PROJECT MEMORANDUM

A User’s Guide for the Acquisition Workforce Projection Model

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PM-1183-OSD

April 2001

Prepared for the Office of the Deputy Under Secretary of Defense for Acquisition Reform and the Deputy Assistant Secretary of Defense for Civilian Personnel Policy

National Defense Research Institute

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Preface

This project memorandum serves as a user’s guide for a simple workforce projection model constructed primarily for use by Department of Defense components engaged in acquisition workforce planning. It was constructed as part of RAND’s overall support for workforce planning requirements established by the Acquisition Task Force 2005 Final Report: Shaping the Civilian Workforce of the Future, prepared for the Under Secretary of Defense for Acquisition, Technology, and Logistics, and the Under Secretary of Defense for Personnel and Readiness, October 2000.

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This research was conducted for the Office of the Deputy Under Secretary of Defense for Acquisition Reform and the Office of the Deputy Assistant Secretary of Defense for Civilian Personnel Policy within the Forces and Resources Policy Center of RAND’s National Defense Research Institute (NDRI). NDRI is a federally funded research and development center sponsored by the Office of the Secretary of Defense, the Joint Staff, the unified commands, and the defense agencies.
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Using the Workforce Projection Model

The accompanying Microsoft Excel workbook provides a workforce projection model. This model is designed to estimate how longevity-related characteristics of a workforce are likely to change over a period of several years. The results can be compared to sets of future workforce requirements developed as part of a comprehensive workforce planning exercise. The model can also be used to estimate how expected characteristics might be affected by alternative human resource programs or policies.

This guide is written for users who already have an understanding of basic spreadsheet functions and features, including cutting and pasting cell contents, using formulas, moving and copying sheets, awareness of relative and absolute cell references, and a sense of when it is appropriate to paste values vs. formulas.

Basic Configuration of the Model

The basic workforce characteristic depicted in the model is year of service (YOS). The model accepts, as user input, the beginning inventory of a workforce, distributed from YOS 1 to YOS 50. The user must also supply target end strengths, i.e., the planned total size of the workforce at the end of the current and each future fiscal year. The model uses continuation rates to calculate the number of workers in each YOS who are expected to remain in the workforce for an additional year. Workers who do not continue from one year to the next are counted as losses. The model then determines the number of gains (new hires) necessary to replace losses while accounting for any change in the target end strength. Although most gains are in YOS 1, many have previous federal service and therefore enter the workforce in YOS 2 and above. In summary, the model starts with a workforce as it looks at the end of FY 2000 and depicts how it might look at the end of each successive fiscal year.

Figure 1 illustrates the basic configuration of the model. Column A of the sheet indicates the YOS. Column B contains the beginning inventory as it looked...
Figure 1 – Basic Configuration of the Model
at the end of FY 2000. Columns C through J contain the projected workforce at the ends of fiscal years 2001 through 2008. Line 56 contains the target end strengths for each fiscal year (set, in this example, to maintain an unchanging workforce size of 127,000 during the projection period). As would be expected, the YOS populations generally get smaller as YOS increases. However, note that this is not always true. Populations in YOS 11 and below are smaller than populations in YOS 12 through 35—a reflection of low hiring levels during the workforce drawdown of the past decade.

Figure 2 shows the bottom half (rows 54 through 74) of the same sheet.
depicted in Figure 1. These rows provide summary statistics regarding the workforce. These include total strengths, total losses and gains, net gains, turnover rates, and several aggregate measures of experience. Note, for example, that the average YOS drops from 20.1 years in FY 2000 to 17.2 years by FY 2008. This expected rejuvenation of the workforce can also be seen in the rows that depict proportions of the workforce in various YOS groupings. Over time, the less experienced proportions of the workforce in YOS 1-3 and YOS 4-10 continually increase while the more experienced proportions in YOS 11-20 decline. Additionally, the last three lines provide an estimate of how much of the current (end FY 2000) workforce will have retired or separated by the end of each projected fiscal year. These data suggest that almost half (47 percent) of the current workforce will have departed by FY 2008.

The spreadsheet depicted in Figures 1 and 2 contains formulas that calculate the expected workforces in each successive fiscal year. Each year group progresses through the matrix on a diagonal path. For example, the beginning inventory has

![Figure 3 - Diagonal Progression of a Year Group Through the Model](image)
4,796 workers in YOS 15. About 95 percent of these workers continue on to YOS 16 in FY 2001. They are joined in YOS 16 by about 1 percent of the 10,084 new hires in FY 2001 (those who enter with 15 years of previous service), resulting in a YOS 16 population of 4,616 by the end of FY 2001. These 4,616 workers are similarly “aged” to arrive at the YOS 17 population of 4,424 by the end of FY 2002. (See the shaded diagonal in the close-up view of the spreadsheet in Figure 3).

The formulas contained in the workforce sheet use continuation rates and the distribution of gains (new hires) by year of service. These rates are contained in a separate sheet in the workbook. Note, in Figures 1 through 3, that sheets in an Excel workbook are identified by a row of tabs along the bottom of the workbook window. The material depicted in Figures 1 through 3 is in the sheet labeled “Base Model.” The accompanying rates are in the sheet labeled “Base Rates.”

Comparing Cases

The Excel workbook, when initially supplied to users, contains two sets of inventory sheets and accompanying rates. These allow the user to establish a base case and an alternative case and to note the differences between the two. The base case might, for example, represent the workforce resulting from current policies and programs. The alternative case might represent, for example, the effects of programs designed to enhance the retention of mid-career workers. The base case is represented in the “Base Model” and “Base Rates” sheets, as described above, while the alternative case would be represented in the sheets labeled “Alt Model” and “Alt Rates.” An additional sheet, labeled “Comparison,” juxtaposes summary statistics for the base and alternative cases.

When supplied to users, the base and alternative cases in the workbook are identical. To construct an alternative case, the user must introduce some differences. Differences are typically introduced by changing target end strengths, changing continuation rates, or changing the distribution of gains. The areas in the model and rates sheets where these differences would be introduced are shaded in yellow. Changes can be introduced in a single fiscal year, to simulate a one-time effect, or over a range of fiscal years, to simulate a continuing policy.

Changing Target End Strengths

This is the simplest and most straightforward kind of change. At an aggregated organizational level, decreasing end strengths would be associated with a
continuing workforce drawdown or outsourcing of activities currently performed in-house. Increasing end strengths would be associated with growth in the mission and budget of an organization or, rarely, the return of outsourced activities to in-house performance. At a disaggregate level, such as within an occupational series, increases or decreases in target end strengths might simply reflect the changing composition of occupational requirements in the organization. The most noticeable and immediate effects of target end strength changes will be increases or decreases in the number of gains. Over time, large or continuing increases or decreases in target end strengths will also affect the experience mix of the workforce.

If a workforce faces programmed strength changes during the projection period, these changes would typically be reflected in the target end strengths in both the Base Model and the Alt Model sheets. For a workforce facing no known strength changes, the Base Model would reflect constant target end strengths in each fiscal year (equal to the total strength in the FY2000 beginning inventory). In this case, the Alt Model might be used to explore the impacts of increasing or decreasing workforce strength during the projection period.

**Changing Continuation Rates**

This type of change would simulate the effects of increasing or decreasing retention of selected parts of the workforce. For example, paying retention bonuses to workers in selected years of service would likely increase continuation rates in those years. Likewise, paying voluntary separation incentive pay (VSIP) to the workforce would likely decrease continuation rates, especially for YOS groups in the retirement-eligible range.

A useful technique for changing a block of continuation rates is as follows. First, open the Alt Rates or other appropriate rates sheet. Select the continuation rates for a block of YOSs and FYs assumed to be affected by the program or policy alternative being simulated. Cut and paste this block into an unused area of the sheet. In another unused cell, enter an appropriate index for modifying the continuation rates—a number slightly greater than one to simulate an improvement in retention or slightly less than one to simulate lowered retention. Multiply each cell in the block by the index value, then copy the results to the area from which the block was originally cut. Finally, inspect the results to insure that no continuation rate is greater than one (no more than 100% of an inventory cell can logically continue from one year to the next).
Changing the Distribution of Gains

This type of change would simulate a shift in recruiting emphasis. For example, a strategy of placing greater emphasis on hiring experienced workers from other agencies would result in a smaller proportion of gains in YOS 1 and greater proportion in YOS 2 and above.

To change the distribution of gains, first open the Alt Rates or other appropriate rates sheet and scroll down to the gain distribution rates on the lower half of the sheet. Select the YOS and FY cells likely to be affected by the program or policy alternative being simulated. Substitute new rates for the ones supplied in the model. Bear in mind that whenever one cell is changed, offsetting changes in the same FY column must be made so that the distribution rates within each FY column sum to one.

Estimating Policy Effects

The model does not have an ability to estimate how much the continuation or gain distribution rates might change as a result of a policy or program change. The user must estimate the direction and magnitude of the effect. One basis for such estimates, if available, would be rates derived from some previous period in which the same or similar policies were in force.³

Customizing the Workbook

When supplied to the user, the workbook contains a beginning inventory for the DoD-wide acquisition workforce (see note 2 above). The continuation rates and gain distribution rates are based on total DoD civil service gains and losses during FY 2000. Users of the model should customize it for use with their own workforces. Customization can be done at either of two levels: modifying the beginning inventory and modifying the rates.

³ In some very sophisticated workforce modeling applications, such as those used by some services for military force programming, retention behaviors have been estimated as a function of the alternative income streams faced by those leaving service and those remaining in service. In such applications, the retention effects of any policy that can be monetarized are readily simulated. However, developing such underlying behavioral models is beyond the scope of work supporting the relatively simple inventory projection model provided here.
Modifying the Beginning Inventory

At the simplest level, the user would substitute a beginning inventory drawn from data on a workforce of interest. The workforce of interest might be the entire workforce in the user’s organization or specific subgroups within the workforce, such as the acquisition workforce, a specific occupation, or perhaps the population with advanced degrees in a specific occupation.\(^4\) Note that the target end strengths must be changed to match the scale of the beginning inventory. Also, beginning inventories in both the base and alternative case sheets should, for most purposes, be identical.

Modifying the Rates

At a more advanced level, the user might wish to substitute continuation and gain distribution rates developed from historic information on the specific workforce of interest. The DoD-wide rates supplied in the model should be accurate enough for most uses. Such rates generally do not vary appreciably across organizations or occupations within DoD. However, using organization-specific or occupation-specific rates would increase the authenticity of the model.\(^5\) Advanced users with the capability to do so should not hesitate to develop their own rates or to use the service-specific rates supplied in the workbook. Service-specific rates can be found on the sheets labeled “DMDC loss data” and “DMDC new hire data.”\(^6\) For most uses, the rates in the base and alternative case sheets should initially be identical. Changes can then be introduced in the alternative case rates to simulate policy or program changes. See the Technical Notes section below for more information on modifying rates.

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\(^4\) Packard algorithm counts of the acquisition workforce by component are provided at the sheet labeled “Packard count.” Beginning inventories for other sub-populations of interest can be readily developed using the Acquisition Workforce Decision Support System (ACQDSS) developed by the Logistics Management Institute (LMI) and furnished to component acquisition workforce management staffs.

\(^5\) One source of error in the DoD rates, when used for sub-populations within DoD, is that they do not account for movement between components or between organizations within a component. For example, a worker who moved from the Navy to the Army would not be picked up as either a loss or a gain in DoD-wide data. Thus, the DoD-wide data tend to slightly understate the losses from sub-populations and also to slightly understate the gains in YOS 2 and above.

\(^6\) The rates supplied in these sheets were developed by the Defense Manpower Data Center (DMDC) using FY 2000 data.
Expanding the Workbook

The workbook can be expanded in several ways. Some users may wish to project their inventories beyond FY 2008. Others may wish to prepare inventory projections on a large number of sub-populations, such as various occupational series.

Extending the Forecast Period

Extending the forecast period beyond FY 2008 is easily accomplished. Simply copy the right-most column on all applicable model, rate, and comparison spreadsheets and paste additional columns further to the right.7

Depicting Multiple Sub-populations

Expanding the workbook to produce separate workforce projections for multiple sub-populations can also be accommodated. Use the Move or Copy Sheet . . . command in the Edit menu to create additional copies of either the Base Model or Alt Model sheet. (Remember to check the “Create a Copy” option in the move/copy dialogue box.) Rename the newly created sheets according to the sub-populations they represent. Enter a new beginning inventory and target end strengths for each of the sub-populations in their respective new sheets.

After the steps outlined above are taken, the new sub-population sheets will use the same continuation and gain distribution rates as the sheet from which they were copied (e.g., the rates in the Base Rates or Alt Rates sheets). To provide the new sub-population models with their own sets of rates, which can then be varied independently, create copies of either the Base Rates or Alt Rates sheets and rename them according to the sub-populations with which they will be associated. Then, for each sub-population, open the workforce sheet associated with it and click on any cell in the middle of the workforce projection matrix (e.g., YOS 15 in FY 2004). In the formula for the cell, note that the expression contains the name of the sheet where continuation and gain distribution rates are found. Use the Find. . . and Replace. . . commands in the Edit menu to find the name of the currently-used rate sheet and replace it with the name of the new sheet containing

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7 If more than four additional fiscal years are added, horizontal spacing between the continuation rates and gain distribution rates on the “Base Rates” and “Alt Rates” sheets must be increased. Otherwise, array formulas used to compute total losses and total gains will not calculate properly.
the rates to be associated with the sub-population. Hitting the Replace All button will change all formulas on the active sheet.

After all sub-population models have been constructed, users might want to modify the Comparison sheet so that it collects all important results from the various sub-population sheets.
Technical Notes

These notes provide additional information about elements of the Excel workbook, primarily for users who wish to customize the workbook or develop more complex simulations for policy analysis.

**YOS Bins**

In an inventory matrix, the bins identify the population in the \( n \)th year of service. Thus, YOS 1 identifies the population with up to one year of service as of the end of a given fiscal year. YOS 2 identifies the population with more than one but less than or equal to two years of service.

In a set of continuation rates, the rate for YOS \( n \) indicates the rate of continuation into the \( n \)th year. Thus, the continuation rate for YOS 10 in FY 2004 indicates the proportion of workers in YOS 9 in FY 2003 who continue into YOS 10 in FY 2004.

The YOS 0 continuation rate is a special rate that indicates the proportion of new hires who survive to the end of the fiscal year in which they are hired. It is not an annual continuation rate, as are the continuation rates for YOS 1 and above, because new hires are in the workforce for less than a full year.

In a set of gain distribution rates, the rate for YOS \( n \) indicates the proportion of annual gains in the specified YOS. Thus, the gain distribution rate for YOS 5 in FY 2006 indicates the proportion of new hires in FY 2006 who will have more than 4 but less than or equal to 5 years of service at the end of FY 2006.

**Total Losses and Gains**

Total losses are computed by multiplying a YOS array of continuation rates by the previous year’s YOS workforce array, then subtracting the sum of the products from the previous year’s total strength.

Net gains are computed by taking the maximum of either zero or total losses plus or minus any change between the target end strength and the previous year’s total strength.

Total gains are net gains divided by the YOS 0 continuation rate (see above). This calculation recognizes that some new hires leave before the end of their first
year. To end up with \( x \) new hires at the end of the fiscal year, an organization must hire more than \( x \) new people during the year.

**Turnover Rates**

There is no single, definitive formula for calculating turnover rates. The computation provided in the workbook is one of the broader and more accepted ones. It is the average of gains and losses in a fiscal year divided by the average of beginning and ending strengths for the year.

**Survivors from FY 2000 Strength**

The calculations used here are made by compounding the continuation rates along a diagonal in the continuation rate matrix, multiplying the compound, multi-year continuation rate by the appropriate YOS bin in the FY 2000 beginning inventory, and summing the products.

**Loss and Continuation Rates**

An annual loss rate, by YOS, is computed by dividing total losses during a year in each YOS by the number of workers in the YOS at the beginning of the year. A continuation rate is the reciprocal of a loss rate.

Users desiring to substitute organization-specific or occupation-specific loss rates in place of the DoD-wide rates installed in the model should paste the new rates into cells B4 through B52 (corresponding to YOS 1 through 49) in each applicable rates sheet. Users should not replace the YOS 0 rate unless they thoroughly understand the computational method for this rate (see discussion under YOS Bins above). Additionally, to truncate the model at YOS 50, the loss rate for YOS 50 should remain 1. When these rate substitutions are made, the model automatically computes the continuation rates in cells C3 through C53 (the FY2001 column). These cells should be copied and pasted to the adjacent columns for FYs 2002 through 2008. Paste values only — not formulas (use the Paste Special command in the Edit menu and click the Values button).

**Gain Distributions**

Gain distribution rates are calculated from the counts of annual gains by YOS appearing in cells B65 through B114 in the rates sheets (corresponding to YOS 1 through 50). The model converts these counts into rates using the formulas in
cells C65 through C114 (the FY 2001 column). Users substituting organization-specific or occupation-specific gain counts in place of the DoD-wide rates installed in the model should paste the new counts into cells B65 through B114, then copy the values from cells C65 through C114 to the adjacent columns for FYs 2002 through 2008. Note that the inventory projection computations in the model use the gain distribution rates but not the actual count of gains. Thus, the gain counts do not have to match the scale of the beginning inventory used in the model.