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BEGINNING OF MILITARY COST ANALYSIS 1950-1961

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March 1988

P-7425

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BEGINNING OF MILITARY COST ANALYSIS, 1950-1961[1]

At the time RAND formed, just after World War II, the traditional way of looking at military procurement was in terms of a piece of hardware like an airplane, and making decisions on the promise of lighter, higher, faster, further, or more payload. RAND started its work using these same criteria. Fairly early in the game, however, it seemed to some RAND researchers that other things were involved. For example, real estate, people, supply and maintenance were required. It wasn't just delivering the bomb--it was what the bomb did to the economic, social and political structure of the country in which it was delivered. There was the cost of producing the delivery vehicle and the bomb, and their impact on the U.S. economy and society, or those of its allies. They were important, too.

WEAPON SYSTEMS ANALYSIS FORMULATED

As a consequence, by 1948, the concept of what we now call Weapon Systems Analysis had been formulated. In this, RAND tried to bring together the political, economic and social, as well as the technical and military considerations. It was not easy to find one way or one unit for expressing this heterogeneous set of criteria and parameters.

Ed Paxson, a mathematician, invented Weapon Systems Analysis and did the first systems analysis study. It was he who decided that a way of bringing this potpourri into common terms was through an economic measure: "cost."

In the first effort, the offensive bomber system study, RAND exercised its rubber airplane model and came up with a turbo-prop design as preferred to a pure jet. In order to cost out the system, the researchers went to Washington and the Air Force supplied dollar figures on the basis of which a cost comparison of the proposed turbo-prop and the then-proposed B-52 and the piston engine B-36, B-50, and B-29 was

[1]This paper was originally presented as a talk on January 9, 1979, at Science Applications, Inc., in Los Angeles, California.

made. The results, based on the Air Force cost data, showed the turbo-prop to be dominant.

The study was briefed to the Air Staff in early November of 1949. It was well received, with no special comment, excepting General LeMay's[2] statement that he wondered about the costs. He asked for another meeting to be held at Wright-Patterson Air Force Base, Air Materiel Command Headquarters, to discuss the dollar data. This session took place just before Christmas in 1949. It was there that the RAND people learned what the Air Force giveth, the Air Force also can take away. It turned out that between Washington and Dayton the cost of the turbo-prop bomber had doubled, and the cost of the pure jet had gone down 50 percent. As a result, when the RAND people came back to Santa Monica, they felt that they had been had. More importantly, they didn't want it to happen again.

RAND ESTABLISHED COST ANALYSIS DEPARTMENT

I had come to RAND to do industrial mobilization studies and at that time was busy examining the petroleum industry and preparing to work on steel and electric utilities. However, I was the only one around who had been identified with a cost activity--that was in my days in the U.S. Tariff Commission. Charlie Hitch knew my history, including the specialized activity at Tariff. As a consequence I was asked to set up a Cost Analysis Department which was established in February 1950.

In the beginning I assumed that we would have just one problem. That would be pricing RAND's futuristic hardware proposals. All other cost estimates for logistics, installations, personnel and related activities that made up a total system would be furnished by the Air Force. That was the premise on which we worked for about three full months. Then we found out that the Air Force's way of doing business did not permit providing data that identified the cost of operating a B-36 bomber as a system. They could tell RAND the cost of a B-36 delivered by General Dynamics. They knew the cost of all the airmen in the Air Force. But they could not separate the costs of airmen and

[2]Commander-in-Chief, newly created Strategic Air Command (SAC).

officers for the B-36 only. They could identify the men in the crews but they found it impossible to identify the B-36 maintenance or supply people at a base, when bombers and fighter interceptors of the Air Defense Command or MATS transports were operating out of the same base.

So by the summer of 1950 it became apparent that we had several jobs, not just the single one of pricing hardware. At that point I decided that the first thing we'd have to do was identify the elements of cost. It may sound simpleminded today, but no one had done it in 1950. So I developed (and I can really say "I" because there was no one else in the department at that time) a list of cost elements. This should not be referred to as a chart of accounts, as it is frequently called; it is a list of cost elements. Interestingly enough, even though the list is longer today and there have been a few deletions, that original has pretty well survived over the years.

As you know, in this business, given a cost element, the next thing is what is the ER (estimating relationship) or CER (cost estimating relationship). Developing cost estimating relationships turned out to be a sizable job. So for the next several years, we spent most of our time collecting all the data that we could find on the Air Force use of resources. These included budget studies, special analyses, manpower studies, anything to relate manpower, installations, maintenance and supplies to the activities of a tactical unit--the squadron that operates aircraft, radars, missiles or other final output activities. As you know, cost analysis is still in that business.

In 1951 it was the difficulties of data problems that led me to develop conceptual costs based on proposed speed, range, altitude etc. Since the objective was to compare alternatives and choose one for further R&D, we were seeking order of magnitude estimates--that is, conceptual costs--for each of the new concepts. After all, conceptual cost estimates are made before the equipment is specified in any detail. Subsequently, a somewhat higher degree of accuracy was sought and, by 1952, parametric cost estimating had evolved from conceptual costing and became the hallmark of RAND's cost methodology.

Let's keep in mind that the cost estimating accuracy to which we should aspire, depends greatly on the stage of development of an item and the use to which the estimate will be put. For the first estimate of a new, technologically sophisticated concept, we can probably achieve accuracy no better than an order of magnitude. In engineering development, our accuracy may still be no better than plus or minus 25 percent. Even in production we just can't expect to achieve a high accuracy like Detroit does with its cars. After you buy thousands upon thousands of springs of the same type, you should know rather accurately what they will cost.

In the beginning we thought the whole game was to obtain a weapon system cost, since we were going to compare alternative future weapon systems. Since we didn't know much about what went into a weapon system, we approached it in a very simpleminded way. We priced everything as though it were all new. Even though the B-52 might go on to a B-36 runway, we had no way of dealing with "sunk" costs. So, our very first studies were in terms of everything spanking new.

To deal with this obvious difficulty, we had to know more about the Air Force. When we accumulated more knowledge of the Air Force, we moved into a more meaningful approach--incremental costs. That is, if we were going to put in the B-52, we learned how many air bases the Air Force had that could take the new B-52s. Incremental costing became the next major step in the evolving methodology.

An important methodological point must be added here. In the first list of cost elements, there was another concept that was new to government: that is, to differentiate between one-time outlays for investment and recurring expenses for operations. Again, this may sound simple, but it hadn't been done. It was an important feature of the move to incremental costing since, as you know, the incremental costs are chiefly in the investment outlays and not in the recurring ones.

By this time, 1953, we were in business. Korea had built-up the Air Force again. From the four billion dollar a year level after Secretary Woodring's[3] cuts in 1949 to an Air Force that was talking

[3]Secretary of Defense.

about 110 wings. When we heard about it, we sat down and tried to figure out what 110 wings would cost. The result was some rather surprisingly big numbers. We put our calculations together and decided we would show the results to the Air Staff. We went to Washington to see General Ollie Picher, who was then in charge of programs. He looked at our first efforts at total force costing. General Picher had two immediate responses: First, why is RAND doing this kind of thing? And second, burn all the copies.

I was not exactly pleased with this reception. In fact I felt as though somebody had cut off my ears, if not my head. So it was down the Pentagon hall to the office of General Putt, Deputy Chief of Staff, Development. After I told the story, he sort of patted me on the head and said, "Well don't worry, Dave, you just keep on making cost estimates. Someday we'll need them." So we kept on plugging at military weapon system cost analysis.

COST ANALYSIS CONTRIBUTES TO ICBM DECISION

In 1953 there was a major new Air Force development with the idea of a feasible intercontinental ballistic missile. Cost analysis played a very important role in that study. RAND's Cost Analysis Department developed estimates of possible costs. We serviced Johnny von Newmann's Teapot Committee for its historic meeting at Palm Springs on Thanksgiving Day, 1953. Our contribution was an estimate that it would cost $1 billion in 1952 dollars to develop the Atlas, that it would cost an additional $1 billion dollars to buy a force of 800 birds. This was equipment only and not a total system cost. The estimate became very important because some people on Teapot were saying it would cost $20-40 billion. Our figure showed the cost was likely to be neither trivial nor sky-high.

The figures we provided were in the range of acceptability but large enough to make people realize that the job was going to take a little doing. Remember, at that time $1 billion was as big as $4 or $5 billion today. Another part of the ICBM story is that in 1954, Brigadier General Schriever, as he was then, was put in charge of the Ballistic Missile Program. Schriever had been a Colonel in Research and

Development until a year before. He had been a leading proponent of the B-58 and had continuously lost rounds in his battle against General LeMay and the B-52.

Schriever was the first blue-suiter to use a weapon systems analysis in the Air Force and, more important for cost analysis, early in the game he became interested in resource requirements in new equipment proposals. As a consequence he and some majors and captains used to come to my offices, which in 1952 were in the Tower Building in Santa Monica. We would give them our data books, and they would make big ones of little ones and little ones out of big ones to cost out their B-58 and B-52 comparisons. It left a marked impression on Schriever. When he became a general, he continued to be a close associate of RAND's Cost Analysis Department.

This is significant because, when he was put in charge of the Ballistic Missile Program, he realized he was going to ask for large quantities of resources. He wanted to have a defensible position on his program--a better one than had characterized prior Air force development proposals. So, in 1954, he invited the Cost Analysis Department into what became the Ballistic Missiles Division (later SAMSO) to help the Air Force estimate the resource implications of the proposed program. In the course of that work we again learned something new.

In the B-52 and earlier systems studies, research and development costs as applied to a total force of, say, twenty wings, hardly amounted to a decimal place. For example, development of the B-52 ran around $100 million. A force of three hundred airplanes cost about $20 billion over a ten-year operating period. Therefore, there was not much importance attached to research and development *per se* in life-cycle costs. However, we estimated it would cost $1 billion to develop the Atlas and $1 billion for the first 800 birds. That meant that 50 percent of the hardware cost was going to the R&D. When expanded into a system for the 800 birds, another billion was added so that R&D accounted for a third of the total cost.

That meant we had to structure fund accounts not only in terms of investment and operation expense, but we had to break out a new category of investment--one called Research and Development. This turned out to

be fortuitous because it was typical of all future weapons systems--aircraft, missiles, or radar. Research, development, test and evaluation had become a very significant part of total costs.

TOTAL FORCE STRUCTURE COST MODEL DEVELOPED

That brings us up to 1955. By that time we had created a pretty well organized way of doing business and we were ready to deal with the total force structure problem that we had tackled several years earlier. Although prepared, we had never had any reason to do the job, because no one had as yet tried a total force structure problem. The analyses had always been in terms of separate segments--strategic bombers, tactical fighters, air defense fighters, radar networks. At that time work on analyzing the tradeoffs in the totality of these separate forces was just beginning.

At this juncture the Air Force had almost $30 billion in *unobligated* obligation authority that Congress had appropriated during the Korea years. This led them to dream up bigger and better air forces.

General Putt, the Deputy Chief of Staff of Development, and General Power, the head of Air Research and Development Command, attended a 1955 Air Council meeting at which some projections for forces were introduced. Using an old envelope and pencil stub they came up with calculations that the forces being talked about might cost as much as $20-$22 billion a year. That no longer sounds like a very impressive number now that we have become accustomed to much larger ones. In 1955, however, the Air Force annual budget was only $15 billion.

One result of the generals' calculations was that they came to RAND in November 1956 and asked if we could do the exercise that General Picher had ordered us to stop and destroy in 1953. I said that we could. So for the first time, we seriously went to work on a total force structure costing job. For this, we developed a model called PROM and did a lot of hand computations. In fact, it took 60 man-weeks to calculate the costs of one force because we were using business equipment machines like Fridens and Monroes and listing-adders, not computers.

The results of this were first, PROM as a model and second, PROM as a display. I don't know whether or not you saw the PROM rooms. PROM was a way of communicating with people on total force structure problems. When we first tried to tell General Putt and General Power about the probable costs--about $40 billion a year--we had analysis sheets laid out for about thirty linear feet. They were ruled in umpteen rows and columns. People just couldn't see the results. This forced us into the display business. Although the PROM boards were rather mechanical, they did enable us to communicate more meaningfully among ourselves and with the outside world. This marked another major new step in the development of cost analysis at RAND.

Although we asked for the assistance of RAND's Computer Sciences people as soon as we completed the first PROM in 1956, it was four years before a computer program was developed and working. Therefore, it was 1960 before we had a capability to price out more than one force quickly. At that point, we had new display and communication problems. The important thing is that we finally found a way of presenting results to people and of answering their questions.

PROGRAM BUDGETING DEVELOPED

One other thing that goes back into the history but doesn't quite fit into the development of cost analysis is program budgeting. In 1951, Colonel Miller, Director of Accounting, Office of the Comptroller, United States Air Force, came to RAND. He wanted help on an expense accounting system they were trying to install. I became interested in it because it seemed one possible way of solving the data problem. In order to get numbers, we were sifting through all kinds of data and most of it was poor. I reasoned that, if USAF had a good expense accounting system at the base and command levels, the numbers for operating costs would fall out automatically.

As we worked on this, it seemed that earlier work I had done in costs at the Tariff Commission and on the War Production Board's Controlled Materials Plan (CMP), which I had developed in World War II, might be useful. CMP was a budgeting system, planning system, or

programming system to manage the nation's resources for war. I thought that, if we could adapt this same concept to the structure of the Air Force's planning, budgeting, and accounting, life could be very simple.

So, in 1952, I prepared a paper with a real jazzy title--"Efficiency and Economy in Government through New Budgeting and Accounting Procedures"--and delivered it to the by-then-Brigadier General Miller. It was received with something less than enthusiasm and, in fact, the distribution of the document was not authorized until March 1961, after Secretary of Defense McNamara announced the introduction of Program Budgeting--PPBS. The next document, titled "What Program Do We Mean in Program Budgeting," was distributed in 1954. It was followed by "A New Approach to the Military Budget," and other RAND documents and journal articles. Finally, in 1960, I convinced myself that this was good and we were going to give it one last college try. That had two results--both of which were fortuitous. First, I wrote a document titled "New Tools for Planners and Programmers," which was read and accepted by some people in the incoming Kennedy Administration. Second, with the introduction of McNamara into the defense job, it became obvious that here was a man who would understand what PPBS was all about. He accepted it and, early in 1961, Program Budgeting became the vehicle for planning, programming and budgeting in the Department of Defense. PPBS is still in place in the Department of Defense, even though the Office of Management and Budget directed: first, Management by Objective and most recently Zero Based Budgets. Probably more important to cost analysts is the emphasis on cost and costing techniques, for example, "Design to Cost," that has developed in recent years.