TITLE: Developments In Air Targeting: Progress And Future Prospects

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VOLUME: 3 ISSUE: Summer YEAR: 1959

STUDIES IN INTELLIGENCE

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DEVELOPMENTS IN AIR TARGETING: PROGRESS AND FUTURE PROSPECTS

Kenneth T. Johnson

Four preceding articles in this series described how the USAF Directorate of Targets has been seeking to increase its capabilities by developing mathematical models and other techniques for the mass handling of data. This final article will look briefly at the progress of these techniques since the articles describing them were published and then examine some other analytical tools in process of development for the target intelligence specialist.

The three mathematical models previously described were the Military Resources Model, the Air Battle Model and the Damage Assessment Model. The Military Resources Model [1] estimates the capability of the Soviet Bloc military establishment, with its supporting economy, to carry out military action and analyzes the effects of planned attacks. The Air Battle Model [2] war-games the interaction of battle forces on the basis of a most exacting layout of both sides. It answers the question, "After x time of the game, to what extent have offensive and defensive plans been carried through or disrupted?" But it must first be supplied data describing what resources are available to each side, what courses of action each will attempt, and all other conditions affecting the outcome; and the preparation of these data is a demanding task and a stimulant for intelligence. The Damage Assessment Model [3] predicts the probable physical, functional, or operational effects of atomic weapons on targets or target systems. It answers questions of the type, "Did the building collapse?" "How many casualties were caused?" The most recent article

[1] See *Studies,* Vol. II, No. 1, p. 51 ff.

[2] See *Studies,* Vol. II, No. 2, p. 13 ff.

[3] See *Studies,* Vol. II, No. 3, p. 23 ff.

of this series[4] treated these models as illustrating one aspect of the manifold problem of data handling, described the Consolidated Target Intelligence File, and highlighted the necessity for better and faster ways of storing and retrieving information.

The Analytical Models in Operation

Many months have been spent in developing these models to bring the fantastic capacity and speeds of electronic computers to bear on the increasingly complex data which must be considered in making operational decisions. How are the computer techniques working out in practice? The Air Battle Model has been in constant use, making test runs to evaluate different target systems, battle plans, and strategies. Lists of ground zeros—points of burst—from the Air Battle Model have been fed into the Damage Assessment Model for the calculation of damage and radiation effects. These results have then been used by target analysts to determine the residual capabilities of affected installations.

The Damage and Assessment Model has kept pace with the Air Battle Model's output of ground zeros and other data requiring effects analysis. Improvements in the form in which the results of the damage and contamination runs are presented have evolved from consultation between analysts and machine programmers. The latest of these improvements has been effected by feeding into the Model criteria for determining automatically from damage and contamination values whether an installation is still operational after attack.

Since publication of the article on the Military Resources Model in the beginning of 1958, a series of operational runs has been made on its economic grid to show the multiple direct and indirect economic effects of Soviet civilian and military programs. Completely effective use of the economic grid is still hampered, however, by data gaps in such important areas as guided missiles and atomic energy; and aggregations in the Model which exclude consideration of certain specialized items of equipment limit the results to statements of general economic capability.

[4] "Data Handling Techniques," *Studies*, Vol. III, No. 2, p. 95 ff.

Developmental work on the military logistics and transportation grids of the Military Resources Model, in progress in the spring of 1958, has provided the basis for the development of a new model covering USSR regional air defense capabilities. This model assesses the capability of a specific region—either an air defense district or a penetration corridor—to mount defensive sorties and missile firings after its logistic and transportation facilities have been damaged by an air attack of any given scope and magnitude. The initial model has just been constructed and an initial run made; further development is in process. The construction of this new model shows how the mathematical modeling technique can be adapted to serve new purposes.

Models have thus already assumed some of the targeting load, but much remains to be done in determining whether and how models can be used in other analytical areas. What is intriguing for intelligence analysts, however, is that in some areas models have brought them to the threshold of a precise means for determining what items of information are of critical importance, a determination which will provide new, sure guidance to collection and analysis activities. This "sensitivity analysis," as it is called, is done by rerunning the same problem several times with varying parameters to determine which variations have a critical effect on the results. It provides also a good antidote to the tendency of analysts, having available the models' huge capacity for data, to become involved in the pursuit of minutiae which have no substantial importance for their problem.

Although the article on Data Handling Techniques appeared in the most recent issue of the *Studies,* some new gains can be counted here, too. Of the more than 200 requests for machine processing of the CTIF already levied by analysts, about 65 can be handled by existing programs and another seven are now being programmed, leaving a substantial 128 yet to be translated into machine language. The bridging of the gap between an analyst's statement of his needs and the marching orders for the machine requires a high degree of rapport between analyst and programmer, and this rapport is being developed. The programmer must discuss the requirement step by step, and patiently record each step in an ungarbled instruction to the machine. Laborious as this process is, it pays off in a better product, and the analyst man-hours that are made available for more difficult jobs grow and grow.

The acquisition of an electronic data plotter has very practically enhanced the utility of the CTIF system. The plotter accepts coordinates from a machine tape or from cards and records the locations directly on a linear projection map. Programs are now nearing completion which by converting latitude and longitude to linear coordinates will enable the machine to plot locations on a map of any projection and any scale that will fit on the 48" by 60" plotting board. Single symbols can be plotted at the rate of 65 to 70 points per minute. The usefulness of the machine is attested by the long queues of waiting analysts eager to short-cut the tedious task of massive data plotting.

In an earlier paper in this series[5] General Samford was quoted as saying that the extent to which intelligence should contribute to the process of war gaming might be disputable but that if an advanced war gaming process were kept closely in mind during all processes of intelligence preparation, the intelligence necessary to a strategy would be better. The validity of this statement is already being demonstrated as the need for detailed layouts of enemy capabilities reveals inadequacies in our estimates. The operation of the Air Battle Model has properly been moved out of Intelligence to the Directorate of Plans, but because Intelligence personnel did the pioneering work on the Model, the Air Battle Analysis Division in Plans is largely staffed with former intelligence analysts. This arrangement facilitates not only the feedback of requirements on intelligence but also the interpretation of the intelligence data to be fed into the Model and the understanding of intelligence requirements for data from its output.

At the Model Application Branch in the Directorate of Targets, a cadre of target intelligence analysts has been assembled and is being oriented to improve the input data for the Air Battle Model and the utilization of its output. The Branch must also keep under review the operations of the Damage Assessment and Military Resources Models, which are wholly and

[5] "Developments in Air Targeting: The Air Battle Model," *Studies*, Vol. II, No. 2, p. 13.

appropriately placed in the Directorate of Targets; new questions arise every day about how best to use the existing models in solving targeting problems. At the same time it is working on the development of new models to handle current problems and anticipating other problems which targeting is going to face tomorrow.

The Data Problem

The inescapable task of assembling intelligence data assumes an aggravated form when the data is to be used as input for a mathematical model. It is not that the use of models creates a data demand; the data problem is there anyway, models or no models. But what the models often do is make the analyst face up to kinds of data the likes of which he had never considered, for example the number of metric tons of pumps and compressors required for each major military component in a prewar build-up of forces. A prolonged bout with the stern requirement of a model for enemy data coefficients, enemy strike plans, or the capacities of enemy installations can bring an analyst to the point of despair. Yet he can take comfort from the ease with which problems can be rerun. The data do not have to be perfect the first time, and a rerun with a new figure may show that the variation is not of critical importance. A capable officer of ours is wont to interrupt a hot debate over input data with "You don't like our figure? Give me one of yours; I'll use it."

The Consolidated Target Intelligence File described in the last article is proving a valuable device in this battle with the data and constitutes a giant step in facilitating mechanized support of target analysis. Another giant step is anticipated in the near future with the application of the new Air Force Intelligence Data Handling System, designated 438-L. The system is scheduled to be operational early in 1962 for the Washington area.

The development of System 438-L was initiated in response to a Headquarters USAF requirement, formalized in March 1956, for an integrated system to accept information from any and all sources and to organize, store, manipulate, and disseminate it without the limitations of capacity and speed inherent in present practices. The aim is the best possible system to meet present and anticipated requirements, whether a fully automatic system of machines and computers, a combination of manual and machine methods, or just human beings. The contractor is putting a broad selection of talent to work on the system, including library scientists, experimental psychologists, computer programmers, and computer engineers.

Although the best approach to a design for this system is still being worked out, it is already apparent that it will be based on a large-scale, high-speed, general-purpose computer to accomplish many tasks. Such a computer will make feasible the development of a rich indexing system, not only by document but by key words on individual pages. This indexing system will enhance the ability of analysts to make subtle correlations of data and develop significant interrelationships which may exist in available information. Data storage and retrieval can be accomplished primarily through microfilm libraries.

The computer in the system will make possible the fast and accurate communication and dissemination of newly collected data, notably that necessary for evaluating enemy intentions and giving warning of attack. Many types of information must be examined rapidly, for example that obtained by missions flown specifically to develop certain intelligence data. It will also analyze reports and documents to produce Order of Battle, Current Intelligence, Technical Intelligence, etc., accumulating bits and pieces of raw information and associating them for development into meaningful products. In target analysis it will be invaluable, for example in the evaluation of foreign target systems, the charting of foreign air facilities, and the development of strategic and tactical targets.

The retrieval facet of the system may function in any of several ways. A question may be given by an analyst to the operator of a Flexowriter or similar device in his working area. It would be put into proper form and automatically transmitted to a Flexowriter in the computer area, which would print it out. Here it would be checked for format and validity and then fed to the computer system. The computer would differentiate among types of questions. The answer to one concerning evaluated intelligence holdings would be obtained from a file of evaluated intelligence directly connected to the computer system. As the result of automatic search procedures the answer would be printed out or displayed, as appropriate.

A demand for raw information, on the other hand, might be answered in any of three forms or some combination of them—a listing of documents or pages pertinent to a study, the documents or pages themselves, or statistical information derived from the documents. If the document itself were desired, the computer system would identify the specific document number. This identification would be hand-delivered to a separate raw information storage device, which would produce either aperture cards or a full-size reproduction of the document.

Information might also be added to the system in several ways. The evaluated intelligence provided by analysts of all agencies would be entered through the same Flexowriter-type device used for querying the system. Raw information selected and extracted from documents by a screening panel would be entered as part of an index storage file. The documents themselves would be microphotographed and placed in the raw information storage section of the system.

The analytic application of the system will cover war gaming, damage assessment, and determining the economic effects of military action, as foreshadowed in the mathematical models we have described. It will also cover target materials and production control, an almost independent area, under a fairly routine application of processing principles. It will provide document security control for all the highly classified information disseminated through the computer. It will make possible a more accurate formulation of collection requirements and furnish a means of evaluating both the requirements process and the collection process. Even our comparatively limited experience with the models we have been using gives us ground to anticipate that actual application of the proposed system will stimulate continuing development of new analytic techniques to enhance the capabilities of Air Force intelligence.

For target intelligence the 438-L system is indeed going to be a quantum jump ahead, and none too soon. The most intensive target analysis effort is now directed against Soviet guided missiles (especially operational launch sites), air defense (particularly the SAGE system), and command control systems, objectives around which the most stringent security barriers are arrayed. The most direct and forthright advances against these objectives could come from a successful collection effort—a drawing, a paper, a plan, a photograph, a defector.

But the more important the target to us, the more important it is to the Soviet that he deny us information on it, and the tougher the collection task. Some people seem even to believe that he can continue to be totally successful in this denial in the areas where it really counts. This brings us back to mass data handling and the possibilities it offers. The realistic solution in these high priority areas may be to break into the complex of activities associated with the target and let them lead us to it.

What is suggested is that we collect and process the less sensitive information, of which there may be an abundance, along with the sensitive. This approach is not new; intelligence analysts have always recognized that bits and fragments of information about persons, places, things, and movements can when assembled, analyzed, and synthesized enable us to make a sweeping end run around a formidable security barrier. What is new is that science has come up with the technology that will permit us to use this practice on a scale and with a speed never before possible. The exploitation now made possible of the vast amount of data already on hand in different forms in many agencies offers immediate promise. It gives impetus to the Air Force's effort to develop yet better techniques for the mass handling of data; for the consequences of failure to provide target information in these critical fields are grave indeed.

Lest the impression be left that target analysis begins and ends with data on individual installations, it is important to round out the picture somewhat. As the Soviet nuclear delivery capability and military might in general have assumed greater and greater proportions the targeting emphasis has shifted from economic and industrial targets to military forces and their immediate supporting resources. Furthermore, it has become more important than ever to draw the full implications of the effects of attacks—to translate the physical destruction calculated to result from planned attacks and the residual military inventories of men and materiel into terms of post-attack operational capability. The criteria for the selection of targets and target systems lie in the implications of these effects; and in this sense effects analysis is the mainspring and director of target selection.

It is clear that the models and data handling developments described in this and preceding papers all contribute in great measure to the central work of target selection and effects analysis. But this is only a part of the picture: the keystone of the effort is the human being, the target analyst, who emerges as the manager, collator, and interpreter of data, instructing the machines, guiding the collectors, using finished intelligence produced by other analysts in their specialized fields, and finally producing integrated intelligence on live enemy forces on a command basis. In these force studies the interrelationships of the forces, their bases, support facilities, and restraints of time, space, command, communications, and competition for common support items such as transportation and fuel are analyzed in detail.

The force study is prepared on a command-wide basis. The producer in effect puts on the enemy hat and examines the interrelationships of the forces in his command, say the First Long Range Air Army, the installations they occupy, the support facilities and activities necessary for their continued operation, their training and maneuvers. This presentation of real-life force intelligence gives new meaning to the importance of targets and target systems. It provides an integrated rational basis for the prediction of wartime deployment and missions and the prediction of qualitative and quantitative peacetime growth. Finally it provides the framework within which targets and target systems may be nominated for attack, a clear understanding of the reasons they are nominated, and, through analysis of the output from machine runs on the damage and contamination model, a realistic interpretation of the operational effects of given attacks.

The preparation of force studies is under way. One has been completed on the Soviet Northern Naval Fleet, another on the Ground Forces in the Caucasus area. Studies will eventually blueprint the opportunities for air action against all forces which threaten the United States and its allies and will be maintained current for immediate application in war planning and war gaming.

Future Data Problems

As the target intelligence analyst strains to see what lies ahead he is awed. As he thinks toward the 1970's he realizes that he must deal with enemy weapon systems not yet in

being, ones which Soviet strategists are currently engaged in planning to bring into the Soviet arsenal at that time. Qualitatively, they will attempt to outdo US and Allied weapon technology. Quantitatively, they will try to provide so many and varied means for fast delivery of nuclear weapons that US defenses will be insufficient to fend off the attacks and US offenses not quick or massive enough to neutralize the Soviet capability. It is the target analyst who must wrestle with the realities of this problem and figure out how to cope with the threat.

In this future period the collection and evaluation of target data will be performed with improved technology, and conclusions will be reached and decisions made with greater speed. Some of the technology for collection devices can be predicted now. For example, aerospace vehicles with a variety of sensing devices—electronic, radar, infrared—promise data in volumes never before dreamed of. The prospect that unfriendly neighbors can look into each others' back yards day in and day out is going to have a profound effect upon what they decide to try to hide, how they decide to hide it, and what they decide is just not worth hiding. Some of the new data, for example infrared detector readings which give warning of missiles being prepared for launching or being launched, will go directly to warning centers for immediate decision on US and Allied action. All of it will be grist for the analyst, to be evaluated against the background of the data stored in the 438-L or some improved system, and all will automatically be added to this massive store. From it the analyst, using advanced techniques, must draw conclusions on which to base action in an era when minutes can decide eternity.