and "Allegiance"—each of 114 bodies, were arranged. The remains proceeded from Abadan to Tehran and thence to Mashad. All the MIAs were reported identified.[135] Thus Iran continues its sad duty of burying recovered solders from a war fought not only in another century but also another millennium.

In April 2000, Brigadier General Abdullah Najafi, chief of the Iranian MIA commission, stated that Iran still had some 30,000 MIAs unrecovered. He added that Iraq claimed 60,000.[136] Three hundred more Iranian MIAs were buried in the *Behest e Zahra* on 26 May 2000.[137] This brought the total to 44,386. Yet another 300 were honored in Tehran on 12 August 2000.[138] The next return of MIA remains did not occur until 10 January 2001, when only 38 Iranian bodies were returned in exchange for those of 332 Iraqi soldiers. In a surprising development, the Iraqis agreed to exhume the bodies of Iranian PoWs who had died in captivity and return them.[139] In August 2001, Iraq returned another 122 Iranian MIAs in exchange for 122 of their own found in the Shalamcheh and Zeid war zones. In September, a new agreement was established between the two countries for continued MIA retrieval operations.[140] In November 2001, an exchange of 78 Iranian bodies for those of 64 Iraqis took place at Dehloran.[141] In January 2002, the Iraqi Foreign Ministry said the remains of 574 Iranians would be exchanged for the remains of 1,183 Iraqis in the near future.[142] In June 2002, the nations exchanged the remains of 80 Iranian MIAs for 91 Iraqis.[143] At this time Iran had returned remains of 5,323 Iraqi soldiers for 3,998 Iranian.[144] In July, the remains of 570 Iranian PoWs who had died in captivity were exchanged for those of 1,166 Iraqi PoWs who had suffered the same fate.[145] This was the forty-eighth exchange of remains since 1991, according to MIA Recovery Committee representative Colonel Alireza Gholami.[146] In September, 88 Iranian and 32 Iraqi remains were exchanged and in October those of 84 Iranians and 64 Iraqis. Some 59 had been lost in the Fath ol Mobin-1 operation and the others in operation *Badr*.[147] In November, 18 sets of Iraqi remains were exchanged for 78 Iranian and in December 74 Iraqi for 77 Iranian.[148] By January 2002, some 48,000 MIAs had been recovered and search was still underway to recover another 10,000 according to General Baqerzadeh.[149]

In January 2003, the bodies of 47 Iran MIAs were returned in exchange for the remains of 131 Iraqi bodies. Thirty-nine of the Iranian MIAs were discovered by searchers from the 25th *Pasdaran* "Karbala" Division. Eight of the bodies were those of POWs who

[132] "Funeral Procession for 72 Martyrs to Be Held Friday," IRNA, 26 July 1999.
[133] "Iran, Iraq Bodies Exchange," BBC News, 2 September 1999.
[134] "Funeral Procession To Be Held for 342 Martyrs in Mashad," IRNA, 3 January 2000.
[135] "Funeral Procession of 456 Martyrs Start," IRNA, 12 January 2000; "456 Martyrs to be Laid to Rest in Mashad," Iran News, 10 January 2000; "Convoy of Martyrs to Arrive at Mausoleum of Late Imam, Funeral will be Held on Sunday," IRNA, 13 January 2000.
[136] "Najafi: ICRC to Decide Fate of Iranian PoWs within a Month," IRNA, 14 April 2000.
[137] "Funeral Procession to be Held for 300 Martyrs on Friday," IRNA, 23 May 2000.
[138] "Funeral Procession to be Held for 300 Martyrs in Tehran," IRNA, 12 August 2000.
[139] "Bodies of 38 Iranian Martyrs Exchanged with Those of 332 Iraqi," IRNA, 10 January 2001.
[140] "Iran, Iraq Exchange 122 Bodies of MIAs," IRNA, 16 August 2001; "Iran, Iraq Agree to Resume Search Operations for Missing Soldiers," IRNA, 11 September 2001.
[141] "Bodies of 78 Iranian Martyrs Exchanged for Those of 64 Iraqi Soldiers," IRNA, 14 November 2001.
[142] "In Brief – Iran Releases 682 Iraqi PoWs," JDW, 6 February 2002.
[143] "Iran Receives Remains of 80 Martyrs of the War," IRNA, 18 June 2002.
[144] "Iran-Iraq Talks Scheduled," AP, 16 June 2002.
[145] "Iran Receives Bodies of PoWs," IRNA, 21 July 2002; "Iraq, Iran Exchange Remains of Dead PoWs," AP, 22 July 2002.
[146] "Iran to Hand over Remains of 1,200 Iraqi Soldiers Soon," IRNA, 16 July 2002.
[147] "Iran, Iraq Swap Bodies of 120 Soldiers Killed in The War," AFP, 17 September 2002;"Iran, Iraq Exchange Remains of 150 Soldiers," AFP, 29 October 2002; "Iran, Iraq Exchange Remains of Soldiers Killed in 1980-1988 War," IRNA, 18 September 2002.
[148] "Iran, Iraq Trade Remains of Soldiers," Reuters, 28 December 2002.
[149] "Funeral for 225 Martyrs of Iraqi Imposed War to be Held Wednesday," IRNA, 5 January 2002.

had died in Iraqi detention camps. Five of the Iraqi bodies were also those of soldiers who had died in Iranian custody. This was the 48th body exchange carried out.[150] In March, all MIA recovery operations were suspended, and Iranian searchers returned home in the looming hostilities between the US and Iraq that became Operation Iraqi Freedom (OIF). In May, Iran received the remains of 45 missing Iranian soldiers from Iraq which had been scheduled to be delivered prior to OIF.[151]

Iran refused, however, the handover of Iranian MIAs discovered by coalition forces in the aftermath of Saddam Hussein's deposition. UK forces had discovered 200 sets of possible Iranian MIA remains in plastic bags in a warehouse in Basra. Many showed signs of torture and execution. US forces had discovered a mass grave outside Mosul with the remains of possibly 300 Iranian PoWs. At the end of forensic investigation at the sites, about 100 were definitely identified as Iranian PoWs.[152] As of 2004, about 7,000 Iranian troops were still listed as MIA.[153] This number was confirmed again in 2008.[154] In November 2007, the apparent fate of a few was revealed when a mass grave was discovered at Al Zubair near Basra containing the remains of 30 individuals, some of whom were definitely Iranian soldiers identified by their dog tags.[155] Documents that came to light in August 2007, indicated at least 700 Iranian PoWs had been executed by direct order of either Saddam Hussein or Lt. Gen. Saber Abduilaziz al-Dorwri, the head of the Iraqi secret service. Some 157 of these Iranian PoWs were unregistered with the International Red Cross at the time of their executions.[156]

On 1 December 2008, the bodies of 200 Iraqi MIAs were exchanged for those of 41 Iranian missing. Only 24 of the Iranian soldiers were identified although another report reduced this to 10 as "positively identified."[157]

Interestingly, the burial of MIAs in prominent places has been met with some resistance. Burials on university campuses became an issue in 2006. In March, three MIAs were buried on the grounds of Tehran's Sharif University and three other unknowns were interred at Shahid Rajaii University. Several hundred students protested these ceremonies, claiming it was inappropriate and would be used in future as a pretext by the government to stifle dissent by claiming war martyrs were being disrespected.[158]

In June 2008, in anticipation of an eventual US invasion of Iran, 320,000 graves were ordered dug in border regions, 15,000-20,000 in each border province. General Baqerzadeh was in charge of this operation. He noted the effort was to "reduce the suffering of the families of the fallen in any attack on our country…and to prevent the repetition of the long and bitter experience of the Vietnam War."[159]

Thus Iran continues its sad duty of burying recovered solders from a war fought not only in another century but also another millennium and preparing its graves registration effort for another war that might take even more lives.

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[150] "Bodies of 47 War Martyrs Returned Home," Tehran Times, 28 January 2003.
[151] "Iranian Inspectors Searching for MIAs in Iraq Left for Home," IRNA, 6 March 2003; "Iraq Put Exchanging Remains of Soldiers with Iran on Hold," IRNA, 26 March 2003;"Iran Suspends Hunt for 1980-1988 War Dead in Iraq," AFP, 2 March 2003.
[152] "Iran to Receive Remains of 45 Soldiers of Iraqi War on Sunday," IRNA, 14 May 2003;"British Find 200 Bodies, Grisly Photos Near Basra," Reuters, 5 April 2003; "Bodies Found may be from Iran-Iraq War," AP, 6 April 2003; "Mass Grave Discovered Near Mosul Could Contain Hundreds of Bodies," VOA News, 18 July 2003.
[153] "All Iranian, Iraqi PoWs Released," Payvand, 28 February 2004.
[154] "7,000 Iranian MIAs from War," PressTV, 14 November 2008.
[155] "Victims of Iran War with Iraq Found in Mass Grave," Iran Mania, 26 November 2007.
[156] "Iraqi General-MKO Executed Iranian POWs," Iran Didban, 16 August 2007.
[157] "Iran, Iraq Exchange Remains of Soldiers," PressTV, 1 December 2009; "Iran, Iraq Swap Soldiers' Bodies from 1980s War," Fars News Agency, 1 December 2009.
[158] "Iran: Students Protest Burials of War Dead on Tehran Campuses," Payvand, 15 March 2006.
[159] "Iran to Ready Thousands of Graves for Enemy Soldiers," Breitbart.com, 29 June 2008.

# Comparing the RAND Version of the 3:1 Rule to Real-World Data

**Christopher A. Lawrence**

For this test, The Dupuy Institute took advantage of two of its existing databases for the DuWar suite of databases. The first is the Battles Database (BaDB), which covers 243 battles from 1600 to 1900. The second is the Division-level Engagement Database, which covers 675 division-level engagements from 1904 to 1991.

The first was chosen to provide a historical context for the 3:1 rule of thumb. The second was chosen so as to examine how this rule applies to modern combat data.

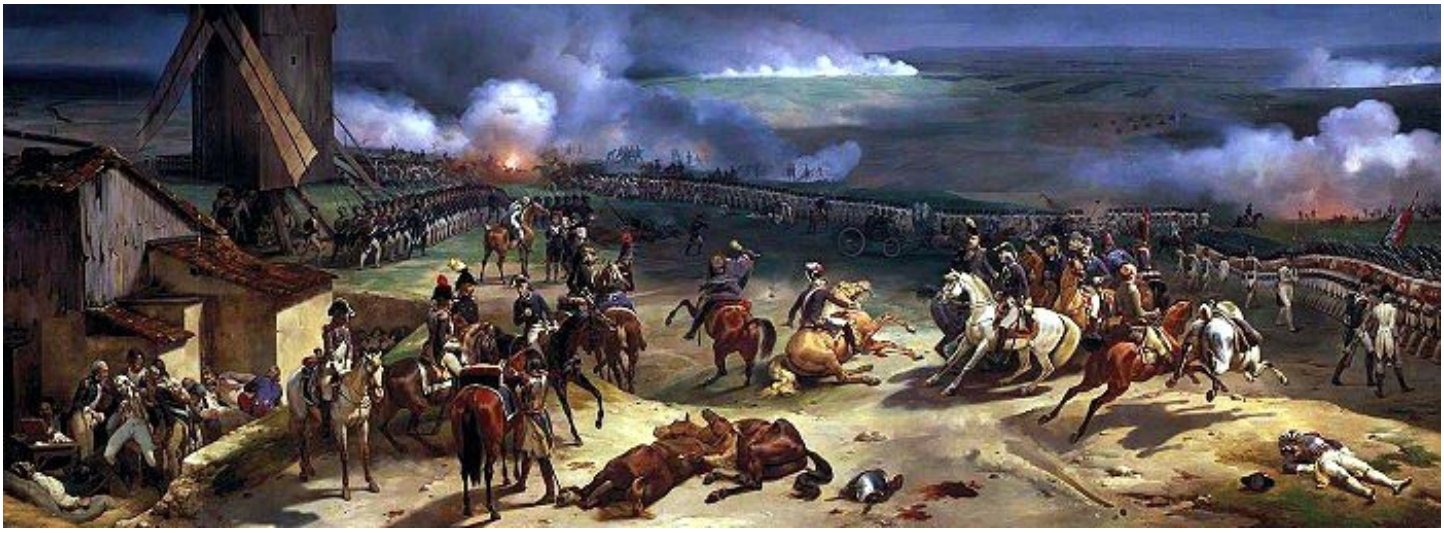
We decided that this should be tested to the RAND version of the 3:1 rule as documented by RAND in 1992 and used in JICM (with SFS) and other models. This rule, as presented by RAND, states: "…the famous '3:1 rule,' according to which the attacker and defender suffer equal fractional loss rates at a 3:1 force ratio if the battle is in mixed terrain and the defender enjoys 'prepared' defenses…"

Therefore, we selected out all those engagements from these two databases that ranges from force ratios of 2.5 to 1 to 3.5 to 1 (inclusive). It was then a simple matter to map those to a chart that looked at attackers losses compared to defender losses. In the case of the pre-1904 cases, even with a large database (243 cases), there were only 12 cases of combat in that range, hardly statistically significant. That was because most of the combat was at odds ratios in the range of .50-to-1 to 2.00-to-one.

The count of number of engagements by odds in the pre-1904 cases:

| Ratio | Number of Cases | Percent |
|---|---|---|
| Less than .20 | 0 | 0 |
| 0.20 - 0.28 | 2 | 1 |
| 0.29 - 0.40 | 2 | 1 |
| 0.40 - 0.50 | 9 | 4 |
| 0.50 - 0.66 | 17 | 7 |
| 0.67 - 1.00 | 64 | 26 |
| 1.00 - 1.50 | 71 | 29 |
| 1.50 - 2.00 | 38 | 16 |
| 2.00 - 2.50 | 16 | 7 |
| 2.50 - 3.50 | 12 | 5 |
| 3.50 - 5.00 | 4 | 2 |
| 5.00 - 10.00 | 5 | 2 |
| 10.00 - 20.00 | 3 | 1 |
| 20.00 or greater | 0 | 0 |

As the database is one of battles, then usually these are only joined at reasonably favorable odds, as shown by the fact that 88 percent of the battles occur between 0.40 and 2.50 to 1 odds. The twelve pre-1904 cases in the range of 2.50 to 3.50 are shown in Table 1.



| Battle Name | Year | Force Ratio | Attacker % Loss | Defender % Loss | Loss Ratio | % per Day Loss Ratio |
|---|---|---|---|---|---|---|
| Hochkirch | 1758 | 2.58 | 9.48 | 29.35 | 0.83 | 0.32 |
| Maxen | 1759 | 2.81 | 2.63 | 7.41 | 1.00 | 0.36 |
| Jemappes | 1792 | 3.08 | 7.50 | 19.23 | 1.20 | 0.39 |
| Hondschoote | 1793 | 3.23 | 7.14 | 23.08 | 1.00 | 0.31 |
| La Rothiere | 1814 | 2.75 | 5.45 | 15.00 | 1.00 | 0.36 |
| Arcis-sur-Aube | 1814 | 2.67 | 1.88 | 8.33 | 0.60 | 0.23 |
| Buena Vista | 1847 | 2.94 | 7.14 | 7.84 | 2.68 | 0.91 |
| Inkerman | 1854 | 2.63 | 36.16 | 25.66 | 3.70 | 1.41 |
| Five Forks | 1865 | 3.00 | 2.11 | 60.00 | 0.11 | 0.04 |
| Coulmiers | 1870 | 3.00 | 3.00 | 9.00 | 1.00 | 0.33 |
| Belfort | 1871 | 2.75 | 2.42 | 1.67 | 4.00 | 1.45 |
| Majuba Hill | 1871 | 3.43 | 0.50 | 81.14 | 0.02 | 0.01 |
| **Average** | | **2.91** | **7.12** | **23.98** | **1.43** | **0.51** |

Table 1

If the RAND version of the 3:1 rule was valid, one would expect that the "Percent per Day Loss Ratio" (the last column) would hover around 1.00, as this is the ratio of attacker percent loss rate to the defender percent loss rate. As it is, 9 of the 12 data points are noticeably below 1 (below 0.40 or a 1 to 2.50 exchange rate). This leaves only three cases (25%) with an exchange rate that would support such a "rule."

If we look at the simple ratio of actual losses (vice percent losses), then the numbers comes much closer to parity, but this is not the RAND interpretation of the 3:1 rule. Six of the twelve numbers "hover" around an even exchange ratio, with six other sets of data being widely off that central point. "Hover" for the rest of this discussion means that the exchange ratio ranges from 0.50-to-1 to 2.00-to 1.

Still, this is early modern linear combat, and is not always representative of modern war. Instead, we will examine 634 cases in the Division-level Database (which consists of 675 cases) where we have worked out the force ratios. While this database covers from 1904 to 1991, most of the cases are from WWII (1939-1945). Just to compare:

| Years | Number of Cases |
|---|---|
| 1904-1905 | 3 |
| 1912 | 1 |
| 1914-1918 | 19 |
| 1938 | 1 |
| 1940 | 2 |
| 1941 | 7 |
| 1942 | 1 |
| 1943 | 285* |
| 1944 | 197** |
| 1945 | 93 |
| 1956 | 2 |
| 1967 | 16 |
| 1968 | 1 |
| 1973 | 32 |
| 1991 | 15 |

* 37 of these do not have force ratios.
** 4 of these do not have force ratios.

As such, 87% of the cases are from WWII data and 10% of the cases are from post-WWII data. The engagements without force ratios are those that we are still working on as The Dupuy Institute is always expanding the DLEDB as a matter of routine. The specific

cases, where the force ratios are between 2.50 and 3.50 to 1 (inclusive) are shown in Table 2:

| Battle Name | Year | Force Ratio | Attacker % Loss | Defender % Loss | Loss Ratio | % per Day Loss Ratio |
|---|---|---|---|---|---|---|
| The Yalu | 1904 | 3.11 | 0.98 | 6.94 | 0.44 | 0.14 |
| Prelip | 1912 | 2.50 | 3.00 | 15.00 | 0.50 | 0.20 |
| First Dardanelles Landing | 1915 | 3.20 | 16.88 | 39.00 | 1.38 | 0.43 |
| Somme: Bazentin Ridge | 1916 | 3.00 | 20.00 | 26.67 | 2.25 | 0.75 |
| Megiddo | 1918 | 2.80 | 3.30 | 19.18 | 0.48 | 0.17 |
| *Changkufen/Hill 52* | *1938* | *2.50* | *4.00* | *2.75* | *3.64* | *1.45* |
| Sele-Calore Corridor | 1943 | 2.96 | 2.02 | 1.45 | 4.11 | 1.39 |
| Capua | 1943 | 3.36 | 0.52 | 0.20 | 8.70 | 2.59 |
| Stalemate at Capua | 1943 | 3.38 | 0.04 | 0.00 | N/A | N/A |
| Monte Grande (Volturno) | 1943 | 3.37 | 0.20 | 0.08 | 8.38 | 2.49 |
| Roccamonfina | 1943 | 3.18 | 0.23 | 0.59 | 1.22 | 0.38 |
| Closing up...Garigliano | 1943 | 3.28 | 0.17 | 0.03 | 19.00 | 5.79 |
| Calabritto I | 1943 | 3.49 | 0.06 | 0.19 | 1.11 | 0.32 |
| Calabritto II | 1943 | 3.47 | 0.45 | 0.29 | 5.43 | 1.56 |
| Calabritto III | 1943 | 3.40 | 0.15 | 0.62 | 0.83 | 0.25 |
| Calabritto IV | 1943 | 3.47 | 1.53 | 0.73 | 6.40 | 1.85 |
| Calabritto V | 1943 | 3.50 | 0.07 | 1.50 | 0.15 | 0.04 |
| Calabritto VIII | 1943 | 2.77 | 0.11 | 0.17 | 1.80 | 0.65 |
| Monte Camino X | 1943 | 3.46 | 0.12 | 2.02 | 0.20 | 0.06 |
| Advance...Merefa River I | 1943 | 2.65 | 0.48 | 0.32 | 4.00 | 1.51 |
| Advance through Dergachi | 1943 | 2.67 | 0.48 | 39.70 | 0.03 | 0.01 |
| Losovo I | 1943 | 3.19 | 0.50 | 7.16 | 0.22 | 0.07 |
| *Kochetovka I* | *1943* | *2.54* | *3.22* | *1.22* | *6.19* | *2.44* |
| *Kochetovka II* | *1943* | *2.89* | *2.62* | *1.39* | *5.44* | *1.89* |
| *Kochetovka III* | *1943* | *2.87* | *3.16* | *1.08* | *8.39* | *2.92* |
| *Kochetovka IV* | *1943* | *2.68* | *0.72* | *0.43* | *4.54* | *1.69* |
| LSSAH Clears Outpost... | 1943 | 2.98 | 0.25 | 1.22 | 0.62 | 0.21 |
| Totenkopf Prepares to... | 1943 | 2.57 | 0.05 | 0.00 | N/A | N/A |
| LSSAH Attacks | 1943 | 3.00 | 2.69 | 18.20 | 0.44 | 0.15 |
| Totenkopf Attacks | 1943 | 2.57 | 0.77 | 3.24 | 0.61 | 0.24 |
| The 106th ID Advances | 1943 | 3.24 | 1.33 | 4.22 | 1.02 | 0.31 |
| The 19th PzD Continues... | 1943 | 2.94 | 2.01 | 6.94 | 0.85 | 0.29 |
| The 7th PzD Turns | 1943 | 3.45 | 1.75 | 12.21 | 0.49 | 0.14 |
| 19th PzD Breaks Through | 1943 | 2.75 | 2.15 | 6.93 | 0.86 | 0.31 |
| The 6th PzD Pushes... | 1943 | 3.19 | 0.82 | 1.63 | 1.60 | 0.50 |
| The Adolf Hitler SS... | 1943 | 3.42 | 0.23 | 0.60 | 1.30 | 0.38 |
| Bowling Alley II | 1944 | 3.12 | 1.95 | 8.13 | 0.75 | 0.24 |
| Bowling Alley I | 1944 | 3.24 | 1.93 | 2.16 | 2.91 | 0.90 |

| Battle Name | Year | Force Ratio | Attacker % Loss | Defender % Loss | Loss Ratio | % per Day Loss Ratio |
|---|---|---|---|---|---|---|
| Formia | 1944 | 3.04 | 0.47 | 3.15 | 0.45 | 0.15 |
| Monte Grande (Rome) | 1944 | 2.87 | 0.32 | 2.43 | 0.38 | 0.13 |
| Itri-Fondi | 1944 | 2.69 | 0.32 | 1.43 | 0.60 | 0.22 |
| Terracina | 1944 | 2.71 | 0.53 | 1.90 | 0.76 | 0.28 |
| Sezze | 1944 | 2.58 | 0.31 | 1.33 | 0.60 | 0.23 |
| Lanuvio | 1944 | 2.83 | 1.28 | 2.86 | 1.27 | 0.45 |
| Valmontone | 1944 | 2.63 | 1.33 | 2.81 | 1.25 | 0.48 |
| Seine River | 1944 | 2.71 | 0.19 | 2.01 | 0.26 | 0.10 |
| Melun | 1944 | 2.87 | 0.19 | 2.01 | 0.27 | 0.10 |
| Boulogne I | 1944 | 2.84 | 0.53 | 4.92 | 0.31 | 0.11 |
| Calais I | 1944 | 3.39 | 0.09 | 3.50 | 0.09 | 0.03 |
| Brest, Suburbs I | 1944 | 2.98 | 0.49 | 5.92 | 0.25 | 0.08 |
| Brest, Suburbs II | 1944 | 3.24 | 0.38 | 10.17 | 0.12 | 0.04 |
| Boulogne II | 1944 | 2.99 | 0.46 | 24.88 | 0.06 | 0.02 |
| Morhange | 1944 | 3.43 | 1.30 | 0.87 | 5.11 | 1.49 |
| Sarre-Union | 1944 | 3.27 | 0.59 | 1.07 | 1.81 | 0.55 |
| Singling-Bining | 1944 | 3.02 | 1.02 | 2.40 | 1.28 | 0.42 |
| Our River North | 1944 | 2.79 | 2.41 | 1.71 | 3.93 | 1.41 |
| Schnee Eifel North II | 1944 | 3.08 | 0.39 | 21.30 | 0.06 | 0.02 |
| Schnee Eifel South | 1944 | 2.56 | 1.82 | 6.98 | 0.67 | 0.26 |
| Bastogne Corridor III | 1944 | 2.64 | 0.54 | 1.16 | 1.23 | 0.46 |
| Aachen 1st ID Attack I | 1944 | 3.03 | 0.78 | 5.68 | 0.42 | 0.14 |
| Aachen 1st ID Attack II | 1944 | 3.23 | 0.54 | 2.30 | 0.76 | 0.23 |
| Aachen 1st ID Attack III | 1944 | 2.73 | 0.36 | 4.48 | 0.22 | 0.08 |
| Aachen 1st ID Attack IV | 1944 | 2.95 | 0.34 | 2.03 | 0.50 | 0.17 |
| Aachen 1st ID Attack V | 1944 | 3.02 | 0.38 | 5.37 | 0.21 | 0.07 |
| Aachen 1st ID Attack VII | 1944 | 3.32 | 0.37 | 5.45 | 0.22 | 0.07 |
| Aachen 1st ID Attack XII | 1944 | 2.52 | 0.59 | 3.06 | 0.49 | 0.19 |
| Aachen 1st ID Attack XIII | 1944 | 2.60 | 0.48 | 12.50 | 0.10 | 0.04 |
| Aachen 1st ID Attack XIV | 1944 | 2.93 | 0.18 | 22.47 | 0.02 | 0.01 |
| Aachen 30th ID Attack III | 1944 | 2.64 | 1.19 | 5.85 | 0.54 | 0.20 |
| *Nikopol Bridgehead* | *1944* | *3.05* | *0.41* | *0.97* | *1.27* | *0.42* |
| *Brody, Phase II* | *1944* | *2.98* | *4.55* | *3.80* | *3.57* | *1.20* |
| *Vistula River, Op. II* | *1944* | *2.74* | *2.89* | *2.04* | *3.87* | *1.41* |
| *Ciechanow, Phase I* | *1945* | *3.48* | *6.34* | *4.68* | *4.72* | *1.36* |
| *Ciechanow, Phase II* | *1945* | *3.11* | *7.02* | *5.90* | *3.70* | *1.19* |
| Kochi Ridge - Onaga I | 1945 | 2.92 | 0.61 | 8.83 | 0.20 | 0.07 |
| Kochi Ridge IV | 1945 | 2.94 | 0.38 | 14.24 | 0.08 | 0.03 |
| Manila, 37th ID 1 | 1945 | 3.41 | 0.48 | 2.40 | 0.69 | 0.20 |
| Manila, 37th ID 2 | 1945 | 3.43 | 0.00 | 2.48 | N/A | N/A |
| Manila, 37th ID 22 | 1945 | 2.54 | 0.78 | 12.01 | 0.17 | 0.07 |

| Battle Name | Year | Force Ratio | Attacker % Loss | Defender % Loss | Loss Ratio | % per Day Loss Ratio |
|---|---|---|---|---|---|---|
| Manila, 37th ID 23 | 1945 | 2.89 | 0.84 | 11.15 | 0.22 | 0.08 |
| Manila, 37th ID 24 | 1945 | 3.23 | 0.55 | 15.49 | 0.11 | 0.04 |
| 1st CavD at Manila 1 | 1945 | 2.73 | 0.12 | 2.80 | 0.11 | 0.04 |
| 1st CavD at Manila 2 | 1945 | 2.81 | 0.00 | 7.68 | N/A | N/A |
| 1st CavD at Manila 3 | 1945 | 3.04 | 0.44 | 1.71 | 0.78 | 0.26 |
| 1st CavD at Manila 4 | 1945 | 3.07 | 0.06 | 5.64 | 0.03 | 0.01 |
| 1st CavD at Manila 5 | 1945 | 3.25 | 0.23 | 1.36 | 0.54 | 0.17 |
| 1st CavD at Manila 6 | 1945 | 3.30 | 0.75 | 19.80 | 0.13 | 0.04 |
| Bir Hassna - Bir Thamada | 1967 | 2.90 | 0.69 | 18.33 | 0.11 | 0.04 |
| *Mitla Pass* | *1967* | *3.03* | *1.25* | *0.62* | *6.11* | *2.01* |
| *Third Army Offensive* | *1973* | *3.50* | *4.77* | *1.08* | *15.42* | *4.41* |
| *Yehudia-El Al* | *1973* | *3.49* | *1.14* | *1.19* | *3.33* | *0.96* |
| *Khafji* | *1991* | *3.00* | *0.96* | *0.43* | *6.76* | *2.25* |
| Between the Wire | 1991 | 2.86 | 0.01 | 2.81 | 0.01 | 0.00 |
| PL NEW JERSEY... | 1991 | 2.53 | 0.10 | 15.33 | 0.02 | 0.01 |
| Big Night-1 ID (M)... | 1991 | 2.77 | 0.12 | 2.50 | 0.14 | 0.05 |
| Medina Ridge | 1991 | 3.26 | 0.18 | 15.83 | 0.04 | 0.01 |
| Objective ORANGE... | 1991 | 2.80 | 0.07 | 4.00 | 0.05 | 0.02 |
| AO BRAGG | 1991 | 2.50 | 0.02 | 2.04 | 0.02 | 0.01 |
| **Average** | | **3.00** | **1.39** | **6.08** | **1.86** | **0.61** |
| Less pre-1943 | | | 0.96 | 5.28 | 1.89 | 0.61 |
| Also less Soviet-doctrine attacks* | | | 0.63 | 5.83 | 1.27 | 0.41 |

* Engagements in italics are attacks by "Soviet doctrine" trained armies, including 10 by the Soviet Army in 1938 and WWII, three by the Egyptians and Syrians in 1967 and 1973 and one by the Iraqis in 1991.

Table 2

This is a total of 98 engagements at force ratios of 2.50 to 3.50 to 1. It is 15 percent of the 634 engagements for which we had force ratios. With this fairly significant representation of the overall population, we are still getting no indication that the 3:1 rule, as RAND postulates it applies to casualties, does indeed fit the data at all. Of the 98 engagements, only 19 of them demonstrate a percent per day loss ratio (casualty exchange ratio) between 0.50-to-1 and 2-to-1. This is only 19 percent of the engagements at roughly 3:1 force ratio. There were 72 percent (71 cases) of those engagements at lower figures (below 0.50-to-1) and only 8 percent (cases) are at a higher exchange ratio. The data clearly was not clustered around the area from 0.50-to-1 to 2-to-1 range, but was well to the left (lower) of it.

Looking just at straight exchange ratios, we do get a better fit, with 31 percent (30 cases) of the figure ranging between 0.50 to 1 and 2 to 1. Still, this figure exchange might not be the norm with 45 percent (44 cases) lower and 24 percent (24 cases) higher. By definition, this fit is 1/3rd the losses for the attacker as postulated in the RAND version of the 3:1 rule. This is effectively an order of magnitude difference, and it clearly does not represent the norm or the center case.

The percent per day loss exchange ratio ranges from 0.00 to 5.71. The data tends to be clustered at the lower values, so the high values are very much outliers. The highest percent exchange ratio is 5.71, the second highest is 4.41, the third highest is 2.92. At the other end of the spectrum, there are four cases where no losses were suffered by one side and seven where the exchange ratio was .01 or less. Ignoring the "N/A" (no losses suffered by one side) and the two high "outliers (5.71 and 4.41), leaves a range of values from 0.00 to 2.92 across 92 cases. With an even distribution across that range, one would expect that 51

percent of them would be in the range of 0.50-to-1 and 2.00-to-1. With only 19 percent of the cases being in that range, one is left to conclude that there is no clear correlation here. In fact, it clearly is the opposite effect, which is that there is a negative relationship. **Not only is the RAND construct unsupported, it is clearly and soundly contradicted with this data.** Furthermore, the RAND construct is theoretically a worse predictor of casualty rates than if one randomly selected a value for the percentile exchange rates between the range of 0 and 2.92. We do believe this data is appropriate and accurate for such a test.

As there are only 19 cases of 3:1 attacks falling in the even percentile exchange rate range, then we should probably look at these cases for a moment:

| Battle | Year | Force Ratio | Attacker % Loss | Defender % Loss | Loss Ratio | % per Day Loss Ratio |
|---|---|---|---|---|---|---|
| Somme: Bazentin Ridge | 1916 | 3.00 | 20.00 | 26.67 | 2.25 | 0.75 |
| *Changkufen/Hill 52* | *1938* | *2.50* | *4.00* | *2.75* | *3.64* | *1.45* |
| Sele-Calore Corridor | 1943 | 2.96 | 2.02 | 1.45 | 4.11 | 1.39 |
| Calabritto II | 1943 | 3.47 | 0.45 | 0.29 | 5.43 | 1.56 |
| Calabritto IV | 1943 | 3.47 | 1.35 | 0.73 | 6.40 | 1.85 |
| Calabritto VIII | 1943 | 2.77 | 0.11 | 0.17 | 1.80 | 0.65 |
| Advance...Merefa River I | 1943 | 2.65 | 0.48 | 0.32 | 4.00 | 1.51 |
| *Kochetovka II* | *1943* | *2.89* | *2.62* | *1.39* | *5.44* | *1.89* |
| *Kochetovka IV* | *1943* | *2.68* | *0.72* | *0.43* | *4.54* | *1.69* |
| The 6th PzD Pushes... | 1943 | 3.19 | 0.82 | 1.63 | 1.60 | 0.50 |
| Bowling Alley I | 1944 | 3.24 | 1.93 | 2.16 | 2.91 | 0.90 |
| Morhange | 1944 | 3.43 | 1.30 | 0.87 | 5.11 | 1.49 |
| Sarre-Union | 1944 | 3.27 | 0.59 | 1.07 | 1.81 | 0.55 |
| Our River North | 1944 | 2.79 | 2.41 | 1.71 | 3.93 | 1.41 |
| Brody, Phase II | 1944 | 2.98 | 4.55 | 3.80 | 3.57 | 1.20 |
| Vistula River Op. II | 1944 | 2.74 | 2.89 | 2.04 | 3.87 | 1.41 |
| Ciechanow, Phase I | 1945 | 3.48 | 6.34 | 4.68 | 4.72 | 1.36 |
| Ciechanow, Phase II | 1945 | 3.11 | 7.02 | 5.90 | 3.70 | 1.19 |
| Yehudia-El Al | 1973 | 3.49 | 1.14 | 1.19 | 3.33 | 0.96 |
| **Average** | | **3.06** | **3.20** | **3.12** | **3.80** | **1.25** |

One will note, in these 19 cases, that the average attacker casualties are way out of line with the average for the entire data set (3.20 versus 1.39 or 3.20 versus 0.63 with pre-1943 and Soviet-doctrine attackers removed). The reverse is the case for the defenders (3.12 versus 6.08 or 3.12 versus 5.83 with pre-1943 and Soviet-doctrine attackers removed). Of course, of the 19 cases, 2 are pre-1943 cases and 7 are cases of Soviet-doctrine attackers (in fact, 8 of the 14 cases of the Soviet-doctrine attackers are in this selection of 19 cases). This leaves 10 other cases from the Mediterranean and ETO (Northwest Europe 1944). These are clearly the unusual cases, outliers, etc. While the RAND 3:1 rule may be applicable for the Soviet-doctrine offensives (as it applies to 8 of the 14 such cases we have), it does not appear to be applicable to anything else. By the same token, it also does not appear to apply to virtually any cases of post-WWII combat. This all strongly argues that not only is the RAND construct not proven, but it is indeed clearly not correct.

The fact that this construct also appears in Soviet literature, but nowhere else in US literature, indicates that this is indeed where the rule was drawn from. One must consider the original scenarios run for the RSAC wargame were "Fulda Gap" and Korean War scenarios. As such, they were regularly conducting battles with Soviet attackers versus Allied defenders. It would appear that the 3:1 rule that they used more closely reflected the experiences of the Soviet attackers in WWII than anything else. Therefore, it may have been a fine representation for those scenarios as long as there was no US counterattacking or US offensives (and assuming that the Soviet Army of the 1980s performed at the same level as in did in the 1940s).

There was a clear relative performance difference between the Soviet Army and the German Army in World War II (see our Capture Rate Study Phase I & II and Measuring Human Factors in Combat for a detailed analysis of this).[1] It was roughly in the order of a 3-to-1-casualty exchange ratio. Therefore, it is not surprising that Soviet writers would create analytical tables based upon an equal percentage exchange of losses when attacking at 3:1. What is surprising, is that such a table would be used in the US to represent US forces now. This is clearly not a correct application.

Therefore, RAND's SFS, as currently constructed, is calibrated to, and should only be used to represent, a Soviet-doctrine attack on first world forces

[1] *Capture Rate Study Phases I and II Final Report* (The Dupuy Institute, March 6, 2000) (2 Vols.) and *Measuring Human Factors in Combat—Part of the Enemy Prisoner of War Capture Rate Study* (The Dupuy Institute, August 31, 2000). Both of these reports are available through our web site.

where the Soviet-style attacker is clearly not properly trained and where the degree of performance difference is similar to that between the Germans and Soviets in 1942-44. It should not be used for US counterattacks, US attacks, or for any forces of roughly comparable ability (regardless of whether Soviet-style doctrine or not). Furthermore, it should not be used for US attacks against forces of inferior training, motivation and cohesiveness. If it is, then any such tables should be expected to produce incorrect results, with attacker losses being far too high relative to the defender. In effect, the tables unrealistically penalize the attacker.

As JICM with SFS is now being used for a wide variety of scenarios, then it should not be used at all until this fundamental error is corrected, even if that use is only for training. With combat tables keyed to a result that is clearly off by an order of magnitude, then the danger of negative training is high.

## Corrections Made for
# Version 2.07 of the TNDM

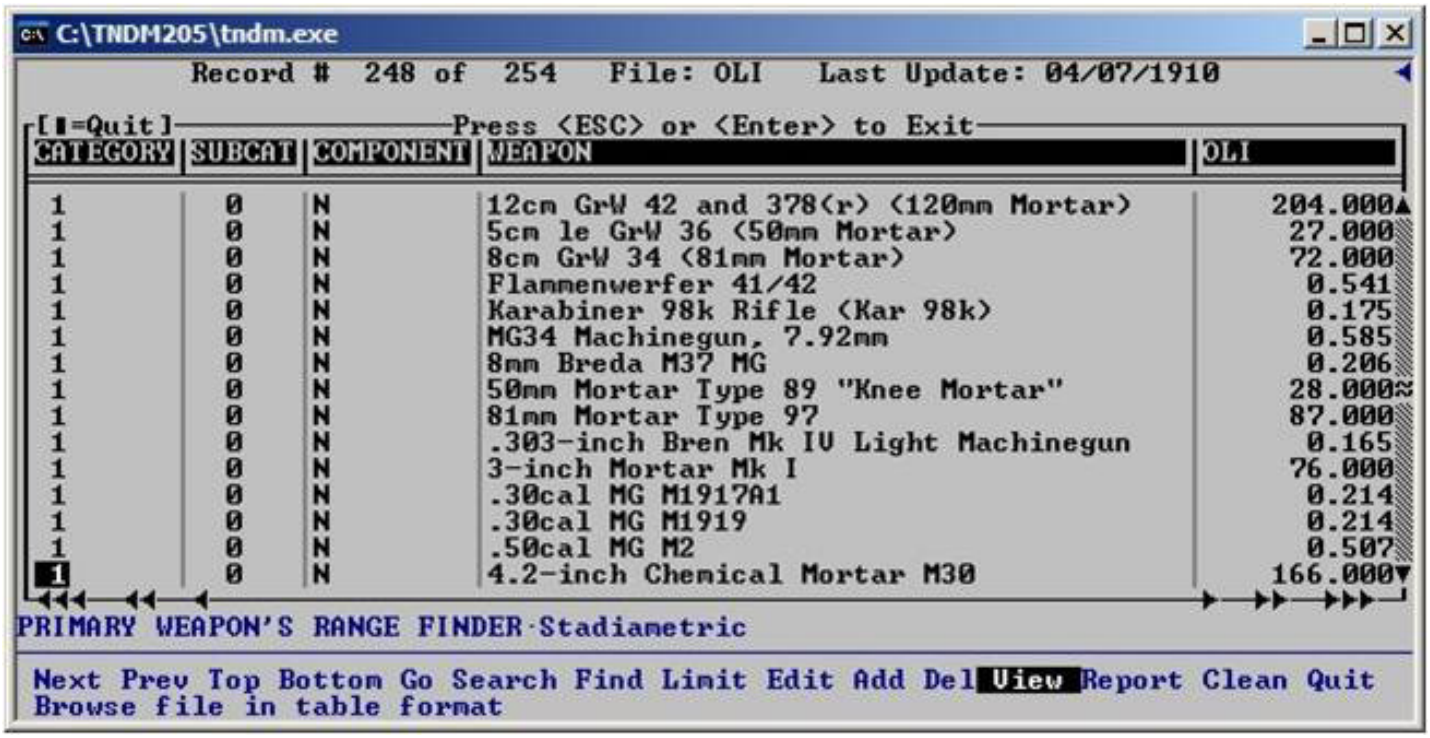
**Alexander Dinsmoor**

*The Dupuy Institute* has released a minor revision of the Tactical Numerical Deterministic Model (TNDM). The two changes in version 2.07 are:

1. The duplicate 'anti-tank missile' entry has been removed from the Weapons Type menu and no longer appears when you are creating an OLI. Previously, both entries functioned and selecting either did not impair the operation of the TNDM. However, this correction removed the duplicate entry.

2. We have tweaked the magazine load capacity function when creating a Mobile Fighting Machine (MFM). Previously, the TNDM was having trouble when you created new MFM components and then tried to use those components to create a new MFM in the same TNDM session. The TNDM was not processing the magazine capacity correctly, and this was impairing the TNDM's ability to correctly establish Operational Lethality Indices (OLIs). The revision allows you to create MFM components and then load them onto a MFM in the same TNDM session. Note, the rate of fire for a MFM is based on the ammunition load for the primary weapon of an MFM.

Hopefully, these changes will resolve some recurring user interface issues and allow for easier use and operation of the TNDM. We will be distributing this revised version to holders of our support contract.




*Sample weapons catalog listing*

# A Summation of
# QJM/TNDM Validation Efforts

**Christopher A. Lawrence**

There have been six or seven different validation tests conducted of the QJM (Quantified Judgment Model) and the TNDM (Tactical Numerical Deterministic Model). As the changes to these two models are evolutionary in nature but do not fundamentally change the nature of the models, the whole series of validation tests across both models is worth noting. To date, this is the only model we are aware of that has been through multiple validations. We are not aware of any DOD combat model that has undergone more than one validation effort. Most of the DOD combat models in use have not undergone any validation.

## The Two Original Validations of the QJM

After its initial development using a 60-engagement WWII database, the QJM was tested in 1973 by application of its relationships and factors to a validation database of 21 World War II engagements in Northwest Europe in 1944 and 1945. The original model proved to be 95% accurate in explaining the outcomes of these additional engagements. Overall accuracy in predicting the results of the 81 engagements in the developmental and validation databases was 93%.[1]

During the same period the QJM was converted from a static model that only predicted success or failure to one capable of also predicting attrition and movement. This was accomplished by adding variables and modifying factor values. The original QJM structure was not changed in this process. The addition of movement and attrition as outputs allowed the model to be used dynamically in successive "snapshot" iterations of the same engagement.

From 1973 to 1979 the QJM's formulae, procedures, and variable factor values were tested against the results of all of the 52 significant engagements of the 1967 and 1973 Arab-Israeli Wars (19 from the former, 33 from the latter). The TNDM was able to replicate all of those engagements with an accuracy of more than 90%.[2]

In 1979 the improved QJM was revalidated by application to 66 engagements. These included 35 from the original 81 engagements (the "development database"), and 31 new engagements. The new engagements included five from World War II and 26 from the 1973 Middle East War. This new validation test considered four outputs: success/failure, movement rates, personnel casualties, and tank losses. The TNDM predicted success/failure correctly for about 85% of the engagements. It predicted movement rates with an error of 15% and personnel attrition with an error of 40% or less. While the error rate for tank losses was about 80%, it was discovered that the model consistently underestimated tank losses because input data included all kinds of armored vehicles, but output data losses included only numbers of tanks.[3]

This completed the original validations efforts of the QJM. The data used for the validations, and parts of the results of the validation, were published, but no formal validation report was issued. The validation was conducted in-house by Colonel Dupuy's organization, HERO. The data used were mostly from division-level engagements, although they included some corps- and brigade-level actions. We count these as two separate validation efforts.

## The Development of the TNDM and Desert Storm

In 1990 Col. Dupuy, with the collaborative assistance of Dr. James G. Taylor (author of *Lanchester Models of Warfare* in two volumes, published by the Operations Research Society of America, Arlington, Virginia, in 1983) introduced a significant modification: the representation of the passage of time in the

[1] It is unclear what these percentages, quoted from Dupuy in the TNDM General Theoretical Description, specify. We suspect it is a measurement of the model's ability to predict winner and loser. No validation report based on this effort was ever published. Also, the validation figures seem to reflect the results after any corrections made to the model based upon these tests. It does appear that the division-level validation was "incremental." We do not know if the earlier validation tests were tested back to the earlier data, but we have reason to suspect not.

[2] The original QJM validation data was first published in the *Combat Data Subscription Service* Supplement, vol. 1, no. 3 (Dunn Loring VA: HERO, Summer 1975). (HERO Report #50.) That effort used data from 1943 through 1973.

[3] HERO published its QJM validation database in *The QJM Data Base* (3 volumes) Fairfax VA: HERO, 1985 (HERO Report #100).

model. Instead of resorting to successive "snapshots," the introduction of Taylor's differential equation technique permitted the representation of time as a continuous flow. While this new approach required substantial changes to the software, the relationship of the model to historical experience was unchanged.[4] This revision of the model also included the substitution of formulae for some of its tables so that there was a continuous flow of values across the individual points in the tables. It also included some adjustment to the values and tables in the QJM. Finally, it incorporated a revised OLI calculation methodology for modern armor (mobile fighting machines) to take into account all the factors that influence modern tank warfare.[5] The model was reprogrammed in Turbo PASCAL (the original had been written in BASIC). The new model was called the TNDM (Tactical Numerical Deterministic Model).

Building on its foundation of historical validation and proven attrition methodology, in December 1990, HERO used the TNDM to predict the outcome of, and losses from, the impending Operation Desert Storm.[6] It was the most accurate (lowest) public estimate of US war casualties provided before the war. It differed from most other public estimates by an order of magnitude.

Also, in 1990, Trevor Dupuy published an abbreviated form of the TNDM in the book *Attrition: Forecasting Battle Casualties and Equipment Losses in Modern War.* A brief validation exercise using 12 battles from 1805 to 1973 was published in this book.[7] This version was used for creation of M-COAT[8] and was also separately tested by a student (Lieutenant Gozel) at the Naval Postgraduate School in 2000.[9] This version did not have the firepower scoring system, and as such neither M-COAT, Lieutenant Gozel's test, nor Colonel Dupuy's 12-battle validation included the OLI methodology that is in the primary version of the TNDM.

For counting purposes, I consider the Gulf War the third validation of the model. In the end, for any model, the proof is in the pudding. Can the model be used as a predictive tool or not? If not, then there is probably a fundamental flaw or two in the model. Still the validation of the TNDM was somewhat second hand, in the sense that the closely-related previous model, the QJM, was validated in the 1970s to 200 World War II and 1967 and 1973 Arab-Israeli War battles, but the TNDM had not been. Clearly, something further needed to be done.

**The Battalion-Level Validation of the TNDM**

Under the guidance of Christopher A. Lawrence, The Dupuy Institute undertook a battalion-level validation of the TNDM in late 1996. This effort tested the model against 76 engagements from World War I, World War II, and the post-1945 world including Vietnam, the Arab-Israeli Wars, the Falklands War, Angola, Nicaragua, etc. This effort was thoroughly documented in the *TNDM Newsletter*.[10] This effort was probably one of the more independent and better-documented validations of a casualty estimation methodology that has ever been conducted to date, in that:

- The data was independently assembled (assembled for other purposes before the validation) by a number of different historians.

[4] The Dupuy Institute, *The Tactical Numerical Deterministic Model (TNDM): A General and Theoretical Description*, McLean VA: The Dupuy Institute, October 1994.

[5] This had the unfortunate effect of undervaluing WWII-era armor by about 75% relative to other WWII weapons when modeling WWII engagements. This left The Dupuy Institute with the compromise methodology of using the old OLI method for calculating armor (Mobile Fighting Machines) when doing WWII engagements and using the new OLI method for calculating armor when doing modern engagements

[6] "Testimony of Col. T. N. Dupuy, USA, Ret., Before the House Armed Services Committee, 13 Dec 1990." The Dupuy Institute File I-30, "Iraqi Invasion of Kuwait."

[7] Trevor N. Dupuy, *Attrition: Forecasting Battle Casualties and Equipment Losses in Modern War* (HERO Books, Fairfax, VA, 1990), 123-4.

[8] M-COAT is the Medical Course of Action Tool created by Major Bruce Shahbaz. It is a spreadsheet model based upon the elements of the TNDM provided in Dupuy's *Attrition* (op. cit.). It used a scoring system derived from elsewhere in the US Army. As such, it is a simplified form of the TNDM with a different weapon scoring system.

[9] See Gözel, Ramazan. *Fitting Firepower Score Models to the Battle of Kursk Data*. NPGS Thesis. Monterey CA: Naval Postgraduate School. http://diana.or.nps.navy.mil/~twlucas/Student%20theses/GozelThesis.pdf, September 2000.

[10] Lawrence, Christopher A. "Validation of the TNDM at Battalion Level." *The International TNDM Newsletter*, vol. 1, no. 2 (October 1996); Bongard, Dave "The 76 Battalion-Level Engagements." *The International TNDM Newsletter*, vol. 1, no. 4 (February 1997); Lawrence, Christopher A. "The First Test of the TNDM Battalion-Level Validations: Predicting the Winner" & "The Second Test of the TNDM Battalion-Level Validations: Predicting Casualties." *The International TNDM Newsletter*, vol. 1 no. 5 (April 1997); and Lawrence, Christopher A. "Use of Armor in the 76 Battalion-Level Engagements." & "The Second Test of the Battalion-Level Validation: Predicting Casualties Final Scorecard." *The International TNDM Newsletter*, vol. 1, no. 6 (June 1997).

- There were no calibration runs or adjustments made to the model before the test.

- The data included a wide range of material from different conflicts and times (from 1918 to 1983).

- The validation runs were conducted independently (Susan Rich conducted the validation runs, while Christopher A. Lawrence evaluated them).

- The results of the validation were fully published.

- The people conducting the validation were independent, in the sense that

a) there was no contract, management, or agency requesting the validation;
b) none of the validators had previously been involved in designing the model, and had only very limited experience in using it; and
c) the original model designer was not able to oversee or influence the validation.[11]

The validation was not truly independent, as the model tested was a commercial product of The Dupuy Institute, and the person conducting the test was an employee of the Institute. On the other hand, this was an independent effort in the sense that the effort was employee-initiated and not requested or reviewed by the management of the Institute. Furthermore, the results were published.

The TNDM was also given a limited validation test back to its original WWII data around 1997 by Niklas Zetterling of the Swedish War College, who retested the model to about 15 or so Italian campaign engagements. This effort included a complete review of the historical data used for the validation back to their primarily sources, and details were published in *The International TNDM Newsletter*.[12]

There has been one other effort to correlate outputs from QJM/TNDM-inspired formulae to historical data using the Ardennes and Kursk campaign-level (i.e., division-level) databases.[13] This effort did not use the complete model, but only selective pieces of it, and achieved various degrees of "goodness of fit." While the model is hypothetically designed for use from squad level to army group level, to date no validation has been attempted below battalion level, or above division level. At this time, the TNDM also needs to be revalidated back to its original WWII and Arab-Israeli War data, as it has evolved since the original validation effort.

**The Corps- and Division-level Validations of the TNDM**

Having now having done one extensive battalion-level validation of the model and published the results in our newsletters, volume I, issues 5 and 6, we were then presented an opportunity in 2006 to conduct two more validations of the model. These are discussed in depth in two articles of this issue of the newsletter.

These validations were against conducted using historical data, 24 days of corps-level combat and 25 cases of division-level combat drawn from the Battle of Kursk during 4-15 July 1943. It was conducted using an independently-researched data collection (although the research was conducted by The Dupuy Institute), using a different person to conduct the model runs (although that person was an employee of the Institute) and using another person to compile the results (also an employee of the Institute). To summarize the results of this validation (the historical figure is listed first followed by the predicted result):

[11] Trevor N. Dupuy passed away in July 1995, and the validation was conducted in 1996 and 1997.

[12] Zetterling, Niklas. "CEV Calculations in Italy, 1943." *The International TNDM Newsletter,* vol. 1, no. 6. McLean VA: The Dupuy Institute. June 1997. See also *Research Plan, The Dupuy Institute* Report E-3, McLean VA: The Dupuy Institute, 7 Oct 1998.

[13] See Gözel, Ramazan. *Fitting Firepower Score Models to the Battle of Kursk Data*. NPGS Thesis. Monterey CA: Naval Postgraduate School. http://diana.or.nps.navy.mil/~twlucas/Student%20theses/GozelThesis.pdf, September 2000.

| | 24 Corps Engagements | 25 Division Engagements |
|---|---|---|
| 1. Win/Lose | 21 correct (88%) | 24 correct (96%) |
| 2. Advance Rates (in km)<br>Wehrmacht<br>SS | <br>80.5 vs 37.99 (47%)<br>63.3 vs 83.3 (132%) | <br>74.9 km vs 48.3 (64%)<br>62.4 km vs 70.4 (113%) |
| 3. German casualty rates<br>Wehrmacht<br>SS | <br>7,491 vs 9,607 (128%)<br>7,899 vs 4,812 (61%) | <br>5,386 vs 6,718 (125%)<br>3,204 vs 2,318 (72%) |
| 4. Soviet casualty rates<br>versus Wehrmacht<br>versus SS | <br>35,702 vs 22,504 (63%)<br>29,311 vs 17,602 (60%) | <br>26,348 vs 21,890 (83%)<br>10,705 vs 8,365 (78%) |
| 5. German armor loss rates<br>Wehrmacht<br>SS | <br>470 vs 463 (99%)*<br>403 vs 305 (76%) | <br>390 vs 328 (84%)*<br>146 vs 139 (95%) |
| 6. Soviet armor loss rates<br>versus Wehrmacht<br>versus SS | <br>621 vs 544 (78%)<br>964 vs 507 (53%) | <br>488 vs 571 (117%)<br>430 vs 357 (83%) |

* Less the 120 Panthers that broke down

There was one other effort that was done as part of work we did for the Army Medical Department (AMEDD). This is fully explained in our report *Casualty Estimation Methodologies Study: The Interim Report* dated 25 July 2005. In this case, we tested six different casualty estimation methodologies to 22 cases. These consisted of 12 division-level cases from the Italian Campaign (4 where the attack failed, 4 where the attacker advanced, and 4 where the defender was penetrated) and 10 cases from the Battle of Kursk (2 cases where the attack failed, 4 where the attacker advanced and 4 where the defender was penetrated). These 22 cases were randomly selected from our earlier 628 case version of the DLEDB (Division-level Engagement Database; it now has 752 cases). Again, the TNDM performed as well as or better than any of the other casualty estimation methodologies tested. As this validation effort was using the Italian engagements previously used for validation (although some had been revised due to additional research) and three of the Kursk engagements that were later used for our division-level validation, then it is debatable whether one would want to call this a seventh validation effort. Still, it was done as above with one person assembling the historical data and another person conducting the model runs. This effort was conducted a year before the corps and division-level validation conducted above and influenced it to the extent that we chose a higher CEV (Combat Effectiveness Value) for the later validation. A CEV of 2.5 was used for the Soviets for this test, vice the CEV of 3.0 that was used for the later tests.

**Summation**

The QJM has been validated at least twice. The TNDM has been tested or validated at least four times, once to an upcoming, imminent war, once to battalion-level data from 1918 to 1989, once to division-level data from 1943 and once to corps-level data from 1943. These last four validation efforts have been published and described in depth. The model continues, regardless of which validation is examined, to accurately predict outcomes and make reasonable predictions of advance rates, loss rates and armor loss rates. This is regardless of level of combat (battalion, division or corps), historic period (WWI, WWII or modern), the situation of the combats, or the nationalities involved (American, German, Soviet, Israeli, various Arab armies, etc.). As the QJM, the model was effectively validated to around 200 World War II and 1967 and 1973 Arab-Israeli War battles. As the TNDM, the model was validated to 125 corps-, division-, and battalion-level engagements from 1918 to 1989 and used as a predictive model for the 1991 Gulf War. This is the most extensive and systematic validation effort yet done for any combat model. The model has been tested and re-tested. It has been tested across multiple levels of combat and in a wide range of environments. It has been tested where human factors are lopsided, and where human factors are roughly equal. It has been independently spot-checked several times by others outside of the Institute. It is hard to say what more can be done to establish its validity and accuracy.

TDI Profile

# Christopher A. Lawrence

*Over the years, we have presented bios of ten people employed by or associated with The Dupuy Institute. In order of appearance, these were: Dave Bongard, Jose Perez, Richard Anderson, Joseph A. Bulger, Jay Karamales, Trevor N. Dupuy, James G. Taylor, George Daoust, Nicholas Krawciw, and Alexander Dinsmoor. Even though I have been the editor of the* Newsletter *and chief operating officer at the Institute for that time, I have always found an excuse to feature someone else. This is in part because my credentials are very limited, as I have only a bachelor's degree, and it is not in history or in operations research.*

*I am a historian by trade. For better or worse, I have learned how to conduct research, write history, and run research projects by following the examples of Trevor Dupuy and Curt Johnson. I am an analyst by trade, having never taken an operations research course in my life. My analytical skills have been developed by following the example of Trevor Dupuy, in addition to a limited knowledge of econometrics and considerable self-study. As such, I am on paper qualified to be neither a historian nor an analyst. Still, I've been paid to do both for over two decades and have done this in a competitive commercial environment. This proof by performance harkens back to a much earlier day in the work of the studies and analysis community, and there are few in the business now who do not have advanced degrees. Anyhow, to present a brief bio:*

Christopher A. Lawrence has been the executive director of The Dupuy Institute for over a decade and is the Institute's president. He has been involved in a varied career, including almost 30 years' work for the departments of Defense, the Army, the Navy, and the Air Force. He has worked both with practical applications and analytical studies. His experience includes work in support of the Naval Sea Systems Command program office for submarine sonar systems and then with General Dynamics as part of the Joint Cruise Missile Program. He has 25 years of experience as a program manager. He has managed more than 40 studies on military topics including urban warfare, enemy prisoner-of-war capture rates, U.S. Army record-keeping, the military consequences of landmine restrictions, comparative mortality rates of different services in Vietnam, casualty estimates for U.S. operations in Bosnia, casualty estimates for U.S. Operations in Iraq, and a range of insurgency studies. He is primarily responsible for the development and maintenance of the Ardennes Campaign Simulation Database, the Kursk Database, the TDI suite of conventional combat, insurgency, and contingency operations databases, and the Modern Insurgency Spread Sheets (MISS). These include the three largest databases on conventional combat and the largest database assembled on insurgencies. He is author of *A History of the Department of Defense Federally Funded Research and Development Centers* and is currently working on completing two books: *Understanding Insurgencies* and *Prokhorovka: The Battle of Kursk*. Mr. Lawrence graduated with a Bachelor of Arts in International Relations from The American University (1978) and has conducted post-graduate work at a number of universities.

Chris lives in Vienna, Virginia with his wife Tatiana and son Sasha. He continues to pursue a range of interests outside of history from hosting jams to managing Little League baseball teams.