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FAA STAFFING

Improvements Needed in Estimating Air Traffic Controller Requirements

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GAO

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June 21, 1988

The Honorable James L. Oberstar, Chairman
The Honorable William F. Clinger, Jr.
    Ranking Minority Member
Subcommittee on Investigations and Oversight
Committee on Public Works and
    Transportation
House of Representatives

At your request we have evaluated the Federal Aviation Administration's standards for staffing the nation's air traffic control system. This report presents our findings, conclusions, and recommendations regarding the adequacy of current air traffic controller staffing standards.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 15 days from the date of this letter. At that time, we will send copies to interested congressional committees, the Secretary of Transportation, and the Administrator, Federal Aviation Administration. We will also make copies available to others upon request.

This work was performed under the direction of Kenneth M. Mead, Senior Associate Director. Major contributors are listed in appendix VI.

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estimating staffing requirements because in some cases they are not aware that headquarters has developed new standards.

Validated staffing standards that accurately reflect needs would provide FAA with an effective management tool and help restore congressional, controller, and facility manager confidence in FAA judgments about its staffing needs. Recognizing the importance of these standards, FAA is now reassessing its standard for determining controller staffing needs at airport terminals.

Principal Findings

FAA headquarters uses staffing standards in developing its budget requests for controller staffing. In recent years, however, the Congress has funded more controllers than were called for in the standards and requested by FAA, in part, because of concern that FAA had underestimated its staffing requirements.

Shortfalls in the Current Standards

FAA's current staffing standards do not accurately reflect field conditions because of incorrect assumptions. For example, FAA has based its center staffing on the assumption that centers are operating with up to eight separate starting times or shifts a day. Using eight shifts increases the number of instances where groups of controllers will overlap. Headquarters believes this allows managers greater flexibility to meet peak traffic periods using fewer total controllers by the end of a given day. Using eight shifts reduces FAA's overall staffing requirements by 4 percent when compared with a traditional three shift operation. However, centers that GAO visited were generally operating with three to five shifts per day. These centers would require more staff than provided by the standard or more overtime to handle peak traffic.

Lag times in FAA's budget and aviation forecast processes also affect the accuracy of the staffing standards but are difficult to remedy. For example, FAA underestimated aviation growth in fiscal year 1987 and had to amend its fiscal year 1988 funding request to increase its controller staffing. The standards cannot adjust quickly to changes in work load, such as an airline's decision to start a new base of operations at an airport.
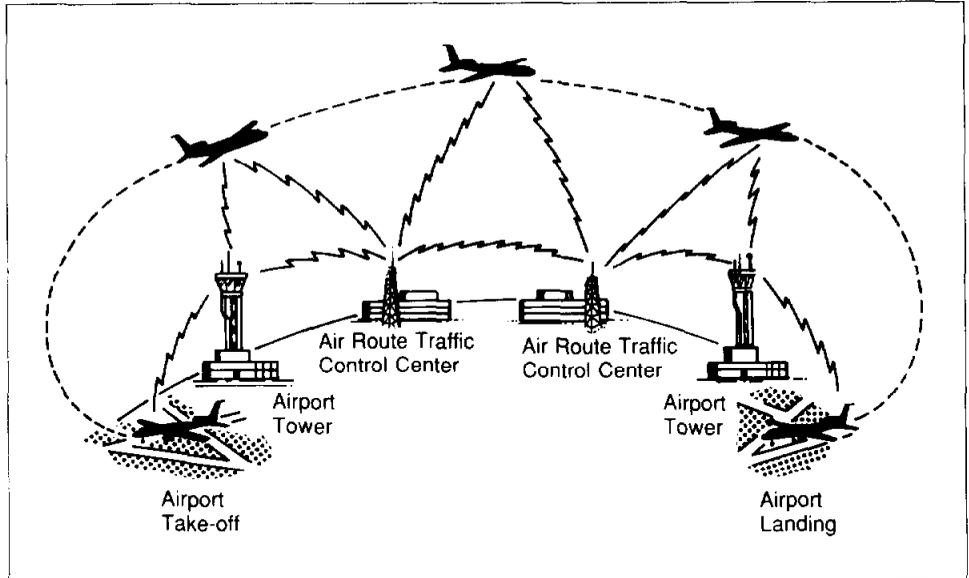
FAA has also underestimated its requirements for controller trainees to replace controllers who leave and meet future work load. In fiscal year 1987, headquarters provided a 6-percent controller staffing allowance to terminals and 9 percent to centers for a pipeline of trainees. These

Agency Comments

The Department of Transportation said that FAA has recognized the need for accurate staffing standards for critical safety functions such as controllers. FAA also has recognized the shortfalls in existing standards and has requested increased controller staffing to meet immediate needs until new standards can be documented. While the Department generally agreed with GAO's recommendations, it indicated disagreement with information supporting these recommendations that, according to the Department, unduly casts a negative light on the standards' technical merits. It did not, however, provide any specific information about its disagreement. The text of the Department's letter to GAO appears in appendix V. A discussion of the Department's comments and GAO's detailed responses appear at the end of chapters 2 and 3.

Contents

Figure 1.1: Aircraft During Flight

three positions—a radar controller, a manual or data controller, and a coordinator or handoff controller. (See fig. 1.2.) An airport tower has two environments: the radar room and the tower cab. The radar room, or TRACON (terminal radar approach control), has a radar position and coordinator position for specific segments of airspace, similar to a center's configuration. The tower cab has a flight data/clearance delivery position and one or more ground controller and local controller positions.[3] (See fig. 1.3.)

Controllers at the full performance level (FPL) are required to be certified on several operating positions within a center or control tower. For example, an FPL controller is required to be certified on all positions—both radar and data—within a given area in a center. Depending on the size and type of terminal facility, controllers may be required to be certified on either the cab or radar room positions or both.

Other Facility Staff

Other staff besides controllers are essential to the orderly flow of air traffic:

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[3]Flight data/clearance delivery controllers are responsible for issuing instructions on approved departure procedures and route of flight. Ground controllers give approval for aircraft to taxi from the gate and control aircraft while approaching or leaving the runway. Local controllers are responsible during an aircraft's takeoff or landing.

Figure 1.3: *Airport Terminal Control Positions*

Ground Controller

Local Controller

Clearance Delivery

Tower Cab

Handoff Controller

Radar Controller

Radar Room
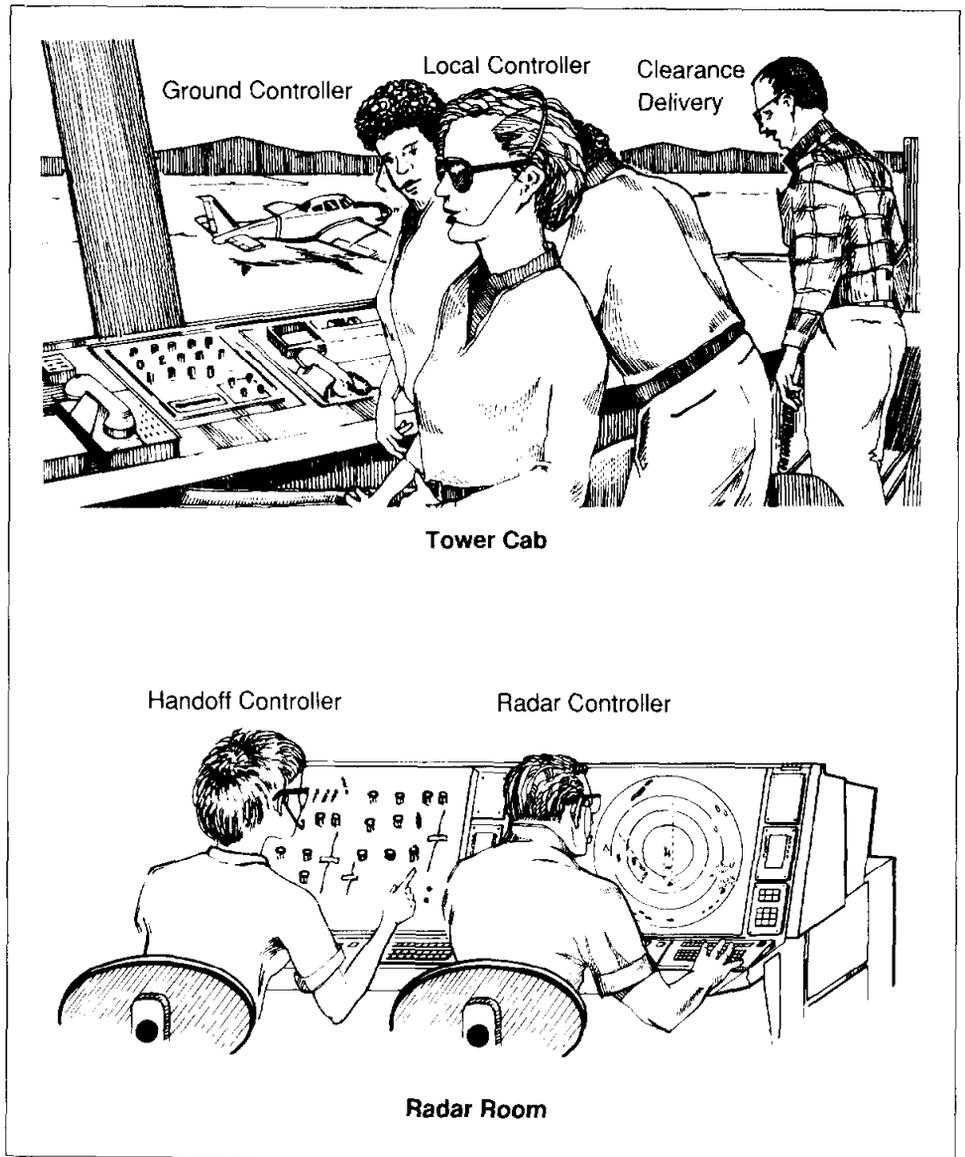
Both supervisors and coordinators are selected from the ranks of FPL controllers.

of maximum utility in targeting areas for improvement in all program functions."

FAA has established staffing standards as ". . . the basic method for determining, analyzing, and distributing employee resources . . ." for FAA programs. According to a 1983 order (FAA Order 1380.34A), staffing standards should be of the highest quality, accurate, and current. This order also requires FAA to officially publish staffing standards as orders and to maintain and review its standards at least once every 2 years. FAA's order supports the use of staffing standards for a variety of purposes such as identifying outstanding performance and determining impacts on staffing from changes in methods and equipment. Within FAA, the Office of Management Systems, under the Associate Administrator for Administration, has primary responsibility for the staffing standards program.

Evolution of FAA's Controller Staffing Standards

Since 1961, FAA has used several different formal standards to develop its budget requests for controllers. The current controller staffing standards are the fifth in this series (see table I.1). Historically, staffing standards have used various methods to determine the number of controllers needed to staff FAA facilities, based either on the control positions that are operating on a specific busy day (such as the 90th percentile or 37th busiest day of the year) or on annual aircraft operations. The standards included adjustments for (1) controllers' leave and days off and (2) time spent on noncontrol activities, such as lunch and breaks. (Additional information on FAA's previous standards is provided in app. I.)

Elements of FAA's previous standards have been criticized both externally, in a 1978 staff report to the House Appropriations Committee, and internally, in FAA's 1982 Manpower Utilization Management and Control System Study (MUMCS). Both reports raised similar points, including the following: (1) FAA's standards were complicated and difficult to understand and, therefore, had little credibility with managers and the field, (2) FAA had not paid sufficient attention to refining and revalidating the standards; and (3) basing staffing on the 90th percentile or 37th busiest day provided excessive levels of staffing for nonpeak traffic periods.

These orders specify the maximum authorized positions for jobs such as quality assurance specialists, automation specialists, training specialists, and others in addition to supervisors and traffic management coordinators.

Objectives, Scope, and Methodology

At an August 14, 1986, hearing, the Chairman, Subcommittee on Investigations and Oversight, House Committee on Public Works and Transportation, asked us to examine the standards that FAA uses to estimate its controller staffing requirements. We were asked to determine

- whether FAA's controller staffing standards reasonably project staffing requirements and, if not, what the problems are with these standards;
- how FAA's staffing standards are used; and
- what needs to be done to improve the standards and their use.

Chapter 2 of this report describes the current FAA standards and problems with them. Chapter 3 discusses what the standards are used for and the extent to which the standards are used by FAA headquarters and the field. Chapter 4 presents several options for FAA to consider in improving both its controller staffing standards and their use.

This report is based on work at FAA headquarters as well as field work in six FAA regions. Our field work was done at 14 locations (representing 15 FAA facilities, as shown in table 1.1). To select these sample locations, we used data from FAA's Personnel Management and Information System (PMIS) and compared the mid-year (March 31, 1987) on-board staffing at each of the busiest air traffic facilities[7] with the fiscal year 1987 staffing standard for each facility. We then selected 12 locations—6 centers and 6 terminals—staffed at various levels: 4 locations were staffed at 100 percent of the standard, 4 below the standard, and 4 above the standard. Two additional locations were selected because of unique circumstances affecting their staffing standard allocations (New York TRACON and Boston Center[8]).

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[7]All level 2 and 3 centers and level 4 and 5 terminals.

[8]Because of the complexity and size of its operations, the New York TRACON has a special staffing standard regression calculation, which applies only to this facility. Boston Center received seven sectors of airspace from the New York Center in July 1986, which required adjustments to its staffing.

at each facility. We interviewed facility management on all of these issues and interviewed members of the controller work force (controllers, first-line supervisors, and traffic management coordinators) to confirm their opinions.

We determined how FAA uses the standards from discussions with FAA headquarters officials as well as managers in the field. We also reviewed FAA's orders on its staffing standards program and compared these with staffing policies that the Department of Defense uses to staff military control towers. Our work included a review of Transportation's 1986 and 1987 internal control reports prepared in response to the Federal Managers' Financial Integrity Act of 1982, and an examination of internal controls affecting FAA's models.

Finally, to help us develop recommendations on corrective actions that FAA should take, we convened a panel of consultants in July 1987—midway through the completion of our field work. The panel, representing various backgrounds in the areas of aviation and work measurement, was convened to ensure that our analysis was not overlooking any important points. The fact that we carefully considered the panel's input does not necessarily mean that the members endorse our conclusions. (See app. III for a list of participating panelists.) In response to FAA's Office of Management Systems' informal comments, we have added a summary of the panel's views as appendix IV.

In conducting our field work, we examined data covering fiscal years 1986 and 1987. Our review was conducted from April to October 1987. We testified on the results of our work before the Subcommittee on Investigations and Oversight on November 18, 1987. At this hearing, FAA was asked to officially respond to our findings, and we have incorporated these views where appropriate in this report. In addition to the official agency comments contained in appendix V, FAA also provided informal comments on our report which have been incorporated where appropriate. This audit was conducted in accordance with generally accepted government auditing standards.

airport terminals. Each terminal's staffing is based on air traffic operations for the 183rd busiest traffic day (average day). FAA headquarters computes the average hourly staff needed based on the applicable regression formula for that terminal.

Center Standard

FAA's center staffing standard was developed by a contractor using an automated time and motion study approach. Controller and ATA tasks were identified, and then controllers performing these tasks were timed during different periods of the day using hand-held "event recorders." Certain activities deemed to be most significant to work load were used in developing the model's formulas. Annually, each center submits aircraft activity tapes for the 37th busiest day (90th percentile day) to FAA headquarters for use in generating staffing requirements. The computer model calculates staffing requirements (in 15-minute increments) for each center's sectors on the 90th percentile day. These sector requirements are then combined to reach total staffing for each center.

As with past FAA staffing standards, adjustments are made to the formulas in both standards to provide for noncontrol duties such as leave and training and reduced staffing coverage for weekends when there is less air traffic. In addition, other adjustments are made to the center standard for the number of shifts and for time spent by supervisors working as controllers. Finally, a separate allowance for a training pipeline is added to a facility's final staffing allocation. Table 2.1 shows the basic assumptions in FAA's terminal and center standards.

Table 2.1: Assumptions in Current Staffing Standards

Assumption	Center standard	Terminal standard
Work load	Total number of aircraft entering, leaving and passing through a sector and aircraft minutes per sector	Average hourly operations
Day measured	37th busiest day (90th percentile day)	183rd busiest day (Average day)
Growth	Facility specific air traffic forecast	Facility specific air traffic forecast
Available time	1,690 hours available for position less lunch + breaks = 1,373 hours productive time per controller	1,680 hours available for position less lunch + breaks = 1,365 hours productive time per controller
Workday	Up to a maximum of 8 shift start times per day	Up to 16 hours of operation with midnight shift staffing for 24 hour facilities
Training pipeline	9 percent	6 percent

Both headquarters and the field may be correct on the complexity issue. Standards developed by compiling work measurement data from many different locations, as was done for the center standard, tend to capture complexity but average it out. As a consequence, locations with very complex work loads can receive too little staff based on the standard.

Standards Do Not Adequately Reflect Changes to Work Load

Once FAA calculates historical controller work load, it factors into the standards estimated aviation traffic growth and anticipated future changes to work load. Using these estimates, it projects the work load, and hence the number of controllers needed, for each fiscal year. However, we found two problems with these projections: (1) FAA's recent aviation growth forecasts have been less accurate than past forecasts and (2) because, for budget purposes, work load estimates must be made months in advance, the resulting time lag can affect the estimates' accuracy. As a result, the standards do not adequately anticipate additional staffing needs resulting from growth and changes in work load.

- Aviation Growth Forecasts. In June 1987, the Secretary of Transportation announced that because of higher than projected traffic growth, FAA required additional controllers. FAA underestimated aviation growth in fiscal year 1987 by 3 percent and had to amend its 1988 budget request to reflect increased staffing needs of 400 controllers. Such inaccurate growth forecasts concern regional and facility officials, who fear that increasing air traffic at selected terminals will require more controllers than the standards' projections provide. For example, officials at the Phoenix TRACON, where growth was particularly rapid, were concerned that the need for controllers would outstrip the staffing standard's projections in less than a year.
- Budget Process Time Lag. FAA does not adjust its staffing projections to account for lag time in the budget process. Air traffic growth forecasts published in February are used in April to make staffing projections for the next budget year (current budget year plus one)—i.e., forecasts issued in February 1988 result in projected controller levels for fiscal year 1990 (Oct. 1, 1989, through Sept. 30, 1990). No provisions are made in the process for changes in work load during that time. For example, although nine new terminal control areas[1] were being planned in spring 1987, FAA's amended 1988 budget requested no additional controllers to handle the work load these new control areas created when they were approved in August 1987. Regional officials contend that because FAA's

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[1] A terminal control area is controlled airspace from the surface upward within which all aircraft are subject to operating rules, pilot rules, or equipment rules.

Table 2.2: Comparison of Average and Busy Day Air Traffic—1986

Facility	Average day	90th percentile day
Chicago O'Hare	3,038	3,363
Miami	1,804	2,006
Minneapolis	1,093	1,340
New York TRACON	4,497	5,396
Philadelphia	1,566	1,789
Phoenix TRACON	2,001	2,227
Salt Lake City	719	892

Note: Fiscal year 1986 traffic was used as the basis for fiscal year 1988 staffing projections.

- **Limitations to Time and Motion Study.** FAA used a time and motion study to develop its current center standard and plans to revise the terminal standard using the same methodology. Controller actions measured on a given day may not adequately reflect work load aberrations caused by weather, flow control, or other restrictions such as runway construction. Another air traffic branch in FAA headquarters attempted to use time and motion studies to help define work load in the past, but it discarded the results because of the difficulty of adequately accounting for factors such as weather conditions. It will be especially important that FAA field test the results of its new terminal standard to determine whether work load aberrations can be accommodated within projected staffing levels. (The issue of validating the staffing standards is discussed in more detail in ch. 3.)

- **Combined Sectors at Centers.** The center standard generates staffing requirements based on tapes of air traffic activity for a 90th percentile day. We found that because of staffing, some centers were unable to open all of their approved sectors on the 90th percentile day and had to combine adjacent sectors into a larger piece of airspace. According to headquarters officials, the model would generate additional staffing— six or seven controllers—for a combined sector to capture this work load. It is important that FAA's standards generate staffing that will allow facilities to operate as configured. If combining sectors limit the air traffic handled by a center, however, the model may not generate sufficient staffing. According to a Chicago Center official, the facility combined 4 of its 42 sectors because of inadequate staffing; as a result the standard generated 58 fewer people (350 versus 408) than would have been generated had the center been able to open all of its sectors.

managers who would, in turn, contact regional management if staffing-related problems arose.

Some Supervisors Are Not Working Control Positions as Required

After FAA's center standard generates staffing requirements, these figures are reduced to account for time spent by first-line supervisors working as controllers. However, we found evidence that first-line supervisors were not working as controllers as often as required and centers have not set up tracking systems to verify the extent to which supervisors spend time controlling air traffic. Moreover, while terminal supervisors are also required to spend time controlling air traffic, FAA has not reduced terminal staffing to account for this time.

FAA policy requires first-line supervisors to rotate through all positions on which they are certified each month and to spend at least 16 hours monthly, or 10 percent of their time, actually controlling traffic. According to FAA, this is done so that supervisors retain currency and a full appreciation of the controller's work environment. According to FAA headquarters officials, half of the 16 hours, or 8 hours per month, is factored into the center staffing standard. This adjustment results in a decrease of about two controllers for most centers.

Facility spot-checks and FAA headquarters evaluations have shown that not all first-line supervisors are spending the required time controlling air traffic. According to Minneapolis Center officials, a recent check of time spent by first-line supervisors working control positions showed a range from a low of 1.7 hours to a high of 28 hours in a 30-day period. A recent headquarters evaluation of Boston Center also reported that four of the six supervisors checked had not worked the required time.

We found that most centers had not established a tracking system to verify that first-line supervisors are actually controlling air traffic. Of the seven centers we visited, only one had established a tracking system for verifying when supervisors control air traffic. Miami Center stresses these requirements and has established a monthly tracking system to verify that supervisors and controllers detailed to staff positions are controlling air traffic at least 16 hours per month. In January 1988, Atlanta Center instituted a similar system.

Table 2.3: FPL Attrition at Sample Facilities

Figures in percent

Facility	Fiscal years	
	FY 1986	FY 1987
Center		
Atlanta	9.9	8.4
Boston	21.6	13.4
Chicago	5.2	6.5
Miami	18.4	21.5
Minneapolis	6	11.6
New York	22.4	21.9
Washington	9.6	10.2
Terminal		
Chicago O'Hare	11.1	21.3
Miami	5.6	22.7
Minneapolis	20	14.7
New York TRACON	14.5	10
Philadelphia	18.2	18.9
Phoenix Tower	21.4	42.9
Phoenix TRACON	12.9	11.4
Salt Lake City	36.8	22.7

FAA's pipeline also does not take into account the fact that facilities need additional developmental controllers to make up for FPL shortages. Field officials complained of this problem during the 1978 investigation by staff of the House Appropriations Committee. The current standards assume that work load is performed by fully qualified personnel and do not add staffing for facilities staffed below this FPL level.

Pipeline Does Not Adequately Reflect Anticipated Losses

FAA's pipeline is not future-oriented because it does not consider potential future losses from retirements or career progression. Several centers we visited had a large number of FPL controllers eligible for retirement at the end of 1987. Compounding this problem at the facilities we visited, we found that nationwide about one-third of area supervisors are eligible to retire. Vacancies in the supervisory ranks will be filled from FPL controllers, leaving new controller vacancies and a 2- to 3-year process before a trainee can become an FPL controller. Several regional and terminal managers told us that FAA does not adequately anticipate losses as controllers progress in their careers. According to Southern Region officials, the region prefers to send trainees to low activity terminals to

FAA's overhead order authorizes staffing without regard to a facility's traffic volume.

Little relationship exists between a facility's work load and its overhead staffing. Centers handling about 1 million operations per year (level II) receive approximately the same overhead staffing as those handling over 2 million operations (level III). FAA considers the figures provided in its orders as maximum staffing allocations, but it allows a facility to apply for an exemption for special needs. Table 2.4 is an example of the staffing limits for selected overhead positions at centers.

Table 2.4: Examples of Overhead Staffing Allowances for Centers

Position	Number of positions		
	Level I	Level II	Level III
Quality assurance specialist	2	3	3
Military operations specialist	2	2	3

FAA Plans to Revise Overhead Staffing Orders

FAA officials told us that the orders defining overhead staffing are being revised. According to a headquarters official, the current orders are simply a staffing guide based on "what someone, at some time, thought was reasonable." However, FAA's planned revisions to these orders address organizational changes at centers and terminals and will not address our concerns that facility overhead staffing should be better linked to relative work load.

Headquarters officials acknowledged that it may be necessary to review the orders to see what areas have changed and adjust staffing allowances accordingly. FAA has also adopted a recent GAO recommendation that FAA revise the definition of the controller work force to include those who are responsible for separating and controlling air traffic, including first-line supervisors and traffic management coordinators.[4] FAA should consider developing staffing requirements for these positions that are better linked to facility size and work load. In November 1987 testimony before the House Subcommittee on Investigations and Oversight, FAA's Administrator stated that FAA is developing staffing standards for supervisory and traffic management coordinators.

Headquarters officials also stated another problem—that FAA cannot obtain sufficient funding to cover all needed overhead positions. FAA had been reducing its overhead air traffic staffing until the fiscal year 1988

[4]GAO/RCED-88-14, October 23, 1987.

enough trainees to cover attrition. Actual attrition at terminals and centers has been significantly higher than FAA's pipeline allowance. To help correct this situation, we believe that FAA's pipeline formula should anticipate potential future losses from retirements and career progression.

Finally, FAA's overhead staffing allowances are not adequately linked to differences in facilities' work loads. While FAA plans to revise its orders on overhead staffing, more consideration should be given to the relative needs of facilities. In addition, reduced funding for overhead staffing has limited facility managers' flexibility to effectively manage operations and provide services.

Recommendations

We recommend that the Secretary of Transportation direct the Administrator, FAA, to:

- Revise the terminal and center staffing standards to better reflect actual field operations. (Specific options to capture complexity and work load are discussed in ch. 4.)
- Require field facilities to establish tracking systems to verify how frequently supervisors and other staff are working as controllers.
- Refine the controller pipeline formula to reflect both historical attrition and anticipated losses. For example, the pipeline allowance could (1) cover a percentage of either the budget year's or a future year's retirement-eligible controllers and (2) include additional positions for lower level terminals, which serve as training grounds for controllers who progress to higher level terminals.
- Base its overhead staffing requirements on operational needs and facility work load.

Agency Comments

The Department of Transportation said that FAA has recognized the need for accurate staffing standards and has expended a great deal of effort in this area. The Department said that FAA has an ongoing process of reviewing and revising standards as needed. FAA has recognized the shortfalls in existing standards and, anticipating needed changes in these standards, has requested authority to hire more controllers than the standards projected.

Transportation generally agreed with our recommendations and said it has intiated actions in most of these areas. However, it took exception to

Transportation agrees with our recommendation that field facilities should track how frequently supervisors and other staff work as controllers and will discuss this at the next meeting of regional air traffic managers.

According to Transportation, FAA has revised the training pipeline to reflect potential losses from retirements. We have reviewed FAA's new formula and believe that it still is not future-oriented and does not accurately capture attrition. Rather than calculate an attrition factor and then add an allowance for retirement eligibles, FAA only factored past retirees into its overall attrition.

What we are recommending is that FAA look ahead to the budget year or beyond. For example, FAA could determine from PMIS how many controllers and supervisors are eligible to retire in 1992; if about 25 percent of those eligible have historically retired, then FAA's allowance should provide sufficient trainees in earlier years to replace this 25 percent by 1992. Second, FAA has measured its attrition as a percentage of operational controllers rather than FPLs. In very few cases would a controller below the FPL level retire from FAA. Losses should be compared with the applicable work force from which they came. Third, FAA's formula assumes that 60 percent of GS-7 controllers and 70 percent of GS-9 controllers pass their training within 6 months. On an annual basis, FAA should monitor whether these assumptions vary from the percent and timing of actual attrition of GS-7's and GS-9's in the field. In the past, when FAA's pipeline formula was established, it was maintained unchanged for long periods without reexamination.

According to the Department, regions have the authority to assign training pipeline positions to lower level facilities if these facilities are viewed as steps in career progression. While regions have this authority, we believe they are unlikely to assign positions in this manner unless (1) sufficient pipeline positions are available that such distribution would not penalize other facilities in the region and (2) headquarters supports this concept of career progression or "seasoning" by also funding needed relocations as controllers move to other facilities.

Finally, Transportation states that FAA is reviewing staffing requirements for supervisors and traffic management coordinators. However, FAA believes that these staffing requirements have been based on appropriate work load factors, which are not necessarily the same as those for controllers. FAA's overhead staffing allowances do not adequately reflect operational needs because, while work load is initially a consideration,

Process Used to Determine Air Traffic Staffing Needs Revision

FAA headquarters uses the staffing standards to develop budget requests. For the past several years, the Congress has authorized additional staffing over what FAA has requested and what was projected by the standards because it believes FAA has underestimated its staffing requirements. These higher staffing levels have offset the impacts that staffing to the level of FAA's standards could have had in the field.

In addition to the standards understating the staffing needed to support the air traffic control system, other aspects of the process used to determine staffing needs are faulty:

- Standards currently in use have not been officially published in an FAA order, as required, and are not well communicated to officials in the field. Regional and facility managers do not understand the standards and are not using them for staffing or other internal management purposes.
- Regions and facility managers have developed their own formulas and processes for estimating staffing needs. The standards are not credible to the field and energy is being devoted to developing staffing requests that are not consistently based.
- Regular revalidation of the basic data in the staffing standards is needed to keep them current and accurate, but FAA has not updated them nor established a process to do so. Recognizing deficiencies in projections from its current terminal standard, FAA plans to redo this staffing standard over the next 2 years.

Congressional Actions Have Offset Impacts of Staffing Standards

Recent congressional actions have offset some of the problems that could have been created by FAA's controller staffing standards. As shown in table 3.1, in fiscal year 1987 the Congress authorized staffing for about 1,100 more positions than called for in the staffing standards. For fiscal year 1988, the Congress authorized over 1,200 additional positions.

We have reported in the past that the growth in air traffic activity has caused work load to reach a point where controllers are stretched too thin.[1] We believe that FAA would have experienced more serious impacts from reduced controller staffing levels if the Congress had not authorized additional staffing. Even at higher staffing levels, some facilities believe they are understaffed.

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[1] Aviation Safety: Serious Problems Concerning the Air Traffic Control Work Force, GAO/RCED-86-121, March 1986.

Staffing Process Established in FAA Orders Is Not Being Used

FAA headquarters stopped using its officially published staffing standards and process at the time of the 1981 controllers strike. It has implemented a new process and standards that were neither well communicated to the field nor officially published. This process no longer incorporates input directly from field facilities. Such input was eliminated as the staffing standard methodologies became more sophisticated, requiring mainframe computer applications.

FAA uses the staffing standards for budget planning but has not used them for other management purposes. In particular, FAA has not used the standards to project the impacts of modernization of the national airspace system.

Current Staffing Process Does Not Follow 1980 Order

FAA's 1983 staffing standards order calls for standards that are suitable for use in the agency's budget process and requires their publication in a separate FAA order. The last officially published staffing standards for air traffic personnel are contained in FAA Order 1380.33B, dated March 10, 1980. This order describes the process that is supposed to be used in developing annual budget estimates for air traffic staffing requirements. As detailed in the order, in October of each year, facilities submit prior year staffing and work load data to the regions. These data include work load and position staffing information. The regions review and verify the facility documentation and submit it to headquarters, along with data on regional staffing needs. In November, headquarters makes computer applications of the staffing standards to these work load data and generates staffing requirements for each facility. These requirements are then forwarded to the regions for use in developing annual budget estimates.

The process currently used, however, does not follow the procedures laid out in FAA's order. Instead of requesting data on staff needs at the facility level, headquarters requests that centers submit computer tapes of a 90th percentile day's traffic to be used in running the model. Terminal facilities routinely submit air traffic activity data through their respective regions to headquarters. However, facilities no longer provide assessments of their staffing needs directly to FAA headquarters.

The air traffic activity data for centers and terminals are fed into the headquarters computer model along with annual aviation forecast data. The resulting computer projection is the controller work force staffing for the budget year. FAA headquarters adds to this base number to provide a pipeline of trainees. These numbers represent the initial facility

Staffing Standards Underutilized as a Management Tool

We found that FAA headquarters was using the standards for resource allocation and in the budget process, but not for various other functions and activities that are specified in the 1983 order. This order cites several internal management processes for which staffing standards "can and should be used," such as assigning work, developing shift schedules, identifying the need for training or procedural changes, determining staffing impacts for proposed changes in programs, and planning for future staffing requirements.
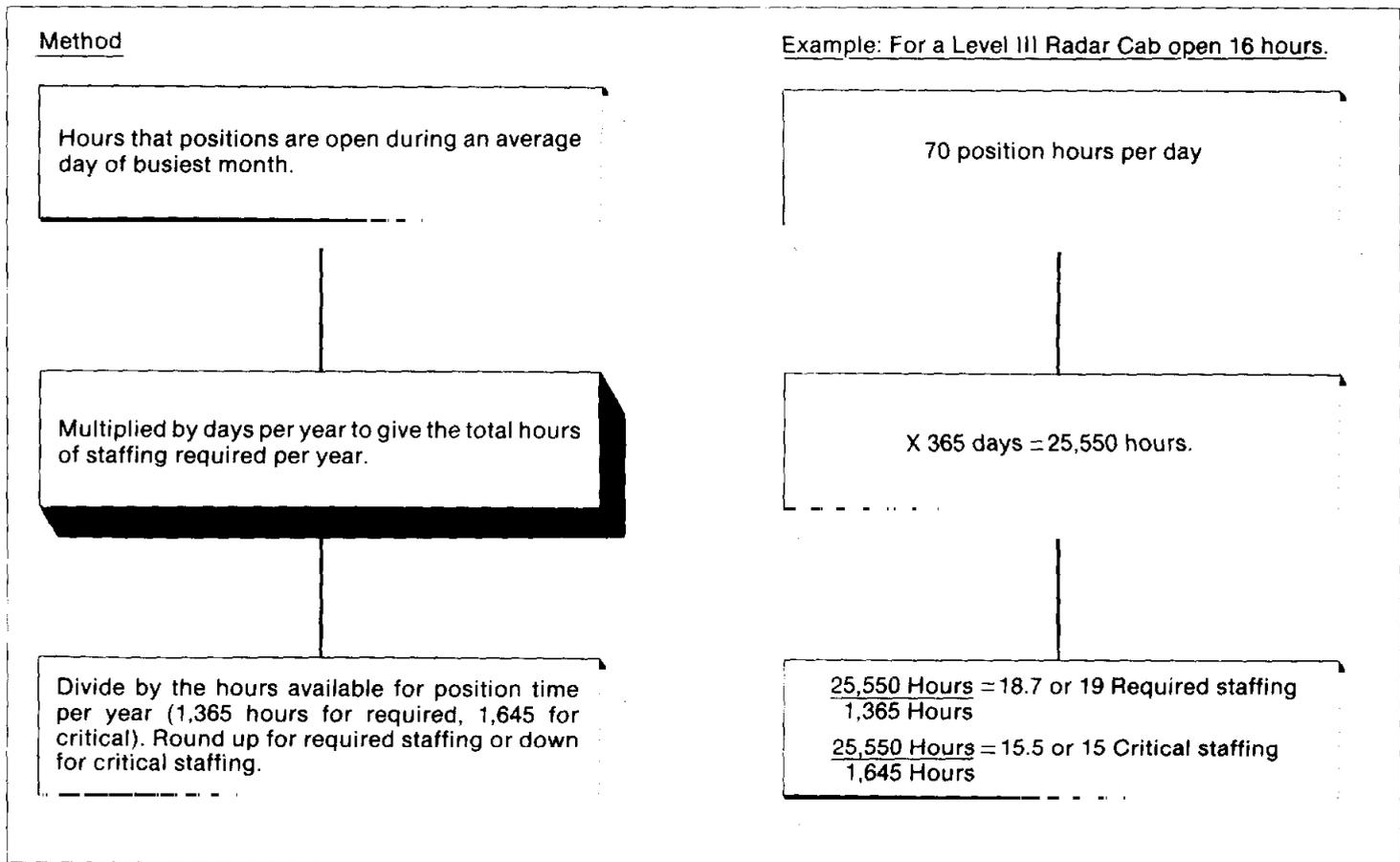
Most of the FAA managers at the regions and facilities we contacted did not understand the current standards. Therefore, they were not using them for other internal management processes. Headquarters officials acknowledge that facility managers do not have a complete understanding of the staffing standards and process, but they believe only a general understanding of them is needed. However, we found that even this basic understanding was lacking at the facilities we visited, given that several facility managers were not aware that FAA's standards had been revised since the air traffic controllers strike. FAA's Associate Administrator for Administration testified that while FAA has not done as good a job as it should have to let managers know what is in the staffing standards and how to use them, FAA plans to share more with them in the future.

Staffing Standards Not Used to Project Productivity Savings

This underutilization of the standards also applies to FAA's plan to modernize the national airspace system (NAS). FAA has not used its controller staffing standards to project productivity savings from the NAS Plan. According to the FAA contractor responsible for ensuring the integration of NAS Plan projects, given the unknown nature of future air traffic operations, FAA did not believe that its staffing standards could adequately reflect future operations. The NAS Plan assumes that modernization will double controller productivity by the year 2000; therefore, estimated staffing requirements were cut in half. However, delays in the NAS Plan's implementation will offset productivity savings for several years. For example, the next major system expected to produce significant savings is consolidated air traffic control (sector suites) which has been delayed to the late 1990s. Even though projections from FAA's staffing standards understate requirements, they exceed the staffing levels published in the NAS Plan. For example, the NAS Plan estimates total air traffic staffing of 17,850 in 1990 as compared with over 20,000 projected by the staffing standards. Thus, the NAS Plan significantly understates the staffing needed to operate the air traffic control system during its modernization.

to estimate staffing requirements. For example, the Western Pacific
Region developed a staffing methodology combining elements of both
the 1980 and 1985 standards. Facilities are required to submit estimated
staffing requests which, when totaled, become the basis for the region's
staffing request to headquarters. (See fig. 3.1.) The region also uses
these results to distribute final staffing allocations to individual facili-
ties. The region developed this process in response to facility managers'
complaints that their staffing allocations, based largely on FAA's staffing
standards, were inadequate to meet facilities' needs. In fiscal year 1988,
using this method, the region's staffing request was 7.5 percent greater
than the staffing standards' allocations.

Figure 3.1: Western Pacific Region's Staffing Method

Method

Hours that positions are open during an average day of busiest month.

Multiplied by days per year to give the total hours of staffing required per year.

Divide by the hours available for position time per year (1,365 hours for required, 1,645 for critical). Round up for required staffing or down for critical staffing.

Example: For a Level III Radar Cab open 16 hours.

70 position hours per day

X 365 days = 25,550 hours.

$\frac{25,550 \text{ Hours}}{1,365 \text{ Hours}}$ = 18.7 or 19 Required staffing

$\frac{25,550 \text{ Hours}}{1,645 \text{ Hours}}$ = 15.5 or 15 Critical staffing

In another example, the Eastern Region initiated a special team valida-
tion effort to support its controller staffing requests because the alloca-
tions headquarters was providing were not adequate to meet the

FAA headquarters officials said that the current standards have not been validated because (1) the air traffic control system has been in a "state of flux" since the 1981 strike with a large number of controllers in training, (2) headquarters is satisfied with the center standard, (3) the terminal standard was never finalized, and (4) of other budgetary priorities. We believe that these explanations do not justify FAA's delay in validating the standards. First, headquarters officials cannot state when for purposes of staffing, the system may stabilize. Second, FAA cannot afford to be complacent regarding any staffing standard since values in the standards can become outdated within a year. Third, although FAA considers the terminal standard to be in draft form, it has been used for budget purposes since fiscal year 1986. Finally, while contract support funding for the Office of Management Systems has declined, resources will always be limited and it is up to FAA management to determine what has priority.

Formal Feedback Seen as Unnecessary

Under FAA's 1983 order, regions are responsible for identifying the need for changes in the staffing standards through "formal feedback processes" or through evaluation of the standards' use and impact. FAA has not established a formal feedback process for these standards. However, headquarters officials told us that they continually receive informal feedback from the field regarding operational conditions. For fiscal year 1988, headquarters also solicited comments from the regions on its proposed staffing standard allocations for consideration in determining the final allocation. We believe that informal, ad hoc feedback on operational conditions is not an adequate substitute for the formal, regular input of facility managers regarding both the currency of the standards and the continuing validity of the assumptions on which the standards are based. Informal feedback does not ensure that all managers have an opportunity to voice their concerns. Moreover, without a formal feedback system headquarters cannot be held accountable for changing the standards to respond to field concerns.

Conclusions

Actions by the Congress to increase controller staffing have compensated for inadequate staffing projections from FAA's standards. Therefore, the field has experienced no direct impacts from the staffing standards.

FAA's current staffing standards are rarely used outside of FAA headquarters. Since the standards and process currently used have not been well communicated to the field, field managers who do not understand

FAA has also begun discussions on the best approach to provide training on the standards to field managers. The staffing standards development process will be part of a new videotape presentation. In addition, FAA is proposing that staffing standards be included as part of all management training. We commend FAA's efforts in this area and believe that such efforts could go a long way toward improving the field's understanding of the role and utility of staffing standards.

methodology may not accurately capture a facility's work load. And, as we have discussed, any adjustments headquarters makes after these measurements are taken should reflect field operations.

Rather than adopting this approach, FAA could adopt or begin to plan for other methodologies. One of these is dynamic simulation—computer simulation of the air traffic control environment at particular facilities. This methodology would most closely capture the actual work load and environment at facilities. However, FAA is in only the early stages of modeling the air traffic system. Increasing the use of dynamic simulation for controller training is one of the Administrator's priorities for 1988.

Another approach would be to measure the functions performed by controllers rather than the time spent on these activities. In preparing for modernization of the NAS, FAA has already contracted for such a study to determine national airspace system capacity. The consulting firm's report identifies discreet elements of a controller's job in terms of actions a controller performs. Software is being developed to use this methodology to identify controller performance limitations, that is, the maximum number of aircraft a controller should handle. An advantage of this methodology is that it takes each discreet function and builds staffing values sequentially. It would allow for staffing values to be modified as new equipment takes over functions formerly done by controllers. Although this report was contracted for another reason, its methodology would provide FAA with a vehicle to link both its staffing projections and its planning for modernization.

Incorporate a Complexity Factor Into the Standards

A controller's work load is best captured in the volume, density, and complexity of the aircraft handled. However, FAA's current standards do not specifically factor in the complexity of a facility's operation. Although FAA had discussed ways to approach this issue in 1984, no consensus was reached on how to incorporate complexity into the current standards. FAA believes that when the terminal standard is revised by doing a timed-motion study at TRACONs, complexity will be reflected in the standard.

FAA could specifically provide for complexity by adding a factor into its standards, similar to the adjustments now made for leave and supervisors controlling air traffic. This factor could be based on

used to monitor staffing requirements. FAA could also choose to adopt a special review process. At a minimum, FAA needs to adopt options that will provide both a feedback and a maintenance process for its standards.

Use Existing FAA Review Processes

Since the strike, FAA headquarters has been unwilling to accept facility managers' judgments of their staffing needs. In 1982, MUMCS criticized FAA's staffing as excessive, in part, because (1) staffing had been provided for positions that headquarters found were not actually used and (2) there was no process for identifying when to establish a sector. This situation changed in 1984 when FAA issued an order—the sectorization program—with criteria for the establishment of full-time sectors in centers. Centers submit air traffic data for regional and headquarters review to support each request that a new sector be established. This review now provides a method for headquarters to verify that center managers have submitted staffing requests that coincide with their authorized sectors. Although no similar program exists for terminals, regions also review the justifications for new operating positions at terminals.

Another ongoing program is FAA's facility evaluation program whereby headquarters and/or the regions visit each air traffic terminal and center at least every 2 years. These evaluations examine how well a facility is adhering to FAA orders and policies. By incorporating the staffing standards in an official order, these evaluation groups would be able to review a facility's work load and staffing submissions to verify that they have been reported accurately. These reviews could also identify staffing problems at facilities.

FAA also sends "tiger teams" to the field to review the operation of traffic management units. These teams could be requested to identify staffing problems that affect traffic management operations, such as the need for coordinators to work control positions because of leave coverage or other staffing requirements.

Initiate Special Staffing Reviews

FAA could also choose to initiate a special review process solely for the purpose of validating staffing requirements. The Eastern Region undertook such a special review in September 1986 to support its staffing request to headquarters. Teams of managers were sent to each terminal in the region to evaluate staffing needs. In several instances the teams'

and follow-through. Informal feedback is not a substitute for such a system because it does not provide FAA with sufficient information to judge the validity of its staffing standards and it does not make headquarters accountable for changing the standards. It also does not give field managers a sense of participation and ownership in staffing decisions. We believe that while informal communication is good, FAA needs to establish formal feedback mechanisms that would operate on a regular, periodic basis.

Formal feedback would also provide FAA with assessments of staffing impacts from changes in facility operations and would help indicate when revalidation of the standards is needed. Since the current staffing standards were developed, several procedural changes have been made that affect a controller's work load. Among these are requirements for debriefings upon leaving a control position, reidentification of aircraft entering a controller's airspace, and the implementation of more sophisticated and centralized monitoring of traffic to prevent sector overload. These procedural changes, as well as the introduction of some new equipment, should be reflected in headquarters' assessment of staffing requirements.

Establish a Regular Maintenance Program for the Staffing Standard

Although FAA's 1983 order requires that staffing standards be maintained and reviewed every 2 years, FAA has not established a review process for its controller standards. FAA's order also requires that standards be validated through field tests after their completion. When the center standard was completed in 1985, the contractor recommended that its time study data be updated annually through visits to at least three centers. These visits have not been made. According to FAA officials, funding for the maintenance of standards has been limited. FAA's contractor estimates that regular maintenance of the center standard would cost about $100,000 a year.

The absence of management attention to refinement and revalidation of the controller staffing standards was a problem first identified in a 1978 staff report to the House Appropriations Committee, and it continues to be a problem. Whatever standards are developed for the controller work force will require updating and review to preclude them from becoming outdated. We believe that as part of its reassessment of the staffing standard, FAA should also commit to regular, periodic reviews of these standards.

In 1970, FAA began using interim regression formulas pending the development of an engineered standard.

Air Traffic Staffing Standards System (FAA Order 1380.33)

Published in 1973, this was FAA's first engineered staffing standard for controllers. A sampling technique was used to measure controller work load on the 90th percentile day and the adjustment factor was increased from 1.58 to 1.6.

Center staffing was based on the following work load factors for the 90th percentile day:

- The type of sector—high or low altitude.
- The aircraft handled—the number of planes entering a sector during an hour period.
- The sector flight time—the average number of minutes an aircraft spent crossing a sector.

The standard's formulas resulted in sector staffing of between one and four controllers. A sector with four controllers became a candidate for resectoring. The center relief allowance factor was 20 percent.

Staffing for terminal radar facilities was based on a formula similar to centers—the number of arrivals and departures per hour and, in the more complex facilities, a calculation for average flight times per position. A 20-percent relief factor was included. The standard was revised in 1976 to include productivity gains from the introduction of new radar systems (ARTS III) at higher activity facilities.

Tower cabs were divided into eight categories, each with a specific formula that translated annual aircraft operations into staffing requirements. This standard did not provide a special relief factor.

1978 House Appropriations Committee Staff Report

The House Appropriations Committee's Surveys and Investigations Staff issued a March 3, 1978, report on FAA's air traffic staffing standard and determined there were significant deficiencies. The report stated that while the staffing standard methodology was conceptually sound, the standard lost credibility because it had not been revalidated in a timely manner. This report questioned the reasonableness of using the 37th busiest day to measure work load because of excess unused shift capacity for centers, which might be reduced by measuring a second peak hour of traffic.

radar positions on the day shift.) An additional half-person allowance was added as a support position and a 10-percent relief factor was established. Although this standard continued to use the 1.6 weekend and leave adjustment factor, staffing requirements were position based. No adjustment was made for facilities with lower weekend traffic.

Terminal cab staffing was based on a minimum number of "given" positions for different types and levels of facilities. Additional staffing was based on predetermined work load levels. No relief factor was applied for terminal cabs nor was a weekend adjustment factor used.

MUMCS criticized prior standards as attempts to justify existing staffing without considering the appropriateness of that staffing level. MUMCS asserted that staffing levels under previous standards were excessive due to political considerations and that the previous standards did not accurately reflect actual work load or manpower requirements. It also stated that previous standards were very complicated and not well understood by management and therefore had little credibility with managers. MUMCS also stated that previous standards could not be used to evaluate facilities, to develop reliable management information, or to make management decisions.

In spring 1983, the Office of the Secretary of Transportation, with input from OMB, criticized MUMCS for being based on operating positions instead of work load as earlier standards had been. In August 1983, FAA's Administrator approved the MUMCS center standard but requested that the terminal sections of the report be validated.

Consultant Panel Members

Name	Specialty
Raymond Belanger, former FAA Director, Air Traffic Service	Prior staffing
Commander Jimmy Calhoun, U.S. Navy	Military staffing
Gary Church, Aviation Management Associates	
Dr. William Collins, Manager, Human Resources Research Branch, Civil Aeromedical Institute, FAA	Controller stress
Dr. Irwin Lazarus, Senior Vice-President, Metter, Marks and Associates, Inc.	Work measurement
Donald Markwell, Assistant Manager for Airspace and Procedures, Chicago Center, FAA	Enroute centers
Russell Shedd, Manager, Syracuse Tower, FAA	Terminals
Earl Wolfe, Director, Air Traffic Control, American Airlines	Industry needs

Comments From the Department of Transportation

U.S. Department of Transportation

Assistant Secretary
for Administration

400 Seventh St., S.W.
Washington, D.C. 20590

APR - 1 1988

Mr. Kenneth M. Mead
Associate Director
Resources, Community, and Economic
  Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Mead:

Enclosed are two copies of the Department of Transportation's comments concerning the U.S. General Accounting Office draft report entitled, "FAA Staffing: Improvements Needed in Estimating Air Traffic Controller Requirements."

Thank you for the opportunity to review this report. If you have any questions concerning our reply, please call Bill Wood on 366-5145.

Sincerely,
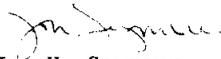
Jon H. Seymour

Enclosures

2

Recommendation 1: The FAA is in the process of revising the terminal staffing
standard to reflect the workload on the 90th percentile day of the year,
making it consistent with the center staffing standard. We plan to initiate
periodic updates of both standards beginning in fiscal year 1989, assuming the
enactment of sufficient funding to do so.

Capturing complexity of field operations, which is also included in this
recommendation, is an issue which the FAA is continually addressing. We are
somewhat hampered in responding to this issue as GAO has not made clear what
it would have us do in this area which we are not already doing. We have had
the participation of air traffic working groups providing technical input on
the relevant factors needed to develop standards and participating in the
design and development of the standards. These working groups have spent a
great deal of time discussing and researching the issue of complexity,
including what constitutes complexity, and how it should be factored into the
staffing standards. In each case, we have followed their guidance.

Recommendation 2: We agree with GAO that field facilities should be utilizing
a tracking system. This subject will be addressed at the next Air Traffic
Division Managers' Conference.

Recommendation 3: The FAA has already updated the training pipeline to
reflect losses based on retirement eligibility of the work force. We have
also included in this update an allowance for projected growth. If, as
reported by GAO, regional managers feel that lower level facilities should be
used as stepping stones to higher level facilities, they have the authority to
assign the training pipeline positions to those locations.

Recommendation 4: FAA is currently reviewing the staffing requirements for
supervisors and traffic management coordinators. GAO suggests that FAA has
not considered appropriate workload factors in assigning positions for other
than the controller work force. The implication is that for incremental
traffic increases, the staff positions should be increased along with the
controller positions. FAA believes that the staffing requirements in these
areas have been based on appropriate workload factors for those positions
(which are not necessarily the same as those for controllers).

Recommendations 5 and 6: We agree with GAO and will address the mechanisms of
a formal validation and feedback process at the next Air Traffic Division
Managers' Conference and will include them in appropriate directives.

Recommendation 7: We agree with GAO that FAA Order 1380.33B, Air Traffic
Staffing Standards Systems, dated March 10, 1980, should be updated. We plan
to issue a revised directive within the next year.

Recommendation 8: We agree with GAO that training on the staffing standards
process would be beneficial. We have begun the process of meeting with
regional resource management staffs to assure that they have an understanding
of the standards and to discuss the best approach for accomplishing the
training for field managers. We have submitted a proposal to the Center for
Management Development to have staffing standards included as part of all
management training. The subject will also be addressed at the next Air
Traffic Division Managers' Conference. Also, we are preparing a videotape for
presentation to facility managers on the staffing standards development
process.

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Enclosure

Department of Transportation Reply to

General Accounting Office Draft Report

Entitled: "FAA Staffing: Improvements Needed

in Estimating Air Traffic Controller Requirements"

The General Accounting Office (GAO) draft report states that staffing
standards are critical for the Federal Aviation Administration (FAA) to
determine how many controllers it needs. According to GAO, current standards
have not been validated and fall short of accurately reflecting FAA's
controller staffing needs, particularly for peak traffic periods and for
assuring an adequate training pipeline.

FAA has recognized the need for accurate staffing standards for critical
safety areas and has expended a great deal of effort in this area for the past
20 years. This is an ongoing process whereby standards are continually
reviewed and revised as needed. FAA recognized the need for updating the
standards in the terminal environment, along with the need to validate
workload measurements for centers and other field organizations. For that
reason, a contract has recently been awarded for $5 million for a 5-year
period to provide industrial engineering support for staffing standards
development and revision.

FAA has also recognized the shortfalls in existing standards which have been
cited by GAO. As it takes an extensive time period to complete a review of a
major work force and document new standards, FAA has anticipated the needed
changes by requesting budget authority to hire additional controllers beyond
what was projected by the standards for immediate needs.

GAO recommends that FAA: (1) revise the terminal and center staffing
standards to better reflect actual field operations; (2) require field
facilities to establish tracking systems to verify how frequently supervisors
and other staff are working as controllers; (3) refine the controller pipeline
formula to reflect both historical attrition and anticipated losses; (4) base
its overhead staffing requirements on operational needs and facility workload;
(5) establish and use a formal validation process to ensure that the standards
are accurate and current; (6) establish a formal feedback process for
communicating with facility managers to ensure adequate consideration of staff
needs for each facility; (7) update the 1980 order on air traffic staffing
standards to reflect the standards and process actually used by FAA; and
(8) train facility managers on the staffing standards and process and in ways
to use the standards to maximize resource utilization.

The Department generally agrees with the recommendations. We have already
initiated action in most of these areas. We do not agree with the
documentation provided by GAO to support these recommendations and believe
that they cast a negative light on the technical merits of the standards,
which is undeserved. Responses to the recommendations are listed below.
Detailed comments with regard to specific statements contained in the body of
the report will be informally provided to GAO under separate cover.

Consultant Panel Views on Selected Staffing Standard Issues

Current Standards	• FAA needs to define what level of service or operations it wishes to provide and staff facilities accordingly. Until FAA has determined this, standards are meaningless because they are measuring work load in an artificially constrained environment.
	• FAA should return to position-based staffing. Knowledge of the traffic patterns in a sector is what dictates staffing requirements.
	• The 90th percentile day may not provide sufficient staffing and should be examined relative to other days to determine where traffic patterns are and whether, because of less "peaks and valleys" during the day, more staffing is needed to accommodate both necessary and noncontrol work.
	• Complexity of different facilities' operations would be difficult to capture in the standards.
Pipeline	• FAA should "front-end load" staffing allocations—make a onetime adjustment to correct current staffing deficiencies, that is, take the numbers produced by the staffing standards and increase the allocation by some amount—10 to 15 percent. Increased staffing was seen as needed in the face of increased training and dual operations during air traffic system modernization.
	• FAA needs to ensure that staffing cuts are not taken until productivity gains from new systems have been realized. Pipeline allowance can be reduced and attrition can be used to reduce staffing when this occurs.
	• The Congress needs to be made more aware of the effects of the budget process on the controller pipeline.
Staffing Standards Process	• FAA's staffing allocations are a product of internal politics since no matter how accurately work load is estimated, how the standards are utilized is a policy decision.
	• FAA should return to a simpler, bottoms-up staffing standard. Facility managers and regions should have input to the budget process and update staffing forecasts.
	• FAA should project staffing for 3 to 6 years ahead.

Changes in Key Assumptions in the Standards

Assumption	1978	1982	1985
Center standard			
Activity day (90th percentile day)	Avg. 2 peak hours		Entire day
Number of sectors	721	559	N/A
People per sector	3	2.5	N/A
Adjustment factor	1.6	1.6	1.73
Shifts	3	3	8
Terminal standard			
Activity day	90th percentile day		Average day
Radar positions	696	579	N/A
People per position	2.5 Up to 6 cab positions	1.5 "Given" cab positions	N/A
Adjustment factor	1.6	1.6	1.74

Staffing Standards Study of Air Traffic Centers and Terminals

The Staffing Standards Study of Air Traffic Centers and Terminals was published in December 1978, approved by the FAA Administrator in March 1979, and incorporated into FAA Order 1380.33B in 1980. Its intent was to correct some of the deficiencies reported by the Appropriations Committee staff and to include productivity gains resulting from automation. After studying other busy days, FAA decided to retain the 90th percentile day, but it initiated the use of the average of 2 peak hours in determining shift work load. The standard continued to use the 1.6 adjustment factor and used a relief allowance of 20 percent.

Under this modified engineered standard, center work load factors remained the same as the previous standard—type of sector, aircraft handled, and sector flight time. However, it was determined that controllers could handle a greater work load due to automation; therefore, the maximum staffing for a sector was reduced to three controllers.

The standard eliminated the use of flight times from the terminal standard. Instead, staffing was based on the type of radar position and hourly aircraft volume. Annual operations were converted into cab work load units for tower cabs. The results were applied against a table that indicated positions for different types and levels of terminal facilities.

Manpower Utilization Management and Control System

Published in July 1982, this study was used as an interim staffing standard following the August 1981 controller strike. Designed as a quick fix for FAA's loss of over 11,000 controllers, it included a review and critique of prior FAA standards. The standard provided staffing for average system requirements and assumed that overtime would be used to cover traffic peaks, prime annual leave periods, and other special conditions.

Under MUMCS, the number of center sectors was reduced from 721 to 559 and staffed with two controllers each for the day and evening shifts. (Three controllers per center area were allowed for the midnight shift.) An additional half-person was added to cover the relief factor of 90 minutes allowed for each controller's lunch and breaks. (This 90 minutes approximately equalled the 20-percent relief factor allowed in earlier standards.) Staffing adjustments were made to reduce staffing at centers that experienced lower weekend traffic.

At TRACONs the number of radar positions was also reduced, with one controller provided per position during the day and evening shifts. (The midnight shift was staffed based on one radar position for every five

Description of FAA's Controller Staffing Standards

Table I.1: Chronology of FAA's Staffing Standards

Year	Title of Staffing Standard
1961	Airway Planning Standard Number Five
1973	Air Traffic Staffing Standards System
1978	Staffing Standards Study of Air Traffic Centers and Terminals
1982	Manpower Utilization Management and Control System
1985	Air Route Traffic Control Center Standards (Final) Terminal Staffing Standards (Draft)

Airway Planning Standard Number Five (APS-5)

APS-5 was the first formal air traffic staffing standard. It was published in November 1961. APS-5 assumed that ". . . almost all traffic control facilities must operate 24 hours daily throughout the year." Since controllers work a 40-hour work week, it recognized the need for an adjustment factor to staff a facility 7 days per week and still allow for annual and sick leave. To accomplish this, FAA multiplied the staffing from this standard by an adjustment factor of 1.58.

The 90th percentile day, which is the 37th busiest day of the year, was selected to represent a "busy day" of aircraft activity—"a day having a volume of traffic which is equal to or greater than the volume during 90% of the days of the year." APS-5 based the number of controllers needed for a facility and the maximum work load for a controller on the following indicators:

- Centers—aircraft handled.
- Nonradar terminal facilities—total operations.
- Radar terminal facilities—total instrument operations.

Center staffing was based on the expectation that a controller could handle a maximum of 80 aircraft per 8-hour shift and 15 aircraft during a peak hour. Terminal staffing was based on a minimum number of annual operations with additional staffing for higher levels of activity. This standard provided an unspecified time period for controller breaks and provided an additional 10 percent relief factor for radar operators to compensate for "stress and tension."

Under this standard, terminal radar facilities received a minimum staffing of 8 to 10 positions to handle 50,000 annual aircraft operations and additional staffing for levels in excess of 50,000. Tower cabs received a base level staffing of five positions per day to handle 25,000 annual operations with additional staffing for levels above 25,000 operations.

Conclusions

FAA needs to revise both its air traffic staffing standards and staffing process, and we have presented a number of ways that FAA could accomplish this. The options discussed in this chapter are not meant to be all-inclusive. They do, however, represent alternatives to FAA's plans to develop a new terminal standard without first revalidating the existing center standard. FAA needs to recognize that in adopting the time and motion methodology for both centers and terminals, it is proceeding with the most complex option—a methodology that will not be easy for the field to work with and will require continuous modifications as FAA moves to a modernized NAS. We believe that FAA has an opportunity now to improve relations with controllers by implementing a staffing process that recognizes the expertise of both field managers and work measurement experts. We believe it is FAA's responsibility to determine which options to implement, anticipating that FAA will work toward its goals of having high quality, accurate, and current standards. In addition, we believe that commitment should be made to standards that will continue to provide flexibility to regional management, be understood by field managers and others who must work with the standards, and be usable for the long term.

recommended staffing differed from the facility manager's request. According to the Eastern Region's Air Traffic Division Manager:

"The 'Team' process, using field managers as key members, proved to be a comprehensive and extremely creditable way to develop and validate our individual facility staffing needs. We recommend a similar approach be used whenever it is necessary to test the practical application of staffing standards at a field facility."

Another potential vehicle for doing special reviews of staffing is the Civil Aeromedical Institute (CAMI), an independent group within the Department of Transportation, which is already used to validate the air traffic screening program at the FAA Academy. Data on trainee attrition are already tracked, and according to a CAMI official, CAMI could monitor all attrition in order to periodically update training pipeline requirements.

Ensure Accountability Through Managers' Performance Appraisal Process

If headquarters is concerned that facility managers cannot be relied on to accurately portray their staffing requirements, there are checks in place to ensure the accuracy of this assessment. Under the Merit Pay program, FAA must annually review the performance of managers. Managers are to be evaluated on their use of agency standards in planning for future needs, and one of FAA's explicit performance objectives could be how well a manager applies the staffing standards to evaluate staffing requirements. In the words of one facility manager, "Headquarters should make managers show how they are using people for air traffic control. Accountability should be expected of facility managers." If such accountability were enforced, FAA could discipline or, if necessary, remove managers who do not accurately report their staffing needs. Conversely, FAA could reward managers who are accurate. Such a policy would serve as an incentive both to use the staffing standards and make realistic staffing estimates and would reinforce recognition of field managers' judgments. In its informal comments, FAA said that although this is a good concept, we have not described how the accuracy of field managers' assessments could be determined. During field facility evaluations described earlier, FAA could verify facility submissions against logs and traffic records.

Require Periodic Feedback From Facility Managers

FAA headquarters officials believe that they have sufficient informal communication with the field to understand the operational impacts of staffing. Feedback in a work measurement system involves several things: a credible reporting system, independent periodic evaluation,

- the types of services provided at an individual terminal, such as monitoring approaches to satellite airports;
- training requirements for specific facilities—for example, the number of instrument landing approaches and terminal control area procedures that a controller must master; or
- what functions a controller actually provides for each aircraft that is being handled, to distinguish between more complex traffic patterns, such as flights requiring special handling or the number of radar vectors provided.

A weighting scheme or scale could be developed to reflect these conditions. FAA officials believe that this would add more subjective judgments into the standards. We recognize the difficulty in accounting for complexity but believe that it is a vital component of a controller's job and, therefore, should be incorporated into the staffing standards.

Adopt Position-Based Staffing Formulas

Staffing for needed shift coverage on each operating position was the basis of some prior FAA standards and most closely reflects what a facility manager considers in evaluating staffing needs. In fiscal year 1987, two regions we reviewed had adopted this simpler approach to assessing staffing requirements. Both the Western Pacific and Eastern Regions developed formulas to reflect the number of operating positions at a facility and the shift coverage required to staff those positions.

FAA's 1980 air traffic order is a position-based standard. The Southern Region has been using this order since 1980, and facility managers we spoke with believe that the results of the order accurately depict staffing requirements. This order was used for the budget process for the year of the controller strike. It was an attempt to improve the accuracy and credibility of input data from field facilities. One of the biggest criticisms of this and prior FAA standards was that there was no validation process to ensure that managers were not inflating their staffing requests. As discussed in the next section, we believe that FAA could effectively address this problem.

Ways to Validate and Obtain Feedback on the Staffing Standards

FAA has continually redone its controller staffing standards rather than modifying one methodology or approach. We believe that FAA needs to develop ways to obtain feedback and revalidate one standard without starting over with a new methodology each time that problems with staffing projections are identified. Since the 1981 controllers strike, FAA has initiated several evaluation mechanisms that we believe could be

Options to Revise FAA's Controller Staffing Standards and Process

Our work has highlighted a number of problems with FAA's controller staffing standards and staffing process. This report has recommended that FAA (1) revise its staffing standards to make them more reflective of actual conditions in the field and (2) improve the staffing standards process. This chapter presents several options for FAA to consider in correcting deficiencies in its standards and in its current staffing standards process. These options are not mutually exclusive; more than one will need to be implemented to ensure that problems with the existing standards are corrected.

Goals for FAA's Staffing Standards

In considering the following options to revise its controller staffing standards, FAA should use several criteria in addition to its overall national objectives for staffing standards—to be "highest quality . . . accurate and current" standards, commensurate with costs. The options should provide flexibility to regional management; should result in standards that can be easily understood; and should involve a methodology that can be used for future years. Continually redoing staffing standards is a costly process because it costs money and because, in redoing its standards, FAA has not gained the support of the work force that its measures are reliable and credible. Further, FAA's current reassessment of the terminal standard will not produce a long-term standard. FAA officials have testified that modernization of the national airspace system will again require new standards, but we believe that methodologies are available which could capture technological changes with minimum revisions to the standards.

Options to Revise FAA's Controller Staffing Standards

FAA could employ a number of methods to make its controller staffing standards more reflective of actual field conditions. These methods range from adopting new work measurement techniques to returning to the use of the 1980 staffing standard.

Use Different Work Measurement Techniques

FAA plans to revise its terminal staffing standard using the timed-motion study methodology and the contractor who developed the center standard. This work is expected to be completed in 2 years at an estimated cost of $1 million. FAA expects to have a final standard in early spring 1990, to be used in the budget process for fiscal years 1991 and 1992. As discussed in chapter 2. this methodology will take timed measurements of controller performance at various terminals throughout the country. Depending on such variables as weather, traffic, and special needs, this

the controller staffing decisions made by headquarters use different methods to estimate their staffing needs. Moreover, the existing air traffic staffing standards order does not reflect the process or formulas actually used to estimate staffing needs.

FAA's controller staffing process is no longer as interactive as in the past because it no longer incorporates direct field facility input. This has contributed to inaccuracy in the standard's staffing projections as well as frustration on the part of field managers who do not feel as though they are participating in the staffing process. We believe that staffing should be justified on a consistent basis. Moreover, the field's use of different methods to estimate staffing needs and the overall credibility problem with the standards do not help to support a "team approach" to managing FAA's programs and activities as advocated by FAA's Administrator.

Finally, although required under FAA policy, FAA has not established a formal method to update and validate its air traffic staffing standards. Periodic review of these standards is needed to better capture changes in facilities' work environments and to ensure that the standards' projections are relevant and accurate. (Ch. 4 discusses several ways FAA could validate and obtain feedback on its staffing standards.)

Recommendations

FAA needs to improve the process that it uses to determine air traffic controller staffing requirements. To do this, we recommend that the Secretary of Transportation direct the Administrator, FAA, to

- establish and use a formal validation process to ensure that the standards are accurate and current,
- establish a formal feedback process for communicating with facility managers to ensure adequate consideration of staff needs for each facility,
- update the 1980 order on air traffic staffing standards to reflect the standards and process actually used by FAA, and
- train facility managers on the staffing standards and process and in ways to use the standards to maximize resource utilization.

Agency Comments

Transportation agrees with all of the recommendations in this chapter. The Department said that the issue of a formal validation and feedback process will be addressed at the next regional air traffic managers conference and incorporated into directives. FAA plans to update its 1980 order on the air traffic staffing standards within the next year.

region's needs. The region was particularly dissatisfied with the allocations for its terminal facilities. Teams were sent to each terminal in the region to validate managers' staffing requests and determine the region's staffing needs. The teams' work became the basis for both a regionally developed staffing formula and the Eastern Region's fiscal years 1987 and 1988 staffing requests.

Facilities' Input to Regions Based on Different Methods

The 15 facilities we visited use a variety of methods other than the staffing standards to assess their staffing needs. One facility manager uses part of the current FAA staffing standard, namely the adjustment factor, and the other 14 use different methods, including the 1980 standards or their own formulas. Managers use these alternative methods because they view the current staffing standards as unrelated to actual field operations, are not aware that standards exist, or do not know that FAA no longer uses the 1980 staffing standards.

Revalidation and Feedback Mechanisms for Controller Staffing Standards Have Not Been Established

According to FAA's 1983 order, staffing standards must be continuously maintained to ensure that they are current and accurate. A formal feedback process is also required. However, FAA has not revalidated the existing controller staffing standards, nor has it established a formal process to directly solicit facility manager feedback. Thus, the standards do not reflect current operational needs and conditions, as we discussed in chapter 2, and many facility managers view themselves as being left out of the decision-making process.

Review and Validation of the Standards Have Not Been a Priority

FAA's 1983 order requires that the Office of Management Systems review staffing standards at least every 2 years to consider whether changes in such things as procedures, program priorities, technology, or personnel mix have had an impact on the standards. It also requires that a new standard be field tested or validated. Such reviews have not been done. Headquarters officials acknowledge that they have not validated the basic assumptions in the standards, such as the allowances for controller training and leave and the work measurements used in the standards' formulas. The contractor who developed the 1985 center standard for FAA had recommended that it review and validate this standard each year by collecting new timed-motion data from three centers. New data, the contractor stated, would capture changes in the air traffic environment and make it easier to plan for the costs of maintaining the standards on a regular basis.

Regions and Field Facilities Use Various Methods in Assessing Staffing Requirements

Many facility managers view the staffing numbers generated by the standards as having little credibility or meaning in relation to their actual needs. In some cases, regions have devised their own methods for allocating resources to facilities. We found that none of the six regions we sampled was using the current staffing standards to assess staffing requirements. Moreover, only one region and its facilities were using the same method to estimate staffing needs. The method they used, however, was FAA's 1980 staffing standards.

Current Staffing Standards Lack Credibility in the Field

FAA's regions are responsible for using staffing standards as the basis for evaluating facility staffing requests and distributing available staff to field facilities. Headquarters expects the regions to use their expertise and knowledge of facility operations in conjunction with the staffing standards. However, five of the six regions in our sample are not satisfied with the staffing standards process because, in their view, the standards either lack credibility or do not fully reflect actual conditions.

The Eastern, Southern, and Western Pacific Regions maintain that the current staffing standards do not adequately reflect work load complexity. Great Lakes and Northwest Mountain Regions identified problems in understanding the staffing standards. Great Lakes regional officials stated that there are "no real staffing standards" because the basis for headquarters' staffing allocations could not be determined. A sharp contrast also exists between the views of headquarters and field facility officials on FAA's controller staffing standards, with headquarters officials describing the standards' staffing levels as "roughly right" while field managers we visited described them as inadequate.

Regions Use a Variety of Methods in Commenting on Headquarters Allocations

None of the six regions we contacted was using the current standards for staffing. One region was using the 1980 staffing standards and the other five were using their own processes.

The Southern Region and the facilities we visited in this region use the 1980 staffing standards to estimate staffing requirements because the region believes that these standards are credible and reflect actual staffing needs. Regional air traffic staff review and validate the facilities' annual staffing requests, by comparing air traffic activity data with information contained in the facility requests.

The five remaining regions—Eastern, Great Lakes, New England, Northwest Mountain, and Western Pacific—have devised alternative methods

staffing allocations that FAA headquarters provides to the regions for comment.

As discussed later in this chapter, the regions comment on headquarters' initial allocations using a variety of methods. Headquarters officials told us that regions suggest small changes to the allocations—"ones and twos"—to meet the special needs of individual facilities. Once an appropriation is passed and after considering regional comments, FAA headquarters provides final staffing allocations, which in many cases are again adjusted by the regions. To make these adjustments, regions must weigh the relative needs of their facilities and, in some cases, redistribute positions from one facility to another. We found that both the suggested and final regional changes were often much larger than headquarters stated. Table 3.2 illustrates the differences between the fiscal year 1987 staffing standard and final regional allocations for our sample facilities.

Table 3.2: Staffing Standard v. Final Fiscal Year 1987 Staffing Allocations for Sample Facilities

Facility	Staffing standard	Final allocation	Increase (decrease)
Centers			
Atlanta	458	410	(48)
Boston	254	307	53
Chicago	328	394	66
Miami	214	233	19
Minneapolis	258	235	(23)
New York	278	288	10
Washington	354	409	55
Terminals			
Chicago O'Hare	91	102	11
Miami	58	75	17
Minneapolis	49	52	3
New York TRACON	125	174	49
Philadelphia	54	56	2
Phoenix	64	65	1
Salt Lake City	39	43	4
Total	**2,624**	**2,843**	**219**

Table 3.1: Controller and ATA Staffing Levels

	Fiscal years			
	1987	**1987**	**1988**	**1989**
Authorized positions	15,000	15,225	15,900	16,800[a]
Budget request			15,805	(amended)
	•	15,000	15,225	(original)
Staffing standards	14,200	14,146	14,657	15,030

[a]1989 request is for controllers, supervisors, and traffic management coordinators.

Facility managers at both centers and terminals believed that they could handle existing air traffic even if they had only the number of controllers projected by the staffing standards. However, they could not operate in other respects as they do now without the additional controllers provided by the Congress. Had staffing not been increased, they predicted other impacts, such as the elimination of all controller training and denial of requests for annual leave. Lower staffing levels could also produce an even greater increase in overtime, reduced levels of service, increased flight delays, and deterioration in controller morale.

Staffing levels are having a negative effect in the field and may not be sufficient to meet staffing needs. FAA experienced a nationwide increase in overtime expenditures in fiscal year 1987 as compared with fiscal year 1986, because of increased overtime at terminals. Our field work also shows that FPL controllers are receiving less refresher training at field facilities than is provided for in FAA's staffing standards due, in part, to the need to use FPL controllers on the control floor. Moreover, according to facility managers at locations staffed above the standard, additional resources are still needed because FPL controller staffing is below optimum, overtime expenditures continue at high levels, and new work load is not factored into existing authorizations.

In recommending increased staffing, the Senate Appropriations Committee cited "substantial shortcomings" in FAA's system for determining its controller staffing requirements. In addition to the technical problems with the standards we discussed in chapter 2, the process for determining staffing has created other concerns.

FAA's orders then set limits on the number of positions a facility can have. For example, FAA is revising its allocation for traffic management coordinator positions to be based on the number of areas in a center plus positions for functions such as departure and arrival sequencing. This is an accurate reflection of work load for a traffic management unit. However, FAA's order states that no more than 20 coordinator positions are allowed. Without this restriction, a center with six areas of specialization would be entitled to 24 coordinators and a center with seven areas, such as Atlanta Center, would be entitled to 27 coordinators. In short, FAA has taken its work load based overhead staffing and imposed limitations which cause these allowances to understate work load.

our casting "a negative light on the technical merits of the standards, which is undeserved."

We believe, however, that our report reflects a number of technical problems with FAA's controller staffing standards. FAA's standards are made up of several elements which are interdependent. These elements are (1) measurements of existing work load, (2) projections of future work load, (3) shift coverage, and (4) allowances for noncontrol time. Because these factors are interdependent, a deficiency in any one element can have a corresponding effect on the accuracy of the other elements and the final results of the standards. For example, when FAA underestimated aviation growth in 1987 by only 3 percent, it affected work load projections in the standards. FAA needed a budget increase of 400 additional controller positions to meet its revised work load. Headquarters has not paid sufficient attention to all the elements in the standards and has not been as active as it should be in ensuring that the standards reflect changing work loads and in obtaining feedback on the accuracy of the standards. According to Transportation, FAA is making a $5-million investment in industrial engineering support for staffing standards development and revision. As stated in chapter 4, initially this considerable investment will be used to redo the terminal standard and will not address weaknesses in the center standard. FAA's center standard cannot readily capture the changes to a controller's functions that will occur because of FAA's modernization efforts. FAA's methodology will require new data collection (on-site measurements of controller actions) at a number of facilities and modifications each time that a new air traffic system is introduced.

In response to our specific recommendation that FAA revise the staffing standards to reflect actual field operations, Transportation states that FAA is revising the terminal standard and plans to initiate periodic updates of both standards beginning in fiscal year 1989. We believe such periodic updates are essential to maintain the credibility of FAA's standards. Transportation said that on the issue of complexity, we have not identified what FAA should do to improve the standards. We disagree. Chapter 4 identifies three ways that FAA could directly reflect or credit a facility's complexity by applying weights in the staffing standard formula for factors such as number of instrument landing approaches or existence of a terminal control area. We offer these options in chapter 4 for FAA's consideration and do not view it as our role to prescribe specifically which option FAA should pursue.

budget request in which the Secretary of Transportation requested 175 additional overhead positions. The Secretary stated that the key to successful operation of the air traffic control system is not just the addition of more controllers, but also the addition of on-site support staff such as supervisors and traffic management coordinators to manage the system.

Regions and field facilities we contacted believe that there is a shortage of overhead staffing. For instance, in fiscal year 1987, the Western Pacific Region requested 785 overhead positions but was allocated only 695 positions by FAA headquarters, 90 positions fewer than requested. According to a regional official, the situation is not expected to improve in fiscal year 1988. Facility managers were filling some positions on a temporary basis with controllers. For example, Miami Center had taken three controllers from the control floor and detailed them to unauthorized positions on its military operations staff, in order to provide adequate service to the military and not affect other users.

Conclusions

Current and accurate staffing standards are critical for estimating controller staffing needs. While they will never be precise measurements of staffing, FAA needs estimates that managers and controllers agree reasonably reflect needs. Reliable standards would also assist the Congress in determining the appropriate levels of funding for FAA to receive.

FAA's current staffing standards do not accurately reflect work load or actual field conditions. As a result, they often understate the staffing required for terminals and centers. FAA needs to reconcile the inconsistency between its standards and field conditions either by changing the standards' assumptions or changing the way that the field operates. Further, if FAA continues to assume that supervisors are working as controllers 8 hours per month and therefore reduces the number of controllers authorized to a facility, then (1) tracking systems should be in place to verify that supervisors are meeting this requirement and (2) this reduction should be applied equally to both terminals and centers. In our opinion, ensuring that supervisors can control air traffic also has implications beyond the staffing standards for air safety since supervisors would be expected to step in to assist in emergency situations. (Ch. 4 discusses a number of options FAA could consider in revising its staffing standards.)

FAA's controller pipeline does not fulfill its objective of having trained controllers available when FPL controllers leave. Rather, FAA replaces FPL controllers with developmental controllers because it has not provided

gain experience. However, these officials believe that the terminal standard does not recognize the need to maintain pipeline positions in low activity terminals to allow for merit promotion and retraining when controllers move from lower complexity to more difficult facilities. According to the Salt Lake City terminal manager, staffing allowances do not reflect the fact that Level IV terminals are stepping stones for controllers aspiring to move on to Level V terminals. This manager explained that the facility has a high, steady turnover rate and therefore relies heavily on the pipeline to keep its staffing levels high. The magnitude of current field training places significant demands on facilities. As of December 31, 1987, about 4,400 controllers were in some stage of field training. Some facility managers told us that managing training has become more difficult because of the large number of developmental controllers currently in the system. On-the-job training of these developmentals is labor-intensive because it requires either an FPL or, in some cases, a qualified developmental instructor to work with and monitor each trainee being checked out on a position.

FAA headquarters officials acknowledged that there are problems with the controller training pipeline and they plan to reexamine this formula. While little has been done to change FAA's pipeline calculation since 1980, FAA is currently working on a program that will enable it to look at historical gains and losses, using personnel system data.

Authorized Overhead Staffing Does Not Meet Operational Needs

FAA orders establish maximum limits for overhead positions, such as supervisors and quality assurance specialists, at terminals and centers. We found that these limits are not adequately linked to a facility's work load and thus may understate or overstate a facility's needs. Budget reductions have also caused a shortage of overhead staffing at field facilities. As a result, limited overhead staffing has affected facility managers' flexibility in effectively managing operations and providing services.

Facility Needs Differ From Staffing in FAA's Orders

Overhead staffing allowances established in FAA's orders exceed some facilities' needs and understate others because they do not provide resources linked to work load. For example, officials at two centers said that their traffic management operations would require less staff than the 20 traffic management coordinators called for in FAA's orders. On the other hand, a recent headquarters evaluation of the Atlanta Center pointed out the need for increased quality assurance staffing because of the center's heavy work load. The evaluation report also noted that

Pipeline Allowance Inadequate to Meet Staffing Requirements

After the staffing standard numbers are generated, FAA adds in an allowance for new or developmental controllers[3] at each facility; the allowance is called the training pipeline. The purposes of a pipeline are, first, to ensure that trained controllers are available when FPL controllers leave, and second, to provide additional FPL staffing to meet increasing work loads.

We found that FAA has underestimated its training pipeline needs because (1) actual facility attrition has been higher than the allowance, (2) the pipeline is not future-oriented and does not anticipate future losses from retirements or career progression, and (3) the pipeline does not take into account the fact that facilities need additional controllers to make up for FPL shortages. As a result, facilities are operating in a "high training, catch up" mode and have lost flexibility because experienced FPL controllers are being replaced by developmental controllers.

Actual Attrition Has Been Higher Than FAA's Pipeline Allowance

In order to fulfill the pipeline's purposes, sufficient controllers must be in training to replace attrition and handle growth. Moreover, because of the long training period to become an FPL controller and failures during training, FAA needs to ensure that it is hiring more than a one-to-one replacement ratio for attrition. FAA calculates its controller pipeline allowance based on past national attrition rates for FPL controllers plus attrition of trainees in the field. In fiscal year 1987, FAA added to each facility's allocation a controller staffing allowance of 6 percent for terminals and 9 percent for centers for a pipeline.

Recent attrition rates have been significantly higher than these allowances. At the facilities we visited, we found that the average fiscal year 1986 attrition rate for FPL controllers was 15 percent at terminals and 13 percent at centers. In 1987 this attrition rate averaged 17.5 percent for terminals and 13.1 percent for centers. Facilities then experienced additional losses of trainees. For example, in addition to losing 22 percent of its FPL controllers, Boston Center lost 9 of its 85 developmental controllers (10.6 percent) in fiscal year 1986. Table 2.3 shows FPL attrition for each of the facilities included in our review.

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[3]Developmental controllers include all persons undergoing initial screening and training at the FAA Academy as well as persons being trained at field facilities.

Staffing Standards Do Not Comport With Actual Field Conditions

Once controller and ATA staffing are calculated, FAA makes adjustments to staffing based on assumptions about field operating conditions. Our work shows that some assumptions in FAA's current models do not accurately reflect actual field conditions, particularly the assumptions that (1) centers work eight shifts per day and (2) less staffing is needed since center supervisors work control positions. This inconsistency between the models and the field's actual operating environment could be corrected by changing either the models' assumptions or the field's operations.

Assumption on Shifts Does Not Reflect Facilities' Schedules

To reduce the number of controllers needed to cover peak work load, FAA headquarters allocates center staffing according to an "optimal shift schedule" by assuming that centers use up to eight shift starting times per day. FAA believes that the use of such a shift schedule allows managers greater flexibility to tailor shifts to meet peak traffic periods using fewer controllers. Staffing spread over eight shifts generates the need for about 4 percent fewer controllers than staffing based on traditional three shifts. Because of shift overlap, fewer total controllers are needed to cover work load by the end of a day.

Most of the centers we visited worked less than eight shifts and therefore would require either more staff than provided by headquarters or increased overtime to handle peak traffic. For example, of the seven centers we visited, four generally operated with three shifts (Chicago, Minneapolis, New York, and Washington), one operated with four shifts (Boston), one with five shifts (Miami), and one with eight shifts (Atlanta).

Eight shifts may not be practical for all facilities. According to New York Center officials, three shifts matches staffing with the center's peak traffic periods. Because of commuting problems in the New York area, multiple shifts are more difficult to manage and have a "human resource" impact. According to the manager of the Washington Center, multiple shifts created problems in getting appropriate supervision and communication with controllers. Washington Center is planning to return to three or four standard shifts after experimenting with more shifts in some areas.

FAA headquarters has not explained to center managers that staffing allocations are based up to eight shifts. According to headquarters officials, only regional directors received a general briefing on the staffing standards. It was assumed that these data would be passed on to facility

staffing standards do not anticipate changes to work load, they produce inadequate staffing levels. According to a Northwest Mountain Region official, since the standards do not capture changes in the air traffic environment, the region must negotiate with headquarters to obtain needed resources in a timely manner.

Problems With Methodologies Used in FAA's Standards

While staffing standards cannot be exact work measurements, we have identified problem areas in FAA's current methodologies that FAA needs to recognize in revising its standards. These areas involve (1) the choice of traffic day to measure, (2) time and motion studies, and (3) use of combined sector data.

• Traffic Day Measured. Reacting to assessments that it was overstaffed for nonpeak periods, in 1985 FAA changed the activity day on which terminal staffing is based from the 37th busiest day of the year (90th percentile day) to the 183rd busiest day (average day). As shown in table 2.2, this change can represent a large difference in work load for some facilities. We found that using an average day understates staffing needs at most terminals because it (1) does not allow for staffing of coordinator positions[2] and (2) increases overtime usage. According to TRACON managers, although controllers generally work radar positions without a coordinator, coordinators are needed in order to reduce operational errors and handle increased levels of air traffic. Moreover, three of the seven terminal facilities we visited more than doubled their overtime usage in fiscal year 1987. Recognizing a problem with overtime expenditures nationwide, FAA plans to change its basis for terminal staffing from the average day of the year to the 90th percentile day when it revises the terminal standard.

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[2]These positions are important during peak traffic operations because these controllers handle the coordination that is required between controllers when control of an aircraft is transferred to adjoining airspace.

Staffing Standards Do Not Accurately Reflect Work Load

FAA's staffing standards estimate the number of controllers required to meet projected work load or air traffic. However, FAA's standards do not adequately account for the complexity of work load, especially for terminals, or planned changes to work load.

In addition, while staffing projections can never be exact, limitations to the current standards' methodologies may cause the standards to inaccurately reflect needs. As a result, FAA's standards understate actual staffing needs.

Complexity Has Not Been Adequately Captured in Standards

A controller's work load is based on three factors—the volume, density (number of aircraft handled at one time), and complexity of air traffic operations. We found that FAA's staffing standards may not adequately reflect complexity—what the aircraft being controlled are actually doing. For example, aircraft that are both climbing and descending in a controller's airspace create a more complex situation than if aircraft are maintaining a constant altitude.

FAA has not incorporated a specific complexity factor into either the terminal or center standard. FAA headquarters officials said that while the center standard does not have a specific complexity factor, complexity is captured in the standard's work measurements of different sectors and, therefore, is adequately reflected in the center standard. We could not verify this point, however, because headquarters was unable to identify which specific sectors were measured in developing the standard.

Field officials are not as confident as headquarters that complexity has been adequately addressed. Four of the six regions we contacted (Great Lakes, Northwest Mountain, Southern, and Western Pacific) believe that current staffing projections do not adequately reflect complexity. For example, in its comments on headquarters proposed fiscal year 1988 staffing, the Southern Region pointed out that the terminal standard does not consider the complexity of satellite airport operations or the heavy military activity that affects the Miami Terminal operation. Similarly, the Western Pacific Region pointed out that the biggest problem with FAA's current staffing standards is that they are based solely on the number of air traffic operations and thus cannot capture complexity of operations. According to the manager of Chicago's O'Hare Terminal, complexity caused by the high number of crossing runways at O'Hare airport was a major determinant of controller work load and needed to be factored into the standards.

Problems With FAA's Controller Staffing Standards and Overhead Staffing

FAA has developed models that produce controller estimates in two parts for each facility—a staffing standard allowance and a trainee allowance, or pipeline. These models may understate controller requirements for the following reasons:

- First, the staffing standard allowance does not fully capture the complexity of a controller's work load or changes to that work load. Lag times in the budget and aviation forecast processes also affect the accuracy of FAA's staffing estimates. In developing new standards, FAA needs to recognize problem areas in its current methodologies.
- Second, certain assumptions in the models do not reflect current operating conditions in the field. FAA has assumed that staffing can be reduced because centers operate with eight shift schedules and supervisors work as controllers at least 8 hours per month. We found that this is not always the case.
- Third, FAA has also underestimated the staffing needed to provide a training pipeline of controllers. We found that the allowances provided do not adequately factor in either actual attrition or potential future losses from retirements or career progression.

Finally, FAA uses orders rather than computer models to determine the number of personnel other than controllers and ATAs (overhead) that facilities need. These orders do not adequately account for differences in facility work load, which can affect staffing requirements. In addition, reduced funding for these positions has limited field managers' flexibility to provide services.

How FAA's Current Staffing Standards Were Developed

FAA's terminal and center staffing models produce requirements for FPL controllers and ATAs. In fiscal year 1987, FAA's standards projected the need for 7,392 controllers and ATAS at terminals and 6,754 at centers, for total controller and ATA staffing of 14,146. These estimates were projected in two parts—a staffing standard allowance and a pipeline allowance—for each facility.

Terminal Standard

The current terminal staffing standard was developed by FAA personnel using a form of work sampling adapted to the air traffic environment. Observations of controllers' work pace were taken at randomly selected times by controllers trained in the data collection process. Correlation analysis was used to establish five regression formulas relating employee-hours to air traffic operations for each of the five levels of

Table 1.1: Facilities Visited by GAO

Criteria	Center	Terminal
Staffing above standard	Chicago Miami	Chicago O'Hare Miami
Staffing at standard	Minneapolis New York	Phoenix[a] Philadelphia
Staffing below standard	Atlanta Washington	Salt Lake City Minneapolis
Other	Boston	New York TRACON

[a]Phoenix is a split terminal facility under different managers. We visited both the Phoenix TRACON and the Phoenix Tower.

We also visited FAA's regional headquarters in the Eastern, Great Lakes, New England, and Southern Regions to obtain regional officials' perspectives on the controller staffing process.

To help us identify problems with FAA's staffing standards, we examined the evolution of these standards and past criticisms of them raised by FAA, OMB, and staff of the House Appropriations Committee. We determined what aspects of and assumptions in the standards have changed over time and examined FAA's rationale for these changes. We reviewed available documentation on FAA's current standards. However, identification of the specific sectors that FAA's contractor studied in developing the current center standard and the results of the controller working groups who assisted in developing the current standards were no longer available from FAA.

To evaluate whether staffing projections from these standards are reasonable, we reviewed correspondence between headquarters and the regions on staffing requirements and discussed regional staffing needs with officials in all six regions. We also reviewed internal FAA evaluations of each facility we visited. At each field facility, we tried to determine (1) the basis for the facility's on-board and requested staffing and (2) what impacts staffing at the level of FAA's standard would have on operations. We analyzed data on each facility's work load and operations, planned changes to this work load, and, where data were available, evaluated operational errors. We collected data related to factors in the standards such as annual and sick leave usage as well as estimates of the time controllers spend away from the control floor on other duties. We reviewed a sample of training records for FPL controllers to determine how much refresher training is being received. We gathered 2 years of data on FPL controller attrition from such things as retirements, promotions, and relocations, as well as intrafacility transfers to staff positions. In addition, we obtained data on trainees who failed training

Current Controller Staffing Standards

The current controller staffing standards have resulted from changes to FAA's staffing approach since the 1981 controllers strike. Before the strike, FAA provided a staffing cushion to protect against "hard times." With the strike, FAA management decided that staffing before the strike was too high. In 1982, FAA shifted to providing a staffing level that would cover average system requirements. FAA accomplished this shift by reducing the number of sectors and terminal radar positions on which staffing was based. FAA then assumed that overtime would be used to cover traffic peaks, prime annual leave periods, and other special requirements.

In 1983, FAA's Administrator, responding to criticism from OMB and the Department of Transportation, requested that the terminal staffing standard be validated. This effort resulted in developing the current standards for centers and terminals (described in greater detail in ch. 2). A group of controllers and FAA's Office of Management Systems completed revising the terminal standard in July 1984. FAA published an initial version in fiscal year 1985 and a second in fiscal year 1986. The terminal standard is still in draft form.

During the spring of 1984, FAA contracted with a consulting firm to revalidate the center standard. A working group of controllers assisted in refining some of the standard's assumptions, particularly increasing the allowance for time spent on noncontrol duties. A new center standard was developed and published in September 1985 and is considered final.[6]

Certain key assumptions in these staffing standards have changed over time. Two significant changes have occurred. First, FAA no longer bases its controller staffing on operating positions. Rather, it has tied the standards to facility work load. Second, FAA changed the adjustment factor for these standards to better reflect nonposition time, such as training and meetings. (See app. II.)

Overhead Staffing at Air Traffic Facilities

FAA does not have a formal staffing standard to determine the number of overhead—staff and supervisory—positions needed at FAA air traffic control facilities. FAA uses two orders, one for centers (Order 1100.123C) and another for terminals (Order 1100.126E) to determine this staffing.

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[6]A 1986 standard that deals with lower activity centers is not covered in our report. This standard covers approximately 300 controllers and ATAs in level 1 centers (Alaska and Hawaii) as well as staffing for oceanic sectors.

Until October 1987, FAA defined the controller work force (CWF) as comprised of controllers and ATAs. In November, FAA adopted a GAO recommendation[5] to revise the definition of the controller work force to include only those personnel who actually control air traffic. As a result, first-line supervisors and traffic management coordinators, who are required to spend 10 percent of their time controlling air traffic, are now included in the definition of the CWF, while ATAs and students at the FAA Academy are excluded.

Background and History of FAA's Controller Staffing Standards

Since the 1960s, FAA has used formal standards to determine its staffing requirements for air traffic control facilities in response to executive branch and agency directives. These staffing standards have evolved over the years from relatively simple formulas to today's more sophisticated computer models.

The Role of Staffing Standards in Federal Programs

Staffing standards are mathematical models that measure the employee hours needed to perform a function and are used to determine the number of employees needed to perform a specific task. Although the term "standard" commonly connotes the idea of a rule or something uniform to be adhered to, staffing standards can be a series of formulas used as guidance. They express the time required by qualified personnel to perform a specific job, taking into account collateral activities and duties. Engineered staffing standards, which are developed by using accepted industrial engineering techniques, are considered to be the best type of staffing standards.

Both executive and FAA orders require the use of work measurement systems in maintaining a quality level of service. Executive Order 12552, dated February 25, 1986, established a governmentwide program "... to improve the quality, timeliness, and efficiency of services provided by the Federal government." To achieve productivity improvements, this order advocates the use of measurement systems and performance standards by government agencies. In addition, the Office of Management and Budget (OMB) has provided guidelines for the continued development and implementation of agency productivity improvement programs. The guidelines call for productivity measures that are ". . . straightforward, easy for managers and employees to understand, and

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[5]FAA Staffing: FAA's Definition of Its Controller Work Force Should Be Revised (GAO/RCED-88-14, October 23, 1987).

Figure 1.2: Center Control Positions

Data Controller

Radar Controller

Handoff Controller
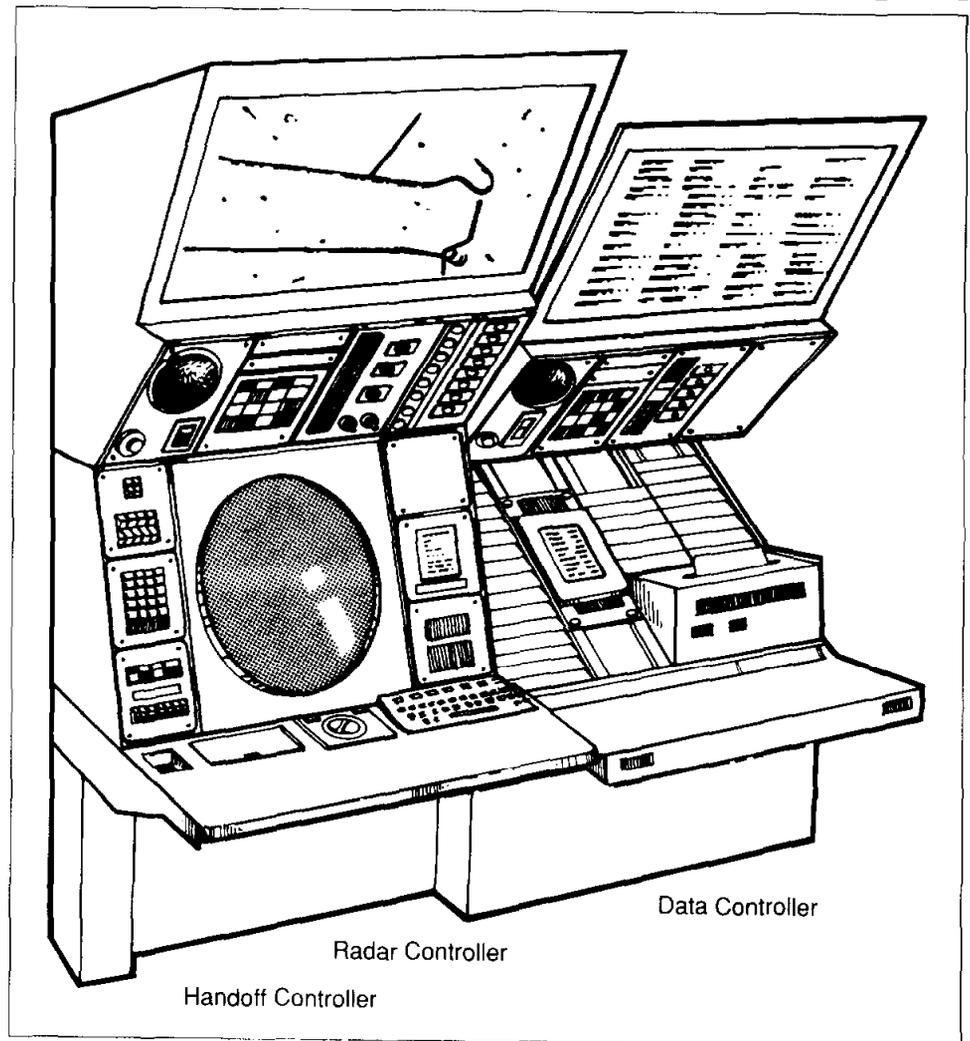
- Large air traffic facilities are staffed with air traffic assistants (ATAS) who assist controllers by handling flight progress strips.[4]
- First-line or area supervisors are responsible for supervising both controllers and ATAS.
- Traffic management coordinators staff the units responsible for monitoring the volume and flow of air traffic to a facility.

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[4]Flight progress strips are paper strips with flight plan data which must be moved to appropriate operating positions as an aircraft progresses in its flight. Prior to the August 1981 controller strike, these duties were performed by controllers.

Introduction

One of the Federal Aviation Administration's (FAA) primary missions is to provide a national aviation system that ensures the safe and efficient use of the nation's airspace. FAA establishes policies for the use of this airspace and provides a service—air traffic control—to promote the safe, orderly, and expeditious flow of air traffic.

Air traffic control specialists—controllers—are directly responsible for ensuring that aircraft are properly separated and that takeoffs and landings are as safe as possible. As of September 30, 1987, FAA employed 13,224 controllers,[1] about 47 percent of whom were involved in en route control and 53 percent in airport terminal control. This report examines how FAA determines the number of controllers it needs to operate the air traffic control system at centers and airport terminals.

The Environment of Air Traffic Control

The air traffic control system includes air route traffic control centers, control towers at airports, and flight service stations. Air route traffic control centers provide for control and separation of aircraft flying en route between destinations and over certain oceanic routes. A network of 20 centers is located in the contiguous United States with 2 smaller centers in Alaska and Hawaii. The principal function of control towers is to control aircraft within the area of one or more airports. Depending on the density and type of air traffic involved, a control tower may handle operations either for the airport at which it is located or for adjacent airports as well. Flight service stations provide pilots with pre-flight and in-flight information on weather and routes.[2]

Role of the Air Traffic Control Specialist

Air traffic controllers are the eyes and ears of the national airspace system. At both centers and airports, controllers use radar and computer surveillance to monitor air space. Controllers at airports also visually guide aircraft, as they depart and land and while they are on the ground, from the control tower cab—the glass-enclosed area at the top of the tower. Figure 1.1 shows how aircraft during flight can be controlled by a series of facilities and controllers within these facilities.

Several different operating positions exist within an air traffic control center and a tower. In a center, each sector (section of airspace) has

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[1] This number excludes students undergoing initial screening to be air traffic controllers at the FAA Academy in Oklahoma City

[2] Flight service stations, staffed by flight service station specialists, are not included in the scope of this report.

Abbreviations

APS-5	Airway Planning Standard Number Five
ATA	air traffic assistant
CAMI	Civil Aeromedical Institute
CWF	controller work force
FAA	Federal Aviation Administration
FPL	full performance level controller
GAO	General Accounting Office
MUMCS	Manpower Utilization Management and Control System
NAS	national airspace system
OMB	Office of Management and Budget
PMIS	Personnel Management Information System
RCED	Resources, Community, and Economic Development Division
TCA	terminal control areas
TRACON	terminal radar approach control

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allowances were not sufficient to cover actual attrition at the facilities GAO sampled: attrition was 15 percent for terminals and 13 percent for centers. Additionally, FAA's trainee allowance does not consider the time needed to train a full performance level controller or potential future losses such as retirements.

Standards Not Widely Used

FAA headquarters stopped using its officially published staffing standards and process at the time of the 1981 controllers strike. It has implemented a new process and standards that were neither well communicated to the field nor officially published. As a result, neither regions nor facility managers are using the current staffing standards to determine their staffing requirements. Of the 15 facilities that GAO visited, only 1 was using a portion of the current staffing standard to estimate its staffing needs; the other 14 used different methods. Several facilities were not aware that FAA had revised the staffing standards because FAA's air traffic staffing standard order has not been updated since 1980. Most facility managers did not view the standards' projections as adequate to meet their staffing needs.

In addition, periodic revalidation and updating of the standards has not been done as FAA policy requires. Rather, FAA has redone the standards each time that problems with its projections have been identified. FAA's inability to adopt and revise a single methodology has contributed to field managers' lack of understanding of, and confidence in, the standards.

Recommendations

To restore congressional confidence in its judgments about controller staffing, GAO recommends that FAA:

- Revise its staffing standards to more accurately reflect controller work load and field conditions. As part of this revision, FAA should refine the way it calculates its training pipeline to anticipate future losses from retirements and career progression.
- Develop a validation process, to ensure that its standards are accurate and current, and a formal feedback process that would provide a method for field needs and perspectives to be better incorporated into the staffing process.

GAO proposes several options through which FAA could revise its controller staffing standards and process and makes other recommendations in chapters 2 and 3.

Executive Summary

Purpose

Air traffic controllers provide a vital service to the nation's flying public by providing for the safe and expeditious flow of air traffic. At the request of the Chairman and Ranking Minority Member, Subcommittee on Investigations and Oversight, House Committee on Public Works and Transportation, GAO examined the standards that the Federal Aviation Administration (FAA) uses to determine the number of controllers needed to staff the nation's air traffic control terminals and enroute centers. Specifically, GAO examined

- whether the standards reasonably project staffing requirements and
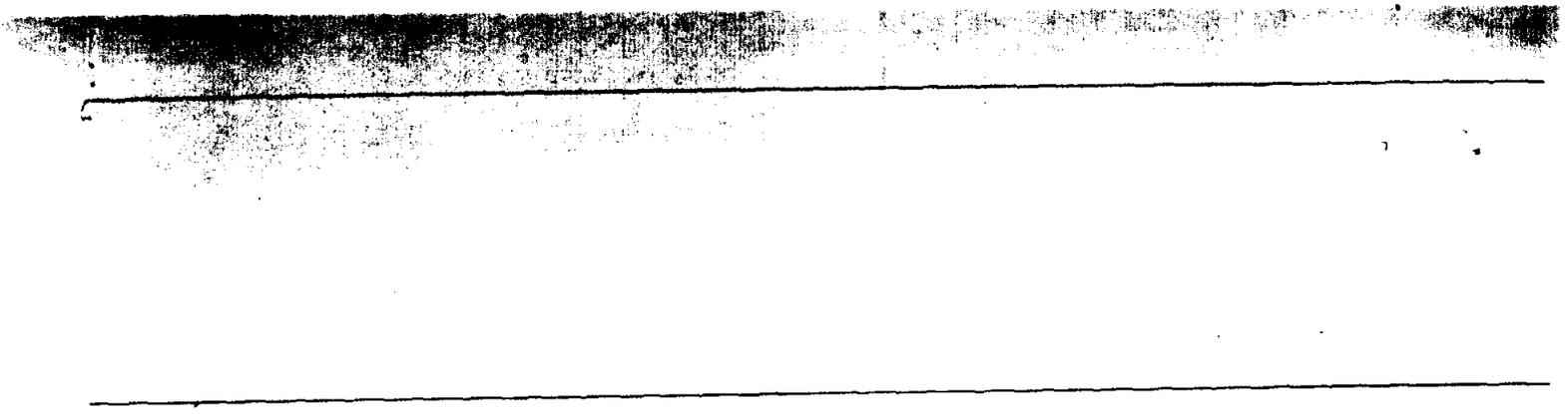- how the standards are used.

Background

Staffing standards are formulas or mathematical models used to determine the number of employees that are needed to perform a task. As such, FAA has established them as the basic method for determining and distributing employee resources. FAA has used staffing standards since 1961 to estimate its controller staffing requirements.

After the 1981 controllers strike, FAA adopted a staffing approach based on meeting average system requirements. This approach was a departure from previous staffing which was based on meeting peak work load. Under FAA's new approach, overtime is used to cover traffic peaks, popular annual leave periods, and other special needs. This approach is reflected in the current controller staffing standards which were developed in 1984 and 1985. Two separate standards have been developed—one for terminals and another for centers. These standards measure the historical work load of controllers at a facility and then project future staffing based on forecasted aviation growth, taking into account factors such as annual leave, breaks, and training time. In addition to calculating the staffing that is required to meet existing work load, FAA makes additional staffing allowances for controller trainees.

GAO's findings are based on work at 15 air traffic control facilities in 6 FAA regions.

Results in Brief

Staffing standards are critical for FAA to determine how many controllers it needs. Current standards have not been validated and fall short of accurately reflecting FAA's controller staffing needs, particularly for peak traffic periods and assuring an adequate training pipeline. Moreover, FAA's current standards are generally not used outside of FAA headquarters. Field managers have developed their own methods for