Appendix E

ASSIGNING MONETARY VALUES TO PERFORMANCE IMPROVEMENTS

Measuring the monetary value of performance improvements is difficult. Whenever possible, the Air Force should attempt to justify bundling decisions on the basis of cost savings alone. That said, bundling can dramatically improve performance, and fairly simple methods can be devised to approximate the monetary value of many different kinds of performance improvements.

This appendix

- offers a broad overview of the challenge of estimating the monetary value of performance improvements
- offers two examples to illustrate different ways to estimate the value of improvements
- asks how estimating the monetary value of performance improvements relates to broader Air Force efforts to reduce total ownership cost
- suggests a set of principles that the Air Force could use to structure a strategic effort to estimate the value of bundling changes that improve performance in specific ways.

A BROAD OVERVIEW

The monetary value of any performance improvement depends on what the Air Force does when that improvement occurs. If a change in bundling improves performance, the Air Force can react in one of

two ways: (1) It can pass that improvement to its ultimate customers by giving them more or higher-quality output for the services that they consume, or (2) it can maintain the level of service that it provides to ultimate customers and use the improvement to cut the cost of providing that level of service. For example, if more housing becomes available, the Air Force can make that new housing available to military families or eliminate other housing and the costs associated with it. If the support of truck engines improves, the Air Force can react by increasing the number of truck engines available for use—and by implication, the number of trucks—or it can reduce its use of other inputs to engine maintenance, like inventory, and avoid the costs associated with these inputs. The first step in asking what a performance improvement is worth is to ask how the Air Force will take advantage of that improvement.

If the Air Force decides to increase the level of a service that it provides to its customers, then the Air Force must estimate (1) how much these customers value that improvement and (2) how much the Air Force cares about what they value. For example, if the Air Force decides to use additional housing to house additional families, the Air Force can avoid the cost of the housing allowances it would pay these families if they lived outside an Air Force Base. But housing allowances often fail to cover the total cost of living off base. The families affected would value this improvement in terms of the full reduction in the cost of living they experience when they are able to move on base.

Does the Air Force care only about its out-of-pocket cost for housing allowances or the total cost its members experience in meeting their housing costs? The answer depends on how the Air Force wants to think about benefits. The total amount that families spend on housing is relevant to these families' perception of their quality of life and hence relevant to questions of force morale and retention. Those in the Air Force most responsible for housing policy—those responsible for military compensation and base housing—should have useful perspectives on this question. Involving them will help the Air Force decide how to frame its approach to estimating the value of bundling-induced improvements in housing. They may also have useful analytic tools that the Air Force can use to do the estimation itself; we return to this below.

If the Air Force decides to hold the level of a service constant and use an improvement to reduce its costs, then it must (1) specify how it will do that and (2) determine how doing so will affect costs. For example, if a change in bundling increases the amount of housing available, the Air Force could identify military family housing with similar characteristics—suitable for similar military families—but high operating costs. By ending its use of this alternative housing, it could eliminate the utility, maintenance, and other costs associated with the substitute housing.

Or the Air Force could identify the highest-cost military housing in the relevant housing market, even if it was suitable for different types of families, and stop using that housing. In that case, the associated costs of utilities, maintenance, and so on would fall more, and total housing allowances or housing expenditures by military families might increase or decrease. The Air Force should calculate an appropriate total amount to reflect this change in costs and use that to value the initial increase in availability of family housing.

Again, choosing how to eliminate housing and how to value the cost savings associated with this change will be easier if functional experts on military compensation and family housing programs participate.

The basic point here is that any bundling-induced improvement will lead to an Air Force reaction. The Air Force cannot place a dollar value on the improvement without understanding (1) how the Air Force is likely to react, (2) how that reaction will affect dollar costs, and (3) which dollar costs are relevant to the Air Force. The functional subject matter experts that help the Air Force react to the improvement can naturally help in answering each of these three questions.

If the Air Force conducted a detailed analysis of how it would react to every bundle under consideration, the cost of the analytic effort would quickly overwhelm any value from improved bundling. The Air Force needs simplified or stylized methods to develop answers to these questions. It is unrealistic to expect that any single template or algorithm could help the Air Force value any bundling-induced improvement in performance, but it should be fairly straightforward to apply the train of thought suggested here to particular kinds of improvement. By doing this and refining these approaches over time,

the Air Force should be able to develop a ready set of analytic tools that it can apply to bundling questions. The next section illustrates this idea in two different Air Force settings.

TRANSFORMING AN AIR FORCE REACTION INTO A MONETARY VALUE: TWO EXAMPLES

This section illustrates how to develop simple analytic methods that can be used to value performance improvements when the Air Force reacts to them in two different ways.

- The first example extends the discussion of family housing to suggest simple analytic gambits that the Air Force can use when it reacts to an improvement by increasing the output that it provides to its ultimate customers.
- The second example considers an equipment maintenance case, where the Air Force wants to ensure the availability of a given number of assets and reacts to any improvement in the availability rate by reducing the total number of assets in a way that holds the total number of available assets constant.

Each example posits a plausible Air Force reaction to an improvement without endorsing that reaction. The examples focus on translating a response into a monetary value, not on choosing the appropriate response itself.

Example 1: Improved Provision of Family Housing

Suppose that a change in bundling makes it possible to vacate one family, prepare a family housing unit for a new occupant, and move the new occupant in more rapidly. For example, a bundle that includes coordinated management of cleaning crews, painters, carpenters, electricians, plumbers, furniture management, inspectors, and moving services might allow an approach that turns such housing units much faster. How much would the Air Force value such an improvement?

The most obvious measure is the housing allowance relevant to this change. Each day of reduced delay reduces by a day the housing allowance that the Air Force must pay. But housing allowances differ

across grades and family types; how can the Air Force know exactly how much in allowances will be saved? A simple approach could use, for each location affected, a simple average allowance per day for officers, another for senior enlisted, and a third for junior enlisted. The Air Force has all the data required to calculate such averages at each location and to update them as allowances or numbers of families on base change over time. Modern spreadsheets make this easy to do. The Air Force could offer these factors to potential providers, who could then use them to determine how big a reduction in delay is cost effective, given their capabilities.

Factors based solely on housing allowances do not typically capture all cost savings relevant to military families. The Air Force has estimates of the percentages of total costs covered by housing allowances. It could use these percentages to adjust the factors above. If relevant stakeholders demand more accuracy, location-specific adjustments could be made, although they impose increasing demands on local analysts because the relevant percentages change over time and at different rates in different places.

If the Air Force seeks still greater accuracy, it can access commercial databases on the cost of living in different locations. With some effort, the Air Force could link the housing types in these databases to the housing requirements it associates with different grades and family types.[1] Important index problems arise here, but they are well understood and easily managed.[2] Alternatively, the Air Force could estimate its personnel's demand for family housing and use the resulting model to impute what different family types pay for housing in different settings.[3]

This discussion raises a number of issues.

- First, many options are available to measure the value of improvement, even after the Air Force determines that it seeks the value of reducing time in off-base housing by one day. This will

---

[1]The Bureau of Labor Statistics uses an approach like this. See, for example, U.S. Department of Commerce (1988).

[2]For more information on this approach, see Mark and Goldberg (1984), Palmquist (1980), and Follain et al. (1979).

[3]For more information on this approach, see Camm and Praskac (1990).

typically be true. In general, the Air Force will prefer the simplest option that the key stakeholders can agree on.

- Second, some options will tend to be more inclusive than others. For example, using a housing allowance is more conservative than seeking information about total family expenditures off base. If the Air Force can justify a bundle with a simpler, less inclusive measure like the housing allowance, it does not make sense to spend more time on analysis that will only increase the value of this measure by being more inclusive.
- Third, much of the information that the Air Force needs may already be available within relevant Air Force communities. In this case, the value of housing allowances is well known. Ongoing assessments of military compensation periodically examine other issues raised here. These assessments may have already developed the information that the Air Force needs to provide a consensus-based estimate of value.
- Fourth, commercial sources of information can be helpful, but they are probably not the first place to look and very well may not be necessary. Relevant functional communities offer the best place to get started. Keeping them involved is likely to improve effective use of any commercial support sought.

Example 2: Improved Provision of Equipment Maintenance

Suppose that a change in bundling could improve the availability of Air Force equipment (for example, air conditioning, commercial-type vehicles, ground-support equipment, or even aircraft and other major end items). This might occur if maintenance were effectively bundled with materiel management or with analytic capabilities that improve demand forecasting, production management, management of parts relevant to time awaiting parts, or life-cycle management of assets. In this case, the Air Force is likely to perceive a required level of service from the equipment assets in question. If an improvement allows a higher level of availability for the "fleet" as a whole, the Air Force might very well react by reducing the size of the fleet.

In this case, the bundling-induced improvement reduces the optimal number of assets required to produce a given level of service, allow-

ing the Air Force to sell some assets, if a commercial market exists for them, or to choose not to replace or repair existing assets that are no longer needed. A sale would generate income; early retirement would avoid repair and replacement costs. How should the Air Force value this change?

The most straightforward approach would be brute force: (1) Determine how many assets are now considered to be surplus, (2) determine which can be sold at what salvage prices, and (3) for the remainder, choose a planning horizon of, say, eight years. Over that horizon, estimate when these assets would have been retired, what their maintenance costs would have been before then, and what their replacement cost would have been upon retirement. Total the salvage values and forgone costs, appropriately discounted. This approach is tedious and is likely to require information that the Air Force does not routinely maintain. But it is well within the capabilities of the Air Force's existing operations research shops.

Aside from the considerable effort required to execute such a study, it has the disadvantage that it does not yield simple planning factors that the Air Force could deliver to potential providers. Such factors would simplify (1) potential providers' ability to choose bundles that increase the availability of assets in a cost-effective manner, and (2) the Air Force's ability to compare alternative offers that claim to increase such availability.

An alternative approach uses simple planning factors to calculate the life-cycle cost of acquiring and maintaining each asset and assumes that the Air Force can avoid these costs for each asset in surplus. This approach is rough and ready, but it relies on data that can be extracted from existing Air Force management systems fairly quickly. Data include

- Acquisition cost
- Expected service life
- Expected operating hours per year
- Expected repair ("demand") rate per operating hour
- Expected direct maintenance man-hours per repair
- Expected real wage per direct man-hour

- Expected material costs per repair
- Expected time in repair.

This approach yields a simple planning factor that the Air Force can supply to potential offerors to tell them how it will value improvements that reduce its need to maintain important assets.[4]

This example confirms observations drawn from the first example:

- Alternative measures of value are available; the Air Force should seek the simplest that the key stakeholders will accept.
- The Air Force already has data, models, and skills relevant to measures of value that reside in the functional communities responsible for the activities in question. The bundling questions raised here may pose new applications of existing data, models, and skills, requiring some new training and posing new workloads on Air Force analysts. But the basic analytic elements already reside in the Air Force.

Thinking more broadly, each type of performance improvement is likely to present a similar set of questions that must be answered in a particular setting. These examples should be understood as specific illustrations of a general approach. That said, they are consistent with the Air Force's current views on "total ownership costs." As the Air Force improves its ability to measure and manage total ownership cost, it should also improve its ability to value a wide variety of improvements in performance. The next section briefly reviews the new concept of total ownership cost.

GENERAL EFFORTS TO REDUCE TOTAL OWNERSHIP COST

DoD is currently committed to seeking performance improvements that reduce the "total ownership costs" of weapon systems and other assets. The Air Force is developing initiatives to do this in its "Reduction in Total Ownership Cost" (R-TOC) program. Although

[4]The Air Force has used this approach to measure the value of improvements in the repair of F-16 avionics components at Ogden Air Logistics Center. Contact Frank Camm at Frank_Camm@rand.org for details.

this program began by focusing on the costs of weapon system support, the Air Force is now extending it to base-related activities, precisely the kinds of activities relevant to typical bundling decisions. The view of performance provided by the Air Force R-TOC program offers an already established Air Force approach that it can apply when valuing the performance improvements offered by bundling. Relying on total ownership cost, defined in this way, simplifies things by allowing the Air Force to draw on a preexisting costing approach and promotes consistency by offering a single approach to value all performance improvements.

At its heart, total ownership cost is simply life-cycle cost; in fact, guidance from the Office of the Secretary of Defense now states that total ownership and life-cycle costs are equivalent. But total ownership cost suggests a new emphasis on seeking costs not normally included in traditional decisionmaking. Consider an example. Traditional analysis of the life-cycle cost of an asset—say, a vehicle—typically considers its purchase price and the dollar outlays required to pay for materiel and labor hours consumed in maintenance over its lifetime. But it does not necessarily include the cost of inventory—a spare or back-up vehicle—required to stand in for an asset while it is in repair. And it rarely includes the value of activities forgone if the asset is not replaced while in repair—the value-added provided by that vehicle in its normal day-to-day use. Total ownership cost explicitly considers such costs. It is by its very nature more inclusive than traditional life-cycle costs. Total ownership cost includes all the costs associated with an asset over its lifetime, including some often not captured by traditional analysis.

These uncaptured costs are critical to the valuation of improved performance. The examples above illustrate this idea. The family housing example captures the cost of housing allowances or, more broadly, family housing expenses off base in a way that informs a change in family housing on base. The equipment maintenance example captures the total costs that the Air Force can avoid if it can effectively reduce its demand for equipment. As the Air Force expands its development of R-TOC databases, it should become increasingly easy to value policies that affect the total ownership costs measured by these databases.

A SET OF PRINCIPLES FOR MEASURING THE VALUE OF IMPROVED PERFORMANCE

As the Air Force formulates a strategic approach to valuing performance improvements associated with alternative bundles, it should seek to develop appropriate formulas and rules of thumb to help potential providers value a variety of specific improvements in performance. These formulas and rules of thumb should not preclude alternatives offered by providers. Rather, the Air Force should develop and offer them with the following goals in mind. The formulas and rules of thumb should:

- Reflect a basic understanding of how the Air Force is likely to react to a performance improvement and how that reaction is likely to affect total ownership cost.
- Be as simple as possible, so long as they reliably document improvements that exceed the stated threshold.
- Provide enough information about how the Air Force values performance improvements so that potential providers need not guess about these values and can focus on bringing their own information to the formulas.
- Be accepted by all the key players so that, when they are applied, discussion can focus more on the provider inputs than on the formulas themselves.

In all likelihood, controversies will arise and formulas will have to be adjusted over time to sustain consensus. Potential providers will propose alternatives to the Air Force formulas that actually meet these criteria better than the proposed Air Force formulas. But a simple, principled, consistent approach that stays focused on identifying when an improvement moves beyond a threshold level of total ownership cost should sustain a constructive ongoing dialogue among all the interested parties, including potential providers.

The development and maintenance of such formulas and rules of thumb would presumably be the responsibility of the Air Force organizations responsible for maintaining the Air Force's strategic approach to bundling, as discussed in Chapter Six. The discussion here helps explain why relevant functional communities should partici-

pate in this strategic approach. The organizations responsible for bundling policy should also coordinate their activities with ongoing Air Force R-TOC activities to take advantage of synergies and ensure consistency in the Air Force's interpretation of total ownership cost in different settings.