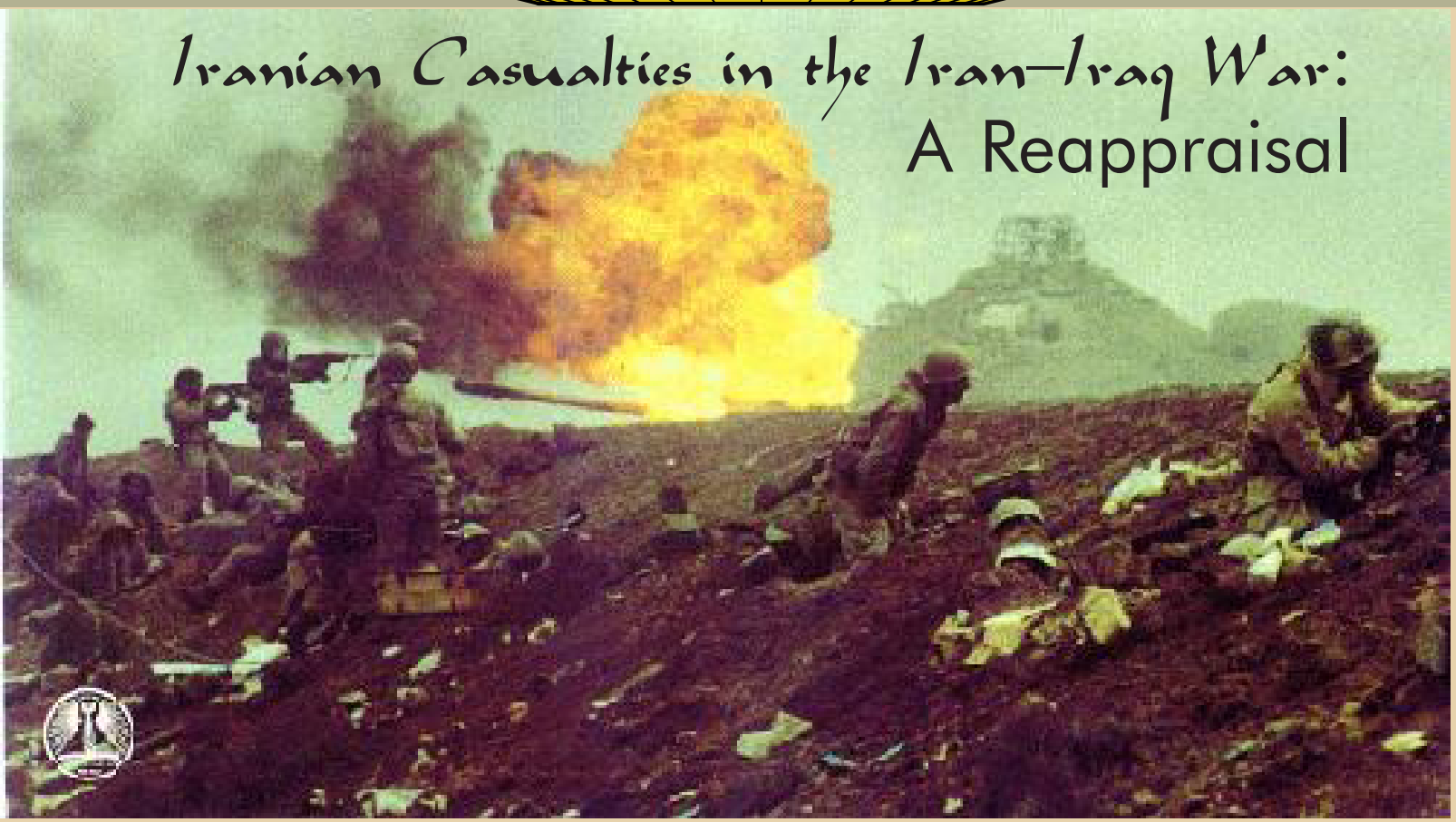
Volume 2, Number 3 December 1997
US$ 6.00

THE INTERNATIONAL TNDM NEWSLETTER



Iranian Casualties in the Iran–Iraq War: A Reappraisal

Also in this issue:

- Time and Breakpoints in the TNDM
- A Look at the OLIs of APCs, ACs, IFVs, and CFVs
- Some Thoughts on the Mobility Equation
- The TNDM OLI Database

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, Richard Anderson, José Perez, Susan Rich, and Jay Karamales 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 Colonel 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

Publisher
The Dupuy Institute

Editor
Christopher A. Lawrence

Production Manager
Jay Karamales
Olórin Press

Contributing Editors
Richard C. Anderson
Jay Karamales
José Perez
Susan Rich

The Dupuy Institute

Founder
Col. Trevor N. Dupuy

President
Maj. Gen. Nicholas Krawciw

Executive Director
Christopher A. Lawrence

Board of Directors
Dr. George A. Daoust, chairman
Dr. Frances B. Kapper
John D. Kettelle
Dr. Douglas Kinnard
Maj. Gen. Nicholas Krawciw
Maj. Gen. James C. Pfautz
Eugene P. Visco
Dr. Abraham Wolf

Board of Advisors
John D. Kettelle, chairman
Dr. Howard F. Didsbury
Irving Green
Stanley Legro, Esq.
Robert S. Libauer
Dr. R. Ann O'Keefe
Dr. Lester A. Picker

Administrative Offices
The Dupuy Institute
1497 Chain Bridge Rd
Suite 100
McLean, VA 22101 USA
VOX: 703-356-1151
FAX: 703-356-1152
NikatTDI@aol.com

From the Editor...

The lead article in this issue comes from Bill Beuttel at Boeing. In addition to his work using the QJM, which he discussed in Volume 2, Number 1, Mr. Beuttel has done some private research on the Iran–Iraq War. This war is the largest conventional conflict since WWII. I find it significant that this war produced a stalemated military situation using modern weapons. The impression is often given that all modern warfare is dramatic campaigns like The Gulf War or the 1967 Arab–Israeli War. Modern warfare can also achieve stalemated situations as happened in the Iran–Iraq War and as almost happened in the Arab–Israeli War of 1973. "Blitzkrieg" is not created by weapons and technologies, it is created by a combination of the proper application of those weapons and technologies by one side and military incompetence by the other side.

The article on "Time and Breakpoints in the TNDM" is a result of a request by one of our users to look into the way his organization is using the TNDM. They are using the TNDM as an attrition calculator in a larger model they have, and have come up with a novel way for determining battle length and breakpoints. This article tries to address whether this is really a valid approach.

Next there are four articles related to the problems created by the revised armor OLIs. I suspect the solution to the problem now is that we need to revise the armor value formula to adjust the weight tables by historical period, as it appears the primary problem with the revised armor values is that they were done for modern weapons, and no attempt was made to address the WWII period. This is discussed in "The Current Status of OLIs" article and will be addressed in more depth in the next issue.

We have also included a request for help from our readers to fill our HERO files. There are 29 "reports" that we do not have copies of. Of those, three are books, three we do not know the names of, and at least six are classified (we are not set up to store classified material). We are hoping that people may have copies of some of these other reports and will forward copies to us. Can't hurt to ask.

Finally, for our "Who is TDI" profile, it is time to properly introduce Dr. George A. Daoust, the Chairman of our Board. Col./Dr. Daoust has been with the Institute since the beginning (1992), when he and Trevor N. Dupuy, operating out of Col. Dupuy's basement, set up TDI from the ashes of his previous for–profit company (which obviously didn't make a profit). I think of it as "re–establishing HERO" as a realistic entity (meaning non–profit, which was the case of all the previous for–profit companies). Col. Daoust has had a varied career ranging from leaping out of perfectly operating airplanes to being an Assistant Secretary of Defense. Col. Daoust has been one of the mainstays of this organization over the last six years.

We have assembled two deliverables for our annual support contract subscribers. One is the latest version of the TNDM, version 2.03, which is a minor update that corrects some small programming errors. The most important change it that is now allows one to properly use the multiple directory option. We have set up our OLI database so that there is a separate directory of weapons for each era. José Perez is already working on version 2.04 (we've spotted a few more minor errors). The other deliverable is the disk of all 1,644 OLIs that we have assembled. It is described in the article "The Current Status of OLIs". We now keep them in separate files for Pre–WWI, WWI, WWII, 1970s, and modern weapons. It is delivered to the customer as five separate files. We expect to update these OLI files further as we continue the battalion–level validation and we will provide these updates to our support contract holders. Hopefully our users will find them useful.

For the next issue, we will have another article from Bill Beuttel called "Causes of Casualties in the Iran-Iraq War (1980-1988)." In is effectively a continuation of the article in this issue. Also, one of our TNDM users has promised me an article on how he is using the model.

The articles addressing a TNDM analysis of the Battle of Dom Bütgenbach have been yet further delayed as both Jay Karamales and I have been distracted by other issues. We should hopefully have it ready for the next issue. We intend to conduct it as an analysis of a multi–day division–level battle, and then fight the battle the way it occurred: as a series

of battalion–level engagements. We will then compare the model results to the historical results. This test is also considered to be part of our ongoing validation effort.

As always, I expect to include some articles in the next issue on our battalion–level validation work. We have still to conduct our analysis of the advance rates and to compile a summary conclusion from the first validation. We also need to test all these changes to our second battalion–level validation data base of 123+ battles from 1914 through 1991. Right now, though, we are going back through the TNDM and running the initial 76 battles not using the OLIs (i.e., every man has a OLI of 1 and no weapons are counted). We are then going to compare them to the runs using the OLIs and see which predicts better. While this will not "validate" the OLIs *per se*, if the runs using the OLIs predict better than the runs without them, then we must conclude that the OLIs are helping to improve the predictive capability of the model. If the reverse is the case, well...

That is all for now. If you have any questions, please contact me. Addresses, E-mail addresses, and phone numbers are in the masthead.

Iranian Casualties in the Iran–Iraq War: A Reappraisal

by H.W. Beuttel

The Iran–Iraq War was the longest sustained conventional war of the 20th Century. Lasting from 22 September 1980 to 20 August 1988, the seven years, ten months, and twenty–nine days of this conflict are some of the least understood in modern military history. The War of Sacred Defense to the Iranians and War of Second Qadissiya to Iraqis is the true "forgotten war" of our times. Seemingly never ending combat on a scale not witnessed since WWI and WWII was the norm. Casualties were popularly held to be enormous and, coupled with the lack of battlefield resolution year after year, led to frequent comparisons with the Western Front of WWI. Despite the fact that Iran had been the victim of naked Iraqi aggression, it was the Iraqis who were viewed as the "good guys" and actively supported by most nations in the world as well as the world press.

Studying the Iran–Iraq War is beset with difficulties. Much of the reporting done on the war was conducted in a slipshod manner. Both Iraq and Iran tended to exaggerate each other's losses. As oftentimes Iraqi claims were the only source, accounts of Iranian losses became exaggerated. The data is highly fragmentary, often contradictory, usually vague in particulars, and often suspect as a whole. It defies complete reconciliation or adjudication in a quantitative sense as will be evident below.

There are few stand alone good sources for the Iran-Iraq War in English. One of the first, and best, is Edgar O'Ballance, *The Gulf War* (London: Brassey's, 1988). O'Ballance was a dedicated and knowledgeable military reporter who had covered many conflicts throughout the world. Unfortunately his book ends with the *Karbala* -9 offensive of April 1987. Another good reference is Dilip Hiro, *The Longest War: The Iran–Iraq Military Conflict* (London: Paladin Books, 1990). Hiro too is a careful journalist who specializes in South Asian affairs. Finally, there is Anthony Cordesman and Abraham Wagner, *The Lessons of Modern War Volume III: The Iran–Iraq War,* (Boulder, CO: Westview Press, 1990). This is the most comprehensive treatment of the conflict from a military standpoint and tends to be the "standard" reference. Finally there are Iranian sources, most notably articles appearing since the war in the *Tehran Times*, *Iran News* , the Islamic Republic News Agency (IRNA) and others.

This paper will approach the subject of losses in the conflict from the Iranian perspective. This is for two reasons. First, too often during the war Iraqi claims and figures were uncritically accepted out of prejudice against Iran. Secondly, since the war the Iranians have been more forthcoming about details of the conflict and though not providing direct figures, have released related quantified data that allows us to extrapolate better estimates.

The first installment of this paper examines the evidence for total Iranian war casualties being far lower than popularly believed. It will also analyze this data to establish overall killed to wounded ratios, MIA and PoW issues, and the effectiveness of chemical warfare in the conflict. Later installments will analyze selected Iranian operations during the war to establish data such as average loss rate per day, mean length of engagements, advance rates, dispersion factors, casualty thresholds affecting breakpoint and other issues.

Casualties as Reported and Estimated

Too often incorrect formulae were applied to calculate casualties or the killed to wounded ratio. The standard belief was that Iran suffered two wounded for every killed—a ratio not seen since the ancient world. Colonel Trevor N. Dupuy established that the average distribution of killed to wounded in the 20th Century warfare is on the order of 1:4 and in fact this relationship may be as old as the year 1700.[1] In Operation Peace for Galilee of 1982 the Israeli ratio of killed to wounded was on the order of 1: 6.5 while the Syrian was 1: 3.56.[2] At the same time in the Falklands UK casualty ratio was 1: 3. For Argentine ground forces it was 1: 4.85.[3] Also it was assumed that Iran must have suffered 3–4 times the casualties of Iraqi forces in many given engagements on the basis of no good evidence this author can find.

Typical western estimates of Iranian losses in the war are given below:[4]

	Low End	High End
KIA	450,000	730,000
WIA	600,000	1,200,000
Total	1,050,000	1,930,000
PoW	45,000	

The lowest estimate of Iranian KIA was from the Pentagon which estimated the killed (military and civilian) at 262,000.[5]

At the end of 1980 the Iraqis claimed 4,500 Iranian KIA and 11,500 WIA.[6] Iraqi claims as of 22 September 1981 were 41,779 Iranian KIA.[7] By the end of August 1981 other estimates placed it as 14,000-18,000 KIA and some 26,000-30,000 WIA.[8] Alternate estimates placed this at 14,000 KIA

and 28,000 WIA.[9] Still others claimed 38,000 KIA.[10] During the first half of 1982 estimate was 90,000 Iranians killed.[11] Iran's casualties in its 1984 offensives resulted in 30,000–50,000 more KIA.[12] In mid–1984 Iran's KIA were 180,000–500,000 and WIA 500,000–825,000.[13] By 23 March 1985 Iranian KIA may have been 650,000 with 490,000 "seriously" wounded.[14] In September 1986 the count of Iranian dead was 240,000.[15] By April 1987 Iran had 600,000–700,000 KIA and twice that number wounded.[16] Iraq claimed 800,000 total Iranian KIA at the time of the cease-fire.[17] Figure 1 graphically depicts this reporting.

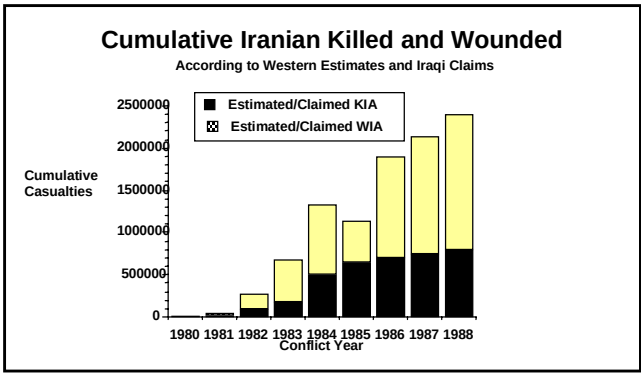


Figure 1: Western Estimates and Iraqi Claims

Official Iranian statistics released on 19 September 1988 immediately after the cease fire listed the following casualty figures:

Killed in Action: 123,220
Regular Army: 35,170 (29%)
Pasdaran: 79,644 (65%)
Paramilitary: 8,406 (6%)

Died of Wounds: No Official Figures, Assumed Contained in Above

Wounded in Action: No Official Figures

"Missing in Action": 60,711 (actually included possible MIA and PoW)

PoWs: ~ No precise figure for status. Included in "Missing in Action"

Non-Battle Deaths, Injuries etc.: No figures

Civilian Deaths Due to Enemy Action: ~ 11,000

Civilian Wounded Due to Enemy Action: ~ No Official Figures but > 34,000

Chemical Casualties: ~ 100,000
Chemical KIA: "25,000" (sic, 2,500 see below)
Military: ~ 45,000
Civilian: ~ 45,000
"Other" (Probably friendly Kurds): ~ 10,000

Iranian Missing in Action: Wanted Dead or Alive

By 1995 Iran had conducted seventeen dedicated MIA retrieval operations from wartime battlefields. Approximately 80% of the MIAs are believed to lie in Iraqi territory. In that year Iran proposed a joint Iranian–Iraqi accord to retrieve the missing of both sides.[18] Brigadier General Mir Feisel Baqerzadeh and IRGC Brigadier General Behahim Safaie head the Special Commission for MIA Retrieval. Iran claimed to have recovered or settled some 21,000 cases by early 1995. In that time 2,505 MIAs had been retrieved by joint search operations in Iraq and another 12,638 in Iranian territory, the latter representing 85% of those estimated missing in Iranian held ground. Back calculating these figures indicates total Iranian missing was now regarded as 72,753, up 20% from the original figure of 60,711. By October 1996 the count was 24,000 retrieved.[19] By June of 1997 the number of MIA cases resolved had risen to 33,000 including 6,000 death certificates issued at family request for individuals of whom no trace had ever been found.[20] As of September 1997 the total number of MIA bodies recovered stood at over 37,000 according to Brigadier General Baqerzadeh.[21] "Martyr" (i.e. killed in action) status entitles the family to a $24,000 lump sum death benefit as well as a $280 monthly pension with provision for $56 a month for each dependent child from the Foundation for the Martyrs.[22]

The rate of actual forensic identification of the remains is unknown. One source mentions a positive identification of some 900. The standard practice seems to be determination of the operation in which they were martyred and the provincial origins of units in that engagement. Wartime operations which have yielded large numbers of MIA remains are *Beit ol-Moqqadas*–4, *Kheiber*, *Karbala*–4, *Karbala*–5, *Karbala*–6, *Karbala*–8, *Karbala*–10, *Ramazan*, *Badr*, *Kheiber*, *Muslim Ibn–e Aqil*, *Wal Fajir* Preliminary Operation, *Wal Fajir*–1,*Wal Fajir*–2, *Wal Fajir*–6, *Wal Fajir*–8, *Fath*–5, and the Iraqi attacks on Majnoon and Shalamech. The retrieval operations are often dangerous and occur in former minefields. As of 1995 eleven IRGC personnel had been killed and fourteen seriously wounded in MIA retrieval operations. Individual military units often recover their own MIAs. In a speech at Gurgan, Ali Mirtaheri, head of the committee in charge of search teams for MIAs of the 27th *Hazrat–e Rasul Pasdaran* Infantry Division, stated in November 1997 that divisional teams had recovered 1,610 MIA bodies. Forty–two team members from the division have been killed and another eighty maimed in the operations (probably from leftover mines).[23]

Due to the number of cases and the vigorous retrieval operations MIA funerals tend to be mass affairs. Burials in Tehran alone tell the story. In October 1993 208 were buried in Tehran and 360 in other locations. In October 1994 1,000 martyrs were buried in Tehran; in April 1995 another 600 of 3,000 just recovered MIAs and the following month 405 more in Mashad; in October 1995 600 were interred; 750 in October 1996; 1,000 more in January 1997; in July 1997 another 2,000 including 400 from Tehran Province were

interred nationwide; in September 1997 200 of 1,233 interred nationwide, including 47 in Qazvin, 34 in Khuzistan, 5 in Shustar and 5 in Sistan–Baluchistan. Of these only 118 were unknowns. [24] Unrecovered Iranian MIAs are carried as active soldiers on their unit personnel rolls with their current status listed simply as "still at the front." Iran has also recovered Iraqi MIAs, returning up to 400 bodies at a time in a mutual exchange program usually accomplished at the Khosrawi border station in Kermanshah Province.[25] A total of 31,000 Iraqi bodies have been so returned compared to 2,500 Iranian dead returned by Iraq as of January 1997.[26] In January 1997, in conjunction with the Iraqi return of the remains of sixty Iranian MIAs of the *Wal Fajir* Preliminary Operation, Brigadier General Mir Feisel Baqerzadeh stated that Iran was willing to assume all search responsibilities and associated costs for both Iraqi and Iranian MIAs on Iraqi territory should Iraq not wish to continue recovery operations.[27] In May 1997 Brigadier General Mohammed Balar, spokesman for the Commission for Iranian PoWs, called on international organizations to pressure Iraq to clarify the status of 20,000 Iranian MIAs.[28]

Actual Numbers of PoWs and Missing in Action

By January 1982 Iran held some 28,423 Iraqi PoWs to Iraq's 5,285 Iranian captives.[29] In early 1984 Iran held 50,000 Iraqis to Iraq's 7,300 Iranian PoWs.[30] In August 1986 Iran claimed to hold some 52,000 Iraqi PoWs.[31] Just before the cease–fire in 1988 the International Commission of the Red Cross (ICRC) estimated 49,285 Iraqi PoWs in fifteen Iranian camps and 12,747 Iranians in ten Iraqi camps.[32]

On 9 August 1988 the ICRC count was 50,182 Iraqi PoWs held in Iran to 13,526 Iranians in Iraqi captivity.[33] Iran had at least 8,500 captured in the final Iraqi offensives of July 1988 and another 700 on 23 August 1988 immediately after the cease–fire went into effect.[34] PoW release had begun long before the war ended. In August 1986 Iran had released 200 Iraqi PoWs and had unilaterally released some 620-650 previously.[35] By 18 October 1988 Iran and Iraq had agreed to begin PoW exchanges. Beginning 30 October 1988 each side exchanged 25 PoWs. Eight of the 25 Iranians were civilian internees captured early in the war.[36]

On 10 November Iran and Iraq agreed again to the exchange of 1,118 Iraqi and 411 Iranian PoWs who were badly wounded or ill.[37] However, after 156 Iraqis and only 57 Iranians had been released the exchange broke down by 27 November over 63 Iraqis who refused repatriation.[38] In January 1989 Iran released 131 sick and wounded Iraqis and Iraq reciprocated by releasing 124 Iranians.[39] In February Iran offered to release another 260 ill Iraqi PoWs. One hundred fifty–eight were released, but 27 refused to return.[40] In March 1989 the more or less official count of PoWs was 50,000 Iraqi to 18,902 Iranians.[41] Iran, on 10 April, released 70 disabled and sick Iraqi PoWs and on 23 May a further 49 plus 15 other PoWs of varied nationalities who fought for Iraq.[42] No further activity occurred until December when Iran proposed more sick and disabled PoWs be exchanged and suggested that a substantial number of Egyptian nationals were among the PoWs it held.[43] Eventually on 14 March 1990 Iran released twenty Egyptians captured fighting for Iraq.[44]

It was not until after Iraq's invasion of Kuwait that the PoW issue came alive again. On 15 August 1990 Saddam Hussein offered to release all Iranian PoWs. He further allowed 17,000 Iranian nationals in Kuwait to return home. By 23 August PoW exchanges were running at 6,000 a day and some 21,000 Iraqi and Iranian PoWs had been repatriated.[45] By 4 September 23,798 Iranian and 24,250 Iraqis had been released.[46] On 16 November the two countries agreed to another exchange of 100 PoWs a day and a group of 200 Iraqis was released on 4 December, another group of 200 on 10 December 1990.[47] There is no record of Iranian PoW releases by Iraq in this time period. However, a total of 39,043 Iranian PoWs were eventually released.[48]

On 1 June 1991 Iran claimed Iraq was still holding at least 5,000 Iranian PoWs, an assertion Iraq denied. When Iran repeated the claim in October, Iraq admitted it had 400 who refused repatriation.[49] During the 1991-92 time frame another 64 Iranian soldiers became PoWs during fighting with the NLA and Kurdish groups supported by Iraq.[50]

Then in early 1991 some 5,000 Iraqi soldiers crossed into Iran to evade coalition forces in the Desert Storm War. Beginning in November 1992 Iran released 400, followed by releases of 1,000 (April 1993), 400 (May 1993), 450 (June 1993) and 459 (July 1993). Eventually 4,115 were released in fourteen intervals with the last known release bringing the total to 4,574.[51] At the same time Iran released 100 Iraqi PoWs from the War of Sacred Defense in May 1993.[52]

At that time the ICRC claimed to have had overseen the repatriation of over 80,000 PoWs held by both Iran and Iraq.[53] This figure is not borne out by the published numbers. At this time the maximum number of Iranian and Iraqi PoWs released from both the Iran–Iraq and Desert Storm wars stood at about 92,267, a discrepancy of 12,000. Some of the 17,000 repatriated civilian internees of the Iraqi invasion of Kuwait may have been counted. The ICRC still had some 19,000 Iraqis and 4,000 Iranians on its books as active PoWs.[54]

By July 1992 the only exchanges were those of 101 MIA bodies.[55] In December 1993 Iran complained Iraq was still holding 8,000 Iranian PoWs. The proof was that 26 Iranian civilian internees from the war had escaped and made it back to Iran that same month.[56]

In January 1994 Iran conceded that many of the personnel it listed as PoWs may have been KIA/MIA.[57] Then in July 1994 Iran accused Iraq of holding 16,000 Iranian PoWs.[58] According to the Red Cross Iran continued to hold as many as 19,000 Iraqi PoWs as of 1994.[59] In 1994 the ICRC calculated 4,168 confirmed Iranian PoWs still in Iraq and some 475 other unaccounted for Iranian PoWs.[60]

In August 1995 the Iraqis complained Iran still held 7,000 of their PoWs.[61] That same month Iran released 100 PoWs. The ICRC claimed at that time it had overseen the repatriation of 82,000 of 100,000 known PoWs of the war.[62] MIA exchanges continued with Iraq returning 144 dead and Iran 200 in June 1996.[63] Since then Iran released 150 of Iraqi

PoWs as late as 28 October and 724 on 27 December 1996 making a total of 974 that year.[64] Iraq insisted there were still 20,000 Iraqis captive in Iran.[65]

In January 1997 the two nations exchanged 60 Iranian and 70 Iraqi MIA remains, but Iraq again insisted Iran held 17,000 of its PoWs.[66] In August 1997 Saddam Hussein claimed Iran still held 20,000 (1997 ICRC figures about 13,000) Iraqi PoWs. He also claimed that all 39,000 Iranian PoWs held by Iraq had been freed except for a pilot downed during the early part of the war who was still being held as proof Iran started the whole thing.[67] The Iranians countered that 5,000 Iraqi PoWs had requested and been granted asylum in Iran which more or less agrees with 1994 ICRC figures for total remaining Iraqi PoWs (19,000 – 5000 = 14,000).[68] In September 1997 47 more Iraqi PoWs were released.[69] In total Iran has released some 48,650 Iraqi PoWs.[70] In November 1997 Iran approved release of another 500 Iraqi PoWs.[71]

Speaking in September 1997 Brigadier General Abdullah Najafi, chairman of the Iranian PoW commission, stated that "not even a single Iranian PoW has been released by the Iraqi regime in the past five years."[72] This suggests that some may have been released as late as 1992, but this author can find no record of this. The cold fact remains that since 1990 (or 1992 at the latest), no known living Iranian PoW has been recovered. 27,000 remains of MIAs have with another 39,000 estimated. A chronology of this confusing and somewhat contradictory chain of events is given below.

August 1988 ~ Official Iranian "missing": 60,711

August 1988 ~ Known Iranian PoWs at Cease-fire (ICRC): 13,526

Aug 88- Jan 89 ~ Known Iranian PoWs Released: 206

Mar 1989 ~ Known Iranian PoWs Still Held (ICRC): 18,902

Mar 1989 ~ Possible Maximum Iranian PoWs Held: 18,902 + 206 (released) + 9,200 (captured at very end and after) = 28,308.

Jan 1990 ~ Maximum Known Iranian PoW ~ 18,902 + 206 = 19,108

Sep 1990 ~ Known Iranian PoW Release: 23,798

Sep 1990 ~ Total Iranian PoW Release: 23,798 + 206 = 24,004 (26% more than known in Jan 89)

Jan 1991 (?) ~ Total Iranian PoW release 39,043. (50% more than known in Jan 89)

Jun 1991 ~ Iran claims 5,000 still held. If so, total PoW was 5,000 + 39,043 = 44,043.

Dec 1993 ~ Iran Claims 8,000 PoW still held. If so, total PoW was = 39,043 + 8,000 = 47,043.

Jan 1994 ~ Iran admits "many" PoWs may be MIA/KIA.

Jul 1994 ~ Iran claims 16,000 PoWs still held. If so, total PoW was 39,043 + 16,000 = 55,043.

Jun 1995 ~ 21,000 MIAs recovered. Iran estimates total missing (and presumed dead) at 72,753, leaving 51,753 missing in action unrecovered.

Oct 1996 ~ 24,000 MIAs recovered. Revised Iranian hopeful estimates list 20,000 more MIA (dead) and 30,000 PoWs still unreleased. If so, total PoW was 39,043 + 30,000 = 69,043.

May 1997 ~ 27,000 total MIA recovered. 33,000 total cases resolved. Residual missing now 39,753. Iran calls on Iraq to clarify status of "20,000 PoW/MIA."

Jun 1997 ~ Iran again claims 5,000 PoW still held.

Oct 1997 ~ Remains of over 37,000 MIAs recovered.

This author's figures (admittedly incomplete) indicate the release of 92,267 PoWs (plus 547 more Iraqis as of November 1997) by both sides resulting from the Iran-Iraq and Desert Storm conflicts. If ICRC figures for "PoWs" (which seems to include PoWs and CIs from both conflicts) are correct 18,000 are still unreleased. Their own figures list 13,000 Iraqis and 5,000 Iranians still unreleased which makes up the difference.

It is the opinion of this author that, aside from the 400 expatriates Iraq admitted, that the "5,000" Iranian PoW and "20,000 PoW/MIA" still unaccounted for will be shown to be KIA (dead on the battlefield or died in captivity) as recovery operations proceed (20 more were delivered to Iran in June 1997 and another 15 in August). The alternate possibility is that some or most of these personnel now serve in the NLA or other Iraqi supported resistance groups and their identities and existence are concealed for this reason. There is no real evidence that such a large number of living Iranian PoWs are still being held by Iraq. Another chilling possibility recently raised is that some Iranian PoWs may have disappeared into the Iraqi biological weapons programs as human guinea pigs.[73]

[Author's note: As this article went to press I uncovered a small piece of information from 1988. In reference to some of the Iranian MIAs being defectors to the Iraqi–sponsored NLA, the Iranians estimated that as many as 3,000 of their troops may have defected while PoWs in Iraq. They have never mentioned this since. Also 136 Iranian soldiers were arrested and shot for desertion.]

The continued Iranian insistence on 5,000 possible remaining PoWs may also be related to the 6,000 missing de-

clared dead at family request without recovery of a body. In an interesting turn to usual practice, the families seem to have given up hope before the government has lost interest.

Further complicating the matter, Iran seems to have lost control of its accounting procedures. Originally listing 60,711 "missing" in 1988, this increased to 72,753 estimated MIA by 1995. If we combine the 39,048 released PoWs with 72,753 estimated MIA, Iran actually had some 111,801 PoW/MIA during the war or 84% more than they first thought. If there *are* 5,000 Iranian PoW still held by Iraq then the total would be 116,801 or 92% higher than estimated.

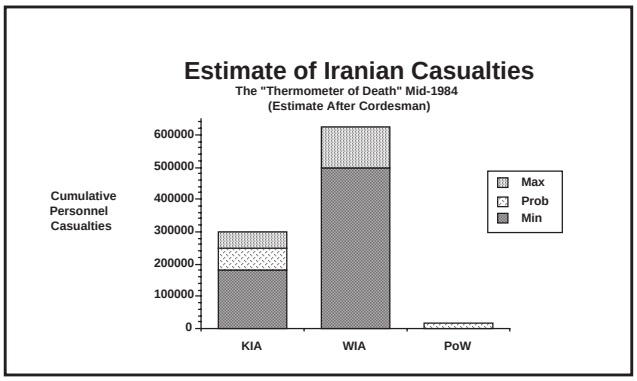
The answer to this poor accounting probably lies in the overall organization for combat employed by Iranian forces during the war. In addition to the regular army and *Pasdaran*, Iran employed a third component called the *Baseej*. The *Baseej al Mostafazim* (Mobilization of the Oppressed) was founded as a wartime expedient to augment the IRGC and formally placed under their control in January 1981. *Baseej* formations comprised 300–man battalions divided into 100–man companies with 22–man platoons armed with light weapons.[74] Their functions were IRGC reinforcement in the war. *Baseej* units fought extensively in the War of Sacred Defense (1980–88). However, their availability was only episodic as their tour of duty was normally only three months, usually from January to March. At this time most *Baseej* were rural peasants, often very young (some only 10) or very old and illiterate, who had to return for spring planting and fall harvests. As a result their training was rudimentary, often as little as two weeks of small arms and hand grenade practice. It was the *Baseej* who were given plastic keys to hang around their necks with the promise these would unlock the gates of paradise if they were killed in action.[75] As many as two million *Baseej* forces saw combat in the imposed war with Iraq.[76]

When the Iranian government offered its original tally of dead and missing in 1988 the *Baseej* losses were not mentioned separately and assumed to fall under the category of *Pasdaran*. It was only after the war when most (if not all) Iranian PoWs had been released and the magnitude of the MIA issue became evident that Iran realized it had suffered far more losses than originally thought. It is likely the degree of *Baseej* unit administration and accountability was far below regular army or established *Pasdaran* formations. Given the episodic nature of their participation, widespread personnel illiteracy and their poor level of training (and the fact they were used as temporary human "fill" for *Pasdaran* formations), it is unlikely that unit returns were maintained in anything like a proper or organized manner.

This author believes that the bulk of the additional true MIAs claimed since the end of the war are represented by primarily *Baseej* fallen who were simply not originally accounted for in established *Pasdaran* or regular army unit returns. *Baseej* units made up to 40% of Iranian force strength during the war. The 73,000 now–claimed missing (and presumed dead) of the war represent 38% of the total known and presumed combat dead (circa 188,000—see below). This is too close to be accidental.

Killed and Died of Wounds.

As early as 1984—only half way through the war—estimates of Iranian casualties were wildly exaggerated as equally as wildly divergent. Figure 2 illustrates this so–called "Thermometer of Death" widely believed in the West.



Of 72,753 currently estimated MIAs virtually all are probably KIA. When this is added to the official KIA count of 123,230 we arrive at a total of 195,983 fallen.

Another clue for total KIA total comes from the *Behest–e Zahra* Military Cemetery in Tehran. In this cemetery rest 36,000 fallen from Tehran Province alone.[77] The Iranian Army was (and is) a territorially based and mobilized entity. Depending on population base, the regions and provinces support various numbers and echelons of operational units. For example, the entire 1st Sarollah Corps is mobilized in Region 10 (Tehran) which has the largest population base. Kerman province, which is far less populous, is home to only the 41st Sarollah Division and the Zulfiqar Brigade.[78] Given this fact we may postulate that total casualties of all provinces are proportional to their populations. If so, the 36,000 KIA from Tehran Province (about 20% of Iran's total population) represents about 20% of total KIA. This leads us to the calculation Total KIA = 36,000 * 5 = 180,000. This proportion is also confirmed by the mass ceremony for 3,000 recovered MIAs in February 1995. Six hundred of these were from Tehran Province, 20% of the total count in this instance.[79] Again when 1,200 martyrs were buried nation wide in October 1997, 112 (or 17%) were from Tehran Province.

If we do a simple average of the two figures we arrive at somewhere in the vicinity of 188,000 KIA. The minimum is too low as all MIAs are not yet accounted for. I use the average rathger than the maximum as I feel that probably several thousand of the missing were defectors or collaborators who joined the ranks of the Iraqi sponsored National Liberation Army of Iran. Iran recruited at least 10,000 Iraqi PoWs into their "Badr" Army of Iraqi expatriates to fight against Saddam Hussein.

The Moshen Rezai Excursion

In September of 1997, outgoing commander of the *Pasdaran*, Major General 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.[80] 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.

Possible Clues to Non-Battle Deaths

Another piece of indirect evidence comes from the vast quantities of Iranian equipment captured by Iraqi forces between March and July 1988. These losses included 1,298 tanks, 155 infantry fighting vehicles, 512 armored personnel carriers, 365 pieces of artillery, 300 anti–aircraft guns, 6,196 mortars, 5,550 recoilless rifles, 8,050 RPG–7s, 60,164 assault rifles, 322 pistols, 501 engineer vehicles, 6,156 radios, 2,054 trucks and light vehicles, 16,863 items of NBC defense equipment and 24,257 caskets.[81] It is the caskets which are of interest.

These were obviously intended for Iranian dead. For an army that popular imagination saw as taking 10,000 dead in a single battle this was a paltry number. In early 1988 Iran had 600,000 troops on the battle front. 24,000 represents only 4% of this number. Interestingly, if this author's calculation of Iranian KIA at circa 188,000 is correct, annual average war deaths would be roughly 188,000 / 8 or 23,500, almost the exact number of caskets. However, the Iranians did not know they were actually taking this many dead. They listed only 123,220 KIA at war's end, not realizing how many "missing" (PoW/MIA) they really had and that over half of these were, in fact, dead. Expected annual war dead under their original figures would have been 123,000/8 = 15,000. This figure is 40% less than the casket cache total, but probably represented an Iranian planning factor for annual graves registration requirements at the front, but with a 60% hedge?

Sixty percent seems somewhat excessive. 10–25% is a more normal "fudge" factor. It may, however, provide a clue to the rate of Iranian non–battle deaths which would require caskets too. In the latter case this would indicate a non–battle to (then known) battle deaths ratio of roughly .6. This would represent something like 74,000 non–battle deaths (accident, disease etc). Ground truth ratio (with now known MIA dead) would be .39. This is almost identical to US experience in WWII (.36) and does not approach the WWI experience (1.43).[82]

Wounded

No official Iranian figures of overall wounded have been released to this author's knowledge. Major General Rezai in the interview cited above mentioned some 200,000 permanently disabled. For reasons given above, this probably represents all components, not just *Pasdaran* forces. Given the standard 4:1 wounded to killed ratio, Iranian wounded must have been about 752,000. This gives a total battle casualty sum of right at 940,000. A problem is we have no data on Died of Wounds (DoW) as a category. Also the war was one of general chemical release which biases figures somewhat as the experience of WWI shows.

If the official Iranian figures are only rigorous KIA (death within one hour and counting 72,754 MIAs as KIAs) then using a "WWI w/gas" planning factor the ratio of wounded to killed would be 5.96 indicating about 1,120,480 "wounded." This is probably high as the blanket Iranian causualty figures for deaths probably include both KIA and DoW.

Pasdaran *soldiers on the march.*

If we consider the Iranian figures to indicate both KIA and DoW the "WWI w/gas" ratio of surviving wounded to KIA and DoW of 4.1 yields 770,800 "surviving

wounded."

The average of these latter two figures is on the order of 945,440 wounded. This produces a ratio of 5:1. It seems reasonable that this average is closest to the truth.

Another clue to total Iranian wounded comes from the statistics of the Khuzistan Blood Transfusion Center. During the war the center provided 736,284 units of blood and blood products for both combatants and civilian patients in the province. The center itself produced 501,639 of the units.[83] In WWII 10–12% of wounded were transfused with an average usage of 4.3 units of blood per patient.[84] It is likely the center used the majority of its blood products for combatants. If the 501,639 units it produced itself was so used with the remainder procured for the civilian population, applying WWII standards the total number of wounded transfused would be: 501,639 / 4.3 = 116,660. This in turn might represent 12% of total wounded. Back calculating gives 116,660/12 * 100 = 972,168. This is very close to the above estimate of 945,000 surviving wounded. It, however, may be high as it would probably include a substantial number who received transfusion, but died of wounds

One last observation—the Iranians tried to make extensive use of Medevac helicopters during the war similar to US Army practice in Viet Nam. In the latter conflict the ratio of KIA and DoW to surviving wounded was 4.16 very close to the "WWI w/gas" planning factor of 4.1.[85] However, the Medevac solution was not completely feasible as it did not suit Iranian climatic and geographic situations. As a result the Iranians built a series of underground clinics immediately behind the front lines which offered the best and most expeditious medical service to their wounded according to Brigadier General Abolqasem Musavi, chancellor of the Iranian Army Medical University. This system allowed speedy evacuation and treatment of wounded even in mass casualty situations.[86]

Given that the Iranian Army suffered on the order of 1,133,000 casualties in the War of Sacred Defense what else does this tell us about the conflict ?

First, the average annual "theater" battle casualties would be approximately 28% or 141,000 battle casualties per year (given that the Iranians had about 500,000 troops committed at any one time). This rate is only little over half that of WWI although about 50% higher than that of WWII. As far as US wars are concerned it most resembles that of the US Civil War (24.6%).

The distribution of casualties is also in accordance with modern experience since 1945. The dead (188,000) represent about 17%, severely wounded (200,000) about 18% and other wounded (745,000) about 65%. This matches closely with T.N. Dupuy's historically derived distribution of modern war casualties of 20% KIA, 15% severely wounded and 65% other wounded.[87]

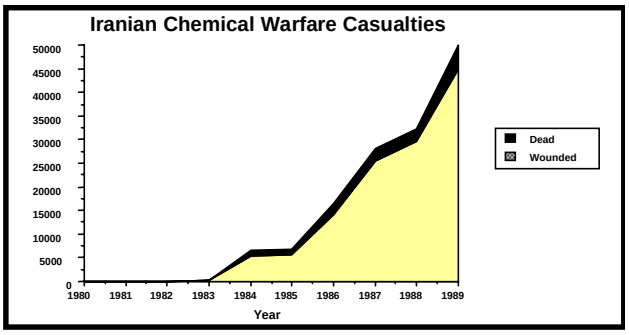
Chemical Casualties

The War of Sacred Defense was the only conflict of the 20th Century other than WWI fought under conditions of general chemical release. The Iranian ground forces were generally ill–prepared for chemical defense. During the course of the war 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 solders became gas casualties because they did not shave often enough to allow their protective masks to make a tight seal.[88]

Throughout the war Iraq employed chemical weapons against Iranian forces 195 times. After the chemical attack on Halabja in March 1988 killed some 4,000–5,000 civilians and maimed 7,000 others, the IRGC sent a video crew to document the atrocity. The video was used as a training film for Iranian recruits. Instead of instilling hatred for Saddam's brutality, the film demoralized its viewers and exaggerated the power of Iraqi chemical weapons.[89] Iranian troops later panicked under gas attack conditions at Fao and Majnoon and abandoned their positions. However, this phenomenon was widespread in the First World War.[90] Further, chemical attacks were usually not significantly lethal. This is again in accord with WWI experience. Gas inflicted 70,552 casualties on the American Expeditionary Force in 1917–18. Of these only 1,221 died (2% lethality). The British Army suffered 185,706 gas casualties of which only 5,899 died (3% lethality). Total British battle casualties for WWI were 677,515 KIA and 1,837,613 WIA. Gas accounted for only 7% of all British casualties and only 1% of all KIA. The Russian Army suffered an amazing 600,000 gas casualties with a lethality rate at times as much as 12%.[91]

Iraq may have first used gas in late 1980 near Salamcheh. Iran reported its first chemical casualty in fighting near Hoveyzeh in early 1981. These early attacks seem to have been limited to the riot control agent CS. On 27 October 1982 near Musain four Iranian soldiers died from toxic chemical exposure, probably mustard gas. 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.[92] Between May 1981 and March 1984 Iran claimed Iraq had employed chemical weapons on forty nine different occasions. This had resulted in 1,200 Iranian dead and 5,000 wounded.[93] Mycotoxins may also have been used.[94] On 17 March 1984 Iraqi forces employed gas which caused 400 Iranian casualties, 40 of which were from nerve agents.[95] In the *Badr* operation (1–18 March 1985) Iraq used chemical weapons five times, but inflicted only 200 Iranian casualties, none apparently fatal.[96] In one unnamed 1985 attack Iran claimed 11,000 troops were exposed to Iraqi chemical agents.[97] In *Wal Fajir*–9 (15 February–11 March 1986) Iran claimed 1,800 chemical casualties from a total of about 30,000.[98] Up to 8,500 Iranian soldier were gas casualties by the end of *Wal Fajir*–8 and *Wal Fajir*–9 (15 February–19 May 1986) with about 700 killed or seriously wounded.[99] In attacks on 27 and 30 January, 9, 10, 12, and 13 February 1986 reportedly 8,500 Iranian gas casualties were suffered of which 35 died and 2,500 had to be hospitalized.[100] In *Karbala*–4 (24–26 December 1986) only five Iranian

troops died from toxic gas out of 10,000 battle casualties.[101] By early 1987 chemical weapons had inflicted at least 10,000 Iranian casualties.[102] In all Iran had suffered 25,600 gas casualties by April 1988 of which 260 (sic 2,600?) died. Iraq's extensive use of chemical agents in the final months before the August 1988 cease–fire may have raised the casualty count to as much as 45,000.[103] In the Iraqi "In God We Trust" offensive of June 1988 against Majnoon Iran claimed sixty soldiers killed and 4,000 wounded by Iraqi chemical weapons which included nerve and blood agents.[104] A small UK article on mustard gas from the Internet cites 5,000 Iranian troops killed by gas and 40,000-50,000 injured during the war.[105] The overall cumulative wartime pattern of Iranian military chemical casualties is illustrated in the below figure.



Speaking in 1996 Abdollah Mazandarani, Secretary General of the Iranian Foundation for Chemical Warfare Victims, claimed 25,000 Iranian soldiers were "martyred" (killed?) by Iraqi use of chemical weapons in operations *Wal Fajir*–8, *Karbala*–8, *Badr*, Fao, and Majnoon. 45,000 civilians were also affected by chemical weapons.[106] Iran claims at least 100,000 wounded by chemical weapons during the imposed war with Iraq. 1,500 of these casualties require constant medical attention to this day. Since 1991, 118 have died as a result of their toxic chemical exposure according to Hamid Sohrab–Pur, head of the Foundation of the Oppressed and Disabled's Center for Victims of Chemical Warfare.[107] One of these was Reza Alishahi who died in September 1994 after suffering 70% disability when he was gassed during the *Wal Fajir* offensives of 1987.[108] Another pathetic story is that of Magid Azam, now a 27–year–old medical student, who was a 16–year–old *Baseej* fighter gassed with mustard in the *Karbala*–5 offensive of January 1987 with no apparent permanent effects. In 1995 his health suddenly began to deteriorate so rapidly he required intensive care. His lungs are now so damaged that only a transplant an save his life. He is one of 30,000 Iranian veterans who have receved treatment for recurring or delayed reactions to chemical weapons. It is estimated that up to 100,000 Iranian soldiers were exposed to toxic agents during the war[109]

In the First World War toxic chemical agents accounted for only 4–5% of total casualties. Of 1,296,853 known chemical casualties in that conflict, 90,080 died (7%), 143,613 were badly wounded (11%) and the remaining 1,053,160 (82%) not seriously affected.[110] 25,000 Iranian military dead out of 45,000 chemical casualties gives an incredible chemical lethality rate of 56%, higher than that for land mines. This claim of 25,000 Iranian troops "martyred" is not an exaggeration, but rather a probable misprint.[111] Elimination of an extraneous zero makes the number 2,500 in line with previously released figures. This would give a chemical lethality rate of 6% per chemical casualty, remarkably close to WWI general rate although somewhat higher than individual US or British expereience. Further, 45,000–55,000 military chemical casualties out of 1,133,000 total combat casualties yields a 4% casualty total for chemical weapons, again in line with overall WWI experience. 2,500 dead from chemical weapons is only 1% of total Iranian KIA. If 5,000 cited above is correct, about 3%. A representative sample of 400 chemical warfare casualties treated at the Labbati–Nejad Medical Center in Tehran in early 1986 yielded 11 deaths (3%) and 64 (16%) very seriously injured.[112]

Civilian Casualties

The Iran–Iraq War produced remarkably few civilian casualties compared to WWI or WWII rates. UNICEF data suggests that prior to WWI that civilians accounted for only 5% of all deaths in a given war. This rose to 15% in WWI and an astounding 65% in WWII.[113] Iran claims 11,000 civilian deaths as a result of the war primarily through Iraqi air and missile strikes. The author's own study of Iranian civilian deaths places it at about 8,800 known deaths indicating this number is probably very close to the true figure. If so, civilian deaths accounted for just 5% of total war dead, a turn of the century standard. The number of wounded has not released, but this author figures can account for over 34,000 civilian wounded by air and missile strikes. Further, Iran claims 45,000 civilian "chemical" casualties. If all claims are true then approximately 90,000 civilians became casualties of the war.

This yields a military to civilian casualty ratio of 11:1. This is far better than the ratio claimed in recent wars of 1:9. This suggests that despite the hysteria surrounding "War of the Cities" the Iranian civilian population was not severely at risk during the war. Compare this to WWII England where the one year German V–1/V–2 campaign killed 8,588 and wounded 46,838.[114] Then contrast it to total English civilian casualties during WWII at 60,000 dead and 86,800 wounded due to the blitz and buzz bombs. UK military killed, wounded and missing (excluding PoW) were 582,900 in WWII giving a military to civilian casualty ratio of 4:1.[115] Of course the WWII German bombing and missile campaigns against England were far more severe than that experienced by Iran at the hands of Iraq.

Civilian chemical casualties match military in magnitude. At first this might seem strange. I have found no WWI data on military to civilian casualty ratios as regards chemical agents so there is no point of comparison or contrast here. The high number of civilian chemical casualties seems to be a function of several factors. First some 2,000 Iranian towns and villages lay in areas where Iraqi forces employed chemical weapons.[116] Secondly, Iraqi chemical strikes were often delivered deep into Iranian rear areas to attack reinforcements

and support troops. Casualties were often high as the rear echelon troops were less well equipped and prepared to cope with chemical attacks.[117] In these rear area attacks the civilian population density must have been much higher than on the front line. Further, civilians probably had no means of chemical defense. Witness the chemical attack on Halabja in March 1988 with mustard, nerve and cyanogen chloride which killed some 4,000–5,000 civilians and maimed 7,000 others. This may explain the 1:1 relationship between overall Iranian military and civilian chemical casualties.

Summing Up

If we estimate that at least 5,000,000 troops (about 12% of Iran's then population) served in the war zone then the military casualty distribution is not less than the following (**Bold** indicates the author's choice from ranges).

Killed in Action/Died of Wounds: **188,000** (156,000 – 196,000) (17%)

Wounded in Action: **945,000** (754,000 – 1,110,000) (83%)

Severely Wounded/Disabled: **200,000** (18%) (Note: carve out of total wounded)

Missing in Action: **73,000** (6%) (Note: Carve out of total KIA plus several thousand possible defectors/collaborators)

PoW: **39,000 –** 44,000

Total Military Battle Casualties (KIA + WIA): **1,133,000** – 1,302,000 (28% theater rate)

Possible Non–Battle Military Deaths: **74,000**

Non–Battle Military Injuries: No idea.

With Civilian KIA (11,000) and WIA (34,000) and "chemical" (45,000) Total Hostile Action Casualties: **1,223,000**

With Possible Military Non–Battle Deaths (74,000): **1,297,000**

Total Deaths Due to the Imposed War: **273,000** (104% of Pentagon Estimate of 262,000)

Of **5,000,000** estimated Iranian combatants (1 million regular army, 2 million *Pasdaran*, 2 million *Baseej*) ~
4% were Killed in Action/Missing in Action
4% were Disabled
13% were Wounded
1% were Non-Battle Deaths
1% were PoWs

Total military losses all known causes ~ 27%
The military battle casualty total percentile (27%) is intermediate between that of WWI (50% ~ British Army) and WWII (13% ~ US Army/USMC, 22% British Army).[118]

The author acknowledges the highly speculative nature of much of the data and argument presented above. It is offered as a preliminary starting point to further study. As such, the author would appreciate hearing from anyone with additional data on this subject. In particular he would invite the Government of the Islamic Republic of Iran to provide any information that would corroborate, correct or expand on the information presented in this article.

Mr Beuttel is employed as a military analyst by Boeing Information, Space & Defense Systems. The views and opinion expressed in this article are not necessarily those of the Boeing Company.

[1] Trevor N. Dupuy, Attrition: Forecasting Battle Casualties and Equipment Losses in Modern War, Fairfax, VA: HERO Books, 1990.

[2] Richard Gabriel, Operation Peace for Galilee: The Israeli PLO War in Lebanon, New York: Hill and Wang, 1984. pp. 235-236.

[3] Martin Middlebrook, Task Force: The Falklands War, 1982, Revised Edition;London: Penguin Books, 1987, pp. 382-385. Martin Middlebrook, The Fight for the Malvinas, London: Penguin Booksm 1990, pp. 283-284. The low British ratio in the Falklands is a result of many ground forces being killed in mass while still aboard the *Sir Galahad*. This deflates the ratio *vis a vi* that actually experienced in ground combat. The shipborne dead should more properly be considered naval casualties.

[4] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, p. 3.

[5] Dilip Hiro, The Longest War: The Iran-Iraq Military Conflict, London: Paladin Books, 1990, p. 4.

[6] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, p. 144, n. 2..

[7] Dilip Hiro, The Longest War: The Iran-Iraq Military Conflict, London: Paladin Books, 1990, p. 275, n. 26.

[8] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, p. 120.

[9] Edgar O'Ballance, The Gulf War, London: Brassey's, 1988, p. 74.

[10] Dilip Hiro, The Longest War: The Iran-Iraq Military Conflict, London: Paladin Books, 1990, p. 54.

[11] Edgar O'Ballance, The Gulf War, London: Brassey's, 1988, p. 88.

[12] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, p. 198.

[13] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, p. 434, Figure 12.3.

[14] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, p. 215, n. 18.

[15] Dilip Hiro, The Longest War: The Iran-Iraq Military Conflict, London: Paladin Books, 1990, p. 175.

[16] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, p. 261.

[17] Dilip Hiro, The Longest War: The Iran-Iraq Military Conflict, London: Paladin Books, 1990, p. 250.

[18] "Iran Proposes Joint Committee to Decide Fate of PoWs," IRNA, 18 October 1993.

[19] "The Remains of 750 Iranian Soldiers..." Al Akhbar Muslim World News, 15 October 1996.

[20] "Remains of Twenty Martyrs of Imposed War Handed Over to Iran," IRNA, 1 June 1997.

[21] "Funeral Service to be Held Nationwide for 1,233 War Martyrs," IRNA, 1 October 1997.

[22] Dilip Hiro, The Longest War: The Iran-Iraq Military Conflict, London: Paladin Books, 1990, p. 54.

[23] "37,000 Bodies of Martyrs Discovered in Seven Years," IRNA, 10 November 1997.

[24] "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.

[25] "3,000 Bodies of Martyrs Found on Former Iran-Iraq Battlefields," IRNA, 15 February 1995; "Funeral Service Held for 405 Martyrs in Mashad," IRNA, 6 March 1995; "Cases of Over 21,000 MIA's Settled So Far, IRNA, 19 February 1995; "568 More Bodies of Iran's MIAs Uncovered," IRNA, 17 October 1993; "Paper on PoW Issues," IRNA, 31 May 1993; "IRGC Official: Investigations Continue to Find Our Martyrs' Bodies," IRNA, 20 February 1995; "Bodies of 65 Martyrs of Iraq-Imposed War Delivered to Iran," IRNA, 13 August 1993; "Leader Attends Funeral for 600 Martys," Iran News, 28 October 1995; "Leader Attends Funeral Service for 1,000 Martyrs," Iran News, 20 October 19997; "War: MIAs Search Operation for MIAs Extended Another Year," IRNA, 23 October 1995.

[26] "Funeral Ceremony for 1,000 Soldiers Killed in War Against Iraq," Iran Weekly Press Digest, 21-31 January 1997.

[27] "Bodies of Sixty Martyrs Handed Over to Iran," IRNA, 7 January 1997.

[28] "Iran Calls in International Clout to Find 20,000 PoWs," Iran News, 20 May 1997.

[29] Edgar O'Ballance, The Gulf War, London: Brassey's, 1988, p. 104.

[30] Dilip Hiro, The Longest War: The Iran-Iraq Military Conflict, London: Paladin Books, 1990, p. 106.

[31] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, p. 266, n. 58.

[32] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, p. 398.

[33] "Persian Gulf War, FYEO, NO. 195, 15 August 1988, p. 195-4.

[34] "Persian Gulf War, FYEO, NO. 195, 15 August 1988, p. 195-4; "Persian Gulf War, FYEO, NO. 195, 12 September 1988, p. 197-3.

[35] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, p. 266, n. 58.

[36] "Persian Gulf War, FYEO, NO. 201, 7 November 1988, p. 201-4.

[37] "Persian Gulf War, FYEO, NO. 202, 21 November 1988, p. 202-6.

[38] "Persian Gulf War, FYEO, NO. 203, 5 December 1988, p. 203-3.

[39] "Persian Gulf War, FYEO, NO. 206, 6 February 1989, p. 206-3.

[40] "Persian Gulf War, FYEO, NO. 207, 20 February 1989, p. 207-5; "Persian Gulf War, FYEO, NO. 208, 6 March 1989, p. 208-3.

[41] "Persian Gulf War", FYEO, NO. 209, 20 March 1989, p. 209-3.

[42] "Persian Gulf War Aftermath," FYEO, NO. 211, 17 April 1989, p. 211-3; "Persian Gulf War, FYEO, NO. 214, 29 May 1989, p. 214-5; "Persian Gulf War Aftermath," FYEO, NO. 215, 12 June 1989, p. 215-9.

[43] "Persian Gulf ", FYEO, NO. 229, 25 December 1989, p. 229-4. The reports indicated 13,000–20,000 Egyptians held, but this figure seems incredible.

[44] "Persian Gulf," FYEO, No. 236, 2 April 1990, p. 236-4.

[45] "Persian Gulf Crisis," FYEO, No. 246, 20 August 1990, p. 246-3; "Persian Gulf Crisis," FYEO, No. 247, 3 September 1990, p. 247-1.

[46] "Persian Gulf Crisis," FYEO, No. 248, 17 September 1990, p. 248-1.

[47] "Persian Gulf Crisis," FYEO, No. 253, 26 November 1990, p. 253-2; "Persian Gulf Crisis," FYEO, No. 254, 10 December 1990, p. 254-1, 254-2; "Persian Gulf Crisis," FYEO, No. 255, 24 December 1990, p. 255-1.

[48] "Iran Calls on Iraq to Release Prisoners of War," Iran News, 18 August 1997.

[49] "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.

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

[51] "1,000 Iraqi Military Men to Return to Iraq," IRNA, 17 February 1993; "Iran Releases More Iraqi PoWs," IRNA, 22 April 1993; "Iran Frees Another Group of Iraqi Army Personnel," IRNA, 19 May 1993; "450 Iraqi Military Men to Return Home Tomaorrow," IRNA, 22 June 1993; "Iran to Set Free 459 Iraqis Tomorriow," IRNA, 13 July 1993.

[52] "Iran to Release More Iraqi PoWs," IRNA, 26 May 1993.

[53] "Iran-Iraq Conflict: Repatriation Process May Resume," ICRC Press Release, 96/40, 28 December 1996.

[54] "Aftermath of the Iran/Iraq War," International Commission of the Red Cross Annual Report 1994, 30 May 1995

[55] "Gulf War Aftermath: Chronology of Events," FYEO, No. 297, 3 August 1992, p. 297-3.

[56] "Persian Gulf ," FYEO, No. 333, 20 December1993, p. 333-3: "Persian Gulf ," FYEO, No. 324, 10 January 1994, p. 324-3.

[57] "Persian Gulf ," FYEO, No. 335, 24 January 1994, p. 335-3.

[58] "Persian Gulf ," FYEO, No. 348, 25 July 1994, p. 348-2.

[59] "Aftermath of the Iran/Iraq War," International Commission of the Red Cross Annual Report 1994, 30 May 1995

[60] "Aftermath of the Iran/Iraq War," International Commission of the Red Cross Annual Report 1994, 30 May 1995

[61] "Persian Gulf ," FYEO, No. 376, 21 August 1995, p. 376-4.

[62] "Iran: 100 Iraqi Prisoners of War Set Free," ICRC News 34, 23 August 1995.

[63] "Persian Gulf ," FYEO, No. 399, 8 July 1996, p. 399-4.

[64] "Iran Releases 150 Iraqi PoWs," Compass Middle East News Wire, 28 October 1996; "General Najafi: Iran Continues to Release Remaining PoWs," Tehran Times, 13 March 1997; "724 Iraqi Prisiners of War Freed Unilaterally," Iran Review, No 2 (January 1997).

[65] "Persian Gulf ," FYEO, No. 412, 6 January 1997, p. 412-4.

[66] "Persian Gulf ," FYEO, No. 413, 20 January 1997, p. 413-3.

[67] "Iraq - Saddam Hits at Iran Over Jets, PoWs," USNI Daily Defense News Capsules, 8 August 1997.

[68] "Issue of Iranian PoWs Should Be Publicized More," IRNA, 18 August 1997.

[69] "Iran Releases More Iraqi PoWs Unilaterally," IRNA, 25 September 1997.

[70] "Iran Calls on Iraq to Release Prisoners of War," Iran News, 18 August 1997.

[71] "Iran to Unilaterally Release 500 Iraqi PoWs," IRNA, 26 November 1997; "Leader Approves Release of Iraqi PoWs," IRNA, 26 November 1997.

[72] "Iran Realeases More Iraqi PoWs Unilaterally," IRNA, 25 September 1997.

[73] "The World's Deadliest Woman?" MSNBC News, November 1997.

[74] Anthony H. Cordesman, The Iran-Iraq War and Western Security 1984-87, London: Jane's Publishing Ltd, 1987, p. 103.

[75] Kenneth Katzman, The Warriors of Islam: Iran's Revolutionary Guard, Boulder, CO: Westview Press, 1994, p. 67, 93.

[76] "Plans for 20 Million Strong Army by 2025," Iran News, 25 September 1997.

[77] "36,000 Martyr Commemoration Ceremony Wound Up," Iran News, 10 May 1997.

[78] Kenneth Katzman, The Warriors of Islam: Iran's Revolutionary Guard, Boulder, CO: Westview Press, 1994, pp. 86-89.

[79] "Leader, President Attend Funeral of 3,000 Maryrs in Tehran," IRNA, 19 February 1995.

[80] "Rezai Speaks Out About His New Appointment, IRGC," Iran News, 13 September 1997.

[81] Anthony H. Cordesman, After the Storm: The Changing Military Balance in the Middle East, Boulder, CO: Westview Press, 1993, p. 404.

[82] Trevor N. Dupuy, Attrition: Forecasting Battle Casualties and Equipment Losses in Modern War, Fairfax, VA: HERO Books, 1990, p. 51.

[83] "Kuzistan's Blood Transfusion Center's Effectiveness Role in Hygiene and War," abstract contained in "Abstracts Obtained from Iran on Medical Research Conducted After the 1980-1988 Iran-Iraq War," www.chronicillnet.org/PGWS/tuite/IRMED/IRANTOC.html.

[84] John Ellis, The Sharp End: The Fighting Man in World War II, New York: CHarles Scibner's Sons, 1980, p.169.

[85] Trevor N. Dupuy, Attrition: Forecasting Battle Casualties and Equipment Losses in Modern War, Fairfax, VA: HERO Books, 1990, pp. 48-50.

[86] "Army Medical Department Acquired Expertise," Iran News, 16 October 1997.

[87] T.N. Dupuy, Attrition: Forecasting Battle Casualties and Equipment Losses in Modern War, Fairfax, VA: HERO Bookss, 1990, pp. 165-167.

[88] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, pp. 516.

[89] Kenneth R. Timmerman, Death Lobby: How the West Armed Iraq, New York:Houghton Mifflin Company, 1991, pp. 293-94.

[90] G. M. Hammerman et al., Impact of the Introduction of Lethal Gas on the Combat Performance of Defending Troops, Fairfax VA: Data Memory Systems Inc., 1985, Contract No. DNA 001-84-C-0241.

[91] Charles E. Heller, Chemical Warfare in WWI: The American Experience, 1917-1918, Leavenworth Papers No. 10, Ft Leavenwoth, KS: Combat Studies Institute USAC&GSC, 1984, pp. 33, 91-92. This represented some 32% of all hospitalized AEF casualties in WWI. Only about 200 were killed in action outright by gas. US troops were ill prepared, poorly equipped and inadequately trained to fight on the European chemical battlefield. See Denis Winter, Death's Men: Soldiers of the Great War, London: Penguin Books, 1978, p.125.

[92] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, pp. 188, n. 23, 513-518.

[93] Edgar O'Ballance, The Gulf War, London: Brassey's, 1988, p. 149; Peter Dunn, "The Chemical War: Journey to Iran," NBC Defense and Technology International, April 1986, pp. 28-37.

[94] US Chemical and Biological Warfare Related Dual Use Exports to Iraq and Their Possible Impact on Health Consequenses of the Gulf War. (The "Riegle Report") citing

H Kadivar and S.C. Adams, "Treatment of CHemical and Biological Warfare Injuries: Insights Derived from the 1984 Attack on Majnoon Island," Military Medicine, (April 1991), pp. 171-177.

[95] Peter Dunn, "The Chemical War: Journey to Iran," NBC Defense and Technology International, April 1986, pp. 28-37.

[96] Edgar O'Ballance, The Gulf War, London: Brassey's, 1988, p. 164.

[97] "Iranians Still Suffering from Saddam's Use of Mustard Gas in War," Buffalo News, 23 November 1997.

[98] Edgar O'Ballance, The Gulf War, London: Brassey's, 1988, p. 179.

[99] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, pp. 224; Peter Dunn, "The Chemical War: Iran Revisited - 1986," NBC Defense and Technology International, June 1986, pp. 32-37.

[100] "Iran Keeps Chemical 'Options' Open; Claims to Have Upper Hand," NBC Defense and Technology International, April 1986, pp. 12-13.

[101] Edgar O'Ballance, The Gulf War, London: Brassey's, 1988, p. 193.

[102] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, p. 264, n. 39.

[103] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, pp. 516-517.

[104] Anthony Cordesman, The Lessons of Modern War, Volume II: The Iran-Iraq War. Boulder CO: Westview Press, 1990, p. 389.

[105] "Bis(2-chloroethyl)thioether, $C_4H_8SCI_2$," www.ch.ic.ac.uk/vchemlib/mol/horrible/war/mustard

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

[107] "118 Iranian Chemically Wounded War Veterans Martyred Since 1991," IRNA, 17 April 1997.

[108] "Latest Victim of Iraqi Chemical Warfare Against Iran Dies," IRNA, 27 September 1994.

[109] "Iranians Still Suffering from Saddam's Use of Mustard Gas in War," Buffalo News, 23 November 1997.

[110] Ian V. Hogg, Gas, New York: Ballantine Books,m 1975, p.136.

[111] This report was taken from the internet where sometimes an extraneous number appears in figures. Such was the case when another report stated that 9974 Iraqi PoWs had been released in 1996, when the true figure was 974.

[112] Peter Dunn, "The Chemical War: Iran Revisited - 1986," NBC Defense and Technology International, June 1986, pp. 32-39.

Time and Breakpoints in the TNDM

by Christopher A. Lawrence

I have written two articles previously about the use of time in the TNDM. This was in Volume 1, Issue 4, "Looking at Time Using the BLODB" and in the following issue "The Second Test of the TNDM Battalion–Level Validations: Predicting Casualties." To briefly summarize the problem, the TNDM treats time as a constant factor, so that if an engagement is 1 hour, casualties and advance rates are 1/24th of a 24 hour engagement. When this was tested using in the battalion–level validation and using the Battalion–Level Operations Database, this appeared to be a reasonable construct except for the really short engagements. I was unable to use the Land Warfare Database for such a test because all the engagements are longer than 8 hours, most being over 20 hours.

The tentative solution that I came to was that all engagements of less than 4 hours should be calculated as a 4 hour engagement.

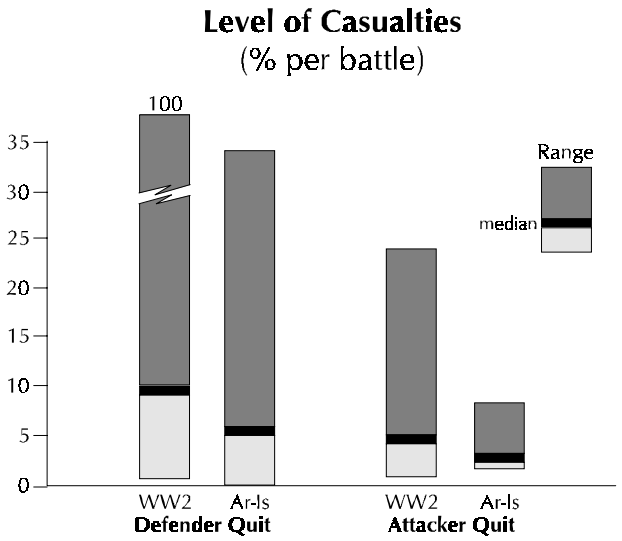
One of our TNDM users became concerned about this solution because of the way he is using the model. He uses the model as the attrition calculator for a larger model which is used for training. During an exercise, the "judge" will ask both the attacker and the defender how many casualties they are willing to suffer to take or hold a position. They then run the model for the number of hours necessary to achieve that casualty level for one side, and then give the two commanders an opportunity to change their orders.

This is a fundamentally different method of using the model. It very much touches on two issues, time and breakpoints. Let's discuss breakpoints for a moment.

A breakpoint is a change in posture. It is when the defender quits defending and starts withdrawing, or when the attacker quits attacking. When people think of breakpoints, they tend to envision people panicking, streaming to the rear, etc. This is an *involuntary breakpoint*. There are also *voluntary breakpoints*, which is when the commander orders that the attack cease or the unit should withdraw. The voluntary breakpoints are more common than the involuntary ones.

The breakpoint methodology used in many US simulations, which is simply a wrong methodology, is to set the breakpoint at some percentage level of casualties (30% or 40% are popular figures). In the real world (meaning history), breakpoints are usually decided by the commander or the situation, not the men. The commander (though maybe not the top commander) decides that the objective is no longer worth holding or the attack is not going to succeed, so he gives an order to withdraw or cease attacking; or the situation has clearly changed so that it does not make sense to continue attacking or holding that position. Command–driven breakpoints, usually driven by the situation, are the norm.

Let me refer you to Trevor N. Dupuy's book *Understanding Defeat*, which came out of a study on breakpoints for the US Army Concepts Analysis Agency. On page 210, Col. Dupuy shows from the Land Warfare Database that the median casualty rate for the attacker in a defeat during WWII was around 9% and during the Arab–Israeli Wars more like 6%, while for the defender the median casualty rate in defeat in WWII was around 4% while for the Arab–Israeli Wars it was around 3%. This chart is included below:



On page 214, Col. Dupuy asks the question

Perhaps now is the time to pose a question to the reader: "If you we fighting a losing battle, at what level would casualties make you quit?" Would you call off an attack, or withdraw from a defense, with casualties as low as many battles in the charts just presented? The casualty levels they show are certainly much lower than the ones that are seen as a matter of course in most current military planning and analysis studies. There does not appear to have been any research about unacceptable losses in combat. Until very recently, the last examination of breakpoints, for example, was published more than thirty years ago. Before the most recent study, and lacking a casualty guideline, a consensus of professional judgement was sought. A group of combat–arm officers ranging from major to lieutenant general were asked individually: "If you were a division commander, how high would casualties have to be in your division for you to quit?" Their answers, while qualified, suggested that most of them would recognize defeat on taking perhaps 50 percent casualties.

Col. Dupuy then analyzed 52 battles for which he could determine the reasons for the breakpoints, and published the following tabulation:

Reasons for a Force Abandoning an Attack or a Defense

Maneuver by Enemy		
Envelopment, Encirclement, Penetration	33	
Adjacent Friendly Unit Withdraw	13	
Enemy Occupied Key Terrain	6	
Enemy Achieved Surprise	8	
Enemy Reinforced	4	64%
Firepower by Enemy		
Casualties or Equipment Losses	10	
Heavy Enemy Artillery/Air Attacks	2	12%
Shortages of Resources		
No Reserves Left	12	
Supply Shortages	2	14%
Conditions External to the Battle		
Truce or Surrender	6	
Change in Weather	2	
Orders to Withdraw	2	10%

In effect, what this user has done is create a casualty–driven breakpoint methodology, with the commander (as opposed to some rule of thumb) determining what those breakpoints are. While I think this is an improvement over a "40% rule," I would be very interested in finding out what is the average or median percent casualties (at division–level or battalion–level combat) that the commanders take during these exercises?

There is a second problem here, which is what to do about really short engagements. I suspect this is not a real problem for this user as I doubt if any commander gives a breakpoint of less than 1% at the division–level or less than 10% for the battalion–level engagements. For most situations, it is difficult to get casualties above those thresholds in less than 4 hours of combat using the model. Therefore, I suspect this problem has not come up very often.

The problem with using the model for hourly casualty rates is that of course, the average hourly figure will be very wrong for any given hour. Over several hours it will be just fine. The problem the model had with predicting casualties in brief engagements (less than 4 hours) was, in fact, that we were using an average hourly figure to try to account for hours that were clearly not average, but indeed quite intense. This led to the interim fix of all engagements of less than 4 hours being treated as 4 hours. I do intend to test this fix in the second validation, When I get the time to complete it.

Hopefully, this begins to answer the questions of our user. My gut reaction when told of his methodology was that there was something wrong with so different an approach. My reaction now is that the user needs to first look at what casualty levels the commanders are setting. In his case, the user does have the advantage of working with officers who have had recent combat experience, so their figures may be tempered by a high degree of reality. Furthermore, the country was very "casualty sensitive" during its operations. If the casualty levels set by the commanders are resulting in battles that are producing casualties that are higher than the historical norms (or the norms from their last war), then in fact he has just created another type of "40% rule" and this is fundamentally flawed.

Perhaps the best way to use the model in his training environment is to simply provide periodic combat reports to the commander, say every four hours, and at that point the commander can then intervene and determine if they need to make a change. For example, if after four hours of engagement, it is clear that the mission is not going to succeed, there is no reason to continue the engagement past that point until you reach 10, 20, 40, or whatever percent level you have previously decided was acceptable.

A Look at the OLIs of APCs, ACs, IFVs, and CFVs

by Christopher A. Lawrence

There are five potential problems with the revised scoring methodology for the Armored Fighting Vehicles (AFVs). They are:

1. The value of the vehicle as an "infantry" weapon is under-represented.
2. The value of the certain tanks relative to each other is not correctly represented.
3. The overall value of the armored forces within a combat unit is not correctly represented.
4. The effects of making infantry mobile is not fully represented.
5. The revised OLIs have not been properly validated.

While this article is intended to only look at the first and fourth problem, let me briefly address all five issues.

The value of the vehicle as an "infantry" weapon is under represented. To me, this is the most clearly identifiable problem to correct in the new AFV OLI methodology. Quite simply, we have a situation where some machine gun armed APCs (Armored Personnel Carriers) have a lower OLI than the same machinegun, man–portable. This is what this article will address.

The value of the certain tanks relative to each other is not correctly represented. This is the issue that seems to be first one that most people look at. Everyone seems to have a clear opinion as to which tank is better than which, and some of the OLIs do not match their opinion. In fact, much of the criticism I've heard related to the QJM seemed to be over whether one tank was better than another. While I agree with some of these criticisms, the predictive accuracy of the model is not going to hinge on whether a Panther is 1.5 times or 1.8 times better than a Sherman. While this is worth taking a look at, the original reason for the new OLI methodology was to correct this problem among modern weapons. I believe this has been reasonably done, and do not intend to address this further.

The overall value of the armored forces within a combat unit is not correctly represented. This concerns me greatly and will be addressed at some point in the future. When the new AFV values were created, when compared to the old values, they ended up overall increasing the OLIs for new tanks and decreasing them for WWII tanks. This fundamentally reduces the overall contribution of armor to the total OLIs for WWII engagements and the value of a tank in WWII compared to other weapons systems (like artillery and aircraft).

The effects of making infantry mobile is not fully represented. This is not a problem, although it may first appear to be one. The OLIs measures the operational combat power of each weapon. It does not measure their combat power when one mobilizes the infantry weapons within the unit. But the TNDM does separately measure the overall effect of mobility on the unit. This point is sometimes missed when looking at the model. Combat mobility is a major force multiplier in the model and is calculated using the mobility equation. How this is done is briefly demonstrated below and in more depth in the following article. The actual value of the APC, beyond its value as an independent weapon system, is measured in the mobility equation.

The revised OLIs have not been properly validated. When the new OLIs were created, they needed to be validated back to the original QJM database. This was not done due to time and money constraints. While the current battalion–level validation is being done using these new values, there is no comparison to the old values that allows one to determine if the change in OLI values provides an improvement or a degradation to predictive accuracy. Of course, the new battalion–level validation database did not exist when the OLI changes were done, and the QJM database has never been computerized.

The obvious solution is the computerize the old QJM database and run the engagements using the current TNDM. As the final outputs for the old QJM database runs were never fully published, this still leaves us no means for direct comparison to the QJM runs short of running the engagements again using the old QJM values. The model has mutated enough from the original validation done 20 years ago, that this may not be an issue. But the model does need to be revalidated to its original engagements, even though its performance as a predictor of the Gulf War was good and validation using the battalion–level operations data base was also good.

APCs, ACs, IFVs and CFVs

There are six basic classes of weapons in the TNDM. They are:

1. Infantry
2. Anti–armor
3. Artillery
4. Air Defense
5. Armor
6. Air Support

OLIs are calculated for either "single weapons" or "mobile fighting machines." Mobile fighting machines consist of Combat Vehicles (AFVs), Combat Helicopters, and Combat

Aircraft. It is in the calculation of the AFV factors that a significant change has occurred since the original model.

In World War II, AFVs consisted of many platforms. These included tanks and many vehicles that are effectively treated as tanks by the model ("heavily armored" tank destroyers, assault guns, etc.). Self–propelled anti–tank guns are classified as anti–tank. There are also self–propelled artillery, which are treated the same as artillery except they are multiplied by the self–propelled factors. This self–propelled factor is applied to artillery pieces, mortars (otherwise classified as an infantry weapon), air defense weapons, and lightly armored or unarmored anti–tank guns. It is multiplied by 1.05 for self–propelled weapons, and 1.10 for self–propelled weapons with crew armor.

Finally there is everything else. These include half–tracks, armored personnel carriers (APCs), and armored cars (ACs). In WWII, most half–tracks served as armored personnel carriers and most armored personnel carriers were half-tracks. Most armored cars were wheeled. All were lightly armored and usually mounted a 20mm gun or less. Of course, there were a large number of exceptions, with the Germans in particular mounting 75mm guns on armored cars and on half–tracks.

Since that time, the half–track has pretty much disappeared and replaced by fully tracked or fully wheeled APCs. The armored cars have begun to look more look modified versions of the APCs, with the US versions being modified fully–tracked APCs. Finally, in recent times, all these vehicles have become more muscular (and more expensive) with better armor and bigger guns (and often less ability to carry infantry) and have become IFVs (infantry fighting vehicles) and CFVs (cavalry fighting vehicles). Some of these IFVs are looking more like light tanks that also carry infantry (and of course, Israel has a main battle tank that also carries infantry).

So the problem from a modeling perspective is how do you count these vehicles? The solution was to count APCs as infantry weapons (but using the armored OLI formula) while counting IFVs and CFVs as armor. A listing of what is being counted in these categories is provided in the two adjoining sidebars.

As discussed in the sidebar on mobility (and in more depth in the following article), the mobility advantage of APCs is accounted for in the mobility equation. Therefore, the only thing we need to look at is the additional combat value of an APC above and beyond its value as a transport. Looking at modern weapons, the obvious case among the US weapons is the M–113 with an OLI of 1.08, while the M–2 MG which is mounted on it, independently has an OLI of .981. As pointed out in Dave Bongard's article in the June 1997 issue, the BRDM–2 has an OLI of .424, or a fraction of the value of its two weapons, the 14.5mm HMG (1.165) and the 7.62mm MG (.460).

The easiest solution to this adjustment might be to simply adjust the formula to account for the weapon. This could consist of a rule that the value of an AFV can never be less than the value of its weapons times the self–propelled factor for armor (1.1). In the case of the M–113, the M–2 MG multiplied by 1.1 equals 1.079, so it would keep its current value. In the case of BRDM–2, its value would become 1.788. From the lists below, the value of all the APCs and armored cars with 7.62mm MGs would be raised slightly to .506. The value of APCs and armored cars with 14.5mm MGs would be raised to 1.282, which is curiously enough, the value of the BTR–60s and BTR–70s armed with a 14.5mm MG. The adjustment in OLIs for the few odd cases (like BRDM–2) may not be significant enough to justify a change to the model. At this point, I am considering taking no action on this part of the issue, and just consider the APCs and other lightly armored vehicles to be adequately addressed due to the mobility formula. As this still only addresses points 1 and 4 as outlined in the beginning of this article, there is still problem of the value of tanks relative to each other, the overall value of tanks, and the validation of armor engagements (points 2, 3, and 5) to be considered.

MOBILITY

As always, in this "simple" model, whenever one peels back the first layer of simplicity, one discovers considerable complexity. Mobility is addressed as the total mobility of the force. This is done by a formula that measures the mobility of the attacker as a ratio of the mobility of the defender. The mobility calculation consists of number of people, plus a weighted count of vehicles other than tanks (multiplied by 12), plus the TLI of the armor vehicles, all multiplied by the a constant for air superiority divided by numbers of troops. The defender is calculated in the same way, then the attacker's number is divided by the defender's number, and the resulting fraction is used at is square root value. This gives a mobility factor for the attacker. The mobility factor for the defender is always 1. The attacker's mobility factor is further influenced by terrain and weather. This mobility number is used as a multiplier of the combat power, and reflects the effect of mobility on combat power.

For example, lets look at the effect of the formula if one force 10,000 truck mounted infantry (assume one truck for 12 people) engages a force of 10,000 "leg" infantry. Just to simplify the math, we will assume no armored vehicles, no air superiority and the terrain and weather "equals" 1. This would result in the attacker (the numerator) set at 20,000, while the defender (the denominator) is still 10,000. This results in a multiplier of 1.41 for the attacker. This is a straight multiplier in the combat power formula. Of course, the ratio of combat power between the attacker and defender is used to determine win and loss (and as a factor in casualties and advance rates).

If you had everyone in APCs instead, then the attacker's values would be 30,000 resulting in a combat multiplier of 1.73 to 1.

Therefore, I can honestly state that the transport and mobility benefit of trucks and APCs is accounted for in the mobility formula. It does not need to be counted for in OLIs (except as applied to SP artillery). Therefore, the armor OLIs of APCs need only account for their additional combat value above and beyond their use as transport for the infantry.

SLIGHT DOCUMENTATION PROBLEM

Note that there is a slight problem with the clarity of the documentation here. If one looks at the rules and procedures manuals, one will discover under the discussion of anti-armor and artillery, that the self-propelled factor is used (as opposed to making them mobile fighting machines). If one reviews the text on the self-propelled equation, the self-propelled factor is applied to standard artillery pieces, mortars and air defense. No mention is made of anti-tank. In fact, by a review of the weapons in the data base, it is clear that the self-propelled factor is applied to all self-propelled artillery, lightly armored or unarmored AT weapons, mortars, and air defense weapons. For example the German WWII 20mm Flak 38 SP and Flak 43 SP AA guns have an OLI 5% greater than their towed counterparts. Similarly, the HOT-2 ATGM on AMX-10, the HOT-2 ATGM on VAB, the SU-60 Tank Destroyer, the LOSAT Bradley/HVM TD, the TOW Hummvee w BGM-71B ITOW, and the AT-3/Sagger 9414 ATG on BRDM-2 are all considered self-propelled AT guns. From WWII, the 4.7mm Pak auf Pzkw 1B, the Marder-III, the Nashorn, and the US GMC w/M3a1 37mm ATG are also listed as self-propelled AT guns.

Also, in the original QJM, the self-propelled factor of 1.1 applied if there was overhead cover. Now it applies to any SP weapons with armor.

WHAT IS MAKING THE BRDM A REAL WIMP?

The combined OLIs of the 14.5mm HMG and the 7.62mm MG is 1.625, yet the OLI of the BRDM–2 is .424, or almost one quarter the value of its component weapons. Looking at the calculations for this weapon, one sees that the TLI of the 14.5mm is 4,369.65 while the TLI of the 7.62mm is 1,598.44. When divided by the dispersion factor, this produces a combined OLI of 1.19. This is lower that the expected value of 1.625. In fact—this is part of the problem—is that the MGs we've been comparing this to have an OLI of 1.165 and .460, while the OLIs for these same weapons used on the vehicles is .87 and .32, for a total of 1.19

This value is then modified by the AFV. This produces a battlefield mobility factor of .85, the radius of action factor is 1.64, the punishment factor is .32, and armor factor of 1.00, a vehicle mobility factor of 1.00, a vehicle supply factor .79 and a vehicle attack factor of 1.02. These multiplied together results in a multiplier of .36, or the final OLI of .426 (with a little rounding). If the higher combined OLI was used of 1.625, then the final value would be .584, which of course is still very low compared to the value of the weapons.

Unfortunately, the difference in the OLIs between the vehicle weapons and the single weapons is because they were calculated by different analysts, most likely using different data. This is not a good justification and forces us to look at the calculations made by those analysts. Yet another task to be added to the list of "to be done" tasks.

Selected List of Post-WWII APCs and Armord Cars in the OLI Database

Country	Name	OLI	Category
S. Africa	Buffel APC	0.411	Inf
	Casspir wheeled APC	0.767	Inf
	Ratel 12.7mm 6x6 command veh	1.020	Inf
	Eland lt armd car (AMC)	55.000	Armor
	Ratel 60 6x6 IFV	53.000	Armor
S. Korea	KIFV (FMC)	1.080	Inf
	KIFV 25mm gun carrier	97.000	Armor
USA	AAV-7A1 Amph Aslt Veh (LVTP7)	1.080	Inf
	M-113 APC	1.080	Inf
	Recon HMMWV (M19 AGL, M60)	77.000	Inf
	LAV-25 25mm 8x8 IFV (Bradley)	65.000	Armor
	M-2HVB HMG	0.981	Inf
USSR/	BTR-152 6x6 APC	0.450	Inf
Russia	BTR-50PA 14.5mm APC	1.282	Inf
	BTR-60P 7.62mm 8x8 APC	0.450	Inf
	BTR-60PB 14.5mm 8x8 APC	1.282	Inf
	BTR-70 14.5mm 8x8 APC	1.282	Inf
	BTR-80 14.5mm 8x8 APC	1.282	Inf
	MT-LB 7.62mm APC	0.682	Inf
	BMD-1 Airborne IFV	59.000	Armor
	BMP-1 73mm IFV	71.000	Armor
	BRDM-2 armd car	0.424	Armor
	BRM-1 recon veh (BMP)	54.000	Armor
	PRP-3 battlefied radar veh (BMP)	0.769	Armor
	SMG 7.62mm MMG	0.582	Inf
	PKV 14.5mm HMG	1.165	Inf

Part of the reason for the low values for the APCs is because the area of the vehicle relative to its weight is so high.

List of All WWII APCs and Armored Cars in OLI Database

Country	Name	OLI	Category
France	AMX UE lt tracked APC	1.293	Inf
	Lorraine hvy tracked APC	7.081	Inf
	Hotchkiss M1914 MG	0.541	Inf
	AMC-29 HT AFV	27.000	Armor
	AMC-35 tracked AFV	38.000	Armor
	AMR-33 lt AFV	4.707	Armor
	AMR-33 tracks ca. AFV	37.000	Armor
	Laffly 50 armd car	29.000	Armor
	Laffly s15 TOE lt armd car	4.495	Armor
	Panhard 165/175 armd car	45.000	Armor
	Panhard 178-P armd car	29.000	Armor
Germany	SdKfz 250/1 lt HT APC	1.230	Inf
	SdKfz 251/1 Med HT APC	8.627	Inf
	MG 34 7.92mm as HMG	1.211	Inf
	SdKfz 231/232 armd car	39.000	Armor
	SdKfz 233 armd car w/75mm L24	96.000	Armor
	SdKfz 250/10 HT lt armd car	31.000	Armor
	SdKfz 250/9 HT armd car	31.000	Armor
	SdKfz 222 (4 rad)	36.000	Armor
	SdKfz 234/1 armd car w/20mm	71.000	Armor
Italy	AB.40 scout car	6.782	Armor
	AB.41 armd car	47.000	Armor
Japan	Model 01 Ho-Ki tracked APC	12.000	Inf
	Model 99 Ho-Ha HT APC	7.330	Inf
	Model 92 7.7mm HMG	0.999	Inf
Poland	wz.34 armd car	25.000	Armor
UK	Bren gun carrier	1.839	Inf
	Bren .303 LMG	0.545	Inf
	Bren "Universal Carrier"	2.953	Armor
	Marmon-Herr. Mk II armd car	7.868	Armor
	Marmon-Herr. Mk IV armd car	53.000	Armor
USA	DUKW amphib truck	0.322	Inf
	LVT-1 amphib APC	9.380	Inf
	LVT-2 amphib APC	15.000	Inf
	LVT-3 amphib APC	17.000	Inf
	LVT-4 amphib APC	18.000	Inf
	M-3 HT (APC, etc.)	8.600	Inf
	M-3A1 HT (APC, etc.)	10.000	Inf
	M2HB .50cal HMG	1.344	Inf
	LVT(a)-1	29.000	Armor
	LVT(a)-2	62.000	Armor
	M-20 armd car	7.635	Armor
	M-3A1 white scout car	5.187	Armor
	M-8 armd car	73.000	Armor
USSR	BA-10 armd car	37.000	Armor
	BA-32 armd car	45.000	Armor
	BA-64 armd car	3.312	Armor

Some Thoughts on the Mobility Equation

by Christopher A. Lawrence

The formula for the mobility equation is:

$$M = \frac{(N_a + 12J_a + Wi_a + 15Wg_a + 15Wy_a) * ym_a/N_a}{(N_d + 12J_d + Wi_d + 15Wg_d + 15Wy_d) * ym_d/N_d}$$

where

N	=	Number of troops
J	=	Number of vehicles*
W_i	=	Total OLIs for all armored weapons
Y_m	=	Air Superiority Factor from Table 5

*This figure is the sum of 1 per truck, 2 per track laying support or non-armor combat vehicle (APC, self propelled carriage or tractor), 10 per available organic aircraft, ½ per motorcycle.

See pages C–38 and C–39 of the *Manual of Rules and Procedures* for more details.

While this is intended to measure the effect of the superior mobility of one force over the other, it also does several other things:

1. Measures the effect of motorization and mechanization.
2. Measures the "maneuver" value of armor.
3. Measures the effect or air superiority.
4. Measures the effect of terrain and weather on mobility.

One must remember in this equation that both the numerator and the denominator are effectively divided by N (the number of people in the force). Actually, it is multiplied by the air superiority factor divided by N, but in the air superiority table, four of the six possible choices is equal to 1, so for many purposes the equation is simply divided by the number of people. This is obviously in the equations so that the mobility adjustment is not affected by the ratio of the number of people on a side.

Let's look at each of these four functions in a little more depth. As discussed in the previous article on OLIs, the measurement of the transport and mobility effect of APCs is covered in the mobility equation. If one force is totally motorized relative to another force, there will get a 1.41 force multiplier. If they are armored (mechanized) they will get force multiplier of 1.73. A mechanized force versus a motorized force will get a force multiplier of 1.22.

But the mobility equation also sums up the total armor for each side, so if all other factors are equal (say for example, each side had a fully motorized infantry force of 10,000 men, which puts a value of 20,000 in both the numerator and denominator), then the side with 100 main battle tanks (M1A2s) would have an additional 143,600 points. This totals up to 163,600, divided by 10,000 which equals 16.36. The defender is still 20,000 divided by 10,000, which results in a final ratio of 8.18, resulting in a force multiplier of 2.86. Obviously significant multipliers can occur if one side is heavily armored.

While it is never discussed what this is intended to represent, as it is in the mobility formula, it is assumed to represent the combat advantage gained by "maneuver" (from J.F.C. Fuller's principles of war). As maneuvering 100 tanks allows one to obtain considerable mass and surprise, then this might be a reasonable interpretation of the output.

Of course, if it is measuring the "maneuver" value of the weapons, this does raise the question of why air weapons are not included in this equation (although aircraft are included in the "J" part of the equation at 10 points per aircraft).

All this is multiplied by air superiority, which is the air superiority factor for the force divided by number of people in the force. The factor is from Table 5, page B–6, and driven first by whether it is wet or dry. If wet, the factor is 1.0. The factor is also 1.0 if neither side has air superiority. So the final number ends up being multipliers by 1/N, or the inverse of the number of people. In effect, the entire equation for each side is divided by the number of people for each side. This of course, results in the equation not favoring any side because of superior numbers of people.

If the weather is dry, then the side with air superiority gets a multiplier of 1.1, and the side with air "inferiority" gets a multiplier to their mobility of .9. How this really works (lets take two Motorized forces of 10,000) is:

(10,000 + 10,000 + 0) x 1.1/10,000 = 2.2

(10,000 + 10,000 + 0) x .9/10,000 = 1.8

2.2/1.8 = 1.22 and the square root of 1.22 is 1.106.

So, the end result is that air superiority usually results in around a 10% improvement in the mobility score, which amounts to a 10% improvement in OLIs. If the defender had air superiority, then the final score for the attacker is .905. If the mobility situation is really lopsided (say the attacker has 100 tanks), the force multiplier effect of air superiority remains constant with the air superiority still being a bonus of 1.106. A simpler structure for the equation might be:

$$\sqrt{\frac{(N_a + 12J_a + Wi_a) / N_a}{(N_d + 12J_d + Wi_d) / N_d}} * ym_a$$

At least the effect of the air superiority factor would be clearly understood to be 1.1 as opposed to 1.1055416 that it currently is.

ALL THE MOBILITY MULTIPLIERS AT PLAY IN THE REAL WORLD: THE BATTLE OF LOMBA RIVER

Lets look at how this all applies to a real world problem. In 1994, when Trevor N. Dupuy was in South Africa, he was presented with three recent historical battles to run on the TNDM to see how they fit. All had a smaller number of South African forces attacking brigade size forces in Nimibia. Just to look at how the mobility equation functions in one of these engagement, we selected the first one he did, the Battle of Lomba River. This engagement occurred March 10, 1987 between the Republic of South African and Angolan government forces. The South African forces consisted of 3 motorized infantry companies, 2 mechanized companies, 1+ armored car squadrons and supporting mortars, AA and artillery. Angolan forces consisted of most of the 47th Armored Bde, with 3 motorized infantry battalions, an armored carrecon company, two tank companies (with T–54/55s) and supporting mortars, AA and artillery. The South Africans had 1,199 troops versus the 47th Brigades 2,264 troops. The South African's were the attackers. South African armor consisted of 38 vehicles with a combined OLI of 10,268. Angolan armor consisted of 28 vehicles (mostly T–55 tanks) with a combined OLI of 9,726.412. The South Africans had 119 trucks vs 141, and Angola also had 3 other tracked vehicles and 3 motorcycles. Terrain was flat–heavily wooded, weather was dry–sunshine–extreme heat. The defender had air superiority. The mobility calculation for this would be:

Attacker
(1199 + 12(119) + 10,268) * .9/1199 = 9.68

Defender
(2,264 + 12(141) + 12(3)(2) + 12(3)(1/2) + 9,726.412
* 1.1/2264 = 6.69

The value of M is then $\sqrt{\frac{9.68}{6.69}} = 1.20$

The 20% advantage multiplier is then further degraded by weather conditions:

m = 1.2 - (1 - .6 x .9)(1.2 - 1) = 1.11

This 1.11 multiplier is multiplied by the entire score, making this a fairly significant force multiplier.

MICRO ANALYSIS, LOOKING AT A SQUAD

Of course, this all relates back to the discussion on the combat values of APCs. While Trevor Dupuy always stressed that one should not use the TNDM for "weapons trade–off" analysis, let's just look at the effects of mechanization on a squad of infantry.

Let's take a squad of infantry—say 12 men, even though US doesn't use this squad size anymore (squad size in the US now is determined by FMC, vice DOD). Assuming armed with 11 M–16s and a M–60, this would give them and OLI of 2.591. Put the same 12 men in a M–113 (they won't fit in a Bradley) with its OLI of 1.080, plus the following multiplier from the mobility equation

$\sqrt{(12 + 12(2) + 0)/12} = 1.73$

resulting in the OLI of the mechanized infantry squad effectively becoming 6.358, while a motorized squad would be 3.664 and foot infantry is rated at 2.591. Now if you only use seven guys (OLI of 1.576) in a Bradley (OLI of 249) you come up with an OLI of 250.576 and a multiplier from the mobility equation of 4.6636895 for a final figure of 1168.609. Of course, the mobility multiplier went "out of control" because of the addition of the armor OLI to it. A US division has one Bradley per 50 men, not per seven. Still the impact is significant.

The mobility equation is then adjusted by weather and terrain. Operational factor for terrain (rm, see Table 2 in manual) and weather (hm, see Table 3 in manual) affects the attacker's mobility. This is done by the following formula:

m = M - (1 - rm x hm)(M - 1)

In effect, the value of M remains the same if the terrain is "Rolling Gentle–Bare" and the weather is "Dry–Overcast –Temperate." The only value above "1" is the terrain value of "Flat–Bare–Hard" which results in a value of 1.05. The lowest value is for something like fighting in "Swamp–Jungle" in "Wet–Heavy Rain–Extreme Heat," which would result in a combined value for rm and hm of .15, which in most cases would serve to cancel any advantages from mobility.

If M = 1 or the value of the terrain equals 1, then M = m. If M is greater than 1, then the reduction effect of terrain and weather on mobility is the "percentage" of the value over one. For example, if the mobility multiplier is 1.414 (square root of 2), and the terrain is "Rolling–Gentle–Heavily Wooded" and the weather is "Wet–Light Rain–Temperate" then the result would be:

1.232 = 1.414 - (1 - .7 x .8)(1.414 - 1)

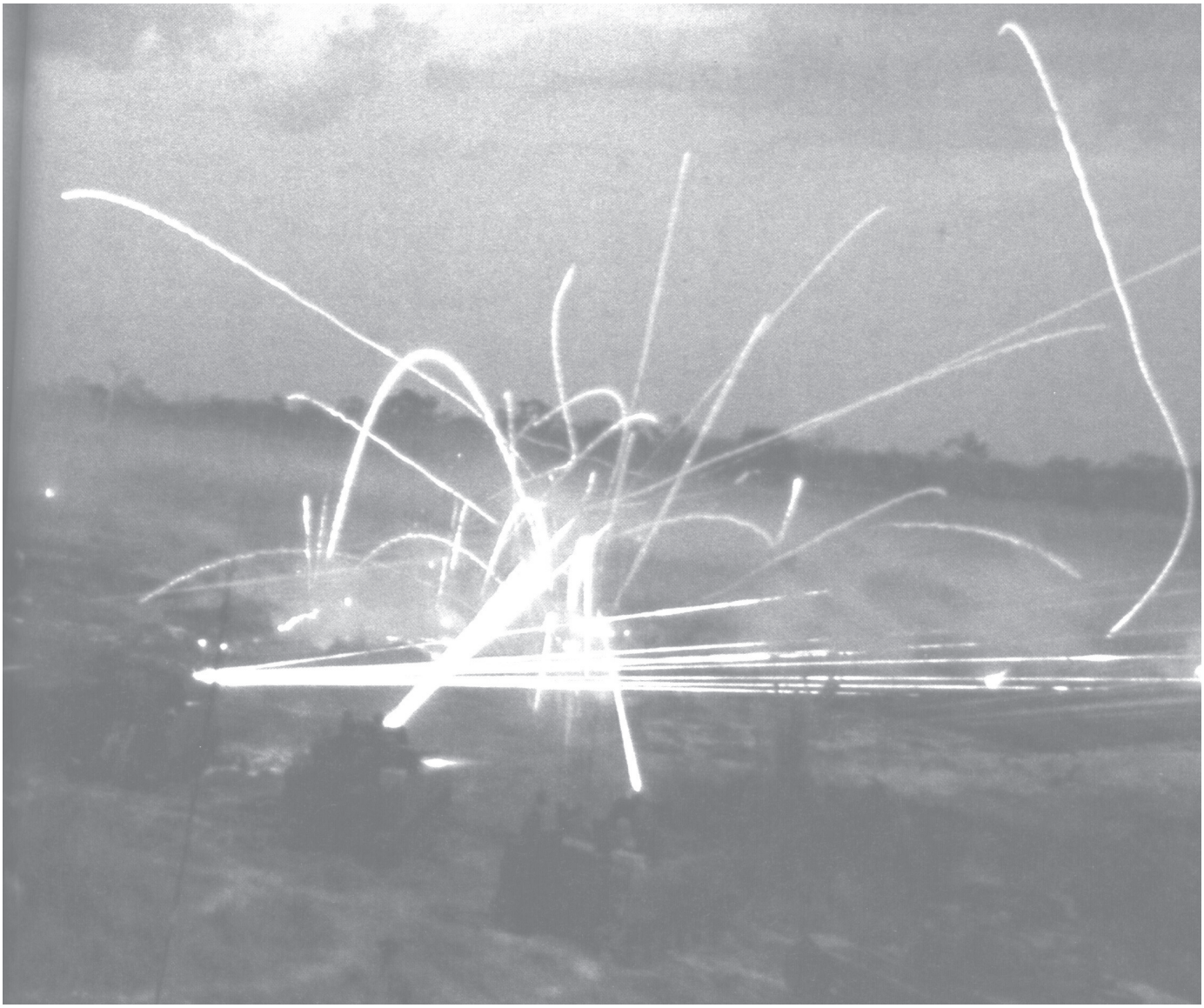
QUALITY SIGNIFICANCE OF QUANTITY

The multiplicative effect of quantity, beyond the benefit of raw numbers, is shown in the table for the "Qualitative Significance of Quantity (q)." This is a table new to the TNDM, and was not in the original QJM (as outlined in *Numbers, Predictions and War*). The table (see page B–9, Table 7 of the *Manual of Rules and Procedures*) ranges for a force multiplier of 1.0 for ratios of 1.5 to 1 or less, to a force multiplier of 1.2 for ratios of 7 to 1 or greater. This quantity factor is used the same way in four different places. It is used in the calculations of the total OLI for infantry and armor as a multiplier of each of those categories of weapons. Meaning that when adding up the total OLI for each of these forces, it looks at the ratio of OLIs for these weapons and adds this multiplier. According to the documentation, there is a similar factor for artillery and air support, but there is no place in the equations where it fits.

Another way of looking at this is .7 times .8 equals .56. This multiplied by the mobility bonus of .414 equals .232. If the value of M is less than 1, meaning the defender is more mobile, then the equation increases the value of the attacker as the weather and terrain degrade mobility of the defender. Say if we set the attacker at .707 (square root of .5) under the same weather conditions, the result would be .83592. This effectively increases the attacker's values by difference between .707 and 1 by 44%. This accounts for the effect of the poor terrain and weather decreasing the mobility of the defender (whose value is always 1).

Keep in mind that the weather also affects the OLI of the attacker, artillery, air, and tanks, as well as the casualty rates. The terrain also affects the velocity (advance rate), defense, infantry weapons, artillery, air, tanks, and the casualty rate.

Of course, all this relates back to whether the value of an APC is now too low. Because of the mobility formula, the value of the APC is not only its OLI, but also its addition to the mobility multiplier for the force. This bonus can be as high as a multiplier of 1.73, and this multiplier affects the OLIs of the entire force. Therefore, at this juncture, I am not uncomfortable with the values of APCs (as I used to consider them to be "overrated" in the OLI system). This does not mean that I am comfortable with the values of the IFVs, as they not only have a much higher value (249 vs 1.08), but also have a major impact on the mobility equation, especially if the armor OLI is high relative to the numbers engaged. An M–113 adds 24 to the mobility equations, while a Bradley adds more than 10 times that amount (all this of course is "depressed" by taking the square root of the value). At this point in time, my tendency is not to look towards changing the OLIs for APCs to correct the perceived "imbalance" in armor value problems. I do intend to look at the armor values of IFVs and MBTs though.



11th Armored Cavalry troops fire machine guns from their M–113 ACAVs and M48 tanks during a nighttime "mad minute" in the Iron Triangle, War Zone C, northwest of Saigon.

The Current Status of OLIs

by Christopher A. Lawrence

The revised armor OLI formulas were created by William Sayers with some minor tweaking and revision by Richard Anderson and Trevor Dupuy. Mr. Sayers became concerned that the armor values reflected in the model did not reflect the combat capabilities of the armored weapons well. He independently created a revised OLI formula for armor (mobile fighting machines in TNDM parlance) and presented this to Col. Dupuy. Col. Dupuy accepted the fact that this formulation was a better construct, and after some testing and minor revisions, incorporated it into the TNDM.

Mr. Sayers was careful to maintain the "balance" of the OLI values. As such, when he was developing his revised formula, he compared a sample mix of his weapons using the new OLIs with a sample mix of the weapons using the old OLIs. He made sure that the new formula, while perhaps dramatically reappraising individual weapons, maintained the same overall average value in the new mix when compared to the old mix. This being the case, it was not really necessary to validate the new values, as in the aggregate, they were the same as the old values. If Mr. Sayers can locate his notes on this, we may eventually talk him into writing an article on exactly how this was done.

But Mr. Sayers only carried out this evaluation for modern weapons, as that is all that he was concerned with. Of course, the QJM was validated to the old formulas using engagements from WWII, the 1967 Arab–Israeli War, and the 1973 Arab–Israeli War. Therefore we ended up with a situation where the new OLI values were not calibrated to the old OLI values for 1970s and earlier data.

As pointed out in the article by Dave Bongard in Volume 1, Issue 6 of the newsletter, the armor values for WWII weapons using the new OLI calculations almost always resulted in a lower set of values. This led to my concern, as discussed in this issue, that the new OLI methodology is not good as applied to WWII weapons. When I discussed this with William Sayers, he clearly stated that his formula could not be applied to WWII without revising it to maintain the same average value across a typical mix of weapons. This was never done, nor was the model ever validated using the new values in the old engagements.

The person maintaining the OLI databases instinctively knew that the new values were not good for the earlier engagements, so he continued to use the old armor OLI formula for all the engagements from the 1970s and earlier. This led to our OLI database being calculated by two completely different formulas for mobile fighting machine (MFM). The formula for "single weapons" has never changed, just the formulas for AFVs, Planes and Helicopters. Therefore, the TNDM is operating from three different weapons calculation formulas: one for single weapons for all years, one for MFMs pre–1980, and one for MFMs post–1980. When we performed the validation for the 76 battalion–level engagements, these were the values used. So, after publishing the wonderful article from Dr. James Taylor about how the one of the strengths of the QJM methodology was the consistent application of scores, we have in fact been inconsistently applying them.

We currently have:

1. A set of scores for single–weapons that have been consistently applied. They were validated within the QJM using WWII, 1967, and 1973 data. They have also been validated within the TNDM using 76 battalion–level engagements from 1918 to 1989.
2. A set of scores for MFMs for before 1980 that have been consistently applied for engagements before 1980. They were validated within the QJM using WWII, 1967, and 1973 data. They have also been validated within the TNDM using 64 battalion–level engagements from 1918–1973.
3. A set of scores for MFMs for after 1980 that have been consistent applied for engagements after 1980. They were constructed so that an average mix of weapons under the new scoring system was the same overall value of an average mix of weapons under the old scoring system. They have also been validated within the TNDM using 12 engagements from 1982–1989.

At this point, I believe the following needs to be done:

1. We need to revise the MFM formula to consistently apply to all periods so we are only using one formula for MFMs.
2. We need to re–run the 64 engagements that were done using the old QJM MFM formula using the revised new MFM formula.
3. We need to then conduct a whole new validation using the new 121+ battalion–level engagement data.

This last step has already been begun using WWI African data and was published in the last issue. The work done on this, of course, has not been affected by the problem of the two different MFMs formulas due to the lack of any such vehicles in these conflicts. As a result of running the African engagements, the next step in the validation is to run all the 76 battalion–level engagements with an OLI of 1 per person (meaning using numbers of people, vice weapons values). This we already have done, and now only need to analyze the results. This will be the next step in the continuing validation effort.

As I do wish to have one OLI formula for all Mobile Fighting Machines in all eras, I will be revising the formula so as to keep the current values but allow reasonable values for pre–1980s armor. I will have a proposed formula in the next issue.

The TNDM OLI Database

by Susan Rich

The Dupuy Institute recently reviewed the status of its OLIs, and separated them out into five databases based on period. A total of 1644 weapons are currently stored in the TNDM OLI database. The OLIs for Pre–WWI (1600 to 1913), WWI, WWII and 1970s (including the 1960s) all use the old QJM formula for Mobile Fighting Machines. The Modern OLIs use the new TNDM formula for Mobile Fighting Machines. All databases use the same formula for single weapons. A copy of this OLI database has been provided to all of the subscribers to our annual support contract.

We have structured the database so that the weapons for each period are stored in a different directory. The numbers of weapons in each directory is:

PRE-WWI	=	49
WWI	=	70
WWII	=	576
1970S	=	35
MODERN	=	914
----------		----------
		1644

The count of weapons by nationality includes:

PRE-WWI (49):

24 INFANTRY WEAPONS:

7 ANY	2 UK
2 FRANCE	2 USA
1 PRUSSIA	8 USA/CSA
2 RUSSIA	

22 TOWED ARTILLERY:

3 ANY	3 RUSSIA
2 CSA	1 UK
4 FRANCE	7 USA/CSA
2 PRUSSIA	

3 MFM COMPONENT (i.e. for Cavalry):

3 ANY

WWI (70):

6 ARMOR:

2 FRANCE	3 UK
1 GERMANY	

27 INFANTRY WEAPONS:

1 ANY	9 GERMANY
2 AUST/HUN	2 RUSSIA
1 BELGIUM	4 UK
3 FRANCE	5 USA

31 TOWED ARTILLERY:

4 AUST/HUN	3 RUSSIA
1 BELGIUM	5 UK
5 FRANCE	4 USA
9 GERMANY	

4 FIXED-WING AIRCRAFT

1 FRANCE	2 USA
1 GERMANY	

2 MFM COMPONENT:

1 FRANCE	1 UK

WWII (576):

133 ARMOR:

16 FRANCE	7 POLAND
37 GERMANY	8 UK
9 ITALY	24 USA
13 JAPAN	19 USSR

82 INFANTRY WEAPONS:

1 ANY	1 POLAND
6 FRANCE	8 UK
13 GERMANY	23 USA
5 ITALY	11 USSR
14 JAPAN	

47 ANTI-TANK WEAPONS:

2 FRANCE	1 POLAND
16 GERMANY	6 UK
3 ITALY	8 USA
5 JAPAN	6 USSR

94 TOWED ARTILLERY:

8 FRANCE	10 UK
17 GERMANY	1 US/FRANCE
5 ITALY	17 USA
21 JAPAN	12 USSR
3 POLAND	

12 SELF-PROPELLED ARTILLERY:

5 GERMANY	1 US/UK
3 JAPAN	2 US
1 UK	

37 AIR DEFENSE WEAPONS:

11 GERMANY	8 USA
8 JAPAN	4 USSR
6 UK	

87 FIXED-WING AIRCRAFT:

39 GERMANY	15 USA
4 JAPAN	18 USSR
11 UK	

84 MFM COMPONENT:

6 ANY	13 UK
32 GERMANY	11 USA
3 ITALY	1 USA/UK
6 JAPAN	12 USSR

1970s (35):

13 ARMOR:

3 FRANCE	5 USA
2 ISRAEL	3 USSR

11 INFANTRY WEAPONS:

1 FRANCE	5 USA
1 ISRAEL	3 USSR
1 UK	

6 ANTI-TANK WEAPONS

1 UK	5 USA

2 TOWED ARTILLERY:

2 USA	

1 AIR DEFENSE WEAPONS:

1 USA	

2 MFM COMPONENTS:

1 FRANCE	1 USSR

MODERN (914):

137 ARMOR:

2 ARGENTINA	18 PRC
2 BRAZIL	8 S AFRICA
1 CANADA	4 S KOREA
7 FRANCE	1 SAUDI ARABIA
11 GERMANY	4 SPAIN
1 IRAN	2 SWEDEN
1 IRAQ	10 UK
5 ISRAEL	24 USA
2 ITALY	25 USSR
5 JAPAN	3 YUGOSLAVIA
1 N KOREA	

220 INFANTRY WEAPONS:

1 AU	10 JAPAN
2 BELGIUM	1 N KOREA
1 BRAZIL	35 PRC
3 CZECH	15 S AFRICA
1 EGYPT	8 S KOREA
2 FINLAND	1 SAUDI ARABIA
10 FRANCE	10 UK
11 GERMANY	35 USA
2 INTERNAT	1 USA/INTL
3 IRAQ	35 USSR
5 ISRAEL	28 YUGOSLAVIA

91 ANTITANK WEAPONS:

3 FRANCE	1 SWEDEN
4 INTERNAT	5 UK
4 JAPAN	17 USA
13 PRC	33 USSR
3 S AFRICA	8 YUGOSLAVIA

59 TOWED ARTILLERY:

1 AU	3 S AFRICA
4 FRANCE	3 S KOREA
1 GERMANY	2 UK
1 INTERNAT	8 USA
1 ITALY	21 USSR
9 PRC	5 YUGOSLAVIA

68 SELF-PROPELLED ARTILLERY:

1 BRAZIL	1 N KOREA
1 CZECH	10 PRC
1 EGYPT	2 S AFRICA
3 FRANCE	1 S KOREA
2 GERMANY	3 UK
2 IRAQ	10 USA
5 ISRAEL	18 USSR
3 ITALY	1 YUGOSLAVIA
4 JAPAN	

97 AIR DEFENSE WEAPONS:

1 CZECH	2 SWEDEN
4 FRANCE	1 SWISS
1 GERMANY	8 UK
1 INTERNAT	1 UK/ITALY
1 JAPAN	13 USA
19 PRC	36 USSR
2 S AFRICA	4 YUGOSLAVIA
3 S KOREA	

47 FIXED-WING AIRCRAFT:

1 ARGENTINA	4 PRC
5 FRANCE	1 S AFRICA
3 INTERNAT	3 UK
1 ISRAEL	15 USA
1 ITALY	13 USSR

26 ROTARY-WING AIRCRAFT:

2 FRANCE	1 UK
1 GERMANY	11 USA
1 S AFRICA	10 USSR

169 MFM COMPONENT:

1 ANY	5 S AFRICA
16 FRANCE	2 SWEDEN
9 GERMANY	4 SWISS
2 INTERNAT	11 UK
2 ISRAEL	1 UK/FRANCE
3 JAPAN	51 USA
2 N KOREA	46 USSR
12 PRC	2 YUGOSLAVIA

We expect to continue updating and improving this database and plan on revising it at least once a year. If any user has values calculated for any weapons that we do not have, we would be happy to incorporate them into our database, as long as we have a reference for the sources used for the calculation.

The Complete Library of HERO Reports

by Susan Rich

While TDI maintains the most complete collection of HERO reports in existence, our collection is incomplete. Of the 130 reports prepared, the 29 listed below are missing from our library. In some cases the missing reports are classified and were destroyed when DMSI closed down. These include reports 12, 13, 20, 42, 61, and 84.

Three of the projects (18, 19, and 29) are books, and we do not have copies of them. Although Trevor wrote over 80 books, they were always considered his personal property and as such were not part of the company project list. A number was assigned to three projects, 104, 127, and 128, but there is no evidence that a report was actually written corresponding to these numbers.

The remaining 17 reports are ones that are simply missing. We ask our readers that if you have a copy of any of these reports in your files, please make a copy and forward it to us so that our collection can be complete.

MISSING HERO/DMSI/TNDA REPORTS 1962-1992

12. Isolating the Guerrilla, Vol. 1 (Confidential)(1965) (ARO)

13. Development of a Public Information Program on Temporarily Incapacitating Chemical and Biological Agents (Confidential) (1966) (US Army)

18. Military History of World War 1 (1967) (Franklin Watts)

19. The Reserve Story (1967) (Army Times Publishing Co.)

20. Comparative Analysis of Armored Conflict Experience (3 Volumes) (Secret) (1967) (PA&E)

21. The Nature of Military Power and its Application in the Future (2 Volumes) (1967) (US Army)

26. Target/Range Experience for Tank and Antitank Weapons (1969) (Batelle)

27. Historical Data on Tactical Air Operations: The Rome Campaign, 11 May-17 June 1944 (1970) (AFS&A)

29. Foreign Area Studies Handbook: Mongolia (1970) (AU)

30. American Revolutionary Bicentennial Commission: A Calendar of Events; American Revolution Commemorative List (1970) (ABC)

33D. Allied Air Interdiction in Support of OVERLORD, 6 June-25 August 1944 (1971) (AFS&A)

37. Familiarization Program - The Founders Project

42. Feasibility Study for Net Assessment of Effectiveness of NATO-Warsaw Pact Forces by Means of QJM (Secret) (1973) (DIA)

43. A Selective Historical Evaluation of the Qualitative-Quantitative Effectiveness of the Employment of Unconventional Forces and/or Resources in Support of Unconventional Forces and/or Resources in Support of National Policy (1973) (Braddock, Dunn & McDonald)

56. Assessment of Arab and Israeli Combat Effectiveness: 1973 War (1977) (CIA)

60. Availability of Historical Data Concerning Soviet Air Defense Experience (1978) (Sandia)

61. Analysis of the Implications of Surprise in Scenarios of Conventional and Tactical Nuclear Combat in Europe (Secret) (1978) (DNA)

69. Navy Nuclear Test Personnel Review

79C. Analytic Research on Strategic, Tactical and Doctrinal Military Concepts: Nuclear Weapons Proliferation: Impact and Response (1980) (DNA)

79E. Analytic Research on Strategic, Tactical and Doctrinal Military Concepts: The Concept of Nuclear Threshold (1980) (DNA)

84. Static Comparison of Combat Capabilities of NATO and Warsaw Pact Forces at Division Level in the European Theater of Operations in the Early 1980s (Secret) (1981) (CIA)

85. Potential Military Aggression Against Jordan (QJM Analysis) (1981) (Keyadah)

89. Conventional Attrition and Battle Termination Criteria (1981) (MRA&L)

96. Artillery Fire and Effect, US Ninth Army, Roer River Crossing, Feb. 23, 1945 (1977) (DNA)

97. Toward an Overview of Modern Chemical/Conventional Combat: A Conference Based on Historical Experience (1983)

104. Unknown

115. History of OTEA

127. Unknown

128. Unknown

TDI Profile: George A. Daoust, Jr.

by Susan Rich

George Daoust is Chairman of the Board of Directors of The Dupuy Institute, which he assisted Trevor Dupuy in establishing in 1992. They shared similar backgrounds and experiences as career Army officers, and maintained a close friendship and business association throughout the years.

Dr. Daoust was born on October 10, 1922 in Oakland, California. He graduated from the United States Military Academy in 1945 as an infantry officer. After graduation from parachute school he served in the 508th Parachute Infantry Regiment in Germany, followed by staff, intelligence, and other troop assignments. From 1949 to 1952 he was an instructor in the Airborne Department of the Infantry School, where he developed new courses and taught classes in Pathfinding, Aerial Delivery, and special operations. In 1952 he was assigned as Chief of Physical Security on the task force conducting the first test of the hydrogen bomb on Eniwetok.

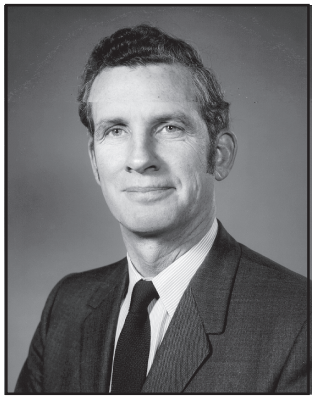
Following staff and troop assignments in Washington, D.C., Japan, and Fort Bragg, Dr. Daoust attended Georgetown University from 1956 to 1958. Continuing his studies there while assigned to the Army General Staff, he received a Ph.D. in International Relations. He was chief of the Communist China General Intelligence Branch during the Taiwan Strait crisis and shelling of Quemoy, and served as Assistant Secretary of the General Staff in 1959–1960.

From 1962 to 1966 Dr. Daoust was Berlin Action Officer in U.S. European Command during the Berlin Wall and autobahn crises. The following year he was responsible for the coordination of political and military activity in Berlin and Germany in the Department of Defense, and was a member of the Berlin Task Force in the State Department.

After being selected for promotion to Colonel, Dr. Daoust retired from the Army as a Lieutenant Colonel in 1967. Upon retiring, he joined Stanford Research Institute in Washington, D.C., where he organized and was Director of the Political/Policy Analysis Department. During the next four years he was project director and editor of several studies, including US–Soviet Interaction Models, U.S. Military Bases in Spain, and a Political, Economic, and Military Evaluation of Japan in the 1970s. During this period he developed a program to adapt the principles and techniques of international crisis management to domestic and urban problems.

Dr. Daoust became a member of the International Institute for Strategic Studies in London, England. He was appointed to the European Advisory Committee in the Department of State. He was also an occasional lecturer and consultant to the National War College and the Industrial College of the Armed Forces.

In 1971 Dr. Daoust was appointed Deputy Assistant Secretary of Defense for Manpower Research and Utilization. In this position he was responsible for the All–Volunteer program during the transition from the draft. He also coordinated the DOD Manpower Research program and monitored manpower utilization. Dr. Daoust served as the manpower representative on the DOD Productivity Steering Committee in 1972–1973 and headed the U.S. Interagency committee on the future of Selective Service. He undertook numerous highly classified, sensitive manpower studies, and directed research to assure more effective utilization of both military and civilian personnel in supporting the DOD's various national security objectives.



The most recent photo (c. 1975) of the man reputed to be Dr. George Daoust.

As an early supporter of Equal Opportunity in the Armed Forces, Dr. Daoust worked to develop support for a model day care system for military installations. This would have allowed mothers to continue a full time career in the military, and would have made a major impact on the early education field, as well as on the individual lives of the participants. Now, 25 years later, this concept is becoming a reality.

After leaving DOD in 1973 Dr. Daoust wrote extensively and participated in numerous hearings and conferences on manpower in the Armed Forces. He was Dean of the International University of Communications, where he taught graduate seminars in Political Geography and Systems Analysis. He was a consultant on manpower and political/military issues until 1975 when he joined Planning Research Corporation (PRC) as Director of Government Relations. This led to his selection in 1981 as Executive Director of the National Council of Technical Service Industries (NCTSI), an association of major defense service contractors. During his years at PRC and NCTSI he was a registered Congressional Lobbyist.

Dr. Daoust left NCTSI in 1985 to take an extended three year vacation with his wife Lucy. They had a van and trailer built to their specifications, and toured throughout the U.S., with side trips to Hawaii, Alaska and Canada. Since returning to their home which Dr. Daoust built 23 years ago in Great Falls, Virginia, they have taken several lengthy trips to

Europe and the Middle East.

Although retired since 1985, Dr. Daoust has remained overcommitted to work. Since 1992 he has published and edited the magazine *Current World Affairs*, which is a quarterly bibliography of current events. He and Lucy share an interest in genealogy, and together spent several long years transcribing, printing and binding 15 volumes of diaries written by Lucy's grandfather, who served in the 7th Regiment, US Colored Troops, in the Civil War and who published the history of their service in 1878.

Dr. Daoust has retained strong ties forged 50 years ago with his classmates at West Point and their families, and enjoys spending time with his daughter (the author of this page) and her children. He maintains that "Life gets better with each passing year, but they sure pass quickly now!" 🌐