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Overview of the Total Army Design and Cost System

Robert L. Petruschell, James H. Bigelow,
Joseph G. Bolten

Prepared for the
United States Army

Arroyo Center

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Preface

This report describes the Total Army Design and Cost System (TADCS), a series of computer models and databases that allows an analyst to use the results of combat analysis and to determine what changes are required in the current force structure to meet the analyst's stated goals and to determine the budgetary implications of those changes. This work was accomplished in the Military Logistics program of RAND's Arroyo Center. The point of contact for the project was the Office of Director of Management, Headquarters, Department of the Army. The work should interest both force planners and cost analysts.

The Arroyo Center

The Arroyo Center is the U.S. Army's federally funded research and development center (FFRDC) for studies and analysis operated by RAND. The Arroyo Center provides the Army with objective, independent analytic research on major policy and organizational concerns, emphasizing mid- and long-term problems. Its research is carried out in four programs: Strategy and Doctrine, Force Development and Technology, Military Logistics, and Manpower and Training.

Army Regulation 5-21 contains basic policy for the conduct of the Arroyo Center. The Army provides continuing guidance and oversight through the Arroyo Center Policy Committee (ACPC), which is co-chaired by the Vice Chief of Staff and by the Assistant Secretary for Research, Development, and Acquisition. Arroyo Center work is performed under contract MDA903-91-C-0006.

The Arroyo Center is housed in RAND's Army Research Division. RAND is a private, nonprofit institution that conducts analytic research on a wide range of public policy matters affecting the nation's security and welfare.

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Imagine a large, multinational corporation that must reduce its work force by nearly 40 percent over a few years, close or relocate most of its overseas operations, completely redirect its strategic focus, and reduce its budget by almost one-third, while simultaneously planning to modernize much of its equipment. The scope and complexity of such a task would severely challenge any organization. But that is exactly the problem that the U.S. Army has been grappling with over the past few years and will continue to address for several more. Sorting out the force-structure and budgetary implications of different reduction strategies could prove to be nearly impossible.

The Arroyo Center has developed the Total Army Design and Cost System to provide decisionmakers a collection of tools to assist in this complex process. This system, which consists of a collection of models, procedures, and databases, was developed with two applications in mind:

- Addressing a broad range of force-structure and resource-allocation issues, to include selecting future structures and the paths necessary to achieve them
- Determining the resource implications of narrower but more detailed proposed changes within the framework of the Total Army.

The Total Army Design and Cost System

Figure S.1 shows the component parts of the Total Army Design and Cost System. In brief, here is how the system works: The process begins with the reception of the results of combat analysis. On the basis of threat analysis, war games, and a number of other processes, combat analysts determine the in-theater combat forces required for a given scenario. The first element in the Total Army Design and Cost Analysis System, the Theater Support model, estimates the number of support units needed for the combat forces. The total force requirement is then passed to the Transition-to-War model, which determines the future peacetime Army, including active and reserve components, needed to

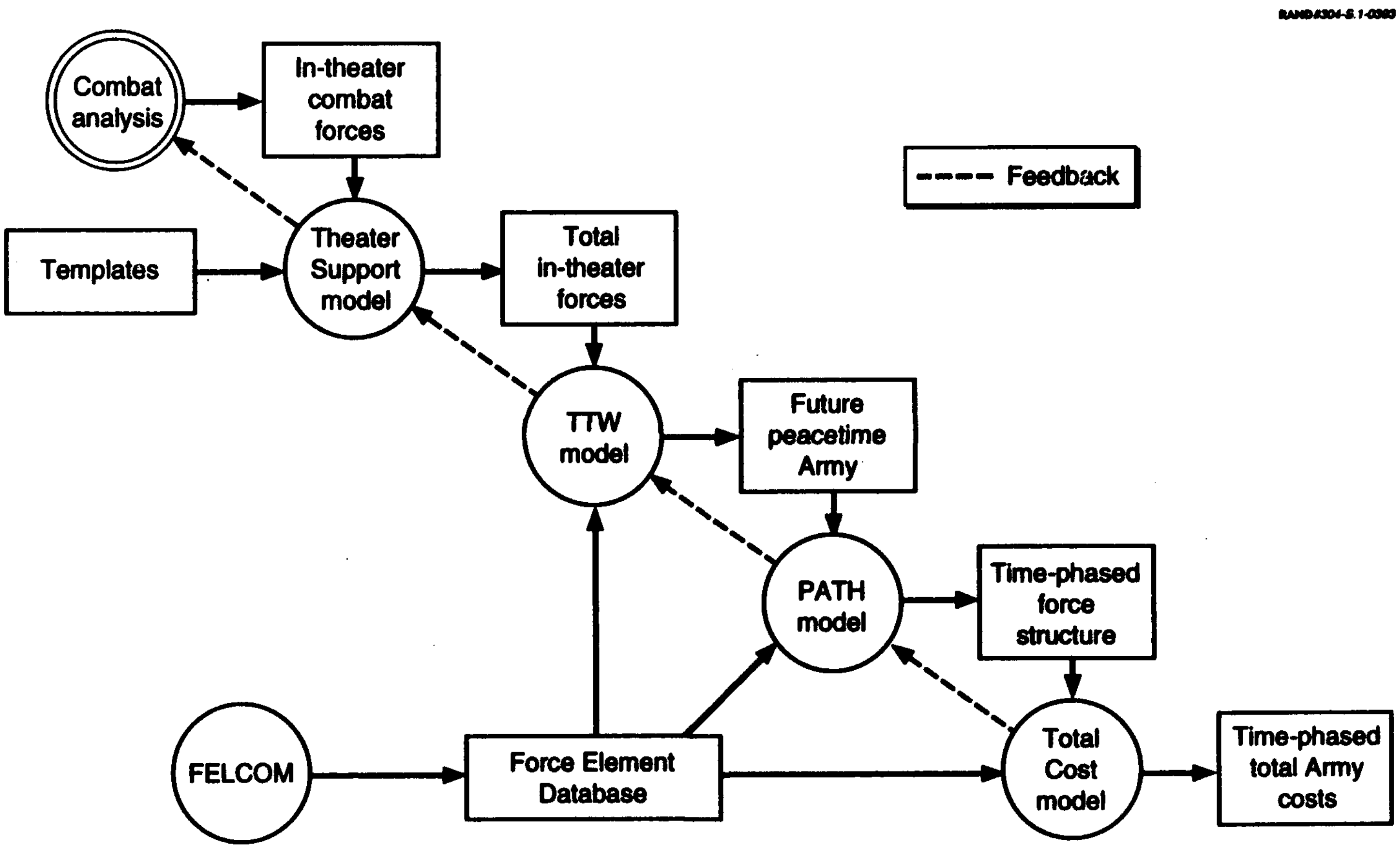

Figure S.1—The Total Army Design and Cost System provide the necessary forces according to a desired schedule. The Path model then compares the present force with the desired future force and provides a road map to follow in achieving the future force. The road map consists of a series of inventories of Army units, beginning with the present force and ending with the desired force. The Total Army Cost model completes the final step by translating the inventories into annual cost and resource requirements.

Three other components—templates, the Force Element Cost Model (FELCOM), and the Force Element Database—are required to make the system work. The template database converts the units used by combat analysts—normally divisions and brigades—into units that better lend themselves to cost and resource analysis—typically battalions and companies. FELCOM estimates the unit costs of force elements, and the Force Element Database simply stores the output from FELCOM along with some other information about the force elements. The various system models draw on the Force Element Database.

The system can iterate force structures to ensure that they meet constraints or to determine that a given structure is not feasible in the face of the constraints. It can also portray costs in the terms most useful to those concerned with building budgets. Specifically, it provides cost estimates either as Total Obligation Authority or outlays.

The system offers the analytic community a flexible tool for addressing a number of force-structure and cost questions. It provides a quick way to assess the implications of changing equipment, types of units, the mix of forces, the balance between components, and other structure issues. A large part of the system's responsiveness stems from the fact that it draws much of its data from standard Army databases. It will spell out the cost implications in terms that clearly reflect the budgetary effects. The essential simplicity of the models and the quick response they offer facilitate consideration of many alternatives.

Limitations

Presently, the system does have certain limitations. None is particularly serious, as long as the analyst knows what they are. The model does focus on that part of the Army organized under Tables of Organization and Equipment (TOEs). For the non-TOE Army, it computes some costs but does not account explicitly for such resources as personnel or equipment. Neither does the system allow the user to modify the non-TOE Army independently of the TOE portion.

Directions for Future Research

The system as it exists is fully functional, and the inputs are current as of the writing of this document. Over time, these would require updating. However, certain aspects of the Total Army Design and Cost System would benefit from additional work. Also, the system would provide more complete results if it were extended into some additional areas. Aspects of the current system needing work include simplifying the Force Analysis Simulation of Theater Administrative and Logistics Support model and altering it so that it uses the system force elements rather than its own, improving the representation of the non-TOE Army, and improving the representation of the force the Army uses in its budget preparation. Useful areas of extension include an expanded capacity to deal with the non-TOE Army independently. Also, the system would benefit if it could consider additional types of resources, such as ammunition and spare parts.

Acknowledgments

The authors are grateful to Joseph Large for his thoughtful review of this report; to Jerry Sollinger for his extensive editing and for shepherding the report through the publication process; and to Rodger Madison for providing us with data processing and computer support. The authors, of course, remain responsible for any shortcomings of the report.

Glossary

ALO	Authorized Level of Organization
AMC	Army Materiel Command
AMDF	Army Master Data File
AVSCOM	Aviation Systems Command
BFVS	Bradley Fighting Vehicle System
BOIP	Basis of Issue Plans
CEAC	Cost and Economic Analysis Center
CER	Cost estimating relationship
CONUS	Continental United States
DCSLOG	Deputy Chief of Staff for Logistics
DCSOPS	Deputy Chief of Staff for Operations and Plans
DFE	Division force equivalent
FA	Field artillery
FAS	Force Accounting System
FASTALS	Force Analysis Simulation of Theater Administrative and Logistics Support
FEDB	Force Element Database
FELCOM	Force Element Cost Model
FYDP	Future-year defense plan
ICP	Incremental Change Package
MICOM	Missile Command
MLRS	Multiple Launch Rocket System
MOS	Military Occupational Specialty
POL	Petroleum, oil, and lubricants
POMCUS	Prepositioning of materiel configured in unit sets
SAMAS	Structure and Manpower Allocation System
SRC	Standard Requirements Code
TADCS	Total Army Design and Cost System
TAEDP	Total Army Equipment Distribution Plan
TDA	Table of Distribution and Allowances
TOA	Total Obligation Authority
TOE	Table of Organization and Equipment
TRADOC	Training and Doctrine Command
TTW	Transition to War
WRM	War reserve materiel

1. Introduction

Today, the U.S. Army faces the challenge of reducing, restructuring, and modernizing simultaneously and doing so in the face of an ever-changing world and significant uncertainty about future roles and missions. This highly fluid and stressful environment raises many questions, such as the following:

- How much of the Army can be in the Guard or Reserve, and how much must be Active?
- What should be the mix
  - Between heavy and light forces?
  - Between maneuver forces and the ability to deliver accurate fires far behind enemy lines?
  - Between support forces that might also play a role in humanitarian missions and combat forces?
- How fast should the Army's size be reduced?
- What effects will all of these issues have on the cost and capabilities of the Army in the next five or ten years?

Clearly, the future Army must be capable of dealing with a wide range of potential contingencies, and it must be both derivable from the present Army and achievable in the requisite time. Finally, all of this must be accomplished without violating any of a wide range of cost and resource constraints.

Research Objectives

The analytical community needs better tools to permit the quick analysis of alternatives that will be essential to support these kinds of deliberations. To fill this need, our research objectives have been (1) to develop the Total Army Design and Cost System (TADCS)—a tool kit of models, procedures, and databases that can be applied to a broad range of resource-allocation issues and to help the decisionmaker choose among alternative future force structures and the paths and programs to achieve them and (2) to establish a framework to integrate the resource implications of narrower but more detailed proposed changes, e.g., alternative new weapon systems, changes in base operating support policies, and altering maintenance and supply procedures.

Overview of the Total Army Design and Cost System

An overview of TADCS is shown schematically in Figure 1. Briefly, the circles represent models, processes, or both, and the rectangles represent databases that are either inputs to or output from the models. The double circle, labeled Combat analysis, is not a part of TADCS. It provides important data but is the province of another set of analysts.

The process begins with a statement of combat forces required in theater, provided by the combat analysts. The combat force requirements are time phased, e.g., arrivals on D day, D+1, etc. The Theater Support model estimates the corresponding time-phased requirements for in-theater combat support and combat service support forces, typically for several theaters. Depending on the particular scenario, the Army might need to fight in more than one theater simultaneously.

Next, the Transition-to-War (TTW) model determines the peacetime Army needed to provide these combat and support forces according to the schedule. In this step, we decide the mix of Active and Reserve component forces and whether units may be based in the Continental United States (CONUS) or must be deployed forward. The output of the TTW model describes a desired future force, a force we need to have in peacetime in some future year—which future year is one of the inputs to the analysis.

The Path model then prepares a time-phased Army force structure or path. A path is simply a sequence of inventories of Army units required at the end of each fiscal year, beginning with the present and ending with the year in which the desired future Army must be in place. The model must observe many constraints in building this path. For example, the forces in place in the first year must match the current Army, and the forces at the end of the path must describe the desired future Army. New equipment cannot be introduced faster than it can be developed and produced. Skilled technicians cannot be available faster than they can be recruited and trained. The budget in any year cannot exceed the amount that the Congress will make available. A path should not result in temporarily reduced capability or "windows of vulnerability" along the way. At present, building the path is largely a manual cut-and-fit process.

The final model on the diagonal is the Total Army Cost model. It translates the specified path into a statement of annual cost and resource requirements. Dollar

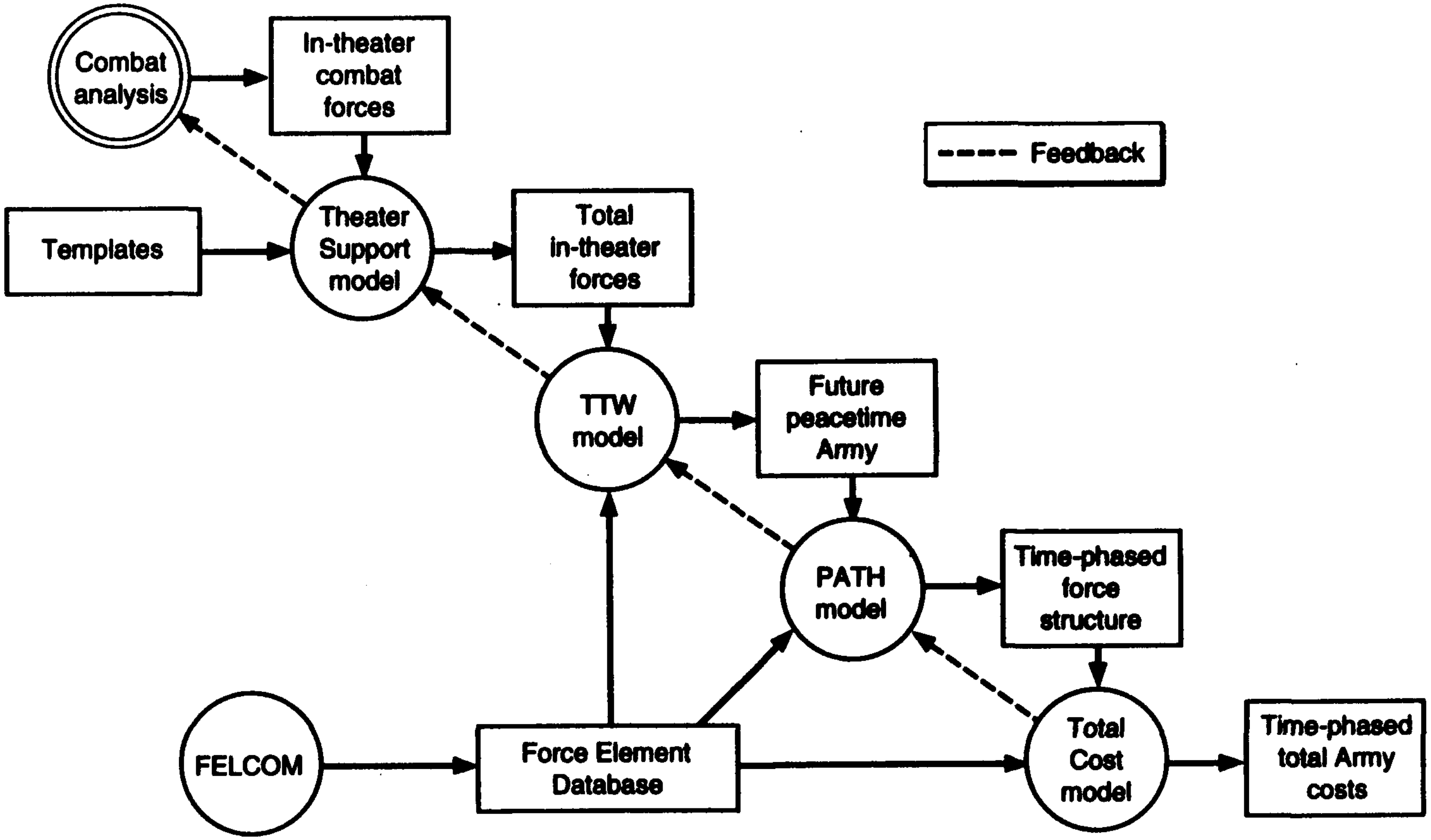

Figure 1—The Total Army Design and Cost System

costs are expressed in terms of either annual Total Obligation Authority (TOA) or outlays (expenditures). Other resources, such as people and equipment, are expressed in terms of annual gains, losses, and resulting inventories.

It is highly likely that the first path specified will violate one or more of the many constraints, so adjustments must take place. The arrow pointing up the diagonal from lower right to upper left in Figure 1 reflects the iterative nature of the whole process. Exactly how far back in the process one will have to go to obtain the desired results depends on the individual case.

Sometimes simply modifying the path will solve the problem. In other cases, a different desired future Army may have to be specified, and this task can be handled by the TTW model. In other cases, there just may not be any way of achieving the desired in-theater Army in the time frame specified, and either the desired theater support forces or the combat forces will have to be changed.

The rectangle designated Templates and the combination of the Force Element Cost Model (FELCOM) and the Force Element Database (FEDB) indicate the remaining two parts of the system in Figure 1. The TADCS treats the Army as a set of force elements, typically battalion- or company-sized units. Combat analysts typically describe in-theater combat forces in terms of brigades or divisions. Sometimes these are actual brigades and divisions, sometimes notional ones (often called Division Force Equivalents [DFEs]). Templates convert the units typically used by the combat analyst into the force elements used in the TADCS. FELCOM estimates the per-unit costs of each force element in the present and future Army, and the FEDB stores the cost output from FELCOM and other relevant information about each force element.

Supporting this system is a collection of Army data sources that include some very large data files and utility programs for accessing, restructuring, relating, subsetting, and reformatting the files as needed. These utilities and the files they work on are not discussed in detail in this report, but they are vital to the system. Also, they are valuable in their own right. The files and utilities will be the subject of another report.

The force elements mentioned thus far have been Table of Organization and Equipment (TOE) units. Generally, these are the units that deploy to and operate in a theater of operations. TOE units make up combat units, such as divisions and brigades. Theater support units are also normally TOE units. The Army contains other units that usually do not deploy, and these are called Table of Distribution and Allowances (TDA) units. In addition, the Army has resources that belong to no unit (e.g., war reserve equipment). The TADCS attempts to account for the costs of the non-TOE part of the Army, but the present version of the system does not explicitly account for resources other than cost in this part of the Army. Neither do our models allow the user to change the design of the non-TOE Army independently of the TOE Army.

How This Report Is Organized

The remainder of this document describes each of the components of the TADCS in more detail. We begin by explaining the function and operation of FELCOM and the Force Element Database. This discussion provides a necessary foundation for some of the subsequent discussions. We next describe how we use the system to design the future Army. This description includes a discussion of the Theater Support model and the TTW model. We then describe the process of moving to a future Army by using the Path model and the Total Army Cost model. The report concludes with an account of studies the system has supported and potential areas of future effort.

2. Cost and Force Elements

This section describes FLECOM and the FEDB. The shaded area in Figure 2 indicates these two elements of the system. We describe them first because these elements affect several of the models and processes in the system.

The Force Element Cost Model

FELCOM estimates the investment and operating costs of an Army TOE unit, e.g., a field artillery (FA) battery, or a collection of TOE units, e.g., a heavy division. The model was originally patterned after one in the Army Force Planning Cost Handbook,[1] last published in November of 1982. We have upgraded and modernized FELCOM significantly since that time. FELCOM is currently implemented as a LOTUS 1-2-3 spreadsheet model.

Inputs to FELCOM are personnel inventories (officers, warrant officers, and enlisted personnel) and equipment procurement costs by appropriation category. One of the utility programs we have written extracts personnel and equipment inventories from the A57 file. We obtain fixed unit equipment prices and appropriation categories from the Army Master Data File (AMDF) and/or SB700-20.

FELCOM estimates only those costs driven by Army TOE units, and these are of two kinds: direct and indirect. Direct costs are those costs incurred by a TOE unit, such as the pay and allowances of TOE personnel, and normal operating costs, such as petroleum, oil, and lubricants (POL). Indirect costs are those costs incurred by other (usually TDA) units on behalf of the TOE unit. These include costs of such activities as depot maintenance, training, and base operating support.

FELCOM does not estimate indirect costs that do not vary with the numbers and activity rates of TOE units. The fixed portion of base operating support cost, the cost of operating major command headquarters, and the costs of research and development are examples. These fixed costs, entered manually, account for roughly half of the Army's total budget.

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[1] U.S. Army, *Army Force Planning Cost Handbook* (AFPCH), Directorate of Cost Analysis, Office of the Comptroller of the Army, Washington, D.C., November 1982.

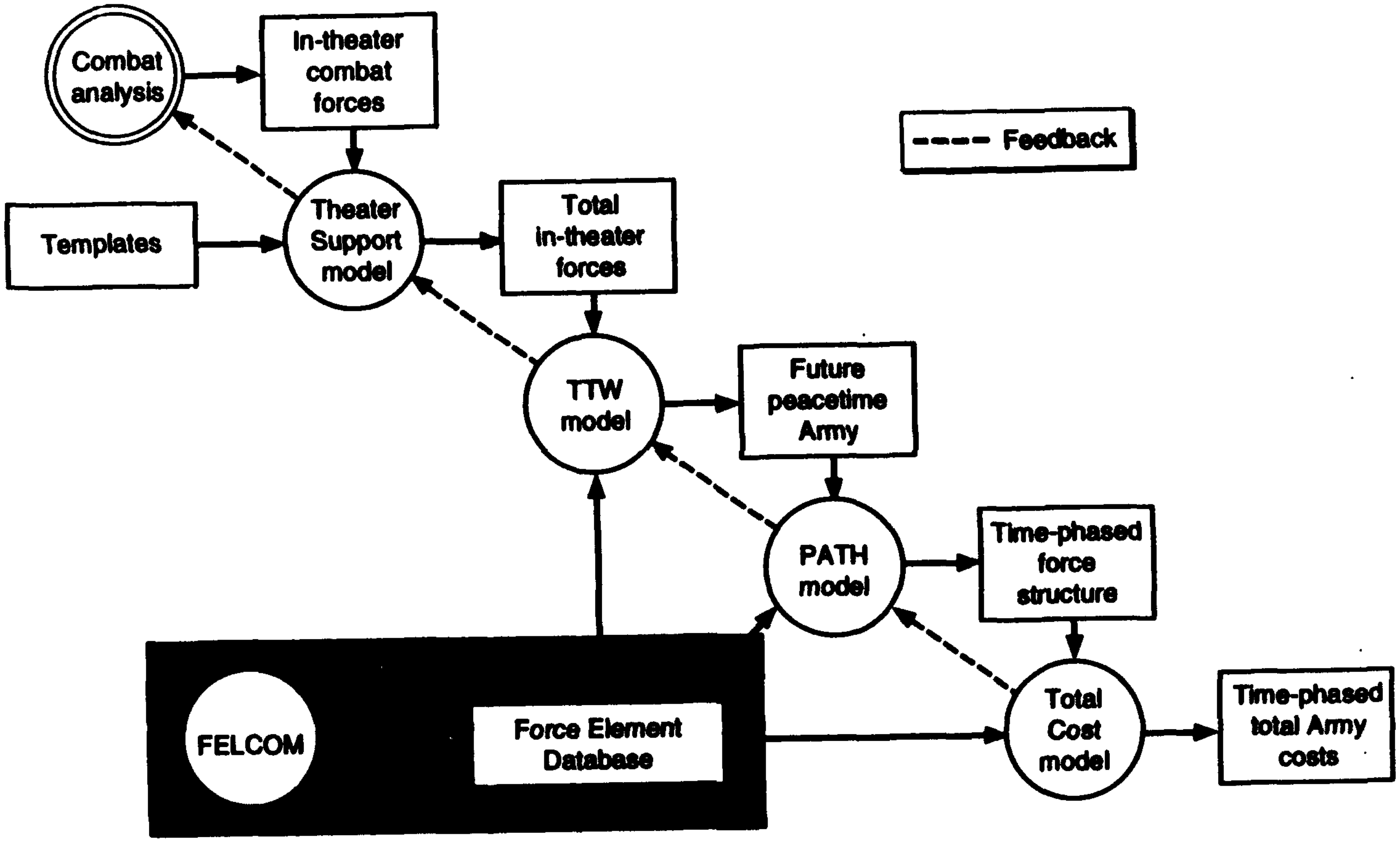


Figure 2—Cost and Force Elements

The Force Element Database

We need a set of building blocks from which we can design a wide range of alternative armies, but the databases we draw from (see Table 1) provide too much detail. For example, the Army's M-Force, the force used to support the President's budget, contains roughly 10,000 individual units, perhaps 8,000 line items of equipment in the Total Army Equipment Distribution Plan (TAEDP), and 3,000 Military Occupational Specialty (MOS) and grade combinations of personnel. A virtually unlimited number of possible TOEs can be constructed from the A57 TOE Edit File, the A58 Basis of Issue Plans (BOIP) File, and the A59 Incremental Change Package (ICP) File. Working at this level of detail is impractical; we must be able to provide a reasonable crosswalk between these Army databases and our descriptions of proposed new Armies. (For that matter, we must be able to describe the current Army in the same terms.)

To reduce the level of detail, we have built an FEDB that contains a restricted set of items that, although limited in number, sufficiently captures the diversity of units necessary to configure the desired alternative armies. For example, the Army may have six to ten different types of M1 tank battalions that differ only slightly. We have selected one as being typical. Similarly, we have selected a limited number of "typical" TOEs that span the range of present and future combat and support units.

Table 1

Army Data Sources Used by FEDB

Database	Source	Data Obtained
FAS/SAMAS	DCSOPS	Unit-level detail about force structure, organization, and deployment
TAEDP	DCSLOG	Equipment assigned to units, POMCUS, WRM, and other nonunit claimants
A57 TOE Edit File & BOIP/ICPs	TRADOC	Manning and equipping requirements for TOE units
AMDF	AMC	Equipment prices, weights, cubes, etc.
TAFCS	CEAC	Cost model and supporting databases, cost factors, CERs, cost element definitions, etc.
Other	AVSCOM, MICOM, TRADOC, etc.	Cost estimates for R&D and new equipment, new TOE designs, etc.

Similarly, we have singled out roughly 40 to 50 important items of equipment to treat explicitly, such as Apache attack helicopters, M1A1 tanks, 155-mm self-propelled Howitzers, Bradley Fighting Vehicles Systems (BFVS), and Multiple Launch Rocket System (MLRS) missile launchers. The remaining equipment items, e.g., small arms and items of personal equipment, are aggregated by appropriation. Instead of categorizing people by MOS and grade, we simply use officers, warrant officers, and enlisted personnel. For the Reserve components, we distinguish between full- and part-time military personnel and also separately account for civilian technicians. Even though we have aggregated and simplified considerably, we have tried to maintain a link between our data and the important Army databases and data sources listed in Table 1.

Table 2 presents a simplified illustration of the contents of the FEDB. The actual FEDB contains much more detail, both in the rows and in the columns. The rows contain the Force Elements and the columns the variables used to capture the relevant information about each force element. For example, the first force element shown is M1 tank battalions. The variable "Compo" allows us to have different M1 tank battalions for the Active, Guard, and Reserve forces. We have a location variable so that we may distinguish among force elements located in CONUS and other places. The real FEDB also includes an Authorized Level of Organization (ALO) variable. Next, we show that the typical active component M1 tank battalion has 560 military personnel. In the real FEDB, these people would be divided into categories for officers, warrant officers, and enlisted personnel.

The next two variables have to do with the major equipment items for this force element. "Unit Equip" indicates that there are 54 M1 tanks assigned to this

Table 2

Illustrative Contents of the FEDB

				Major Equip					
Force Element	Compo	Loc	# of Mil pers (#/Bn)	Unit Equip	Cost/ item ($M)	Comm Items per Bn ($M)	Oper Cost per yr ($M)	Effect Index	Mob/ Deploy Res Req
Tank bns M1	Act	CONUS	560	54	2.3	10.0	40.0		
Mech bns M2	Act	CONUS	850	80	1.0	6.0	25.0		
FA bns 155SP	Act	CONUS	700	24	0.8	4.0	35.0		
FA bns MLRS	Act	CONUS	900	27	2.0	5.0	60.0		
Etc.									

battalion and that each tank costs $2.3 million. The real FEDB contains the inventories of all 40 to 50 major equipment items, together with their prices. Next, we show the aggregate investment cost per battalion, e.g., $10 million for all other common items of equipment. Following that, we indicate that it costs $40 million per year to operate one of these tank battalions. These costs are generated by FELCOM, as discussed earlier. The real FEDB contains many more than the two cost elements mentioned here.

The remaining two variables are included simply to suggest the other kinds of information that we intend to include in the FEDB. The effectiveness index might be a firepower score. Resources required for mobilization and deployment would include train-up times, lift requirements, and so forth. Table 2 has been simplified to help illustrate the basic idea of the FEDB; at present, our actual FEDB contains about 7800 force elements and 110 variables.

3. Designing a Future Army

The steps involved in designing the future Army are those included in the highlighted region of Figure 3. The overall process involves taking the combat forces defined by the combat analysis, describing them in terms of force elements, adding the theater support units, and then describing the peacetime Army that can provide those forces.

Templates Convert Units into Force Elements

The required arrival of combat units in theater is illustrated in Figure 4. As indicated, the requirement is typically stated as "so many armored divisions in place on day 1, so many on day 10, so many on day 15," and so on. Similar schedules are given for light infantry divisions, cavalry brigades, etc. However, as mentioned, our analysis process works with force elements (i.e., companies and battalions), not with divisions and brigades. The templates convert these higher level units into force elements.

A template is a list of the force elements that belong to a parent unit, such as a division or brigade. Figure 5 shows the kinds of force elements specified in a template for an armored division. Because the figure displays choices for the user (e.g., AH-1 versus AH-64 attack helicopters and M60 versus M1 tanks), it does not represent a single template but is rather a set of possible templates. Templates identify each of the force elements by a Standard Requirements Code (SRC), ALO, component (Active, Guard, Reserve), etc. All the force elements listed in any of our templates appear in the FEDB together with the cost, deployment, and other data used in the various steps of the employment process.

To illustrate the process, let us define an armored division from the template as follows. First, we take the entire list of battalion- and company-sized units under the box labeled "Division Troops." From the choices in the Aviation Brigade list, we select one headquarters and headquarters company, two AH-64 attack helicopter battalions, one cavalry squadron, one UH-60 assault helicopter company, and one command aviation company. We could have selected AH-1S attack helicopters or UH-1 transport helicopters. Each implies a different organization and thus would yield different cost data. Because there are no choices in the division artillery (Divarty), we use the entire list of force elements shown under that box. For the maneuver units, we select six M1 tank battalions

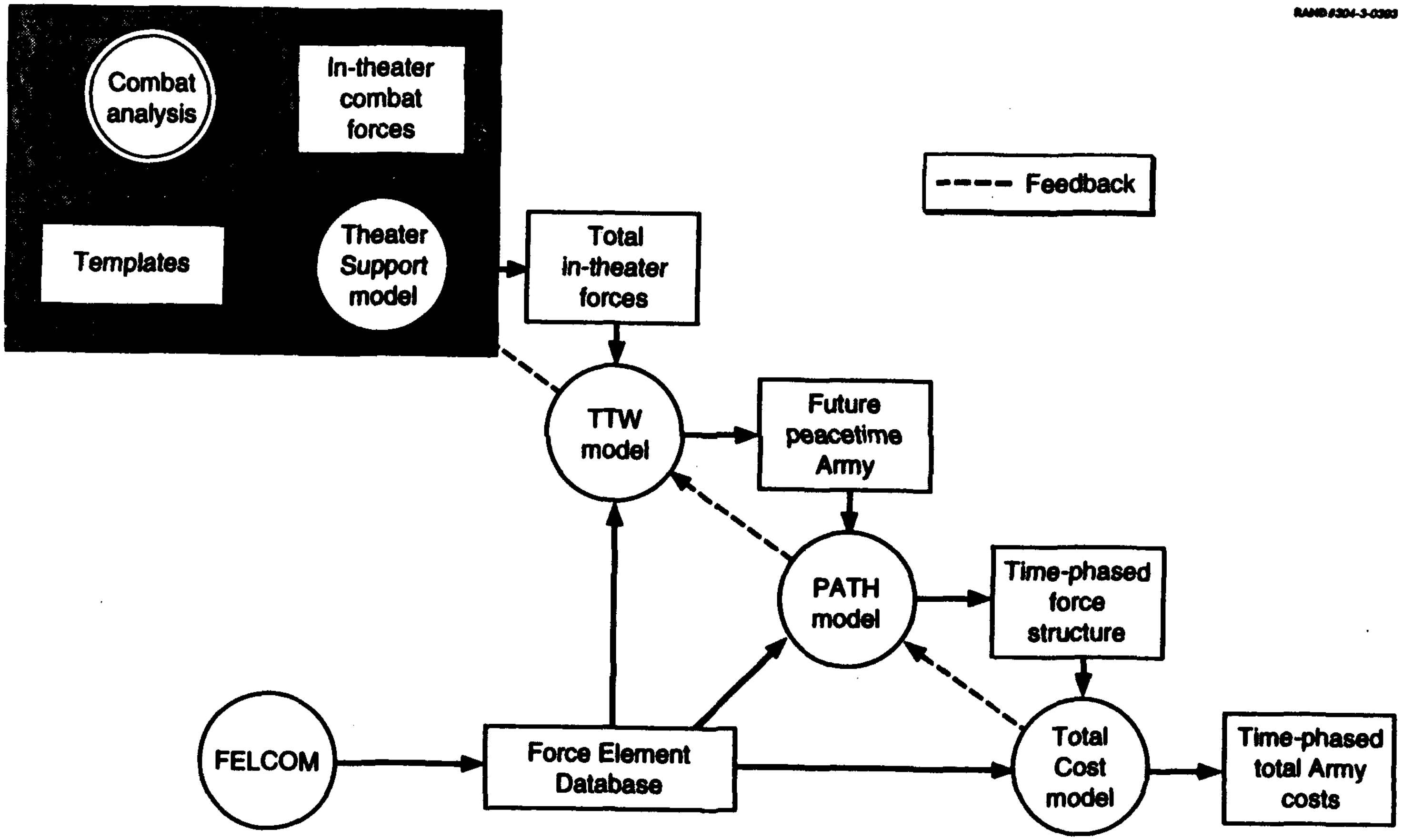
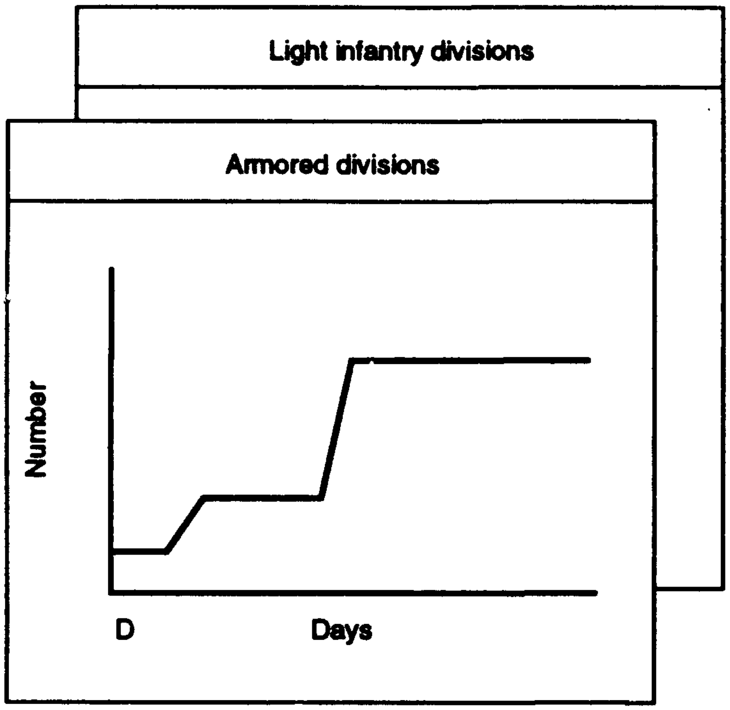


Figure 3—Designing a Future Army



- Combat analysis specifies large units (divisions, brigades), not small units (battalions, companies)
- Combat analysis may specify units (division force equivalents) or specific units (24th Mech)

Figure 4—Arrival of Combat Units in Theater

and four BFVS mechanized infantry battalions. Finally, we accept the list of force elements shown under the Division Support Command.

This particular template reflects a fairly standard armored division configuration. We have constructed templates for airborne, air mobile, mechanized infantry, and regular and light infantry divisions and for various kinds of brigades and regiments. We have templates that describe actual divisions, brigades, and regiments and templates that describe typical (idealized) organizations. We have also built templates for certain nondivisional combat units, including FA brigades, air defense artillery brigades, engineer groups and brigades, and special operations groups and regiments. However, if a particular force alternative includes some other kind of parent unit, we would first have to create a new template and then ensure that all required force elements were included in the FEDB.

A template specifies the major items of equipment for its companies and battalions. In the armored division template above, for example, we elected to equip the tank battalions with M1 tanks. We could have chosen M60A3 tanks if we wanted a less modernized division, or M1A1 tanks (or even M1A2 tanks) if we wanted to modernize the division further. When we design an army,

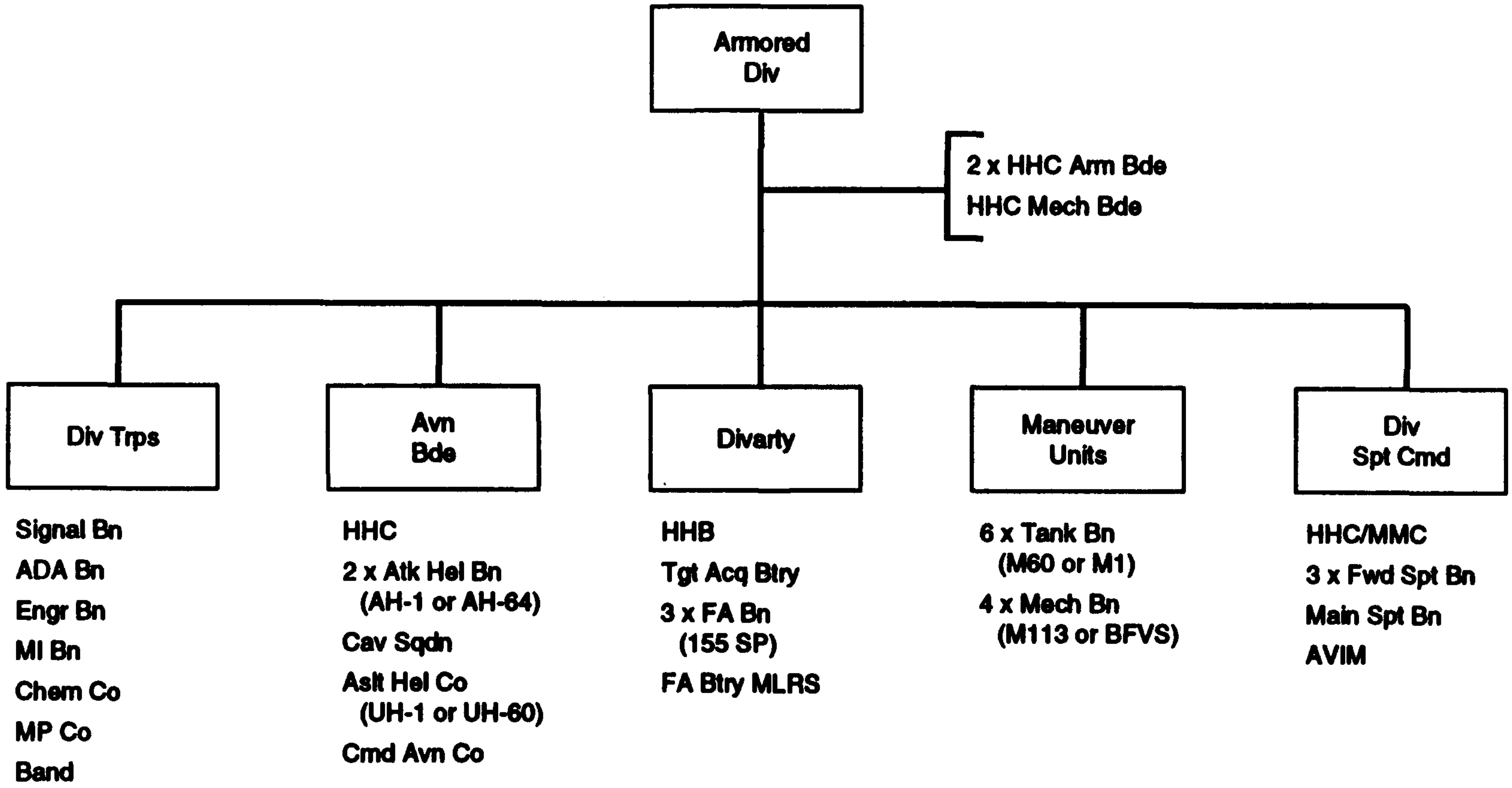


Figure 5—Template of Possible Armored Division

therefore, we do not separate force structure and modernization. When we specify the force structure—the inventories of units by SRC, component, ALO, etc.—we have automatically specified the degree of modernization.

Templates for divisions, brigades and regiments, and nondivisional combat units describe a little more than half the TOE units in the present Army. The remaining TOE units are theater-support units, such as medical companies, transportation companies, ammunition-handling companies, POL-supply companies, and the like. We have not constructed templates for theater-support units, because requirements for such units are not generally specified by the combat analyst. Instead, the Theater Support model calculates these requirements.

The Theater Support Model Determines Support Unit Requirements

To date, we have used the Army's Force Analysis Simulation of Theater Administrative and Logistics Support (FASTALS) model to estimate the requirements for theater-support units. The model was developed by the U.S. Army Concepts Analysis Agency and is currently being used by the Army staff in the Total Army Analysis process. We have been fortunate to obtain access to this model and have used it in all of our analyses.

FASTALS is a complex model that has to be configured differently for each theater. Although knowledgeable people in the Army often disagree about the model's results, these disagreements usually stem from uncertainty about the many inputs. Our judgment is that, structurally, the model is quite a good representation of the many complex relationships among the various combat and support units in theater.

Figure 6 indicates the general process that FASTALS uses to estimate the requirement for theater support units. As shown on the left, the required combat force elements are specified along with a menu of support force elements, the support doctrine, the theater infrastructure, and a statement about the availability of host-nation support to offset U.S. force structure.

As the circled arrows in the center of the diagram indicate, FASTALS uses an iterative process to arrive at a stable support force. Starting from required combat force elements, it allocates support units according to existence rules (we need one of unit "X" for every five of unit "Y") and workload rules (we need a unit "Z" for so many Army personnel, or so much maintenance workload, or so many tons of supplies to be transported). As each unit is added to the list, it

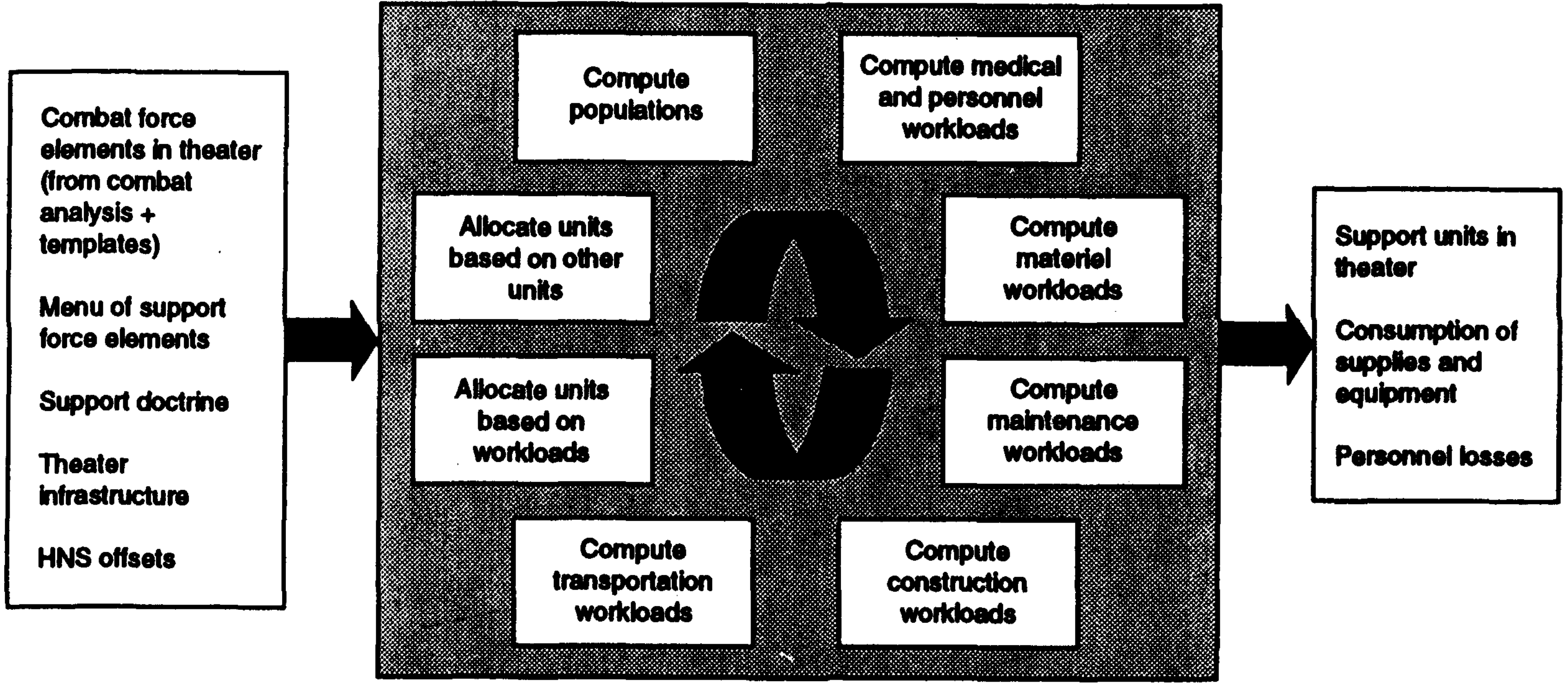


Figure 6—Logic Flow in Theater Support Model (FASTALS)

leads to still more units via the existence rules. Each added unit also increases the size of various population subsets, as well as workloads for material handling, equipment maintenance, construction, transportation, and so forth. Added workloads lead to more units via workload rules. After several iterations, and the application of smoothing rules and rules regarding the minimum and maximum number of force elements of each kind, things stabilize, and the outputs are available.

FASTALS outputs consist of the desired schedule of theater-support units at the force-element level and information about consumption of supplies and equipment and personnel losses. Illustrative force elements and schedules appear in Figure 7.

One of the problems in using FASTALS is relating the units allocated by FASTALS to the force elements in the FEDB. Some of the units named in the FASTALS files do not appear in the FEDB, and sometimes not even in the A57 file. In such cases, we must either add the unit to the FEDB or substitute a unit type that is in the FEDB.

Another problem concerns modernizing theater-support units. For example, some TOEs for ammunition-handling companies contain the variable-reach forklift, and some do not. A FASTALS input file will contain either one or the other but typically not both. Thus, if we wish to design an Army whose theater-support units are at a different stage of modernization, we must adjust those units outside the FASTALS model. We have devised solutions for both problems, but we do not regard them as completely adequate.

Although FASTALS is an excellent model, it is large and hungry for inputs compared with the other models in our system. Thus, when we think about future research tasks, simplifying FASTALS is usually near the top of the list.

The Transition-to-War Model Defines the Peacetime Army

The TTW model designs a peacetime Army that would be required to generate specified schedules of force-element arrivals in theater. These schedules are produced by the combat and theater-support analyses one theater at a time, but we combine different theaters into one or more *worldwide* scenarios. In defining a worldwide scenario, it is important to specify requirements for force elements in all theaters, even those where there is no conflict. Just because conflict occurs in only one theater (e.g., Europe) does not mean that force elements are not needed in other theaters (e.g., CONUS). If the user fails to stipulate that some forces are

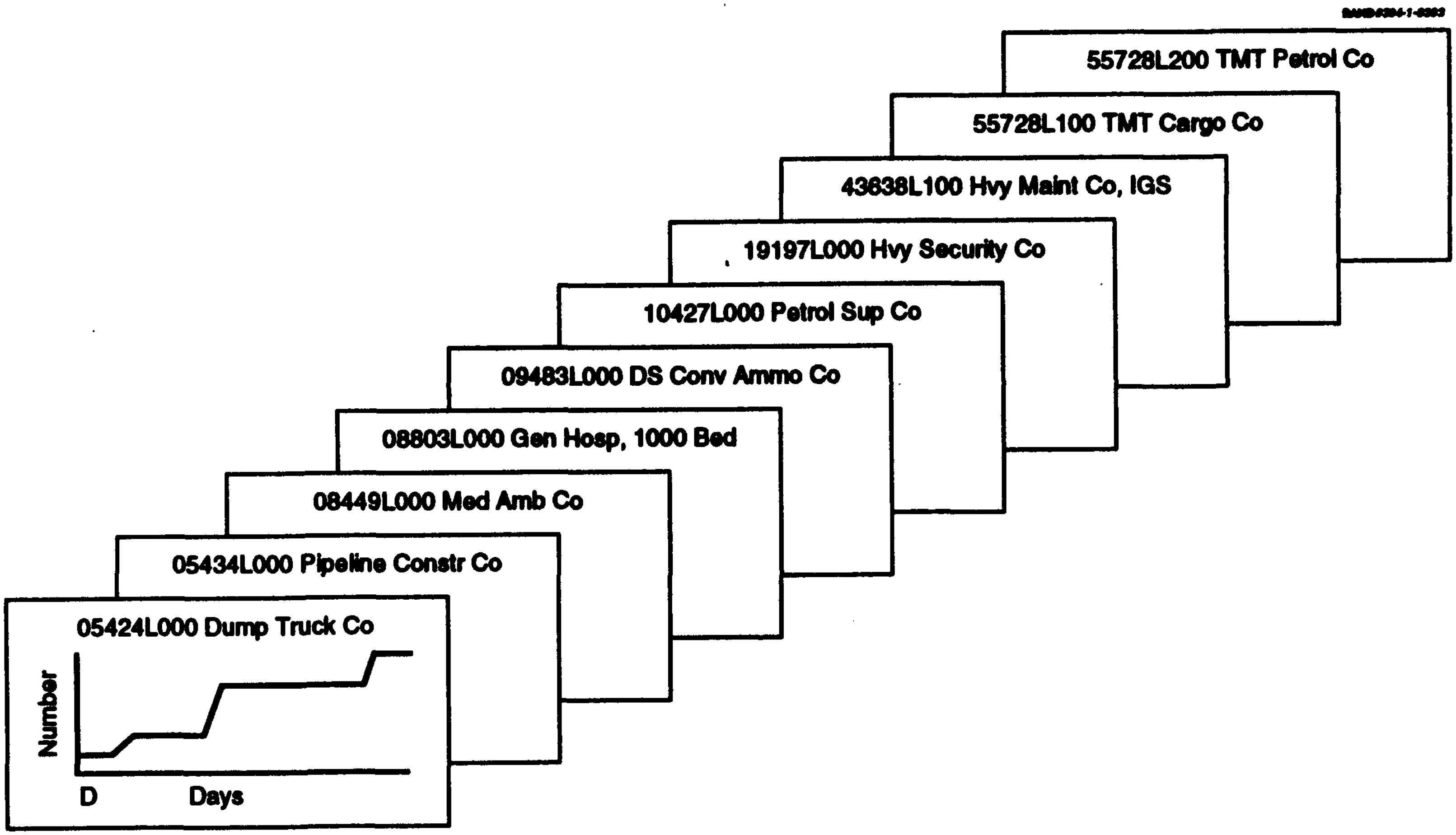


Figure 7—Theater-Support Force-Element Arrivals

to remain in CONUS, the model may denude CONUS of all forces and send them to Europe, rather than design a peacetime Army with sufficient forces for both theaters.

The user may specify several worldwide scenarios, and the TTW model will design a single peacetime army that can mobilize and deploy to meet (as nearly as possible) the requirements of any of the worldwide scenarios. That is, the army designed by the model will not generally be able to meet the requirements of all the worldwide scenarios simultaneously. Rather, it will be able to meet the requirements of whichever scenario happens to occur. But it will simultaneously meet the requirements in all theaters of that scenario.

The peacetime Army is described by inventories of force elements from the FEDB. The FEDB contains several versions of each kind of TOE unit, including units in different components (Active, Guard, and Reserve), in different locations, and with different ALOs. Since the number of units of each version is selected during the TTW analysis, it is here in the Army design process that questions of Active-Reserve mix and ALO are settled. In our analyses, we have generally specified the component mix and ALOs for combat units prior to the TTW analysis, and allowed the TTW analysis to make the determination only for theater-support (and some nondivisional combat) units.

To support the design of a peacetime Army, we need the following kinds of data: For each force element, we need data to implement constraints on the peacetime force structure and to describe what is required to mobilize and deploy the force element. The peacetime data include cost and resource indexes, such as annual operating costs for a force element, to be used in determining if a structure exceeds affordability constraints. They also include military and civilian personnel for use in personnel ceilings. Mobilization and deployment data include the number of people and the amount of equipment that will deploy. Also needed are the time to train the force element to the point at which it will be ready to deploy and the amount of training capacity (e.g., firing or maneuver ranges) the force element will occupy while training. Many of these data elements can be found in the current FEDB, and ultimately all of them should be stored there.

The TTW model allows investigation of a number of interesting issues. Typically, the peacetime cost of an Active unit will exceed the cost of the same kind of unit in the Reserves, but the time and resources needed to get it to a theater will be less. Thus, by adjusting affordability constraints, one can trade off cost against the capability of the Army, where capability is measured in terms of the availability of force elements in theaters over time. Similarly, one can determine how much we must pay for the ability to respond to very short warning times or how much benefit would accrue from buying more strategic lift assets.

At present, there are two versions of the TTW model, a simulation model and a linear program. While the linear programming version is more flexible—it allows the user to impose constraints and investigate trade-offs more easily—it becomes impractically large if there are more than a handful of different force elements. Thus, for most of our analyses, we have used the simulation version.

The final output of this part of the TADCS is a description of the desired future peacetime Army.

4. Moving to the Future Army

The final steps in the process are building the path for evolving today's Army into the desired future Army and estimating the cost and resource implications of pursuing that path. These elements of the system are included in the shaded area of Figure 8.

Building a Path

A *path* is a time-phased force structure like the one shown in Table 3. The rows in the top part of the table correspond to force elements and the columns to fiscal years. The numbers in the cells indicate the year-end inventories of each force element desired. The simple path presented here reflects a gradual increase in the number of tank and FA (MLRS) battalions and a decrease in the number of mechanized and FA battalions (155 SP). Of course, the path has many other dimensions, including operating tempos, deployment, and unit location, but, for the sake of simplicity, we do not show them here.

We want to capture the total Army budget in the cost model. We draw many of the costs directly from the force elements and the FEDB discussed in more detail in the next section, but they do not provide all the costs. For that reason, certain costs, such as those for research and development and command and administration, are treated as *throughputs* (see lower panel of Table 3). We obtain them from an exogenous source—generally, the Army budget or FYDP—and simply add them into our calculated total. The throughputs also need to be time phased.

Building a path is a complex process. The inventories in the first fiscal year should reflect the present Army, and those in the last fiscal year should describe the desired future Army. But there are many choices to make regarding the inventories in the years between. We do not wish to violate real-world constraints on budget, personnel availability, and equipment production capacity, among others. But at the same time, we need to maintain adequate military capability throughout the path. Meeting this need requires not only adequate inventories of combat units but also a proper balance between combat

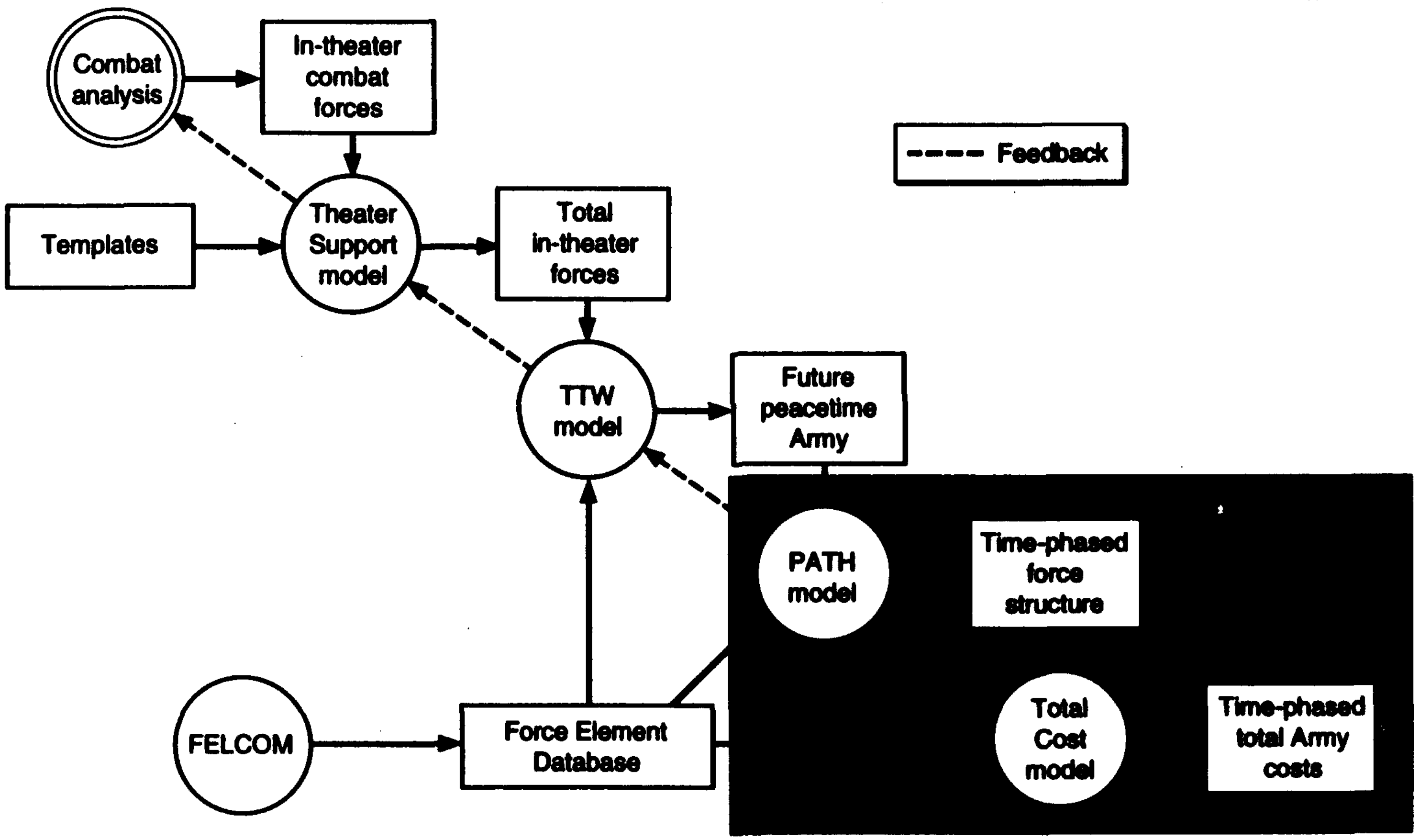


Figure 8—Moving to a Future Army

Table 3

Sample Path

	Fiscal Years				
Elements	1992	1993	1994	1995	1996
Tank Bns (M1)	40	45	50	50	50
Mech Bns (M2)	65	60	55	45	45
FA Bns (155 SP)	50	48	44	38	30
FA Bns (MLRS)	10	14	18	26	30
Time-Phased Unallocated Costs ($B)					
R&D	5	5	5	5	5
HQ & Admin	1.6	1.6	1.6	1.6	1.6

and support units (this balance is ensured in the end-state Army by the theater-support analysis).[1]

Developing a path is an iterative process. We generate an initial path, for example, by interpolating between initial and end-state force elements. Then we estimate the time-phased cost in constant dollars and resource requirements for the path using the Total Army Cost model; note any shortfalls or violated constraints; make necessary adjustments; and repeat the process. Sometimes we may not be able to attain the desired future Army by the year specified and will have to revise our objectives.

Estimating a military capability index for each year of the path by summing the effectiveness indexes in the FEDB for the different force elements and multiplying them by the force-element inventories would be a straightforward process. Such a capability index could identify vulnerabilities in a path, which could provide another reason for revising it. Similarly, we could determine the equipment inventories implied by a path by summing the inventories by force element from the FEDB and multiplying them by the force-element inventories. Large annual increases in the inventory of any item of equipment might signal a production-rate problem. To date, our path-building exercises have considered neither of these possibilities.

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[1] Incidentally, it is not straightforward to describe the present Army in the necessary form, i.e., as inventories of force elements from the FEDB. The M-Force lists all Army units and identifies a TOE for each TOE unit. It also specifies a location and ALO for each TOE unit. Unfortunately, the identified TOE does not always specify the same equipment for the unit that the TAEDP reports the unit is authorized. For example, the TOE identified in the M-Force for a particular tank battalion may contain M60 tanks, while the TAEDP may show that the unit is authorized M1A1 tanks. "Correcting" the M-Force is currently a manual, and very laborious, task.

The Total Army Cost Model

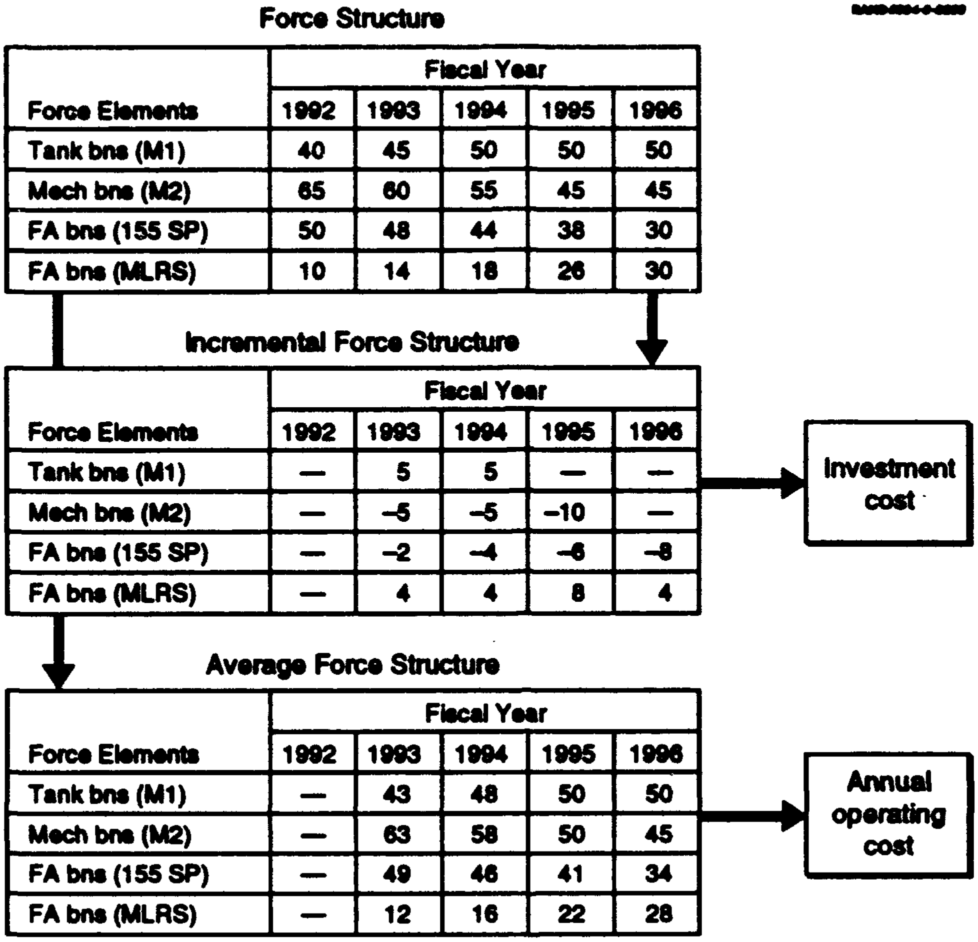
The Total Army Cost model takes the force element descriptions and unit costs from the FEDB and the time-phased path from the Path Analysis and estimates the time-phased cost and resource requirements by force and cost element. In this subsection, we will attempt to convey the general principles and constructs behind the Total Army Cost model, rather than provide a detailed statement of the many variables, equations, and other components. That more detailed material will appear in another report. Here we report only that a preliminary version of the model exists and is implemented in dBase. We will describe the general nature of this model in a series of rather simple steps. First, the model calculates both an incremental and average force structure. The incremental force structure consists of the changes in force-element inventories from one year-end to the next; it is used to calculate investment costs. The average force structure consists of the average of force element inventories at one year-end and the next; it is used to determine annual operating costs. All costs calculated to that point must be shifted in time to convert delivery dollars into TOA and outlay dollars.

Calculating Incremental and Average Force Structures

Figure 9 illustrates the first step in estimating the time-phased total Army costs. The time-phased force structure or path described earlier appears at the top of the figure. The figure shows we begin by calculating two other force structures from that one: an incremental force structure and an average force structure.

The incremental structure reflects the annual changes required to transition from the present to the future force structure. This structure allows us to determine the investment costs required to move to a given structure. We obtain the incremental force structure for year n by subtracting the force element inventories in year n-1 from the inventories in year n. For example, we show 45 M1 tank battalions in FY93 and 50 in FY94. Thus, the incremental force structure for that force-element in FY94 is +5 (see FY94 for that force element in the box labeled Incremental Force Structure). The data in this box indicate the changes in force structure scheduled to take place over the years of the path, and these changes provide the basic information for estimating the investment costs required to create the desired force.

Note that some increments are positive, suggesting that additional investments must be made, while other increments are negative, indicating that resources are



Force Structure

Force Elements	Fiscal Year				
	1992	1993	1994	1995	1996
Tank bns (M1)	40	45	50	50	50
Mech bns (M2)	65	60	55	45	45
FA bns (155 SP)	50	48	44	38	30
FA bns (MLRS)	10	14	18	26	30

Incremental Force Structure

Force Elements	Fiscal Year				
	1992	1993	1994	1995	1996
Tank bns (M1)	—	5	5	—	—
Mech bns (M2)	—	–5	–5	–10	—
FA bns (155 SP)	—	–2	–4	–6	–8
FA bns (MLRS)	—	4	4	8	4

Average Force Structure

Force Elements	Fiscal Year				
	1992	1993	1994	1995	1996
Tank bns (M1)	—	43	48	50	50
Mech bns (M2)	—	63	58	50	45
FA bns (155 SP)	—	49	46	41	34
FA bns (MLRS)	—	12	16	22	28

Figure 9—How the Total Army Cost Model Uses the Time-Phased Force Structure

available for use by other force elements. Resources freed by one force element can be used by another if they are the correct resources and if the timing of the actions is right. Frequently, it is desirable to adjust the path to take maximum advantage of potentially available assets.

In many cases, freed resources, such as trucks or people, may be transferred directly from one force element to another at little or no cost. Other cases may incur transition costs, e.g., to convert a maintenance person from a BFVS specialist to an M1 Tank specialist. Certain kinds of trucks may be transferred easily, while other kinds of equipment may have no use at all in the new force elements. We have made the simplifying assumption that all available common items of equipment can freely transfer.[2] How these shifts in equipment occur will clearly affect the total investment cost. The algorithm for modeling this process is only partially worked out at present. We have the general logic but have not yet implemented it in our model.

The average force structure shown in the lower part of Figure 9 provides the basis for calculating annual operating costs. We assume that if one unit of a force element appears at the end of fiscal year n but not at the end of fiscal year n-1, it has been in the force for one half of the year. In other words, the average inventory in fiscal year n is simply the average of the end-year inventories for fiscal year n and fiscal year n-1. Taking FA Battalions (155 SP) as an example, the FY96 end-year inventory is 30, and the FY95 end-year inventory is 38. The average inventory for FY96 is thus 34.

Calculating Time-Phased Investment Cost

Figure 10 shows how the incremental force structure is used together with data from the FEDB to calculate the time-phased investment cost by force element. In this example, we look only at two kinds of investment cost—that for purchasing major items of equipment (M1 tanks, BFVSs, Howitzers, and MLRS launchers) and that for common (all other) items of equipment.

The top right-hand table shows the investment costs for the major items of equipment. Note, for example, that in FY93 the incremental force structure (top left table) calls for the addition of 5 M1 Tank battalions. The FEDB shows that each M1 Tank battalion requires 54 tanks and that each tank costs $2.3 million. Thus, we multiply five battalions times 54 tanks times $2.3 million to obtain the $621 million indicated in the Major Equipment Investment table for the M1 Tank battalions in FY93.

Similar calculations are performed for each of the other cells in the Major Equipment Investment table containing a positive number. Where the number is negative, we have assumed an investment of zero. In this simple example, we have taken no credit for the fact that some of the equipment made available might offset some of the new investment requirements.

We have also ignored major equipment not found in TOE units, including equipment assigned to TDA units and to nonunit claimants, such as war

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[2] We single out the most important equipment items in each force element for individual treatment. The remaining equipment, which we call common items, is treated in the aggregate. See the discussion of the FEDB for more information.

Incremental Force Structure

Force Elements	Fiscal Year				
	1992	1993	1994	1995	1996
Tank bns (M1)	—	5	5	—	—
Mech bns (M2)	—	–5	–5	–10	—
FA bns (155 SP)	—	–2	–4	–6	–8
FA bns (MLRS)	—	4	4	8	4

Force Element Database

Force Elements	Mil Per per Bn	Major Equip		Com Items Inv $ per Bn	Oper Cost per Bn per Yr	Effect Index
		Unit Equip	Cost/ Item			
Tank bns (M1)	560	54	2.3	10.0	40.0	
Mech bns (M2)	850	80	1.0	6.0	25.0	
FA bns (155 SP)	700	24	0.8	4.0	35.0	
FA bns (MLRS)	900	27	2.0	5.0	60.0	
Etc.						

Costs in millions of $

Major Equip Invest

Force Elements	Fiscal Year				
	1992	1993	1994	1995	1996
Tank bns (M1)	—	621	621	—	—
Mech bns (M2)	—	—	—	—	—
FA bns (155 SP)	—	—	—	—	—
FA bns (MLRS)	—	216	216	432	216
Total	—	837	837	432	216

Common Items Invest

Force Elements	Fiscal Year				
	1992	1993	1994	1995	1996
Tank bns (M1)	—	50	50	—	—
Mech bns (M2)	—	–30	–30	–60	—
FA bns (155 SP)	—	–8	–16	–24	–32
FA bns (MLRS)	—	20	20	40	20
Total	—	32	24	–44	–12

Total Investment Cost

Force Elements	Fiscal Year				
	1992	1993	1994	1995	1996
Tank bns (M1)	—	671	671	—	—
Mech bns (M2)	—	–30	–30	–60	—
FA bns (155 SP)	—	–8	–16	–24	–32
FA bns (MLRS)	—	236	236	472	236
Total	—	869	861	388	204

Figure 10—Calculating the Investment Cost

reserves. Clearly, as the TOE Army changes in size or composition, the equipment assigned to the non-TOE Army will change. While the TAEDP shows the equipment currently assigned to the non-TOE Army, we have no means to estimate how these inventories will change in response to changes in the TOE Army. Perforce, we assume non-TOE equipment inventories remain constant.

Investment in common items is calculated similarly, except that we have assumed all common items are completely fungible; if they are not needed by one force element, they can be transferred to another. Thus, the table contains both negative and positive numbers. When the incremental force increases, the numbers are positive; when it decreases, the numbers are negative. For example, the incremental tank battalions each require $10 million worth of common items of equipment (see FEDB in Figure 10). Similarly, eliminating five mechanized battalions in FY93 at $6 million per battalion yields a negative $30 million in the common items table. So, introducing five new battalions in FY93 requires an investment of $50 million, as indicated in the Common Items of Investment table. The totals are simply the sum of the positives and the negatives. The assumption of fungibility is not completely correct, but it makes the example easier to follow and allows us to emphasize the more important and general parts of the process.

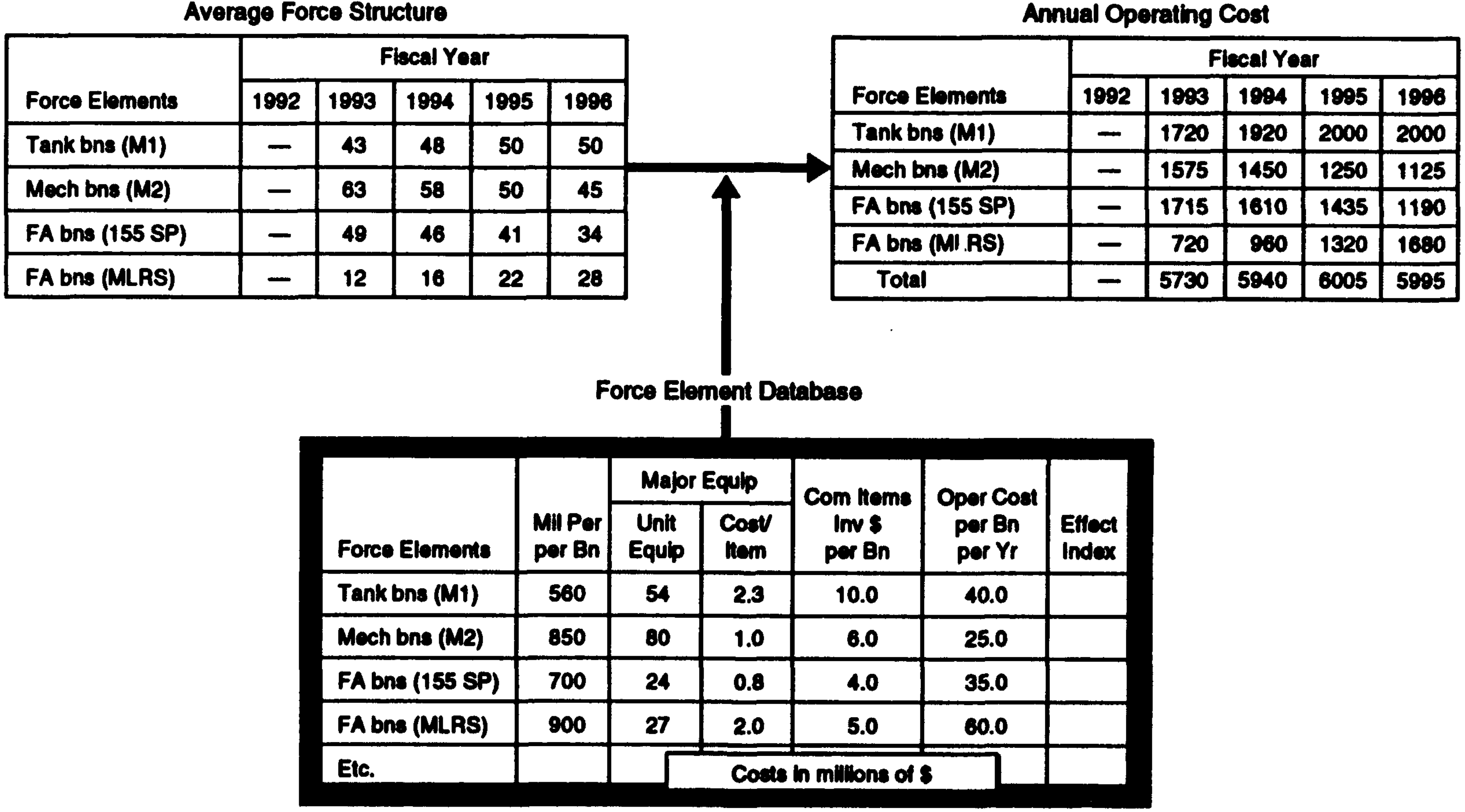
We conclude the investment cost calculation by adding corresponding cells in the Major Equipment Investment table to those in the Common Items Investment table. The results appear in the Total Investment Cost table in the lower right-hand corner of Figure 10.

Calculating Time-Phased Annual Operating Cost

Figure 11 shows the calculation of the time-phased annual operating cost. Here, we use the average force structure, instead of the incremental force structure we used earlier, but the process is similar. For example, the annual operating cost for the 43 M1 tank battalions in the force during FY93 is simply the operating cost per battalion per year (taken from the FEDB) times the average number of battalions in the force during that year. In this case, it is 43 times 40 or $1,720 million.

Converting Currencies

At this point, the system has calculated the total investment and operating costs (except for throughputs), but it expresses those costs in a currency called "delivery dollars." These dollars represent the cost of equipment or services at the time of delivery. Although they reflect actual costs, delivery dollars do not



Average Force Structure

Force Elements	Fiscal Year				
	1992	1993	1994	1995	1996
Tank bns (M1)	—	43	48	50	50
Mech bns (M2)	—	63	58	50	45
FA bns (155 SP)	—	49	46	41	34
FA bns (MLRS)	—	12	16	22	28

Annual Operating Cost

Force Elements	Fiscal Year				
	1992	1993	1994	1995	1996
Tank bns (M1)	—	1720	1920	2000	2000
Mech bns (M2)	—	1575	1450	1250	1125
FA bns (155 SP)	—	1715	1610	1435	1190
FA bns (MI.RS)	—	720	960	1320	1680
Total	—	5730	5940	6005	5995

Force Element Database

Force Elements	Mil Per per Bn	Major Equip		Com Items Inv $ per Bn	Oper Cost per Bn per Yr	Effect Index
		Unit Equip	Cost/ Item			
Tank bns (M1)	560	54	2.3	10.0	40.0	
Mech bns (M2)	850	80	1.0	6.0	25.0	
FA bns (155 SP)	700	24	0.8	4.0	35.0	
FA bns (MLRS)	900	27	2.0	5.0	60.0	
Etc.						

Costs in millions of $

Figure 11—Calculating the Annual Operating Cost

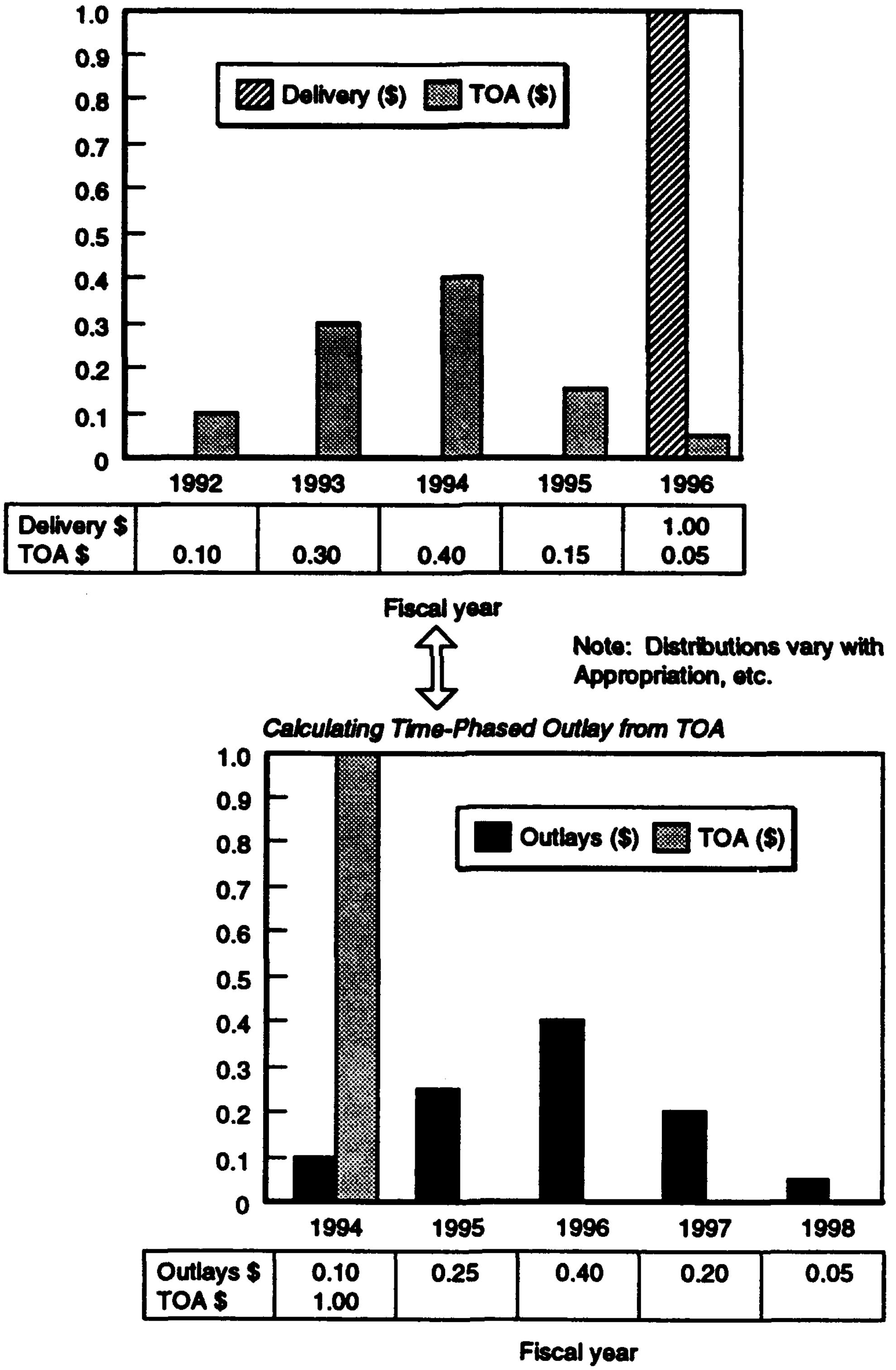
occur at the proper times to be useful to those who build budgets. Accordingly, the Design and Cost system converts delivery dollars into currencies more commonly used in the preparation of budgets; specifically, it translates delivery dollars into TOA and outlay dollars. This conversion process is one of the more useful aspects of the system.

Because the distinctions among these currencies are crucial and because many are unclear on the precise distinctions, it is worthwhile to explain them in some detail. The difference among the three currencies can be largely viewed as a matter of timing. As mentioned, costs in delivery dollars are reported at the time of delivery. TOA is the currency of the Congress and the budget. It is the authority provided by the Congress to obligate money or enter into contracts, and the Army must have that authority before it can order equipment, contract for services, or hire people. If the Army wants to take delivery of a piece of equipment in a particular year, it must obtain the obligation authority from two to five years in advance.

Outlay dollars reflect money paid by the Treasury in response to vouchers presented for payment. They follow TOA in time, because money cannot be spent unless it is obligated, and it cannot be obligated unless authority to do so has been granted. Outlays are the most important of the three currencies for judging the effect of alternative Army paths on the economy. Outlays are also the currency of the deficit, for the deficit is simply the difference between revenues received and payments made by the Treasury in the same fiscal period. The capability of the TADCS to show the TOA and outlay dollars required by year for a given path is particularly valuable to analysts, because it allows them to see the *budget* and other economic implications of different alternatives.

For annual operating costs, the delivery dollars, TOA, and outlays occur essentially in the same year and thus require no conversion. Such is not the case with investment dollars. In practice, the relationships among these different currencies vary with the appropriation category and, within an appropriation category, may even vary with the type of item being procured. For this overview, we will again simplify by assuming a single typical set of relationships and proceed from there. The relationships among delivery dollars, TOA, and outlays that we have assumed are shown in Figure 12.

The graph at the top of the figure shows the conversion of delivery dollars to TOA. The Y axis indicates the percentage of total dollars and the X axis fiscal year. The data table beneath the X axis shows the actual values used to plot the bars. The black bar indicates that all of the delivery dollars (i.e., a fraction of 1.0)



	1992	1993	1994	1995	1996
Delivery $					1.00
TOA $	0.10	0.30	0.40	0.15	0.05

Note: Distributions vary with Appropriation, etc.

	1994	1995	1996	1997	1998
Outlays $	0.10	0.25	0.40	0.20	0.05
TOA $	1.00				

Figure 12—How the Army Cost Model Converts Currencies

are required in FY96. The smaller bars indicate the fraction of those delivery dollars that Congress must authorize (TOA) in each preceding year's budget so that the required deliveries can be accomplished.

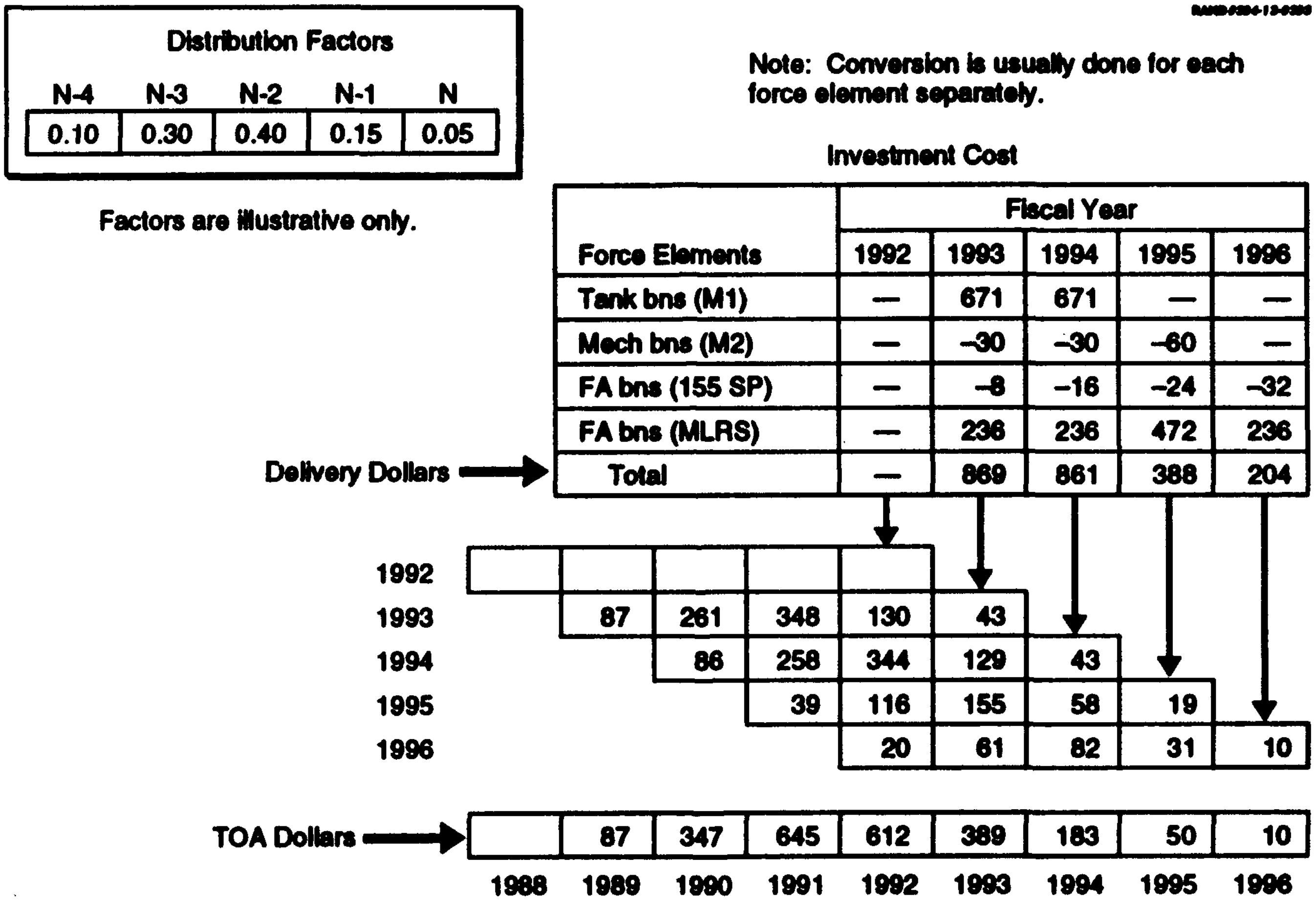
To illustrate, suppose that the delivery dollars in FY96 reflect the delivery and acceptance by the Army of N new helicopters. Obtaining the budget authority and letting the contracts is a five-year process. The graph shows that a tenth of the total value of those helicopters would need to have been included as Obligation Authority in the Army's FY92 budget; 0.3 in the FY93 budget; 0.4 in the FY94 budget; 0.15 in the FY95 budget; and the final 0.05 in the FY96 budget. The model uses these fractions to convert delivery to TOA dollars.

The graph at the bottom of Figure 12 demonstrates the conversion of TOA into outlays. Consider the outlays flowing from the FY94 TOA in the top graph. This amount appears as the tallest bar in the lower graph. The graph indicates that 0.1 of this TOA would be converted into outlays in FY94, 0.25 in FY95, 0.4 in FY96, 0.2 in FY97, and the final 0.05 in FY98. Given TOA dollars, this set of factors allows us to project outlays or spending.

Because TOA must precede deliveries, it is very difficult to look at annual budget (TOA) data and draw accurate inferences about force structure changes over time. This difficulty emphasizes that when the Congress *enacts a budget, it* does not spend money. It only grants the authority for a government agency to enter into contractual agreements with providers of equipment and services that will result in the spending (outlay) of money and the delivery of that equipment and those services in future years.

The example shown in Figure 13 further illustrates how the model uses the factors from Figure 12 to convert delivery to TOA dollars. The investment cost table is the same one as shown in Figure 10 and reflects delivery dollars. Normally, the distribution factors would be applied to each of the investment appropriations separately. However, for illustration purposes, we apply them here to the total investment cost in delivery dollars. The arithmetic is the same, and the essential points will be made equally well.

We have time-phased delivery dollars, and we wish to use our factors to calculate time-phased TOA. The transformation is shown below the investment cost table in Figure 13. Starting with the 869 million delivery dollars shown for total investment in FY93, our factors say that 10 percent of it must have been provided as TOA four years earlier, so the FY89 cell of the TOA row reflects $87 million. We continue applying the factors and complete the FY93 row. Then we shift to the 861 million delivery dollars shown for FY94. Again we apply the distribution factors and fill out the FY94 row. We continue the process for the



Distribution Factors

N-4	N-3	N-2	N-1	N
0.10	0.30	0.40	0.15	0.05

Factors are illustrative only.

Note: Conversion is usually done for each force element separately.

Investment Cost

Force Elements	Fiscal Year 1992	1993	1994	1995	1996
Tank bns (M1)	—	671	671	—	—
Mech bns (M2)	—	–30	–30	–60	—
FA bns (155 SP)	—	–8	–16	–24	–32
FA bns (MLRS)	—	236	236	472	236
Total	—	869	861	388	204

1992									
1993		87	261	348	130	43			
1994			86	258	344	129	43		
1995				39	116	155	58	19	
1996					20	61	82	31	10
TOA Dollars		87	347	645	612	389	183	50	10
	1988	1989	1990	1991	1992	1993	1994	1995	1996

Figure 13—The Conversion of Delivery Dollars to TOA

delivery dollars shown in FY95 and FY96 to complete the required rows. Now we note that while our delivery dollars (a direct reflection of force changes) extend over the period FY93–FY96, the Budget or TOA dollars extend over the period FY89–FY96.

We will not illustrate the conversion from TOA to outlays, as the reader can perform this operation with the information provided. As an aside, remember that the Gramm-Rudman Bill imposes constraints on outlays, not TOA. This constraint is another reason for projecting outlays during the planning and programming process and is why we include the capability in our model.

5. Concluding Remarks

How the System Has Been Used

It is important to note that the system does not necessarily have to operate as such. That is, an analyst can use its component parts separately. It might be better viewed as a tool kit containing a number of different but compatible tools. Standard Army databases and utilities for accessing them are some of the tools. An analyst can use these tools in their own right or in conjunction with the models and databases designed specifically for the system. At RAND, both the National Defense Research Institute and the Arroyo Center have used the system or its components to support a wide range of studies. Table 4 lists some of the more important studies and the portions of the TADCS that supported them.

Directions for Future Research

At present, we have no plans to refine or expand the system, but several aspects of the system would benefit from additional effort in each area. Refinements would include the following:

- Simplifying FASTALS and integrating it by having it use the system's set of force elements
- Devising an automated way to represent the M-Force in terms of the system's force elements

Table 4

Applications of System Components

	Studies Using the System Component			
System Component	Light Helicopter Experimental	Joint Close Support	Transition to War	Assessing Structure and Mix of AC/RC Forces
FEDB				√
Template file			√	√
Theater Support model			√	√
TTW model			√	√
Path building		√	√	√
FELCOM	√	√	√	√
Total Cost methodology		√		√

- Improving the investment cost calculation in the Total Army Cost model by implementing a common-item algorithm, tracking net increases and decreases of major equipment items, and implementing the funding and outlay profiles necessary to convert delivery dollars to TOA and outlays
- Providing the models and the capability to consider explicitly the personnel and equipment in the non-TOE part of the Army.

Useful areas of expansion include the following:

- Giving the system the capability to effect independent changes to the TDA and non-TOE part of the Army. It presently addresses them but only as dependent variables or throughputs. Some policies, however, do change those portions of the Army independent of the TOE units. Consolidation of activities and contracting with commercial agencies for maintenance or training are two examples of such policies.
- Expanding the resources considered. Supplies, such as ammunition, spare parts, or POL, consume considerable funds. Similarly, installations such as ammunition plants, schools, and depots also require significant dollars. Analysts would benefit from the ability to explore alternatives in these areas, particularly in light of the fact that they may offer the most likely place to realize future economies.