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GAMING AND SIMULATION
THE NEXT TWENTY FIVE YEARS

by

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FOREWORD

This paper was written for presentation to the March 1982 meeting of the Military Operations Research Society. It was the theme paper for the session on Gaming and Simulation. Since that meeting, the ideas have been presented at a number of meetings of Professional societies; and informally to members of both the Simulation and the Test and Evaluation Communities.

The message is that both Communities need to combine and integrate their efforts so that we may not only build a consistent, consistently expanding data base which can be used to design increasingly more focussed Test and Evaluation programs; but also use that data base to run simulations simultaneously with our tests. The result of that combination of capability will not only be beneficial to both communities, but will also provide means to validate in the field the many critical assumptions necessarily built into any model.

In short, this paper suggests that "Real Time Analysis is of benefit to everyone with a part to play in the complex business of System Design, Acquisition, Operation, and Support.

An old German proverb says, "The Historian is a Backward Looking Philosopher." I suppose that's akin to saying that hindsight is always 20/20. I remember 1958 quite well - at the time, I was involved in developing the Atlas missile system, practicing a newly maturing profession, Operations Research. We knew what simulation was in those days: for ATLAS it was, mainly, computing re-entry trajectories under various sets of assumptions about wind profiles, It was also simulating system responses to control commands, and there were other kinds of simulations for the various sub-systems. There was rather use of analog computers for both system and sub-system simulations.

We did gaming too. We had a very basic model of the ICBM-AICBM problem which was, essentially, a simulataneous solution of the equations of motion of the two vehicles. We simply established envelopes of trajectory for each, solved for the extreme values, which we called "bounds", and then "rolled the dice" to get a distribution function of outcomes between the bounds. We thought life was complex!

It got more complex when ORO-RAC began to develop CARMONETTE. Expanding use of digital computers permitted things like digital terrain maps, iterated trajectory computations, and much closer representation of what we all perceived real like to be like.

During the period between 1958 and 1960, the concepts of Field Experimentation and building data bases began to emerge. These concepts led to establishment of the Combat Development Experimentation Center (CDEC) at Ford Ord, California; the facility which provided the basis for a continuing field data collection effort to try to understand the dynamics of ground warfare. A parallel development was establishment of the Modern Army Selected System Test, Evaluation and Research (MASSTER) activity at Fort Hood, Texas.

By 1962 there were ground warfare models, and some data coming from the CDEC activity. But in 1962 CDEC's data collection devices consisted of stop watches, clipboards, and a rather gross position location system based on signs placed over the terrain which the players identified and called out. The real data collection device was the controller, with All his human failings.

Why this quick review of history? Because if look back on our current state of the art and methodology from the vantage point of 2008, we might say that little progress had been made in integrating and using data bases for modeling and simulation during 1958 to 1985. I will illustrate what I mean.

The past 25 years have seen staggering advances in computational capability. Along with hardware improvements there has been some advance in software technology. My computer friends confidently inform me that we can expect ever greater advances quickly. They predict that 1 megabyte memories soon will be found within a soldier's back pack - thus providing im with picosecond computational capability.

The number of models used for computer simullation has increased enormously. Figure 1 lists the 36 models for Air-Ground Force conventional conflict listed in the latest SAGA manual. Each was developed to address different aspects of a Ground-Air battle But there is one common requirement: All models and computer assisted games use data base information as the basis of model or game operation. The quantity and quality of the data base may be the cause of considerable difference in results obtained from one model/game to the next. This is true even when models have been structured to provide comparable results. Even setting aside data base limitations, there is an additional problem - Models and Games are difficult Model rules generally are the product of cerebration with due regard to a data base. Once programmed, any changes to model decision rules can become very difficult. Most importantly, model validation, the acid test, continues to raise practical problems. The Army Model Improvement Program (AMIP) is looking at these problems and is tasked not only to provide improved models for future use, but also to look at the data base used to exercise those models. There is considerable hope that the end result of all this effort will be a believable data base useful across the entire spectrum of models in the Army's active library.

AIR-GROUND FORCES - CONVENTIONAL CONFLICT
MODELS, GAMES, AND SIMULATIONS

ADAGE	COUNTERCOM
AFACE	DIVWAG
BGM	DUNN-KEMPF
BGWG	DYNCOM
BLOCKBUSTER	EVADE II
BRIGADE & UNIT WAR GAME ASSISTED COMMAND POST EXERCISE	IDAGAM IIA
BRIGADE LEVEL RESEARCH WAR GAME	IDAHEX
BRIGADE LEVEL WAS GAME ASSISTED COMMAND POST EXERCISE	IDATAM
CAMMS	IEM
CARMONETTE & CARMONETTE/TRASANA	KORA
CASSANDRA	NCM
CATTS	PEGASUS
COMANEX	STAR
CACDA JIFFY WAR GAME	STATE III
COMMANDER	STOCHADE
COMO III	TAC DISRUPTOR II
CORDIVEM	TAC EVALATOR
	TAGS

Figure 1

Of course, generating credible, validated data is always a problem. It tends to be very expensive to provide and field the forces involved, and the instrumentation necessary to collect a detailed data base. Developing a data base suitable for exercising models or games requires replication of whatever exercise is fielded to generate the data. The technology to provide better data collection devices is now, or shortly will be available. TRADOC's five year instrumentation plan details instrumenttion for the future - devices which will:

> Provide line-of-sight verification

> Provide player generated terrain position

> Make continuous records of player sightings and weapon firings

> Validate firer-target pairing

> Generate estimated casualties automatically

The precursor for such hardware might well be the Electronic Line of Sight System used in the Advanced Attack Helicopter Operational Test (AAH-OT-II)

Having now given my impression of our current situation with regard to experimental and training instrumentation, computer hardware, models, and data and having stated those developments I think we can expect to be available in the near term, what capabilities do I postulate for the year 2008? What can we say about the next 25 years? An eternal optimist, I think we are on the threshold of a most fascinating and useful break-through which will encourage increased use of gaming and (validated) simulation as test and evaluation tools. I would like to share a concept with you, not only because I hope you will find merit in it, but also because I hope you find sufficient advantages to be gained to encourage you to direct your efforts toward making it happen. The concept is best described by the words "REAL TIME DATA ANALYSIS"

What does real time analysis mean? What can it permit us to do that we can't do now?

First: real time analysis lets us compare what is happening in the field with what was expected to happen there. The expected results would be derived from exercise of a model or simulation. That effort would use a data base built by integrating data derived from the entire operational, training, and testing universes. That data integration would require great care. Until now, it has been very difficult to cross-correlate data produced in different kinds of field situations. The primary reasons have been:

> A data universe structure has been lacking or if one has been present, it has not been uniformly applied to every field activity. Lack of definition for each variable, or if their values are not collected in every case, data correlation may be impossible.

> There has been no standardized set of information gathering equipment (instrumentation). Thus there are many instances of dissimilar information collection equipment producing test data about the same variable in the same circumstances to much different accuracies.

In practice, the entire data base would not necessarily be used in real time analysis; rather an abridged data set (or data compendium) would likely be placed on line. Used in this sense, a data compendium might be visualized as a set of probability distribution functions derived from the complete data base for specific use in real-time analysis. These would be linked with decision rules derived from the model or simulation. The compendium, operating with the model (or simulation) would provide projected results based on the data base. The actual field data would also be fed to the model thus permitting real time data to provide "current status" while the model predicts future outcome based on compended data. Such a process is analagous to current NASA methodology: real-time data provides the "how-goes-it", while data base information is fed to the dynamic flight models to provide "probable outcome."

In simplest terms, real-time analysis lets us do three things simultaneously:

> Establish an integrated internally consistent data base and provide for its continuous growth within whatever set of routine test, evaluation, experimentation, and/or training programs are current

> Install sets of Models and Games which could not only be used to make continuing runs with existing data but also could be fed the live data produced during routine training or testing programs with the live data rather than the data base used to drive the model.

> Provide immediate evaluation of the results of testing and training activities against "expected" or "normative" results produced by the models or games when they are driven by the data base statistics.

Of course, all the functions now performed by models or games would still be available. There seems to be no loss of capability inherent in real-time analysis, only certain kinds of gains. Figure 2 illustrates the concept. It is a kind of closed loop system in which:

> Continued data base expansion provides great scope for exercise of models and games; this in turn gives

WHAT IS "ON-LINE, REAL-TIME ANAYSIS"?

THE SIMULTANEOUS DEVELOPMENT AND REAL-TIME USE OF OPERATIONAL TEST DATA

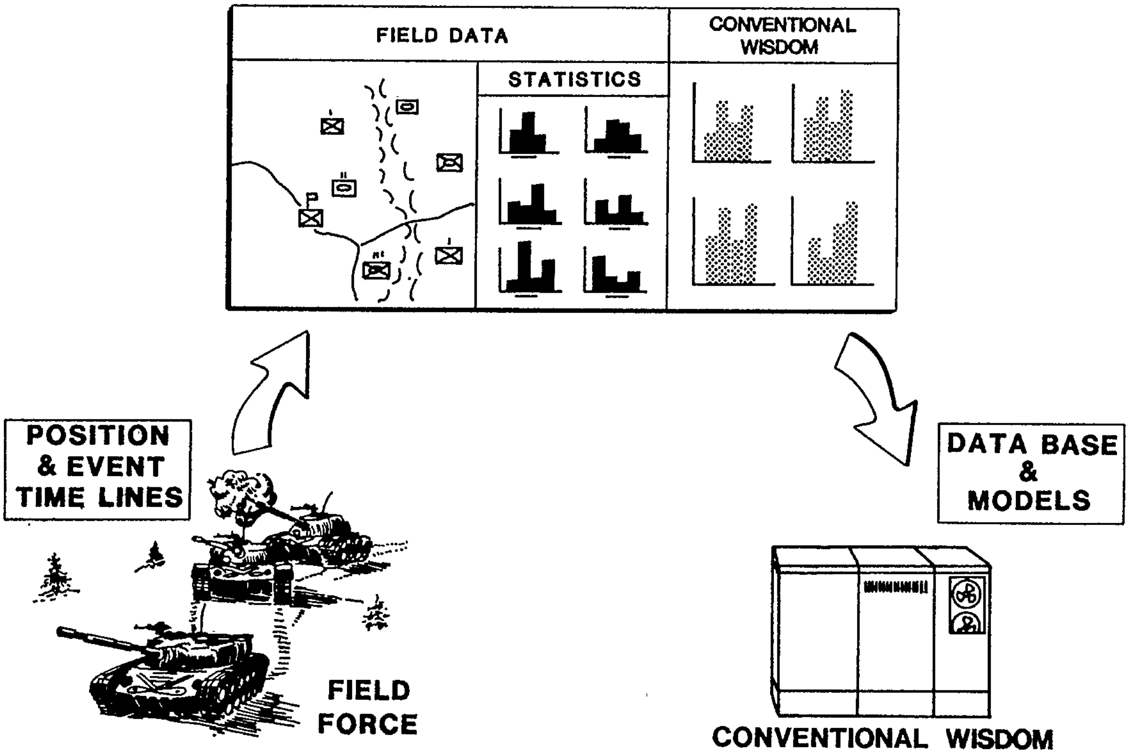

Figure 2

> Potential to test likely advantages of proposed new systems before they are built and permits

> Verification of the effects of performance differences on the outcomes of battle as indicated by the models

Another way of to look at potential values of real time analysis is shown in Figure 3. If the live data were used on-line, we could compare field results and model generated statistics while forces generating the data were still in the field. In the case of a test program such as AAH-OT-II, considerable effort might have been saved.

In that program initial runs indicated there were few engagements between the AAH helicopter and the ground forces. Model runs would have indicated an expectation of much higher contact potential. If we had been able to compare model runs with the data as it was generated, we would have been able quickly to analyze the reasons for the differences, (in this instance AAH flight path and weapon use doctrine), and to make test changes to provide for optimum data production. In short, rational incremental test design, planning, and operations become possible. Incremental testing permits us to focus on generating really crucial test data - knowing it can be used immediately and its utility verified before forces leave the field.

There are other benefits too. We might be able to incorporate development test results directly within any compendium data base. We could do that by accumulating test statistics while the test was was in progress and combining them with the distribution statistics within the compendium. We could quickly determine whether test data statistics were within the data universe represented by the compendium distribution functions, to whatever confidence levels and accuracy criteria (1, 2, or 3 sigma) we we wished to specify). And, if they were, we could combine the two data sets and then use that combined data for subsequent test runs.

The capability to transmit from field sites to modeling or gaming facilities some distance away via satellite can provide a means to overcome terrain limitations imposed by fixed instrumentation. Removing that barrier permits every training activity to become a data generator: Each test produces information for the data base, and is part of the data compendium used to exercise those models which simulate the real world.

Figure 4 summarizes these concepts.

I know there must be skepticism about the practicality of building a data base and its compendium from large numbers of uncontrolled exercises and tests. It is a difficult task but not an imposs-

WHAT DOES "ON-LINE, REAL-TIME" ANALYSIS PERMIT US TO DO?

- MAKE REAL-TIME COMPARISONS BETWEEN RESULTS IN THE FIELD AND ALL PRIOR RESULTS STORED IN A DATA-COMPENDIUM-ARCHIVE
- PLAN AND EXECUTE SEQUENTIAL OPERATIONAL TESTING DESIGNS
- FOCUS MOST SHARPLY ON TIMELY, COST EFFECTIVE PRODUCTION OF CRITICAL TEST DATA

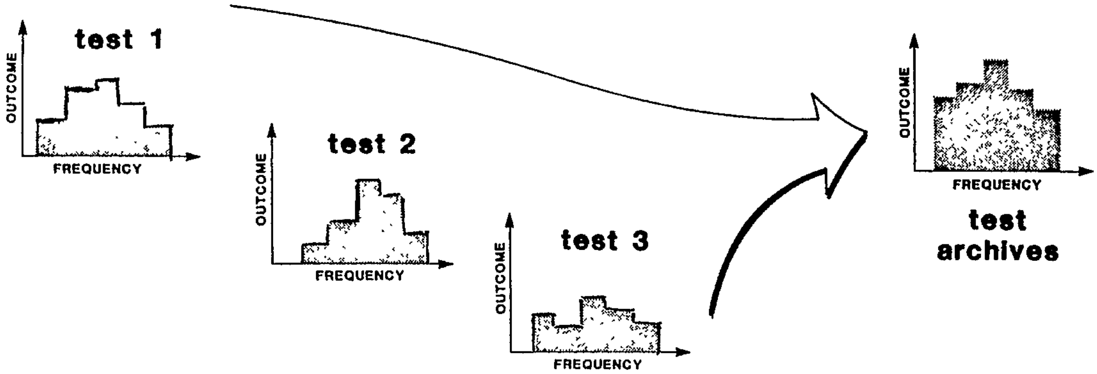

Figure 3

CORROLARY BENEFITS OF "ON-LINE REAL-TIME" ANALYSIS

- CAN INCORPORATE DEVELOPMENT TESTING DATA RAPIDLY INTO OPERATIONAL TEST PLANNING AND EXECUTION
- CAN PERFORM COST-EFFECTIVE TESTING UNDER OPERATIONALLY REALISTIC SETS OF TERRAIN-TACTICAL SITUATION VARIABLES
- CAN PROVIDE ENHANCED TRAINING EVALUATION CAPABILITIES BY MAKING POSSIBLE IN-SITU "ON-LINE REAL-TIME OBJECTIVE ANALYSIS OF TROOP PERFORMANCE"
- CAN AUGMENT OPERATIONAL TEST DATA BY USING DATA DEVELOPED FROM ROUTINE TRAINING EXERCISES, **THUS**

CLOSED LOOP TESTING ON-LINE REAL-TIME ANALYSIS

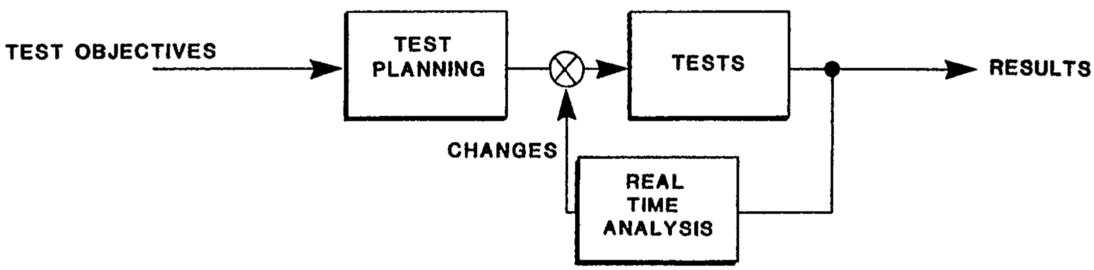

Figure 4

ible one. I built a data base from combat interviews, after action reports, field tests and computer asisted gaming. During the course of that program, a key hypothesis to the concept presented here was tested: The hypothesis that one can devise tests or field experiments which will sample the combat universe sufficiently well to generate a data base which looks just like combat. That hypothesis by the way, is fundamental to all sampling activity. I will describe briefly the work done under the Advanced Research Project Agency's (DARPA) Small Independent Action Force (SIAF) program during the period from 1968 through 1971 in Viet-Nam, in Hawaii, and at the Special Forces School at Fort Bragg, North Carolina.

During the Viet-Nam war, it was observed by the MAC-V staff that small (less than 10 man) unit patrols which operated independently fared much better than larger units which operated internal to Battalion or Division structure and under control of those elements. Small unit mission objectives appeared to be met better and with fewer casualties to themselves. The question was: Why? ARPA undertook to find out. The first step was to perform a "Logical Analysis". These days, that's called a "Dendritic"! In those days it was called "Structuring". Modelers may recognize it as defining the variables and their dependencies. Whatever one calls it, it simply means defining that matrix array which includes every factor (and all subordinate levels) that can effect the problem. The SIAF reports list 135 factors as being of possible importance. That array of variables was used to design a field data collection program.

In-depth combat unit interviews were the primary data source. The interviews were held in the combat area immediately after patrols returned from their missions. The debriefing was a step-by-step process which took the patrol members through their missions minute by minute. It began with the moment of insertion and ended with unit extraction. Information elements developed by this process were those indicated to be of importance. For example, patrol speed of movement was considered as a function of:

> the kind of terrain
> type of foliage
> foliage density
> terrain trafficability
> unit perception of enemy activity (based at first on the Operations Order, later on the unit's own sense)
> numbers and kinds of "enemy" troops sighted and their equipment
> current patrol fire-fight history and their prior combat experience (as a patrol and as individuals in other patrols).

Results of 1,000 debriefings of U. S. patrol units - U. S. Army Long Range Reconnaissance Patrols (LRRPS), Navy SEALS, and Fleet Marine Force (FMF) units were formed into probability distribution functions for things like movement rates, and probability of detection. We managed to gather enough data to insure that the matrix cells did have sufficient content to make the statistics meaningful. We assumed in all of this that prior experience heavily influenced current and future actions. That assumption provided for interactions between events which occurred in different time frames.

With the interview data base in hand, a similar kinda of data set was obtained by analysis of patgrol after action reports. 1,500 reports were analyzed, none of which duplicated the interview data.

It took a great deal of effort to search out of the written reports a level of detail sufficient to permit comparison between the two sets of data. In fact, some of the data were not available in some reports because the interview time step process was at too fine a detail level to be contained within a written after action report.

The two data sets were compared to test the hypothesis that they were a part of the same data universe. They were. The two sets of data were combined into a single data compendium whose population contained 2,500 samples of combat patrol data.

Next we addressed the question, "Is extensive combat data collection necessary to achieve a representative data base, or can a Field test or an Experiment be structured to provide the requisite data?" We designed and conducted a test program in Hawaii. We ran the program on terrain which closely resembled Viet-Nam. We used combat veteran patrol leaders and members. We provided enemy forces who also had Viet-Nam combat experience. We measured patrol raes of movement, measured lines of sight, measured terrain characteristics. We took great pains to ensure accurate data reporting. We again compared statistically the data we measured from our 25 Hawaiian patrols with the data in our compendium. The Hawaiian data was not only within the combat data universe, but represented it quite well.

We next asked whether it was always necessary to collect field data or whether one could get useful data from various kinds of computer assisted games. We designed an interview program for application, in a non-combat environment, to combat veteran troops at the Special Forces School. We cued them with maps, pictures of terrain, and supplied Operational orders and other information about the patrol as they were leading it. The choices made by patrol leaders, the speeds of movement they selected; the decisions about whether to break cover, engage, and so on, were within the previously constructed data compendium. Figure 5 summarizes the steps we performed to build the SIAF data base, and Figure 6 summarizes the way in which the SIAF data were used.

<u>BUILDING THE SIAF DATA BASE</u>

> PERFORM THE LOGICAL ANALYSIS
> COLLECT THE PRIMARY DATA SET
> COLLECT THE SECONDARY DATA SET
> TEST "DATA UNIVERSALITY" HYPOTHESIS
> FORM THE DATA UNIVERSE (DATA BASE)
> DESIGN A FIELD TEST
> EXECUTE THE FIELD TEST
> TEST HYPOTHESIS THAT FIELD TEST DATA IS WITHIN THE COMBAT DATA UNIVERSE
> TEST THE HYPOTHESIS OF DATA UNIVERSALITY
> FORM INTEGRATED SIAF DATA UNIVERSE
> DESIGN AN INTERVIEW PROGRAM
> APPLY QUESTIONNAIRES TO COMBAT VETERANS
> TEST DATA SET STATISTICS AGAINST ALL OTHER INDIVIDUAL DATA SETS
> TEST THE HYPOTHESIS OF DATA UNIVERSALITY
> FORM AN INTEGRATED SIAF DATA UNIVERSE

Figure 5

SIAF was one of the less complex kinds of combat activities. I'm not certain we're yet ready to surmount difficulties in building similar kinds of data bases for, say, Air-Ground Battalion level

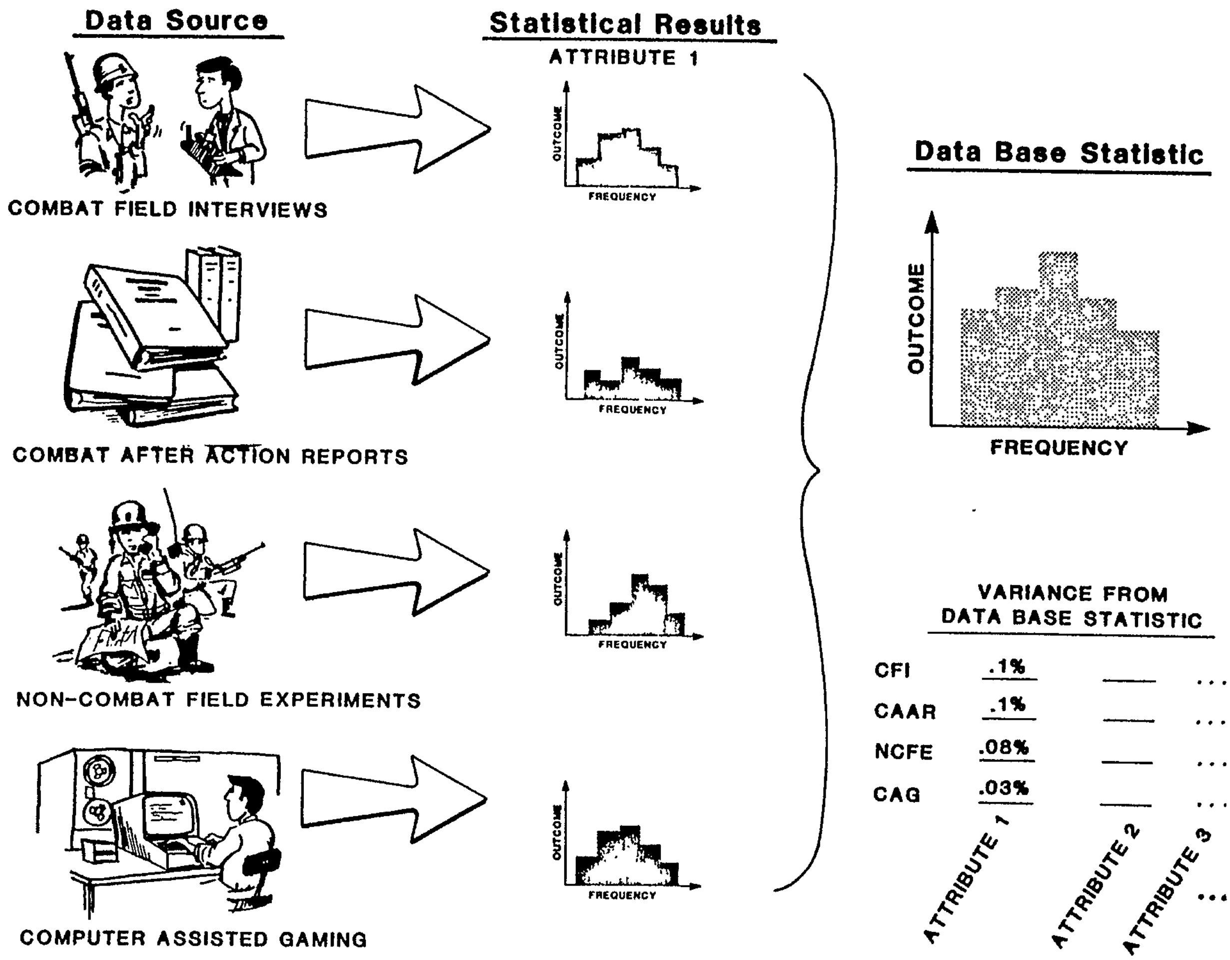

Figure 6

operations. However, at some time within the next 25 year span, it will be possible to do so. As an immediate starting point, consider the following: In three consecutive years, (1979 through 1981) there were three separate activities which developed Air-ground, and Ground-air engagement data. At CDEC, the Joint Test and Evaluation of Tactical Aircraft Survival Program (TASVAL), Joint Operational Test and Evaluation of Advanced Armored Vehicles (ARMVAL) and AAH-OT-II test programs have explored various aspects of the problem. At Fort Bliss, Texas a test was conducted of the Multiple Integrated Laser Engagement System used in Air Defense Mode (MILES/AGES AD). The test was primarily to measure any improvement in Air Defense effectiveness when the MILES training system was used as a training tool. Even though this program had other objectives, it produced Air-ground, Ground-air engagement performance data. Could all these data be formed into a data compendium useful as input to any of the existing models, games, or simulations? Even if we aren't yet ready for Air-Ground data base building, is there perhaps sufficient information about Infantry operations to permit us to apply the SIAF methodology again in today's Infantry context?

Lest we get caught up in the complexity of building data bases, let me say that only 5 types of common data elements were required to build the SIAF data base. My experience in building other data bases generally confirms the SIAF example. Figure 7 shows the 5 generic data characteristics.

DATA ELEMENTS NECESSARY TO FORM A COMMON DATA BASE

1. TIME:
   ABSOLUTE, OR
   RELATIVE (EXPERIMENTAL)
2. POSITION:
   ABSOLUTE (LAT. LONG.) OR
   RELATIVE (BETWEEN PLAYERS)
3. EVENTS
4. AMBIENT ENVIRONMENT
5. REAL TIME CASUALTY ASSESSMENT:
   DIRECT FIRE
   INDIRECT FIRE

Figure 7

All information must be related within some common time line - experimental time, local time, or when data is to be sent over long distances via satellite in absolute time (GMT).

It has almost always been necessary to know participants actual positions on the battlefield (simulated, real, or game); but in some cases, relative positions have been enough: for instance when assessing direct fire casualties produced by various kinds of weapons.

Events which occur during play must be recorded and their time of occurrence logged so that complete time lines can be generated for all players designated as critical to the outcome of the play.

It has been necessary to reduce ambient environmental situations to objective measurements: level of illumination, any weather parameters, and soil trafficability are examples. The objective characterization of terrain is also required, and the level of terrain detail affects the number and kind of variables that can be included within a data universe.

To permit exercise of any model structure, there needs to be an appropriate means to assess and generate casualties. Since outcomes depend on timely and accurate casualty assessment, players need to be advised of their casualty status when the event occurs; and they must be rendered incapable of continuing play beyond that time.

The means to collect these data generics are mostly in hand. The critical requirement appears to be achieving distributive data collection: collecting information on the players rather than using the player reports processed and interpreted by a central computer. Distributive data collection might require some advances in software (perhaps development of a high level microcomputer language). But the advantages to be gained are well worth the effort. The NAVSTAR system used together with MAFIS will provide a total capability for each player to collect his own position information and to integrate position, and other data elements into a single data message. Today (1982) a version of ELOSS could provide such a capability within the kinds of limited terrain boundaries involved in the kinds of data collection programs I have discussed here. ELOSS will also provide line of sight and target pairing information. A marriage between ELOSS and MILES could provide direct fire casualty assessment on the players. In short, what I do not see immediately available, I certainly can see within the very near future.

Given an integrated data universe and the capability to collect required data elements routinely then what? The field experiment, test, and training programs would be able to focus directly on augmenting information in existing data universes rather than in collecting sufficient data to demonstrate test objectives in a single program. When the exercise of models indicates that outcome change depends on changes to one performance parameter or to a particular parameter set, the test program can focus on determining whether those parameter changes result from changes in organization, tactics, terrain, or equipment. Figure 8 shows how real-time on-line analysis concepts could be used.

I know of no specific DoD agency charged with examining this kind of concept. I know of no concentrated activity aimed at providing the capabilities I have described. Given that a data universe inclusive of all testing, experimental, gaming, and model run data is worthwhile; Given it is achievable near term; Given that the end result would be a significant advance, what would we have to do to build that capability? Figure 9 summarizes the essentials.

Had someone asked me 25 years ago what capabilities we would have today, I would have erred on the side of optimism. I'm not sure my optimistic nature hasn't biased this presentation as well. But I think not. I believe we can achieve a limited real-time on-line capability within only 3 to 4 years. If that is so, then 25 years from now, we might be able to develop contingency plans of such demonstrable effectiveness that we might even achieve man's most elusive dream: Peace.

Thank you. Now I'll take your questions.

(Presented March 28, 1982)

DATA FLOW AND MODEL USE

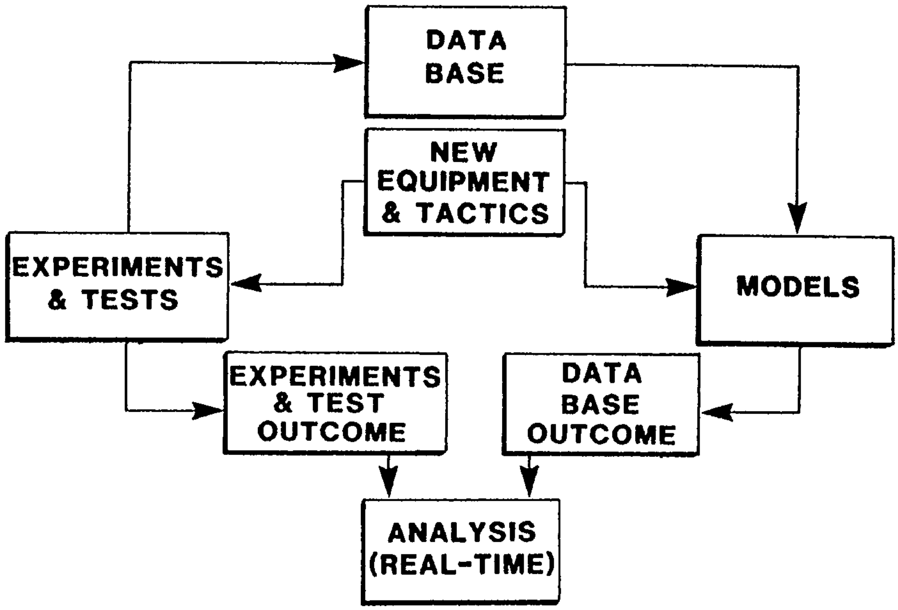

Figure 8

WHAT IS REQUIRED TO ACHIEVE AN "ON-LINE, REAL-TIME" ANALYSIS CAPABILITY?

DESIGNATE AN OPERATIONAL ORGANIZATION TO ACCOMPLISH AN INTEGRATED PROGRAM. THE ELEMENTS OF SUCH A PROGRAM ARE:

- CONSTRUCTION OF A DATA COMPENDIUM
- PROVISION FOR (DEVELOPMENT AND OPERATION OF) INTEGRATED DATA COLLECTION EQUIPMENT
- OVERSIGHT OF DEVELOPMENT, INSTALLATION AND OPERATION OF A STRUCTURED, INTEGRATED SET OF SUITABLE MODELS
- CONSTRUCTION AND OPERATION OF THE ON-LINE, REAL-TIME ANALYSIS FACILITY

Figure 9

BIOGRAPHICAL SKETCH - HENRY C. ALBERTS

A native of New York, Mr. Alberts received his B. S. degree in Physics and Mathematics from Queens College (1949); and his M. S. degree in Physics and Mathematics from the University of Delaware (1953). During the Period 1949 to 1953, Mr. Alberts did basic research in supersonic aerodynamics and fluid flows behind shock fronts. He applied his work to the practical problems of design and construction of the ATLAS re-entry body during the initial program development effort. During the following two years, Mr. Alberts managed the effort to instrument ICBM/AICBM testing at Eniweitok and the development program which sought to understand the physics of atmospheric reentry and communications transmission through ionized mediums.

Mr. Alberts joined the Stanford Research Institute staff supporting the Army's Combat Development Command effort to develop a Ground Forces Experimentation Center at Fort Ord California. He conceived, directed the development, installation and operation of the first automated instrumentation system for Army ground force use in simulated combat exercises. Mr. Alberts received a Citation for his "dedicated efforts in support of CDEC's pioneering programs."
During 1966, Mr. Alberts served as a Technical Advisor to the U. S. Seventh Army, where he helped design tactical information and control tests. He was also a member of the U. S. delegation to the NATO conference on Field Experimentation.

Mr. Alberts joined SRI's office in Stockholm where he did Management Consulting to European Industry.

Returning to the U. S. in 1968, Mr. Alberts served as a consultant to the U. S. Commission on the Causes and Prevention of Violence. He was cited by the Commission for his "creative, innovative work in structuring the crime of political assassination." During 1969 he also consulted to the Office of the Secretary of Defense on problems of modelling Small Independent Action Force Operations.

In 1970, Mr. Alberts founded a data processing and information systems design company. He designed, developed, installed and operated distribution and financial information systems for major retail organizations based in the Washington area, and as well for agencies of both Federal and State Governments.

Mr. Alberts was a U. S. delegate to the NATO conference on Logistics in 1970 and his work in analytical approaches to logistics systems appears in the publications of the NATO Logistics Organization.

Mr. Alberts joined General Research Corporation in 1975 to serve as Program Manager of the Joint Logistics Commander's DoD Materiel Distribution Study Program. He also managed other DoD supported studies in Foreign Military Sales, Mobilization Planning, and Manpower Analysis areas, and supported MCOTEA activities at Quantico.

Returning to CDEC in 1980, he reviewed instrumentation system capabilities and develop an instrumentation modernization plan.

ation system capabilities and develop an instrumentation modernization plan.
Joining MRJ Inc. in 1981, he developed models and simulations of various kinds of military security and information systems. His work in developing organizational models was widely accepted as a major advance in that field. He presented a paprer at the 25th Anniversary MORS meeting session on Gaming & Simulation entitled "Gaming & Simulation, The Next 25 Years.

Mr. Alberts is Founder and President of two small businesses: ALGREN Services Corporation, an organization which specializes is design, installation, and operation of custom computer data base and accounting systems; and ALCO Realty Corporation, a real estate investment and development organization.

Mr. Alberts joined the Faculty of the Decense Systems Management College in December 1983. He teaches Software (Quality9 Assurance, Metrics, and Test and Evaluation), and Industrial Production (the Industrial Base), and does research into design and utilization of Software.