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APPLICATION OF DIVWAG AT RODMAN LABORATORY

BY
SIMULATION AND TECHNOLOGY DIVISION

INTERIM REPORT

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The DIVWAG Model is a computerized wargame model which has been successfully run in prior applications as a tactics model. The model has been modified to determine the difference in effectiveness of field artillery caused by varying system parameters. Rodman Laboratory is using DIVWAG in a simulation mode. In this model of operation, once a game has been completed, a representative period of play is selected for further analysis.

The data base and gamer inputs for the start of the period are still available. The model can be exercised independent of the gamer staff and the original output produced. Data base changes are made to reflect variations in artillery performance parameters such as range, mobility, vulnerability, target acquisition, weapon error, response time, rate of fire, etc.

Effectiveness indicators to assess the change in effectiveness due to the parametric variations in artillery performance parameters have been determined. Graphical methods have been developed to visually display output (e.g., different red (blue) target types engaged during a period of play by a blue (red) artillery battery as a function of range and game time).

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TABLE OF CONTENTS

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LIST OF FIGURES

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LIST OF TABULAR DATA

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1.0 INTRODUCTION

In September 1974, a task was initiated within Rodman Laboratory to develop a method of determining artillery weapons effectiveness. This task could have been accomplished by utilization of either the best applicable mathematical model currently available (with modification where needed) or development of an entirely new model. However, the development of a new model could not be accomplished within the time and cost constraints. A literature review of existing models was conducted, and the Division Wargame (DIVWAG) model was deemed most suitable. A description of DIVWAG is contained in Appendix A.

DIVWAG is defined as a stochastic, computerized war game periodically requiring human input. A typical gaming cycle is briefly described below:

(a) The gamers establish the data base (terrain, weather, unit organization, weapons, equipment, etc).

(b) The gamers make plans (move, fire, engage in combat, fly reconnaissance sorties, etc).

(c) A control group reviews gamer plans and makes necessary adjustments to the computer input data.

(d) The "computer" assesses results (determines casualties, equipment losses, new unit locations, new intelligence to gamers, etc).

(e) The control group receives output, analyzes it, and provides new status reports to the gamers on which to initiate a new period of play.

This is the standard operational mode for DIVWAG; however, DIVWAG is being used in a simulation mode at Rodman Laboratory. In this mode of operation, when a game has been completed, a representative period of play is selected for further analysis. The data base and gamer inputs for the start of the period are still available. Thus, the model is exercised independent of the gamer staff and the original output produced. Data base changes are made to reflect variations in artillery performance parameters such as range, mobility, vulnerability, lethality, weapon error, response time, rate of fire, etc. An analysis of the output will show the relative increase (decrease) in effectiveness.

When this effort was initiated at Rodman Lab, the only installation to have DIVWAG operational was the Combined Arms Combat Development Activity (CACDA), Ft. Leavenworth, Kansas. The only game that CACDA had completed was the Family of Scatterable Mines (FASCAM)[1] game. Basically, in this study, effectiveness, uses, and logistical implications in providing scatterable mine capabilities to the Blue* force (friendly) were investigated. Two distinct games were conducted: (1) A base game in which elements are considered involving standard TOE armored and mechanized infantry divisions conducting covering force, delay, defend and counterattack roles employing only conventional mines, and (2) a test game in which the events of the base game are repeated, except that scatterable mines and conventional mines were provided to the Blue force. The FASCAM scenario consisted of a mid-intensity environment with the setting in the Fulda Gap region of Germany. The capabilities, organizations, and tactics simulated were those predicted to exist in the 1978-1980 time frame.

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* Throughout this paper the terms blue and red will be capitalized only when reference is made to force, i.e., Blue force.

2.0 CONCLUSIONS AND RECOMMENDATIONS

The first independent test of DIVWAG at the Rodman Laboratory was to subject the model to a random number seed change. This was required to determine if the model was sensitive to this input. The base case (Period 1 - FASCAM) was repeated, changing only the random number seed. The output of the base case and random number seed games were then subjected to detailed analyses of the following: (1) Sequenced Events by Type; (2) Artillery Rounds Fired (by total force, by battalion level, and by individual battery); (3) Number of Targets Acquired; (4) Military Activities by Individual Units and (5) Personnel Casualties and Equipment Losses.

Based on the analysis of this data, it has been determined that there were no significant differences and that the model is insensitive to changes in the random number seed. Future experiments will be run to determine the sensitivity of the model to changes in the weather environment. Two experiments will be conducted: (1) optimum weather - clear daylight with no precipitation and (2) minimum weather - dark with rain. These variations will allow investigation of how this parameter, weather, impacts the target acquisition process and effects the mobility of maneuver units.

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3.0 DISCUSSION

CACDA was requested to furnish this Laboratory with source programs, model documentation, and input data necessary to make DIVWAG operational on the Mobility Equipment Research and Development Center, (MERDC), Ft Belvoir, Virginia, CDC 6600 computer. The material requested was obtained through several coordination visits to CACDA, telephone conversations, and correspondence.

The FASCAM study consisted of fourteen 2-hour game periods. Unfortunately, CACDA had retained only the data tapes necessary to originate Period 1 - Start of Game. Since artillery was heavily played in this period, this period was deemed most suitable for making DIVWAG an operational analysis tool at Rodman Laboratory. To achieve this objective required the accomplishments of the following tasks:

a. The Review and Understanding of FASCAM Scenario

The Blue force consists of an H-Series Table of Equipment (TOE) mechanized infantry division deployed along the Fulda River, with a General Outpost (GOP) force positioned east of the river. Two brigades of an H-Series TOE armor division are deployed as a covering force along the international border. To the north, an allied corps is deployed; to the south, a blue armor division is deployed.

At H-hour on D-day, the Red (enemy) force crossed the international border with a motorized rifle division in the north, a tank division in the south, and a second tank division as the second echelon force. Leading elements of the Red assault were four reinforced motorized rifle battalions and five reinforced tank battalions. Blue covering force delays. Blue units withdraw as their personnel strength falls below 85 percent.

b. The Review of Model Documentation and Comparison of Actual Program Logic

The accomplishment of this task entailed considerable effort. DIVWAG documentation[2] comprises eight volumes. The computer program itself has thousands of executable logic statements.

c. The Review of the Data Base

The data base composes approximately ten thousand cards. A few

keypunch errors were discovered and corrected.

d. The Establishment at MERDC, of the Necessary Source Program Libraries, Data Base Tapes, and Special Report Routines Needed to Execute DIVWAG

This was a considerable data management task. Over thirty tapes were involved. Special reports are output summaries developed to aid gamers and analysts. The primary types are:

(1) Gamer Report. An intelligence summary is provided for each division size force simulated. The force status summary contains force status and unit activity for the period. A comprehensive listing of barriers and facilities status is included.

(2) Killer Victim Report. Force losses and ammunition expenditures are accumulated for direct fire systems engaged in ground combat.

(3) Battle Summary. Pertinent ground combat information for each attacker/defender pair of every ground combat battle is listed by game time in chronological sequence.

(4) Air Ground Report. A comprehensive review of each air mission is provided. This includes the following: (a) mission scheduling and allocation of resources, (b) flight vulnerability to air defense fires, and (c) assessment of air mission unit and ground target.

(5) Movement Report. All unit movements generated are listed for each unit.

(6) Artillery Summary. Compilation of artillery missions, assessments, and losses are all recorded. This report is used to determine effectiveness of friendly and enemy artillery units. This may result, for example, in a change of tactics or a move of artillery units to more effective positions.

(7) Unit Loss Report. Unit losses by equipment classess are summarized.

e. Successful Establishment of DIVWAG Operation at MERDC

This task was accomplished with the use of Period 1 as the base case and was a major milestone. The DIVWAG system comprises five functional components. These components include four major processors and, at the "heart" of the system, a DIVWAG data file and data file

access package. The basic system flow is represented in Figure 1.

(1) Data File and Access. All constant data required by the DIVWAG system are maintained on the DIVWAG data file. The DIVWAG data file is segemented into 55 logical files. The DIVWAG disk access package is used to perform input/output operations on the DIVWAG data files.

(2) Constant Data Input Processor. This processor consists of a group of independently run jobs, each of which reads input data cards, edits, and loads a selected portion of the DIVWAG data file.

(3) Orders Input Processor. This processor is made up of two components. The DIVWAG Source Language (DSL) Compiler translates gamer instruction into a set of machine language routines which are written on a disk file. The Operating Instruction Loader is a simple data loader with card input, edit, and resultant output to a data file.

(4) Period Processor. The processor acts as an executive routine, directing the execution of the simulation through the use of a multiple overlay structure. The input resides on disk. The output consists of the same disk data (updated to reflect the progress of the game) and a set of Period History Magnetic Tapes which record each event simulated.

(5) Period Output Processor. This processor provides a formatted listing of the contents of those disk resident files that dynamically change during the game. A succinct report of game status upon which to base the development of orders for the next game period is provided.

A number of hardware problems surfaced at MERDC when Rodman Lab personnel began to implement DIVWAG. MERDC analysts were responsive in resolving these problems. MERDC has made two changes to their operating system since September 1974. Each change creates an inherent delay since job control language (CDC-SCOPE) is modified to fit the new operating system requirements. MERDC has only two high-speed data transmission lines (4800 baud), of which only one is available to Rodman Laboratory on a part time basis. However, a fast line must be used because (1) the use of a slow line ties up the terminal for long periods of time, excluding other terminal users, and (2) an unresolved card reader "glich" occurs when a slow line is used which prevents data from being transmitted.

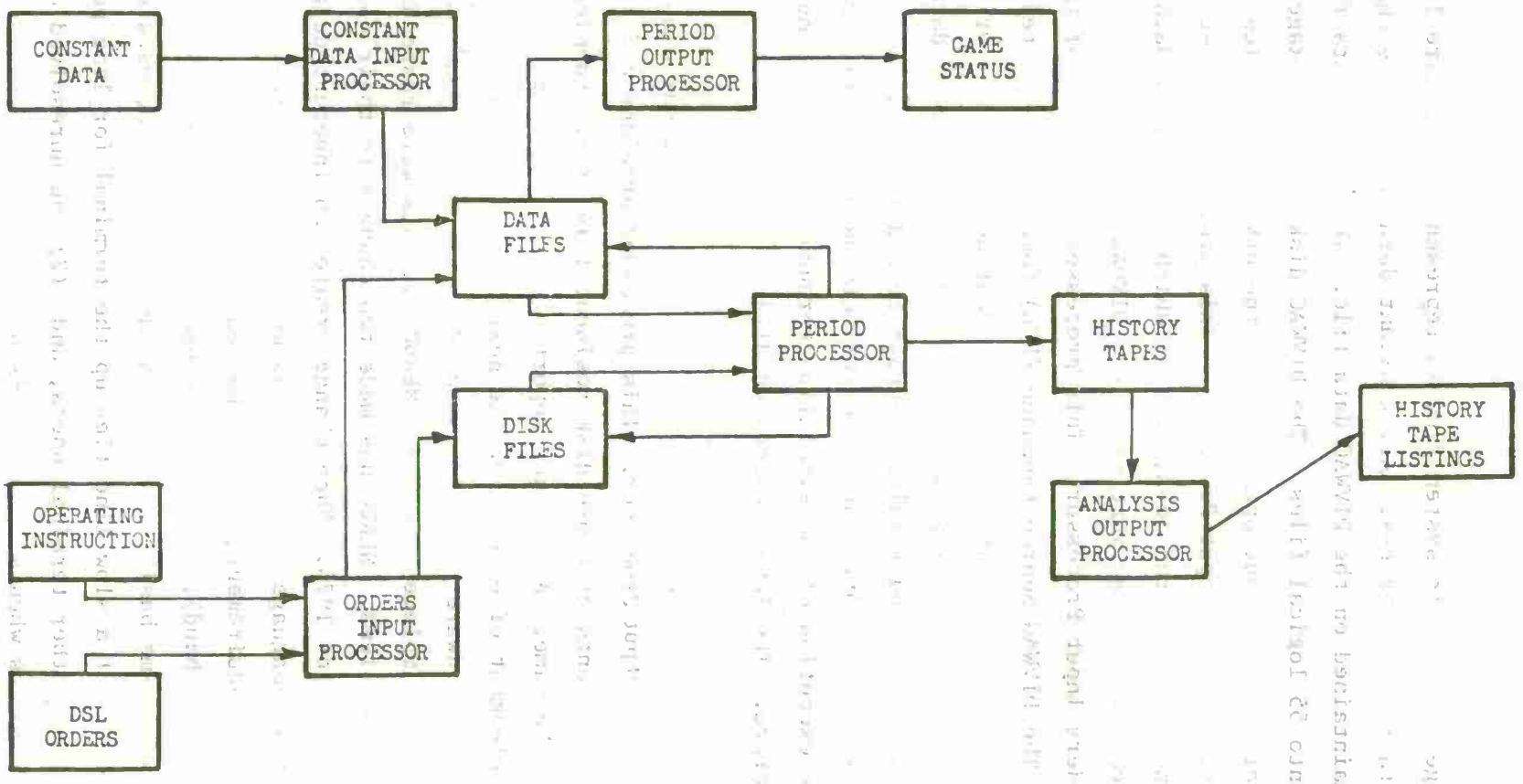

Figure 1 DIVWAG System Flow

f. Minimization of Cost

Computer costs have been reduced from $2000 to $950 per period run. This reduction was primarily achieved by the combining of job steps, when possible, and replacement of relatively slow tape data storage by disk storage. This has permitted a reduction in the number of tape drives required from four to two. This was extremely beneficial, as MERDC has only five tape drives. Further reduction in the number of tape drives could be made by modification of the source program libraries. These libraries were developed under contract (for CACDA) when computer costs were not a major consideration. Therefore, the program is, by no means, as efficient as it could be. However, the cost incurred to make the program more efficient would probably be greater than any computer savings achieved.

g. Determination of Suitability of Output

An extensive analysis of the base case results was made. The special reports are a good summary of selected events; but, by themselves, they are insufficient in detail for the in-depth analysis of artillery play desired. Thus, the period history tapes (which contain each event simulated) were examined in great detail. This entailed the reducing and correlating of a large volume of data. Special processing programs were developed to facilitate handling.

Indicators to assess the change in effectiveness due to variations in artillery performance parameters were determined. Graphical methods were developed to visually display output (e.g., different red (blue) target types engaged by a blue (red) artillery battery as a function of range and game time).

3.1 Random Number Variation Analyses Conducted

The Intelligence and Control portion of DIVWAG simulates the sensing and collection functions of various airborne and ground-based sensor collection systems. To allow the individual collection system to generate discrete sensing reports involves the use of a stochastic approach in most of the collection system submodels. The number of targets reported is determined on the basis of expected value calculations as are all environmental parameters. This combination of stochastic techniques for event sequencing purposes and the expected value calculations permits economy of computer usage and reasonable assurance that the game results will not be driven by random chance.

However, to assess the randomness effect, the first parametric variation (from the base case) was to change the random number seed and repeat the period. Comparisons between the base case run and the random seed change run were made for: (a) Sequenced Events by Type, (b) Artillery Rounds Fired (by total force, by battalion level, and by individual battery), (c) Number of Targets Acquired, (d) Military Activities by Individual Units, and (e) Personnel Casualties and Equipment Losses.

(1) Sequenced Events by Type

DIVWAG operates with a basic event sequencing logic. Within this logic, there are two parts to most of the models of military activity, a delta time computation for the activity and an activity assessment computation. An activity is this dealt with in two distinct steps within the flow of gamed activity. In the first step, the delta time computation portion of the activity model is exercised to determine the time at which the activity is to be assessed. In the second step, the actual assessment of the results of the activity is accomplished. Since accomplishment of an activity will generally take some finite amount of time, usually a period of simulated time (Δt) occurs between activity initiation time (T) and activity assessment. During this intervening period of time, other activity assessments and delta time computations for the same or other units can be made.

Fourteen different types of events occur that are distinguished in DIVWAG. A comparison is made in Table 1 between the base case period

(BASE) and the random number seed change period (RANDOM) for each of the fourteen event types simulated in DIVWAG. There is no significant difference.

Table 1 Event Comparison

EVENT TYPE	NUMBER OF EVENTS BASE	RANDOM	DIFFERENCE (%)
STAY	829	854	+3.02
MOVE	180	183	+1.67
AREA FIRE	1528	1558	+1.96
GROUND COMBAT	144	141	-2.08
ENGINEER	40	40	--
TRANSFER	1	1	--
NUCLEAR	0	0	--
SUPPRESSION	153	148	-3.27
INTELLIGENCE	1715	1749	+1.98
AIR GROUND	164	161	-1.83
MORTAR FIRE	223	228	+2.24
COMBAT SERVICE SUPPORT	1	1	--
AIRMOBILE	446	437	-2.02
RECON	54	56	+3.70
TOTAL	5478	5587	+1.91

(2) Artillery Rounds Fired

Within DIVWAG, the Area Fire/TACFIRE Model represents the scheduling, delivery, and assessment of nonnuclear area fire munitions by cannon systems, missile systems, multiple rocket launchers, and the assessment of mortar fire generated by the Ground Combat Model. The aspects modeled include the fire planning, target analysis, fire direction, and fire support coordination functions inherent in the employment of field artillery, as well as, the assessment of target damage resulting from the

execution of the scheduled fire missions.

Fire units used in the model may be at a battalion or at a battery level of resolution, at the user's discretion. Each fire unit may contain up to four weapon/ammunition combinations, although only one combination can be used for a single fire mission. Two types of artillery fire are involved: (1) DSL (preplanned) and (2) TACFIRE (target of opportunity).

The model representation of planned fires on areas or points is accomplished in response to DSL FIRE orders. The DSL FIRE orders take priority over any FIRE orders developed within the "automatic" or TACFIRE mode of the model. With the DSL FIRE order, the gamer can specify the number of rounds or volleys and the munition type to be used. The locations specified for the fire are derived from the output intelligence report of the previous period and from the gamer's coordination of fire support with the plan of operation for the next period.

Fire missions against targets of opportunity are represented in the TACFIRE system submodel. These are targets that have not been previously considered, analyzed, or planned, and are usually expected to be fleeting in nature. Specific TACFIRE missions include counterbattery fires; supporting fires requested by maneuver units engaged in ground combat; and fire missions against targets detected by unattended ground sensors, radar detection systems and by air reconnaissance missions. The targets developed in the Ground Combat Model correspond to direct support (DS) requests. Within the model, a maximum of two DS fire units is allowed for each maneuver brigade/regiment. TACFIRE controlled missions are fired as full unit volleys. The number of rounds or rockets fired per volley is equal to the number of integral tubes or launchers. In the TACFIRE mode, each division is allowed a maximum of 36 fire units. No limit is set on the number used in the DSL mode.

The Blue force artillery consisted of 155mm and 203mm (8-inch) Self-Propelled Howitzers and 155mm Towed Howitzers. The Red force artillery consisted of 122mm Howitzers and Rocker launchers, 130mm Guns and 152mm Gun/Howitzer combinations. Comparisons of selected artillery results are shown in Tables 2 through 5.

Table 2 Total Artillery Rounds Fired

	BLUE ROUNDS FIRED			RED ROUNDS FIRED		
	DSL	TAC	TOTAL	DSL	TAC	TOTAL
BASE	1924	3732	5656	2801	3555	6356
RANDOM	1923	3774	5697	2801	3385	6186
PERCENT CHANGE	0	+1.13	+0.72	0	-4.22	-2.67

The number of rounds fired by some units varies considerably from the BASE, as is evident in Table 3. However, if the battery resolution blue units are grouped into their proper battalions, it can be seen (for the most part) that the increased (decreased) rounds fired by one battery is compensated for by the other batteries in their battalion (See Table 4).

(3) Number of Targets Acquired

Within DIVWAG, the following types of targets, activities and sizes are gamed.

TYPE	ACTIVITY
Infantry	Stay
Armor	Move
Mechanized Infantry	Fire
Reinforced Task Force	Attack
Tube Artillery	Defend
Missile Artillery	Engineer
Air Defense Guns	Withdraw
Air Defense Missiles	SIZE
Air Base	Platoon
Engineer	Company
Command Post	Battalion
	Battalion Plus

An intelligence report is an output report developed dynamically for each division size force at the end of a period. An example of such

Table 3 Artillery Rounds Fired by Individual Resolution Units

BLUE ROUNDS FIRED					RED ROUNDS FIRED						
IUID*	UTD*	BASE	RANDOM	CHANGE (%)	IUID	UTD	BASE	RANDOM	CHANGE (%)	UTD	WEAPON TYPE
4	IAFA	324	324	---	563	MAFA	161	164	+1.86		
5	IAFA	83	93	+12.05	565	MAFA	156	180	+15.38		
6	IAFA	102	90	-11.76	567	MAFA	94	94	---		
31	IAFA	150	138	-8.00	579	MAFA	108	108	---		
32	IAFA	78	72	-7.69	719	GRFA	486	488	+0.41		
33	IAFA	53	52	-1.89	720	HGFA	324	314	-3.09		
104	IBFA	184	204	+10.87	723	GRFA	270	270	---		
105	IBFA	164	164	---	724	HGFA	360	270	-25.00		
106	IBFA	168	168	---	725	GHFA	414	414	---		
110	IAFA	306	330	+7.84	728	GRFA	382	454	+18.85		
111	IAFA	306	324	+5.88	729	GHFA	324	324	---		
112	IAFA	306	270	-13.33	730	GHFA	351	317	-9.69		
144	IAFA	306	270	-13.33	733	NLFA	13	14	+7.69	IAFA	155mm SP Battery
145	IAFA	270	300	+11.11	734	NLFA	12	12	---	IBFA	203mm SP Battery
146	IAFA	210	252	+20.00	735	NLFA	12	12	---	IGFA	203mm SP Battery
185	IAFA	270	258	-4.44	806	GHFA	468	485	+3.63	IHFA	155mm Towed Battery
186	IAFA	312	336	+7.69	807	GHFA	414	390	-5.80		
187	IAFA	348	342	-1.72	808	GHFA	386	403	+4.40	GEFA	152mm Gun/How Battalion
205	IGFA	144	164	+13.89	811	NLFA	12	13	+8.33	GHFA	122mm How Battalion
206	IGFA	152	196	+28.95	812	NLFA	12	12	---	GRFA	152mm Gun/How Battalion

Table 3 Artillery Rounds Fired by Individual Resolution Units (Con't)

BLUE ROUNDS FIRED					RED ROUNDS FIRED						
IUID*	UTD*	BASE	RANDOM	CHANGE (%)	IUID	UTD	BASE	RANDOM	CHANGE (%)	UTD	WEAPON TYPE
207	IGFA	152	188	+23.68	813	NLFA	12	12	---	HGFA	130mm Gun Battalion
211	IGFA	148	152	+2.70	956	GEFA	288	288	---	HPFA	130mm Gun Battalion
212	IGFA	159	150	-5.66	957	HPFA	360	336	-6.67	MAFA	122mm How Battery
213	IGFA	147	120	-18.37	960	GRFA	469	452	-3.62	NLFA	122mm Rocket Launcher Battery
217	IHFA	304	224	-26.32	961	HGFA	468	360	-23.08	NOTE:	All blue units are of battery
218	IHFA	270	270	---							resolution while the red units
219	IHFA	240	246	+2.50							are for the most part battalion
		5656	5697	+0.72			6356	6186	-2.67		size.

* The symbol IUID represents individual unit identification designator. The IUID identified a specific unit at a specific location. The UTD (Unit Type Designator) system has been designed to identify each type unit by its military echelon, its principal military function (e.g., maneuver, fire support), and its arm or branch. (See Appendix B).

Table 4 Artillery Rounds Fired by Blue Battalions

BATTALION TYPE	BATTERY UIDS	ROUNDS FIRED BASE	ROUNDS FIRED RANDOM	PERCENT CHANGE
155mm SP	4,5,6	509	507	-0.39
155mm SP	31,32,33	281	262	-6.76
203mm SP	104,105,106	516	536	+3.88
155mm SP	110,111,112	918	924	+0.65
155mm SP	144,145,146	786	822	+4.58
155mm SP	185,186,187	930	936	+0.65
203mm SP	205,206,207	448	548	+24.55
203mm SP	211,212,213	454	422	-7.05
155mm TOWED	217,218,219	814	740	-9.09
	TOTAL	5656	5697	+0.72

Table 5 Artillery Rounds by Weapon Type

WEAPON TYPE	BASE	RANDOM	PERCENT CHANGE
Blue Force			
155mm SP	3424	3451	+0.79
203mm SP	2418	1506	+6.19
155mm SP	814	740	-9.09
Total	5656	5697	+0.72
Red Force			
122mm How	2876	2879	+0.10
152mm Gun/How	1895	1952	+3.08
130mm Gun	1512	1280	-15.39
122mm RL	73	75	+2.74
Total	6356	6186	-2.67

a report is given in Figure 2. The following discussion relates to that figure and the circled number thereon.

(a) The first four items are the standard heading. The game identifier (1) is an optional legend that can be an input during processing. The date and time (2) are the wall clock time at the end of processing. Page numbers (3) appear as indicated. The beginning and ending time (4) is given for the game period simulated.

(b) The report title (5) identifies the force, Blue or Red receiving the report and an index (1, 2, or 3) indentifying the specific division force. Four intelligence files are maintained, one for Blue and three for Red. The intelligence index (6) is assigned at the time that the target is first reported and is a permanent part of the report through all parts of the model. The last three digits of the intelligence index (6) indicate the sequence number assigned to that particular report. The first two digits in a five digit index or the first three digits in a six digit index will identify the unit, by UID, acquiring the intelligence. The information items are estimated location (7), size (8), activity (9), type (10), and direction of movement (11). The time of last detection (12) and the number of sightings (13) indicate how often and the last time that the unit was reported to the division.

One hundred targets were detected by Blue during both BASE and RANDOM. Red detected 29 targets during BASE and 32 targets during RANDOM. A distribution of these target types is shown in Table 6.

Table 7 is a distribution of target activities.

The random seed change has not introduced any significant changes in the intelligence gathering process.

(4) Military Activities by Individual Units

Another criterion considered was whether actual individual unit activities were altered. A comparison of Blue and Red units that have activity is shown in Tables 8 and 9. Only one of 47 Blue units changed activity. IUID 218, a 155mm towed artillery battery, received 51 rounds of counterbattery fire, and 64 casualties occurred in BASE, but no counterbattery fire was received in RANDOM. Five out of 52 Red units changed some activity. Four units had an activity in RANDOM that was not present in BASE. IUID's 720 (130 BN), 734 (MRL BTY), and 807 (122 BN)

(1) RANDOM

(2) DATE: 12/15/75 TIME: 13/01/02 (3) PAGE 1

(4) BEGINNING TIME DAY 1 HR 6 MIN 0
ENDING TIME DAY 1 HR 8 MIN 0

(5) ***** BLUE 1 INTELLIGENCE REPORT *****

(6) INDEX	(7) EST. LOCATION X	Y	(8) EST. SIZE	(9) EST. ACTIVITY	(10) EST. TYPE	(11) EST. DIRECTION OF MOVEMENT	(12) TIME LAST DETECTED	(13) ATTRIBUTED SIGHTINGS
7001	168510	141667	PLT PLUS	ATTACK	MECH INF	W	1635	1
48001	164916	107660	CO	ATTACK	REINF TF	WSW	1628	1
78004	165010	124832	CO	ATTACK	REINF TF	W	1617	2
78007	169967	142753	PLT	ATTACK	ENGINEER	W	1639	1
82002	163952	111901	PLT	ATTACK	ARMOR	WSW	1610	1
82005	164017	113992	CO PLUS	FIRING	ARTYTUBE	W	1643	3
82012	166448	120932	CO	DEFEND	REINF TF	W	1647	2
82013	161869	116619	CO PLUS	MOVING	REINF TF	W	1621	1
82021	162236	112440	PLT	ATTACK	ARMOR	WSW	1643	1
82024	164470	124777	PLT	ATTACK	MECH INF	W	1645	1

Figure 2 Example of Intelligence Report

Table 6 Types of Targets Detected

TYPE	RED		BLUE	
	BASE	RANDOM	BASE	RANDOM
MECH INF	11	8	9	11
REINF TF	23	22	14	15
ENGINEER	12	10	0	0
ARMOR	8	8	1	1
ARTY TUBE	9	13	5	5
ADA-MSL	27	31	0	0
COMMAND POST	10	7	0	0
INFANTRY	0	1	0	0
TOTAL	100	100	29	32

Table 7 Types of Target Activities Detected

ACTIVITY	RED		BLUE	
	BASE	RANDOM	BASE	RANDOM
STAY	32	33	0	0
MOVE	4	3	0	0
FIRE	8	9	5	5
ATTACK	44	45	0	0
DEFEND	12	9	24	27
INFANTRY	0	1	0	0
TOTAL	100	100	29	32

Table 8 Blue Military Activity

IUID	UNIT DESCRIPTION	ARTILLERY FIRED		GROUND MOVEMENT		AIR SORTIES FLOWN		ARTILLERY FIRE RECEIVED		GROUND COMBAT		AIR SORTIES RECEIVED	
		BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM
1	155mm ART BN							X	X				
4	155mm ART BTY	X	X										
5	155mm ART BTY	X	X					X	X				
6	155mm ART BTY	X	X	X	X								
7	TK BN MIXED							X	X	X	X	X	X
14	MEC INF BN			X	X			X	X	X	X	X	X
21	MECH INF BN			X	X			X	X	X	X	X	X
31	155mm ART BTY	X	X	X	X								
32	155mm ART BTY	X	X										
33	155mm ART BTY	X	X	X	X			X	X				
34	TK BN			X	X			X	X	X	X	X	X
41	TK BN			X	X			X	X	X	X	X	X
48	TK BN			X	X			X	X	X	X	X	X
54	MEC INF BN							X	X	X	X	X	X
78	BRIGADE HQS					X	X	X	X				
82	BRIGADE HQS					X	X	X	X				
92	ENG CO			X	X								
93	ENG CO			X	X			X	X				
97	ENG CO			X	X								

Table 8 Blue Military Activity (Con't)

IUID	UNIT DESCRIPTION	ARTILLERY FIRED		GROUND MOVEMENT		AIR SORTIES FLOWN		ARTILLERY FIRE RECEIVED		GROUND COMBAT		AIR SORTIES RECEIVED	
		BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM
104	203mm ART BTY	X	X										
105	203mm ART BTY	X	X										
106	203mm ART BTY	X	X										
110	155mm ART BTY	X	X										
111	155mm ART BTY	X	X										
112	155mm ART BTY	X	X										
144	155mm ART BTY	X	X										
145	155mm ART BTY	X	X										
146	155mm ART BTY	X	X										
185	155mm ART BTY	X	X										
186	155mm ART BTY	X	X										
187	155mm ART BTY	X	X										
205	203mm ART BTY	X	X										
206	203mm ART BTY	X	X										
207	203mm ART BTY	X	X										
211	203mm ART BTY	X	X										
212	203mm ART BTY	X	X					X	X				
213	203mm ART BTY	X	X					X	X				

Table 8 Blue Military Activity (Con't)

IUID	UNIT DESCRIPTION	ARTILLERY FIRED		GROUND MOVEMENT		AIR SORTIES FLOWN		ARTILLERY FIRE RECEIVED		GROUND COMBAT		AIR SORTIES RECEIVED	
		BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM
217	155mm TOWED BTY	X	X					X	X				
218	155mm TOWED BTY	X	X					X	NO				
219	155mm TOWED BTY	X	X										
264	ENG CO			X	X								
265	ENG CO			X	X								
280	AIRCAV TP					X	X						
285	ATK HEL PLT					X	X						
288	MOHAWK FLIGHT					X	X						
297	RECON FLIGHT					X	X						
298	RECON FLIGHT					X	X						

X - Indicates that a Military Activity has taken place.

Table 9 Red Military Activity

IUID	DESCRIPTION	ARTILLERY FIRED		GROUND MOVEMENT		AIR SORTIES FLOWN		ARTILLERY FIRE RECEIVED		GROUND COMBAT		ATT HEL SORTIES RECEIVED		AIR DEFENSE FIRE RECEIVED	
		BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM
516	AIR ARMY					X	X							X	X
517	RECON BIRD					X	X								
563	122 BTY	X	X					X	X						
565	122 BTY	X	X												
567	122 BTY	X	X					X	X						
577	RECON BN							X	X						
579	122 BTY	X	X												
677	MR BN+							X	X	X	X	X	X		
682	MR BN+							X	X	X	X	X	X		
693	MR BN+			X	X			X	X	X	X	NO	X		
709	MR BN+			X	X			X	X	X	X				
719	152 BN	X	X					X	X						
720	130 BN	X	X					NO	X						
723	152 BN	X	X	X	X			X	X						
724	130 BN	X	X												
725	122 BN	X	X												
728	152 BN	X	X					X	X						
729	122 BN	X	X												
730	122 BN	X	X					X	X						

Table 9 Red Military Activity (Con't)

IUID	UNIT DESCRIPTION	ARTILLERY FIRED		GROUND MOVEMENT		AIR SORTIES FLOWN		ARTILLERY FIRE RECEIVED		GROUND COMBAT		ATT HEL SORTIES RECEIVED		AIR DEFENSE FIRE RECEIVED	
		BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM
733	MRL BTY	X	X												
734	MRL BTY	X	X					NO	X						
735	MRL BTY	X	X												
744	REAR SVCS					X	X								
755	TK BN+							X	X						
759	TK BN+			X	X			X	X	X	X	X	X		
764	TK BN+							X	X	X	X	X	X		
769	MR BN-							X	NO						
783	TK BN+			X	X			X	X	X	X	X	X		
784	57 T BTY			X	X										
795	TK BN+							X	X	X	X	X	X		
800	TK BN+							X	X	X	X				
801	57 T BTY			X	X			X	X						
802	REAR SVCS			X	X			X	X						
806	122 BN	X	X					X	X						
807	122 BN	X	X					NO	X						
808	122 BN	X	X					X	X						
811	MRL BTY	X	X												
812	MRL BTY	X	X												
813	MRL BTY	X	X												

Table 9 Red Military Activity (Con't)

IUID	UNIT DESCRIPTION	ARTILLERY FIRED		GROUND MOVEMENT		AIR SORTIES FLOWN		ARTILLERY FIRE RECEIVED		GROUND COMBAT		ATT HEL SORTIES RECEIVED		AIR DEFENSE FIRE RECEIVED	
		BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM	BASE	RANDOM
822	REAR SVCS					X	X								
881	ENG CO			X	X			X	X						
892	ENG CO			X	X										
900	TK BN							X	X						
903	ENG CO			X	X										
916	AA REGT							X	X						
926	ENG CO			X	X										
935	ENG CO			X	X										
946	ENG CO			X	X										
956	152 BN	X	X												
957	130 BN	X	X												
960	152 BN	X	X					X	X						
961	130 BN	X	X												

X - Indicates that a Military Activity has taken place.

received 10, 12, and 65 rounds of counterbattery fire resulting in 8, 10, and 61 casualties, respectively. IUID 693 (MR BN^{+}) received one helicopter sortie, resulting in 2 casualties. IUID 769 (MR BN^{-}) received 12 artillery rounds in BASE, causing one casualty.

(5) Personnel Casualties and Equipment Losses

Currently, DIVWAG will accommodate 200 unique items for each Blue and Red force. These items can be grouped into general categories for summary reporting purposes. No significant change in Blue or Red personnel or equipment losses was caused by the random number changes except air defense weapons and ammunition, and artillery weapons and ammunition whose totals are so small that the percentages are misleading; this is evident in Tables 10 and 11.

The personnel strengths of units at the end of Period 1 base case game is comparable with results of RANDOM game; i.e., in both cases the following units became ineffective (50% of original strength); 92, 93, 217, 297, 516, 563, 677, 682, 693, 709, 759, 764, 806, (Table 12). The only other units affected much more drastically in one game than the other are 218 and 807, and both of these were previously discussed.

Table 10 Blue Losses (by Category)

ITEM CODES	CATEGORY	BASE ARTILLERY	BASE GROUND COMBAT	BASE CLOSE AIR	BASE TOTAL	RANDOM ARTILLERY	RANDOM GROUND COMBAT	RANDOM CLOSE AIR	RANDOM TOTAL	TOTAL CHANGE (%)
20-49	INDIVIDUAL AND CREW SERVED WEAPONS	127.8	140.5	20.3	288.6	128.5	138.0	20.4	286.9	-0.59
50-76	ARTILLERY WEAPONS AND AMMUNITION	0.8	—	—	0.8	0.8	—	—	0.8	0
77-84	AIR DEFENSE WEAPONS AND AMMUNITION	0.9	—	—	0.9	1.2	—	—	1.2	+33.33
85-106	AIRCRAFT, MUNITIONS AND EQUIPMENT	0.1	—	—	—	0.1	—	—	0.1	0
108-116	ELECTRONICS AND SENSORS	395.6	—	--	395.6	396.2	--	—	396.2	+0.15
118-134	SCATTERABLE MINE SYSTEMS				NA				NA	NA
135-150	ENGINEER EQUIPMENT	29.8	—	—	29.8	30.0	--	—	30.0	+0.67
151-184	VEHICLES (WHEELED)	190.91	—	.04	190.95	189.27	—	.04	189.31	-0.86
185-200	VEHICLES (TRACKED)	15.7	28.5	5.0	49.2	16.5	28.2	5.2	49.9	+1.42
201	PERSONNEL	407.9	285.7	47.9	741.5	362.3	280.5	48.1	690.9	-6.82

Table 11 Red Losses (by Category)

ITEM CODES	CATEGORY	BASE ARTILLERY	BASE GROUND COMBAT	BASE ATTACK HEL	BASE AIR DEFENSE	BASE TOTAL	RANDOM ARTILLERY	RANDOM GROUND COMBAT	RANDOM ATTACK HEL	RANDOM AIR DEFENSE	RANDOM TOTAL	TOTAL % CHANGE
21	INDIVIDUAL WEAPONS	3138.9	—	—	—	3138.9	3083.1	—	—	—	3083.1	-1.78
22-49	CREW SERVED WEAPONS	128.2	208.0	4.6	—	340.8	127.7	208.1	5.7	—	341.5	+0.21
30-69	ARTILLERY WEAPONS AND AMMUNITION	0.7	—	—	—	0.7	0.8	—	—	—	0.8	+14.29
70-84	AIR DEFENSE WEAPONS AND AMMUNITION	6.8	—	—	—	6.8	7.1	—	—	—	7.1	+4.41
85-91	AIRCRAFT, MUNITIONS AND EQUIPMENT	—	—	—	1.0	1.0	—	—	—	1.0	1.0	0
110-134	ELECTRONICS AND SENSORS	—	—	—	—	NA	—	—	—	—	NA	NA
135-159	ENGINEER EQUIPMENT	2.8	—	—	—	2.8	2.8	—	—	—	2.8	0
160-184	VEHICLES (WHEELED)	60.6	30.5	0.3	—	91.4	61.1	30.5	0.4	—	92.0	+0.66
185-200	VEHICLES (TRACKED)	7.8	38.8	1.5	—	48.1	9.8	39.4	1.6	—	50.8	+5.61
201	PERSONNEL	1476.3	1020.6	11.6	2.0	2510.5	1522.5	1027.5	13.5	2.0	2565.5	+2.19

Table 12 Personnel Strength

IUID	UNIT DESCRIPTION	BEGINNING OF GAME	END OF PERIOD 1 BASE	END OF PERIOD 1 RANDOM
1	155mm ART BN	540	506	506
4	155mm ART BTY	112	112	112
5	155mm ART BTY	112	91	91
6	155mm ART BTY	112	112	112
7	TK BN MIXED	657	594	592
14	MEC INF BN	790	703	705
21	MEC INF BN	872	768	762
28	155 ART BN	540	512	512
31	155 ART BTY	112	112	112
32	155 ART BTY	112	112	112
33	155 ART BTY	112	84	84
34	TK BN	657	568	566
41	TK BN	657	579	582
48	TK BN	554	482	481
54	MEC INF BN	708	692	687
90	ENG BN	1285	1037	1037
92	ENG CO	154	68	68
93	ENG CO	154	66	66
97	ENG CO	154	117	117
104	203 ART BTY	112	112	112
105	203 ART BTY	112	112	112
106	203 ART BTY	112	112	112
110	155 ART BTY	112	112	112
111	155 ART BTY	112	112	112
112	155 ART BTY	112	112	112
144	155 ART BTY	112	112	112
145	155 ART BTY	112	112	112
146	155 ART BTY	112	112	112
185	155 ART BTY	112	112	112
186	155 ART BTY	112	112	112
187	155 ART BTY	112	112	112

Table 12 Personnel Strength (Con't)

IUID	UNIT DESCRIPTION	BEGINNING OF GAME	END OF PERIOD 1 BASE	END OF PERIOD 1 RANDOM
205	203 ART BTY	102	102	102
206	203 ART BTY	102	102	102
207	203 ART BTY	102	102	102
211	203 ART BTY	102	102	102
212	203 ART BTY	102	80	80
213	203 ART BTY	102	96	92
217	155 TOWED BTY	111	26	27
218	155 TOWED BTY	111	47	111
219	155 TOWED BTY	111	111	111
264	ENG CO	148	111	111
265	ENG CO	148	111	111
280	AIRCAV TP	201	199	197
285	ATK HEL PLT	24	22	20
288	MOHAWK FLT	2	2	2
297	RECON FLT	2	0	0
298	RECON FLT	2	2	2
RED				
516	AIR ARMY	2	0	0
517	RECON BIRD	1198	1197	1197
563	122 BTY	69	28	13
565	122 BTY	69	69	69
567	122 BTY	69	54	54
577	RECON BN	289	284	284
579	122 BTY	69	69	69
677	MR BN+	527	233	230
682	MR BN+	548	147	145
693	MR BN+	527	224	225
709	MR BN+	527	160	160
719	152 BN	315	308	308
720	130 BN	341	341	332
723	152 BN	315	266	310

Table 12 Personnel Strength (Con't)

IUID	UNIT DESCRIPTION	BEGINNING OF GAME	END OF PERIOD 1 BASE	END OF PERIOD 1 RANDOM
724	130 BN	341	341	341
725	122 BN	260	260	260
728	152 BN	315	239	253
729	122 BN	260	260	260
730	122 BN	260	148	148
733	MRL BTY	66	66	66
734	MRL BTY	66	66	56
735	MRL BTY	66	66	66
744	REAR SVCS	1054	1044	1044
755	TK BN+	344	343	343
759	TK BN+	344	173	174
764	TK BN+	365	121	103
769	MR BN⁻	71	70	71
783	TK BN+	365	337	320
784	57 T BTY	67	67	67
795	TK BN+	344	281	297
800	TK BN+	365	316	318
801	57 T BTY	67	61	61
802	REAR SVCS	222	211	211
806	122 BN	260	104	105
807	122 BN	260	260	198
808	122 BN	260	159	160
811	MRL BTY	66	66	66
812	MRL BTY	66	66	66
813	MRL BTY	66	66	66
822	REAR SVCS	1054	1046	1046
881	ENG CO	76	67	67
892	ENG CO	76	76	76
900	TK BN⁻	91	90	90
903	ENG CO	76	76	76
916	AA REGT	272	270	270

Table 12 Personnel Strength (Con't)

IUID	UNIT DESCRIPTION	BEGINNING OF GAME	END OF PERIOD 1 BASE	END OF PERIOD 1 RANDOM
926	ENG CO	76	76	76
935	ENG CO	76	76	76
946	ENG CO	76	76	76
956	152 BN	219	219	219
957	130 BN	207	207	207
960	152 BN	315	294	294
961	130 BN	341	341	341

A.0 Appendix A Model Description

DIVWAG can play a Blue force of up to division size against a Red force of up to three divisions, each supported by appropriate combat support and combat service support. Maneuver force resolution is generally battalion level, but is company level in special cases. Support elements level of resolution is such that, in isolated instances, even individual items are considered (e.g., aircraft and sensor).

DIVWAG is composed of nine major submodels which provide for the simulation of: (1) movement of units, aircraft, and logistics; (2) ground combat between opposing forces; (3) artillery fire and assessment of casualties; (4) direct aerial fires of armed helicopters and assessments; (5) close air support, air defense fires and assessments; (6) airmobile movement; (7) intelligence acquisition, processing and dissemination of reports; (8) combat services of replacement supplies, and equipment and personnel; (9) barrier construction, effects, and removal; and (10) nuclear fire and assessment.

Up to 1000 units and 400 types of equipment, supplies, weapons, ammunition, and other material can be gamed. Units are represented, by rectangles of gamer specified dimensions, according to unit type and activity (stay, move, fire, attack, defend, withdraw, or engineer). Unit movement is preloaded according to gamer specified movement type (administrative or tactical), route type (cross country, paved road, gravel road, or dirt road) and unit formation (column march, reconnaissance, or deployed).

Terrain is currently loaded for a rectangle of about 100 by 200 kilometers (sufficient for a division-sized conflict in Europe). The terrain is divided into 2 x 2 kilometer cells. Each cell is coded for roughness , vegetation, forest trafficability, and elevation. A maximum of nine individually homogeneous weather zones can be defined, each with hourly changes in termperature, precipitation, fog, cloud cover, wind speed, wind direction, and humidity. Terrain and weather conditions modify line of sight by air, air defense, ground combat, and target acquisition elements. Mobility and weapons effects are also modified by terrain and weather conditions.

The six major functions simulated in DIVWAG are described in the following paragraphs:

Mobility - Movement is automatically suppressed (interrupted) by counterfire (air or ground), for preloaded periods of time. Accelerated rates within preloaded maximum capabilities then are generated to try to make up for lost time. Movement is halted for delays if fuel is exhausted. Adverse weather, terrain, and light conditions degrade movement rates. Moving units encountering barriers attempt to circumvent them. If this is not possible, movement is delayed while the appropriate engineer activity takes place.

Ground Combat - The effectiveness of infantry antitank weapons and armor crew-served weapons against opposing unit weapons and vehicles is simulated. Personnel casualties are assessed according to fire received by an associated vehicle or weapon and the degree of protection afforded to passengers or crew members. Dismounted infantry neither inflict casualties nor suffer casualties, unless they are defined as a "weapon system" (e.g., a man carrying an antitank weapon).

Sixteen surface units for each force can engage in each battle. Up to 23 battles can be conducted concurrently. Each force may employ eight types of weapons systems and sixteen weapon/ammunition combinations in ground combat.

Line-of-sight probability is considered depending on terrain and vegetation masking as well as weather consideration. Up to 10 types of sensors including visual, can be simulated. Line-of-sight probability is combined with probability of sensor looking in the right direction, probability of pinpointing, background reflectance, duration of target exposure, exposed target area, weapon firing rate and accuracy, and ammunition lethality for each weapon-target combination at the appropriate range, to determine the number of acquisitions and number of hits and kills. Targets are given preloaded priorities according to type, activity, and proximity. Ammunition expenditures are accounted for and lower priority targets dropped as ammunition levels decrease. Unit movement is slowed simulating weapons stopping to fire.

Air-Ground - Attack of ground targets by armed helicopters (DAF)

and high performance aircraft (CAS), and attrition of aircraft by hostile air defense weapons is simulated. Unlike ground-to-air engagements the detailed interactions of air-to-ground engagements are not explicity simulated. Preloaded tables are used to compute aircraft and ground target losses and aircraft ammunition expenditures.

DAF and CAS strikes can be planned and ordered by gamers prior to each period of play and are automatically generated by the model to strike targets of opportunity. Assessment of ground targets varies with five target types, four weather-light conditions, five target postures (assembly, attack, defend, delay, move), and the aircraft munition mix for DAF.

Air defense weapons within range of aircraft flight paths fire at the aircraft if there is time for acquisition and response. Aircraft do not take evasive action. Air defense weapon effectiveness considers weather, visibility, terrain, vegetation, aircraft speed and altitude, presented vulnerability areas, and weapon system accuracy and lethality.

Engineer - Engineer play simulates the scheduling and execution of engineer tasks and assesses delays incident to the tasks and the related barriers and facilities. The model accepts engineer tasks, assigns priorities to them, determines task feasibility, assigns resources according to task priority, mobilizes task forces, executes the tasks, reports results, demobilizes the task forces and maintains current status information on barrier and facilities.

Intelligence and Control - Automatic play of command and control is limited to the assessment of delay time for processing and reacting to intelligence, the use of method-of-attack decision tables for selection between aerial or artillery attack on targets of opportunity, and the reaction of units to obstacles. Communication systems are not simulated. Information is assumed to be available when and where needed, subject only to certain time delays.

All sensors must be given a location (or flight pattern) and direction or zone of coverage. Aircraft systems will not perform unless given specific mission instructions for each game period. Radars and Unattended Ground Sensors (UGS) are located and orientated at the start of the game and will perform automatically thereafter, although changes are possible

between each game period. Sensors play appropriate preloaded characteristics such as range, field of view, range gating, scan rates, and in some cases, location errors. Sensor detection is modified by line of sight, terrain characteristics, cover, camouflage, weather, visibility, and target motion. Ground observers are played automatically by front line maneuver units. Sensors are attrited by enemy action as appropriate.

Sensors only report those portions of targets that the above restrictions permit them to observe. Sensors report number of personnel and equipment recognized, time, estimated location, activity, and direction of movement. Input data tables set time delays for collection, analysis, routing, and decision. Sensor reports (including ground observers) follow task organization channels. Input decision tables cause sensor reports to be interpreted and converted into estimates of target unit size and type. These reports are then processed and forwarded through the appropriate intelligence channels. Target acquisition (sensor) reports automatically generate appropriate air or artillery fire support.

Artillery - Cannon, rocket, and missile artillery of battery and battalion level of resolution is played. Up to 36 fire units on each side can be used in automatically model-generated fire missions. Each fire unit can utilize up to four weapon/ammunition combinations, but cannot mix them in a single fire mission. Artillery average response times, firing rates, and average time of flight are preloaded and automatically considered. Artillery units are suppressed and cannot fire when under attack by air or other artillery. Automatic massing of fire is not possible and moving fire units are not available for fire missions.

Targets of opportunity are generated by ground combat units, intelligence sensors, and aerial reconnaissance. The targers are automatically fired on, dependent upon the following; availability of an inactive fire unit within range, ammunition levels, and preloaded preference for method and level of attack for weapon/ammunition type, target type, size, location and activity. Preference for attack of targets of opportunity automatically considers artillery unit mission (direct or general support) and source of request (support unit or other). Moving targets are not fired

on if they are expected to move 3,000 meters before fire can be brought on them.

Round-to-round dispersion errors are played causing some rounds to miss area targets; however, the centroid of artillery volleys coincides with aim points specified by gamer-ordered or model-generated intelligence. Target casualty assessment is based upon preloaded lethality of munition against each type of equipment and for personnel in various postures: warned-unwarned, standing-prone-foxhole, or protected by equipment. Lethal areas are modified by target area forest conditions.

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B.0 Appendix B

The symbol IUID represents individual unit identification designator. The IUID identifies a specific unit at a specific location. The UTD (Unit Type Designator) system has been designed to identify each type unit by its military echelon, its principal military function (e.g., maneuver, fire support), and its arm or branch.

The first character describes the military echelon. For this purpose the alphabet has been divided as follows:

A = The top command of each side
B = Division/division equivalent
C, D = Brigade/regiment/group
E, F, G, H = Battalion/squadron
I, J, K, L, M, N = Company/troop/battery
P, Q, R, S, T = Platoon
U, V, W, Y = Section/flight/squad/team
Z = Dummy units

The letter A, used to describe the top echelon on opposing sides (Red and Blue), is predetermined; and AABB designates the top Blue echelon, and AARR designates the top Red echelon. Beginning at the brigade/regiment/group echelon (letters C and D) and on through the alphabet to the letter Z, it has been found convenient to make some division of letters to the respective forces; for example, C assigned to Blue and D to Red, E and F to Blue, and G and H to Red. There is no model rule for such a division; it is a matter of convenience.

The second character has no predetermined meaning; and, thus, no specified alphabetical designation can be used. It is required to permit unique UTDs for which the other three characters are the same.

The third character is fixed and is used widely by the subsystems of DIVWAG. The permissible letters and their meanings are:

C = Command and control
F = Fire support (area fire)
S = Other combat support
L = Combat service support
M = Maneuver

I = Intelligence

T = Target acquisition

It is of paramount importance that F and M be used as appropriate. Specifically, the INC Model uses the M to determine those type units that can communicate. The Combat Service Support Model uses M to determine maneuver units so it can give them priorities for resupply. The third character F is to be used only for those units that physically deliver indirect fire support; i.e., the actual firing unit. Thus, in the case of artillery, if the battalion is the resolution unit, the third character will be F; however, if the resolution unit is the firing battery, the battery will be given the F.

The fourth character is also fixed and predetermined and is used to specify arm or branch as follows:

A = Artillery

C = Cavalry

D = Air defense

E = Engineer

H = Attack helicopter air base

I = Infantry

J = Intelligence

L = Logistical

S = Signal

T = Armor

W = Naval

Y = Air Force air base

Z = Army Security Agency

The four-character UTD is equivalent to the TOE number. All identically organized and identically equipped type units will be identified by the same UTD.

Literature Cited

1. (C) DIVWAG ANALYSIS OF THE FAMILY OF SCATTERABLE MINES (FASCAM) (U), United States Army Combined Arms Center, 28 June 1974.

2. DEVELOPMENT OF A DIVISION WAR GAME MODEL (DIVWAG), Volumes II through VIII, United States Army Combat Development Command, December 1971.

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General Thomas J. Rodman Laboratory
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Application of DIVWAG at Rodman Laboratory
by Simulation and Technology Division

Prepared by: Jerry W. Frantz, Group Leader
George F. Stiles, Analyst
CPT Michael A. Roddy, Analyst
William A. Werker, Analyst

Security Class. (of this report): Unclassified
Technical Report R-TR-76-008

39 Pages, Incl Figures

The DIVWAG Model is a computerized wargame model which has been successfully run in prior applications as a tactics model. The model has been modified to determine the difference in effectiveness of field artillery caused by varying system parameters. Rodman Laboratory is using DIVWAG in a simulation mode. In this mode of operation, once a game has been completed, a representative period of play is selected for further analysis.

The data base and gamer inputs for the start of the period are still available. The model can be exercised independent of the gamer staff and the original output produced. Data base changes are made to reflect variations in artillery performance parameters such as range, mobility, vulnerability, target acquisition, weapon error, response time, rate of fire, etc.

1. DIVWAG
2. War Game
3. Simulation
4. Mathematical Model

I. Jerry W. Frantz, Group Leader
George E. Stiles, Analyst
CPT Michael A. Roddy, Analyst
William A. Werker, Analyst

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