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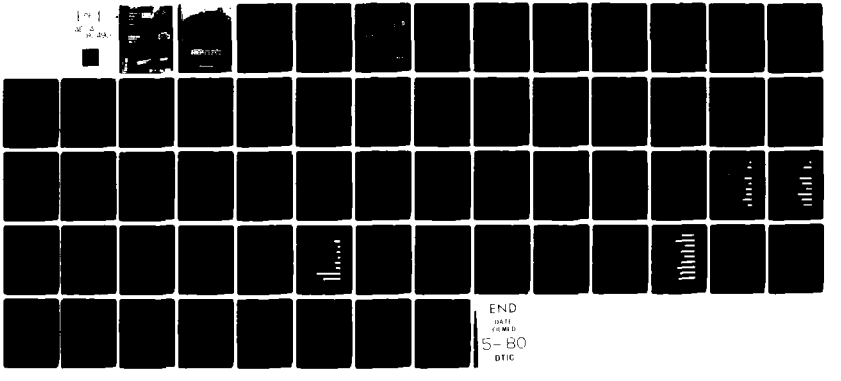

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An examination of the relation to efficiency of current Department of Defense (DoD) standards for Reserve Officer Training Corps (ROTC) detachments. This work, part of a larger study of ROTC management, was undertaken in response to a congressional request to the Office of the Secretary of Defense (Manpower, Reserve Affairs, and Logistics). After describing the current standards and the reasons for the request, the authors discuss measures of efficiency and show that the current standard fails to single out some inefficient units and discriminates against some that are efficient. Additional analyses lead the authors to the conclusion that criteria for detachment viability should deal with several measures of efficiency, rather than with a single measure, as does the current standard. They recommend that the military Services specify measures of ROTC participant quality and improve their ROTC management data in other ways. The note discusses further research that will be conducted for this study. (Author)

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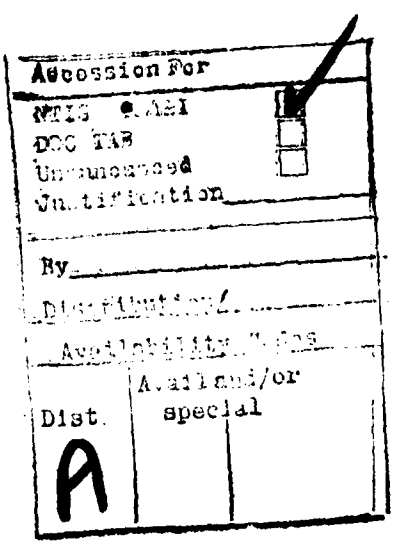
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PREFACE

This note was prepared as part of Rand's Defense Manpower Studies Program, a program sponsored by the Office of the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics)--OASD (MRA&L). This study was conducted under Task Order 79-I-3.

Because manpower issues are assuming ever greater importance in defense planning and budgeting, the purpose of this study program is to develop broad strategies and specific solutions for dealing with present and future defense manpower problems. This includes the development of new methodologies for examining broad classes of manpower problems, as well as specific problem-oriented research. It is hoped that this study program, in addition to providing analysis of current and future manpower issues, will contribute to a better general understanding of the manpower problems confronting the Department of Defense.

This note presents findings from the second phase of Rand research on ROTC management--examination of the current Department of Defense standards for viability of individual ROTC detachments.[1] The work reported here was undertaken to assist OASD (MRA&L) in responding to a Congressional request to propose an alternative to the present standard, which establishes the viability of an ROTC detachment solely on the basis of the numbers of officers it produces. The Congress

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[1] The first phase of the work is described in Carpenter-Huffman et al., 1979.

asked that the alternative more systematically take into account other detachment characteristics, such as cost and quality.

SUMMARY

We undertook the research reported in this note to assist the Office of the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics) [OASD (MRA&L)] in responding to a Congressional request to improve DoD standards for Reserve Officer Training Corps (ROTC) detachments. Current standards place detachments on probation when they fail to enroll specified minimum numbers of participants in the junior year of the program.[1] The Congress also requested that OASD improve procedures for disestablishing detachments that continuously fail to meet the standards. The improved standards and procedures are systematically to take account of criteria other than enrollment such as cost and quality. The request was motivated by the Services' reluctance to disestablish an appreciable number of detachments that have not met the current standards for more than one year and by the very small number of detachments subject to disestablishment with the current four-year probationary period.

Examination of the history of application of the current standards shows that the Services have used them selectively to disestablish units. Although legislation has been responsible for retention of several units that have failed the standards, criteria such as the quality of the participants or representation of students with special characteristics have accounted for the retention of other units failing

[1] These minimums are 17 for detachments offering a four-year program and 12 for detachments offering only a two-year program.

the standards. In fact, the current Department of Defense Directive dealing with this matter specifies that these other criteria may be considered in the decision to disestablish a unit failing the enrollment standard.

We have based our work on the presumption that the standard(s) and procedures should provide incentives for the Services to improve the efficiency of their ROTC programs. Thus, we began by defining measures that, taken together, would establish the efficiency of both individual detachments and the set of detachments that make up a Service's ROTC program. These measures fall into the categories of officer production, detachment (and program) cost, officer quality, and the mix of officer types (such as those in minority groups or with scientific or technical academic majors) produced by a set of detachments. At the outset, we asked each of the Services to supply us with data describing individual detachments in these terms for Academic Years (AY) 1972-1973 through AY 1977-1978.

One of our major findings concerns the Services' ability to respond to our request for data. Both the Air Force and the Navy gather large amounts of useful data; in fact, the Air Force has built a comprehensive computer data base covering several years of Air Force ROTC. But none of the Services gather data that would permit accurate assessment of student flows into and out of ROTC programs; such an assessment is needed to relate ROTC resources to officer production. In addition, the Services gather data describing the quality of only

those participants in the program who are on a scholarship or in the junior or senior year of the program. Finally, the Army does not estimate ROTC cost by detachment. Thus, our first recommendation is that each of the Services examine the desirability of collecting more complete data describing their programs and that the Army report ROTC cost by detachment.

At the time of publication of this note, we are still in the process of putting the data the Services have provided us into a form for analysis; hence this note reports work in progress, rather than completed research. Nevertheless, we have reached several conclusions from our work to date.

Probably the most important of these is that the current DoD standard is not an effective tool for ROTC management. As pointed out above, because of the grace period, it has placed very few detachments at risk.* More important, the standard fails to identify as candidates for disestablishment those detachments performing poorly on the basis of the quality of the participants or the cost of producing graduates. Worse, in some cases the standard discriminates against detachments with below average cost and above average quality.

We have also verified that cost and quality are positively related in all three Services; this implies that a standard based on cost alone would be detrimental to ROTC programs.

More generally, we have found that detachments that are similar with respect to one measure of efficiency may be quite disparate with respect to others. We conclude from this that attempts to improve

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*Despite this, the Air Force notes that it has closed 25 percent of the total AFROTC units since 1972 "for non-viable enrollments based on the DoD standard." The Army total has been reduced by 15 percent during a similar period.

program efficiency by basing a standard on a single measure would be misguided.

The most important question for further analysis is, What should the DoD standard be? At this point, we believe that any standard should take account of essential measures of ROTC efficiency--production, quality, cost, and diversity. How these measures should be combined and whether they should be applied at the detachment or program levels, or at both levels, are matters for further research. The specifics of how each component of efficiency (particularly quality and diversity) should be measured also requires further investigation.

ACKNOWLEDGMENTS

We express our appreciation to people in the Department of Defense and the military Services whose help made this work possible. Lieutenant Colonel William Scott and Major William Mason, Department of the Army, Commander William Bailes, Department of the Navy, Lieutenant Colonel Philip Purdom, Department of the Air Force, and Captain Burke Strickland, Air University, provided us with data and helped us to interpret them. Lieutenant Colonel David Hosley supplied advice and coordinated our efforts with those of the Services.

We are also indebted to our Rand colleagues, Richard Cooper and David Grissmer, who supplied valuable direction for our efforts; William Albright, whose earlier, unpublished work provided important insights; and Richard Fernandez and Glenn Gotz, whose critiques of the draft of this note were especially helpful. Many people helped us turn the data into analyzable form. We are especially indebted to Corazon Francisco, Mary Jo Parise, Jack Seinfeld, and Joanne Wuchitech for ensuring the successful execution of this difficult task.

CONTENTS

I. INTRODUCTION

During peacetime, the Reserve Officer Training Corps (ROTC) is a major source of new officers for each of the military Services but the Marine Corps. Therefore, the characteristics of officers obtained through ROTC programs determine the character of the officer force, to a large degree. In the current period of tight budgets, it is essential that the Services make the best use of their ROTC resources to obtain not only the number of officers they need but the quality and types of officers that will provide effective military leadership both now and in the future.

The research reported in this note has been undertaken to assist the Office of the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics) in preparing a directive that will ensure the efficiency of the Services' ROTC programs. We begin by describing the current directive (Department of Defense Directive Number 1215.8, May 1, 1974) and the application of the standards it sets forth. In Sec. III we describe measures of ROTC efficiency. Next we briefly mention previous research on the relation of the current DoD standard to measures of efficiency, and in Sec. V we describe our findings on this issue from analysis of recent data supplied by each of the three Services. The note concludes with a summary of our findings to date and a discussion of what we yet need to do.

II. REVIEW OF CURRENT DOD STANDARDS

In 1974, the Department of Defense established standards to encourage efficiency at the detachment level; these set the number of students that must be enrolled in an ROTC detachment in the junior year of the program. Detachments offering both two-year and four-year programs were to enroll at least 17 to 20 students; detachments offering only the two-year program were to enroll 12 to 15. The Service Secretary would set the minimum within the ranges specified. A detachment falling below the minimum would be allowed one school year of grace to increase enrollments. The directive specified that criteria other than enrollments, such as cost per officer produced, the quality of officer produced, the degree of support from the host institution, and the Service longevity of graduates from particular institutions could also be considered in the decision to disestablish a detachment. (Office of the Assistant Secretary of Defense, Manpower and Reserve Affairs, 1974, Sec. IV.C.7.)

In October 1975, about a year and a half after the directive was issued, third-year enrollments were still below the lower of the two minimums[1] in 150, or over 30 percent, of the 487 detachments fielded by the three Services with ROTC programs.[2] This did not lead to wholesale disestablishment of detachments, however, even though a

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[1] Although a range of minimums was specified in the directive, apparently only the lowest value has been applied.

[2] The Marine Corps obtains some officers through Naval ROTC.

number of detachments remained below the minimum for several years.

Figure 1 displays the percent of current Air Force detachments that have been below the minimum since Academic Year 1974-1975. The data are disaggregated by the number of years for which the detachment has been below the minimum. Since 1974, 80, or over half, of the current detachments have fallen below the minimum at least once. Of these, over 20 percent have done so for three out of the five years! Since 1974, the Air Force has disestablished 27 units that have fallen below the standard at least once. Thus, it is apparent that the Air Force has applied the directive selectively to disestablish units; the other Services have followed the same path.

The House Appropriations Committee became concerned about this shortly after the directive was issued. The Army had the biggest problem and was granted time to turn large enrollments in the freshman and sophomore years into the required number of juniors. By 1976, the patience of some was wearing thin:

> We have 31 Army units that for 5 consecutive years have not produced 15 graduates. We have one Navy and six Air Force units in that category. The numbers of units not hitting 15 in any 1 year during that past 5 years is a high percent of the ROTC detachments.

The speaker went on to suggest that since the cost of an Officer Candidate School graduate is about one-tenth the cost of an ROTC graduate, unproductive ROTC units would have to be eliminated. (Hearings of the Committee on Appropriations, House of Representatives, April 1976, p. 457.)

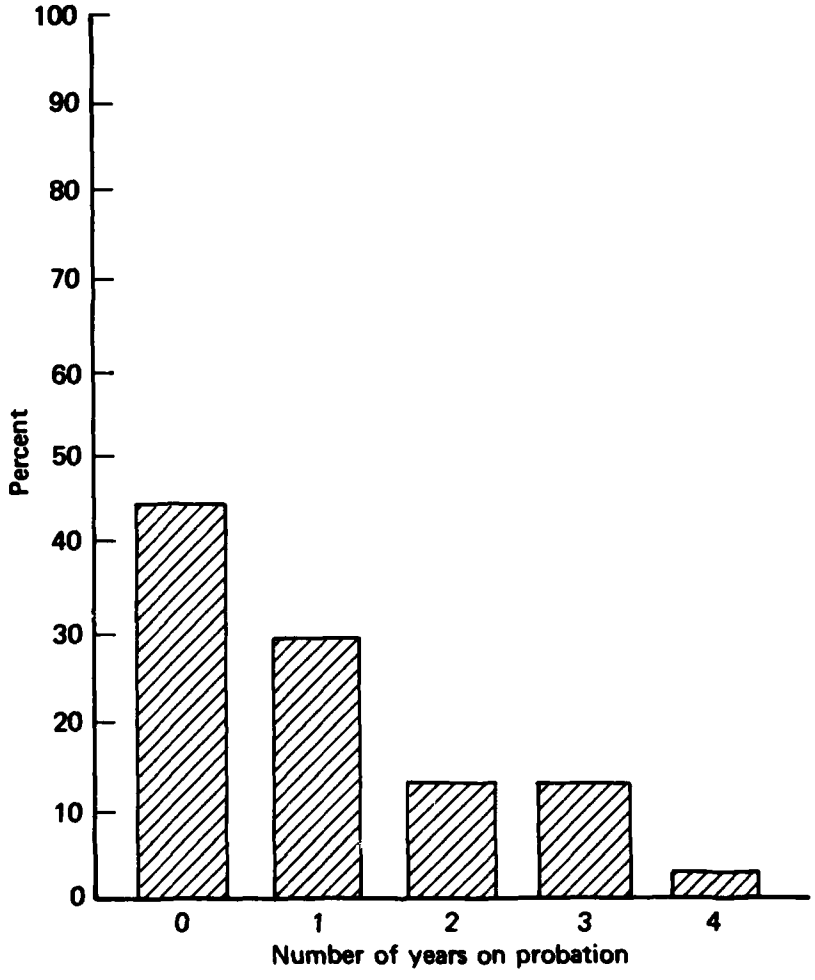

Fig. 1 — Percent of current Air Force ROTC detachments by number of years on probation since AY 1974-1975

In 1977, Section 855 was added to P.L. 95-111 prohibiting the expenditure of funds for any ROTC detachment that had failed to meet the enrollment standard for four successive academic years (except that at least one detachment was to be maintained in each state and at each state-operated maritime academy). Units in consortia are to be considered as a single unit under this provision. (U.S. Code Congressional and Administrative News, p. 91.)

The question arose again in 1978. This time, the House reduced from four to three the number of years that an ROTC unit could be below the standard, but:

> The Senate deleted this section because the provision relies solely on enrollment as a guide to closing ROTC detachments without considering other factors. ... The conferees agreed that enrollment criterion should not be the only factor in evaluating an ROTC detachment.

They cited the other criteria mentioned in the present directive and went on to say that:

> While these criteria may have been considered in the past by the Department of Defense, ... a more systematic and objective set of factors should be drawn up by the Department to evaluate the performance and cost effectiveness of ROTC detachments. (Amendment No. 75, Conference Report on H. R. 13635, p. H 12400.)

III. MEASURES OF ROTC EFFICIENCY

The foregoing underscores Congressional concern with ROTC detachment efficiency. ROTC efficiency may be considered at several levels. Efficient detachments are those that produce sufficient numbers of officers with the characteristics desired to meet Service needs, at reasonable cost. Efficient ROTC programs are those whose detachments, taken together, have these characteristics and which, in addition, fulfill the Services' needs for total production and for program diversity with regard to representation of special groups such as minorities and women, geographic representation, provision of officers with needed professional skills, and the like. Finally, the efficiency of ROTC as an acquisition method is measured by its cost and effectiveness relative to those of other methods of acquisition of officers. At this point we are primarily concerned with detachment-level efficiency, since this is the level of current Congressional concern; a thorough analysis of policies applied at the detachment level must, however, address their effects on overall program efficiency.

Throughout the remainder of the discussion we shall deal with three factors that, taken together, describe detachment efficiency: production, cost, and quality. We shall also consider program diversity. We begin by discussing possible measures for each of these.

PRODUCTION

The measure of ROTC production most related to efficiency would seem to be the number of commissionees from each detachment. This measure, however, is not as directly related to resource expenditures as we would like because graduates of ROTC programs frequently are not commissioned immediately upon graduation. (They may still need to complete academic requirements, for example.)

The DoD directive sets standards for opening enrollment in the junior year of the ROTC program. In the past, attrition during the last two years of ROTC was low because enrollees in the third year were required to contract for military service. Therefore, third-year enrollment was a reasonable surrogate for production.

Closing enrollment of fourth-year ROTC students is another possible measure of production. Its advantage is that it takes account of attrition in the last two years of ROTC study. This measure does not, however, account for delays in commissioning. Later in this note we will use both fourth-year closing enrollment and third-year opening enrollment as production measures. Whenever we use the term "graduate," we will mean fourth-year closing enrollment.

COST

The best measure of cost would be that associated with the production of a particular group (or cohort) of officers. It would be the cost of the accumulation of resources expended to provide ROTC to each person in the group, which we term the "cohort cost," since it is generally accumulated by each person in the cohort as it passes

through the program. (We say "generally" because the cohort rarely passes through the program intact; some individuals leave the program and others enter it along the way.) The cohort cost is very different from the cost per graduate, which is usually calculated by dividing the detachment cost in a given year by the number of graduates in that year.

Although it is possible to estimate costs by cohort, such estimates cannot, at present, accurately capture expenditures because (1) existing data do not describe attrition from or additions to the cohort and (2) some important resources, such as staff time, cannot accurately be ascribed to particular cohorts. Nevertheless, over the long run, cohort costs should be used because they provide more precise information for management analysis.

Given current inadequacies in cohort costs, in the analysis below we shall use average cost per graduate, that is, the total detachment cost in one year divided by the "production" in that year (i.e., the closing enrollment in the fourth year of the program). An ultimate goal of our analysis is to find out what determines the cost per graduate for each detachment and each Service.

We have begun by examining for the Air Force and the Navy the relationships between total detachment cost and variables that should generate this cost. These variables are enrollments at the different program levels (freshman, sophomore, junior, and senior), the numbers of enrollees on scholarship at each level, and the average cost of tuition at the associated institution. Regression analysis shows that

these variables accounted for 94 percent of the variance in Navy ROTC detachment cost in Academic Year 1977-1978 and for 89 percent of the variance in Air Force ROTC detachment cost in Academic Year 1975-1976 (the latest year for which we have AFROTC cost data). Thus, expenditures at the detachment level in these years appear to have been geared largely to enrollments in various categories.

QUALITY

The quality of an ROTC detachment should be gauged by the quality of the officers it produces. In principle, officer quality should be composed of the quality of the individual chosen to participate in ROTC and the quality of the particular ROTC program that inculcates skills and attitudes needed in the officer force. A large body of research in higher education[1] has shown that the ability of an institution to select higher quality students in the first place dominates the contribution of the institution's program to graduate quality. This may hold for officer acquisition programs as well; eventually, we would like to examine this thesis for each of the Services. At this point, however, we shall assume that detachment quality is largely measured by the quality of those enrolled in the detachment.

Because the Services want officers with leadership potential, they seek students who have demonstrated above-average abilities in the past. For award of scholarships and selection of participants in the last two years of the program, the Services rely heavily on students' scores on academic achievement tests such as the Scholastic

[1] See, for example, Astin, 1968.

Aptitude Test (SAT) score or its equivalent. We should point out that the Services usually have academic achievement test scores only for scholarship students or students in the last two years of the program.

Measures that more accurately reflect Service needs may be found in students' scores on tests tailored to the interests of the particular Service, such as the Weighted Professional Officer Course Selection System (WPSS) of the Air Force, the CEB (Cadet Evaluation Battery) of the Army, or cadet ratings in summer camp. Most of these measures are positively correlated with such academic scores as the SAT. Each Service needs to specify the measures that best suit its purposes; the Air Force has chosen the WPSS as the primary measure of AFROTC quality.

Lacking measures of quality for all of the Services, we have relied on SAT scores in the analysis to follow. Where no measures of academic achievement were provided by the Service (as in the case for almost all of the Army program and for as much of the Air Force program as we were able to analyze up to this writing), we used as a measure of quality the median SAT score of all freshmen entering the university at which the detachment is located. Table 1 justifies this procedure, showing the correlations between university-wide measures of academic achievement and measures limited to persons in ROTC detachments at those universities. The sources of data are noted on the table.

The table shows that in every case the correlations between university-wide and detachment-limited measures of academic achievement are quite high. The lowest is 0.77 between scores on the Officer Qualifying Composite for Air Force ROTC commissionees from 1968-1973 and the American College Testing program composite. This relatively

Table 1

CORRELATIONS BETWEEN MEASURES OF QUALITY (R)

	University-wide SAT[a]	Army Camp Ratings, 1976[b]		
		Military Skills	Job Performance	Physical Fitness
SAT, entering Army ROTC cadets, 1976[c]	.901	.601	.103 (N.S.[d])	-.140 (N.S.)
SAT, 4th year Army ROTC cadets, 1976[c]	.870	.577	.239	-.180 (N.S.)
SAT, entering Navy ROTC midshipmen, 1976[e]	.799	-	-	-
SAT, entering Navy ROTC midshipmen, 1977[e]	.879	-	-	-
OQT, commissionees Air Force ROTC, 1968-1973[f]	(.77)[f]	-	-	-

[a] Median SAT for entering freshmen; from College Board.

[b] Average ratings by detachment of cadets in summer camp, calendar year 1976.

[c] Averages for 97 detachments in first ROTC region.

[d] N.S.: Not statistically significant ($p > .05$).

[e] Average SAT by detachment.

[f] Includes only commissionees scoring above 55th percentile on the OQT. (Alley and Berberich, 1976, p. 12). Correlation is with Mean ACT (American College Testing program) score for all freshmen at the institution.

low correlation may arise from a section of the OQC (the Officer Biographical Data) that is not directly related to academic achievement.

Also shown on the table are correlations between various summer camp ratings for Army cadets and academic achievement test scores. Although some correlations are still good, most are, not surprisingly, appreciably lower than those between the academic achievement measures; one, physical fitness, seems to be negatively related to academic measures, although the relationship is not statistically significant. (Here, and throughout the remainder of the note, p must be less than .05 for significance.) This finding underscores the need for the Services to specify measures of quality that reflect their needs.

DIVERSITY

As noted previously, the Services need some officers with particular professional training, such as engineers or physicists, and strive to attain representation of minorities, women, and different regions of the country. Program-level measures of the success with which these goals are met are simply the percentages of officers produced in each category.

Table 2 (A, B, and C) displays detachment distributions for some of these categories of ROTC enrollees for recent years. The percentages of detachments whose black enrollments fall in various ranges are shown for the three Services in Table 2A. The data are for different academic years because of data insufficiencies. The Army, for example, does not gather data on black enrollments. As a surrogate, we used the percentages of black enrollments at the host institutions,

Table 2A

PERCENT OF DETACHMENTS WITH BLACK ENROLLMENTS, BY VARIOUS RANGES

Percent Black Enrollments	Army AY 1976-1977[a]	Navy AY 1977-1978	Air Force AY 1975-1976[b]
0-10	79	90	64
10-20	11	2	23
20-30	2	0	4
30-40	1	0	2
40-50	0	0	0
50-60	0	0	0
60-70	0	2	1
70-80	0	0	1
80-90	1	0	0
90-100	6	7	4
Average % black enrollment	11.4	10.0	12.4

[a]Data on black enrollments not available for Army ROTC detachments. Detachments categorized here by percent black enrollments for host institution.

[b]AY 1975-1976 selected because of completeness of data base at the time of writing.

which were not available for AY 1977-1978. Also, at the time of writing, our most complete file for the Air Force was for AY 1975-1976.

Despite these problems, the table shows similar patterns of black enrollments for each Service. About 90 percent of the detachments have less than 20 percent black enrollments; there are small clusters of detachments with high percentages of black enrollments; there are no detachments with black enrollments in the middle range (40 to 60 percent); and the average black enrollments for all of the Services are on the order of 10 to 12 percent. (We shall conduct further analysis of the relationship of black enrollments in ROTC to black enrollments in the host institution.)

Table 2B shows quite a different picture for female enrollments--different from that for black enrollments and different among the Services. Although most detachments enroll less than 40 percent females, nearly two-thirds of the Army detachments enroll between 20 and 40 percent; almost all Navy detachments enroll less than 10 percent and over three-quarters of Air Force detachments enroll less than 20 percent. The differences are reflected in the Services' overall averages of percentages of female enrollments, shown in the table.

Finally, Table 2C presents data on technically qualified Air Force cadets, that is, cadets pursuing academic majors in science or engineering or those who have completed a course in calculus, for AY 1975-1976, the only year with data on this subject currently available to us for analysis. As shown, over half of the Air Force detachments had enrollments of less than 20 percent of technically qualified

Table 2B

PERCENT OF DETACHMENTS WITH FEMALE ENROLLMENTS,
BY VARIOUS RANGES

Percent Female Enrollments	Army AY 1977-1978	Navy AY 1977-1978	Air Force AY 1975-1976
0-10	8	88	25
10-20	26	10	53
20-30	43	2	20
30-40	19	0	2
40-50	3	0	1
50-60	1	0	0
Average % female enrollment	24.0	5.8	14.2

Table 2C

AF DETACHMENTS WITH TECHNICALLY QUALIFIED ENROLLMENTS, BY VARIOUS RANGES (AY 1977-1978)

Percent Technically Qualified Enrollments	Percent of Detachments
0-10	8
10-20	20
20-30	30
30-40	22
40-50	13
50-60	3
60-70	2
70-80	1
80-90	1
Average % technically qualified	29.3

cadets in that year; the overall average for the Air Force was 20.4 percent.

A full analysis of the sources of ROTC program diversity and the relationships between enrollments in different categories, cost, and quality would be very complex. Therefore, we have not treated diversity further in the analysis that follows.

IV. PREVIOUS EXAMINATIONS OF THE RELATION OF THE DOD STANDARD TO ROTC EFFICIENCY

Next to the budget, the DoD standard is OSD's primary tool for affecting Service management of ROTC programs. Some people have made a strong case for the standard in its present form. They feel it is a useful device from a political point of view because it is clear to both the detachment commander and the university president when a detachment is marginally productive; no complicated cost figures or arguments about quality are needed. Moreover, the standard is flexible enough to be manipulated, to some extent, by addition of scholarships or increased recruiting efforts (or by their opposites, if a marginal detachment is not really wanted). The years of grace allow time for such measures to take effect.

But the history of application of the DoD directive demonstrates that the Service Secretaries have considered other detachment characteristics than enrollment (and, by implication, production) in deciding whether to disestablish a detachment. Although some of their decisions may have been influenced by political considerations, there are other factors at work. The secondary influences mentioned in the directive itself and by Congress in their request for a reappraisal of ROTC standards also play a prominent role. For example, Michigan Technological University, one of the three Air Force detachments that has been below the standard for four out of the five years since AY 1974-1975,

> is a distinguished ... middle-sized university of engineering and science ... It has the largest enrollment in Metallurgical Engineering in the United States and recently graduated more Civil Engineering students than any other university or college. (Barron's, 1978, p. 388.)

Detachment efficiency has been the subject of several research investigations. A series of studies at the Air Force Human Resources Laboratory developed criteria for the effectiveness of AFROTC detachments and examined relationships between the criteria and characteristics of the detachments and the institutions hosting them.[1] This work established that some characteristics of institutions that were positively related to detachment viability, e.g., total male enrollment, were negatively related to other measures of effectiveness such as student academic quality. The investigators noted that:

> By taking a course of action which may optimize performance in one area of concern, say expected enrollment and productivity, it is likely that unacceptable decrements in "program effectiveness" may result in other areas (i.e., input quality) unless there were some basis for considering both factors simultaneously. (Alley and Berberich, 1976.)

A 1976 memorandum from the Assistant Secretary of Defense, Manpower and Reserve Affairs, requested that the Services create a common methodology for costing ROTC units. In response, the Navy developed a computerized procedure for estimating cohort costs. In the memorandum reporting on this procedure, Barrow (1977a) found that both low cost and high cost detachments failed to meet the current DoD standard. He

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[1] See, for example, Alley and Berberich, August and December 1975 and 1976.

recommended that cohort cost per commission would be a better criterion of efficiency than the current one. He added, however, that quality and the kinds of officers produced should also be considered in any standard.

In another study, Barrow related cohort cost to promotion and retention of officers in the Navy. A preliminary analysis showed that cost per commission and the quality of the school were positively related. He concluded that:

> by and large the Navy gets what it pays for. At institutions with higher cost per commission, higher quality education is available. (Barrow, 1977b, p. 6.)

V. ANALYSIS OF THE RELATION OF THE DOD STANDARD TO CURRENT ROTC EFFICIENCY

In this section we discuss our examination of the ways in which the DoD standard is related to the efficiency of current ROTC programs. The analysis draws from data recently provided by the Services and entered into a comprehensive data base. Because complete and accurate data are essential for management of ROTC efficiency, we begin this section with a description of the data now available.

ROTC MANAGEMENT DATA

We mentioned some deficiencies in these data in the foregoing discussion. For a variety of reasons (among them, the ROTC program management structure, privacy issues, and the cost of obtaining data), none of the Services currently gathers all of the needed data in a form suitable for thorough analysis of program efficiency. For example, none has data describing the quality of participants other than those in the last two years of the program or on scholarship, and although the Army has gathered data on academic quality, it is not in readily accessible form. None of the Services routinely collects the data that would be required to determine the rates of attrition from the program, which would be needed to construct cohort costs. In fact, the Army does not now determine the cost of individual detachments; such data are essential for determination of detachment efficiency.

The inaccessibility and incompleteness of data have been major constraints on the completion of our analysis. Only the Air Force stores these data for computer retrieval; the Army and Navy data must be manually encoded from a variety of sources before computer analysis can be carried out. Because of the small number of detachments in the Navy program, this is not a difficult task. Processing of the Army data is considerably more time consuming, however, because of the large numbers of detachments and because there have been several changes in data formats over the period of concern.

We discuss Navy ROTC first because the Navy provided relatively complete data early in our work and we have been able to examine the program in some detail. The Air Force, whose program we discuss next, provided even more comprehensive data, but we received it too late to enter and verify more than a small portion of it. In the case of the Army (whose program is over one and one-half times larger than the Navy and Air Force programs combined) some essential data, particularly cost per detachment, were missing. Therefore, to carry out any analysis of the Army ROTC program, we have had to construct estimates of cost and quality.

We have concentrated our analysis to date on comparing ROTC detachments within individual Services, rather than making comparisons among the Services. In particular, we have not been able to analyze each Service's cost accounting system in the detail required to ascertain the comparability of cost data from one Service to another. Therefore, we present all costs in terms of the average cost of each

Service's graduate, where cost per graduate is, as above, the cost of a detachment in one year divided by the number of graduates from that detachment.

The discussion in the next three subsections follows the same order. First, we consider the relation of the current DoD standards to detachment cost. Next, we examine its relation to detachment quality. Finally, we graphically display the relation of the standard to quality and cost taken together. Because the analyses are, in most cases, confined to the most recently completed Academic Year, 1977-1978, we end each discussion by considering the consistency of these results from one academic year to the next.

NAVY ROTC

During Academic Year 1977-1978, the group of Navy ROTC detachments with enrollments below the DoD minimum, taken together, produced graduates at a lower average cost per graduate than did the group of detachments satisfying the criterion. The average cost per graduate of the group of detachments with less than 17 in the junior year of NROTC was 85 percent of the Navy-wide average as opposed to 104 percent for the group of detachments with at least 17 in the junior year. These results are not representative of the preceding years, however; for the preceding three years, average costs of detachments meeting the standard were below those for detachments failing to meet it. Therefore, we shall analyze the cost of Navy detachments for both Academic Years 1977-1978 and 1976-1977.

Figures 2A and 2B show for Academic Years 1976-1977 and 1977-1978 the average cost per graduate for groups of detachments whose opening enrollments in the junior year fell into different ranges. For AY 1976-1977, Fig. 2A suggests that there was a tendency for costs to decline as enrollments increased, not only for smaller detachments but for larger detachments as well. The average cost per graduate of the detachments falling in the highest range was only 59 percent of the overall average cost. Regression analysis verifies that this relationship is statistically significant.

Also shown in Fig. 2A are the standard deviations in average cost per graduate for detachments with enrollments in the different ranges. In general, the standard deviations are large enough that we may conclude that some schools fall below the average Navy cost per graduate in each enrollment range, regardless of the mean for the schools in that range.

Figure 2B for Academic Year 1977-1978 tells a similar story, except that in this year the negative correlation of cost per graduate with size of junior enrollment was not statistically significant. At this point, we cannot say whether AY 1976-1977 or AY 1977-1978 will be more representative of the distribution of future Navy costs with enrollment size. Whichever pattern prevails, however, the DoD standard will be deficient in at least two respects. First, several of the smaller detachments already fall well below the average cost per graduate; in fact, detachments with costs below the Navy average can be found for virtually every enrollment level.

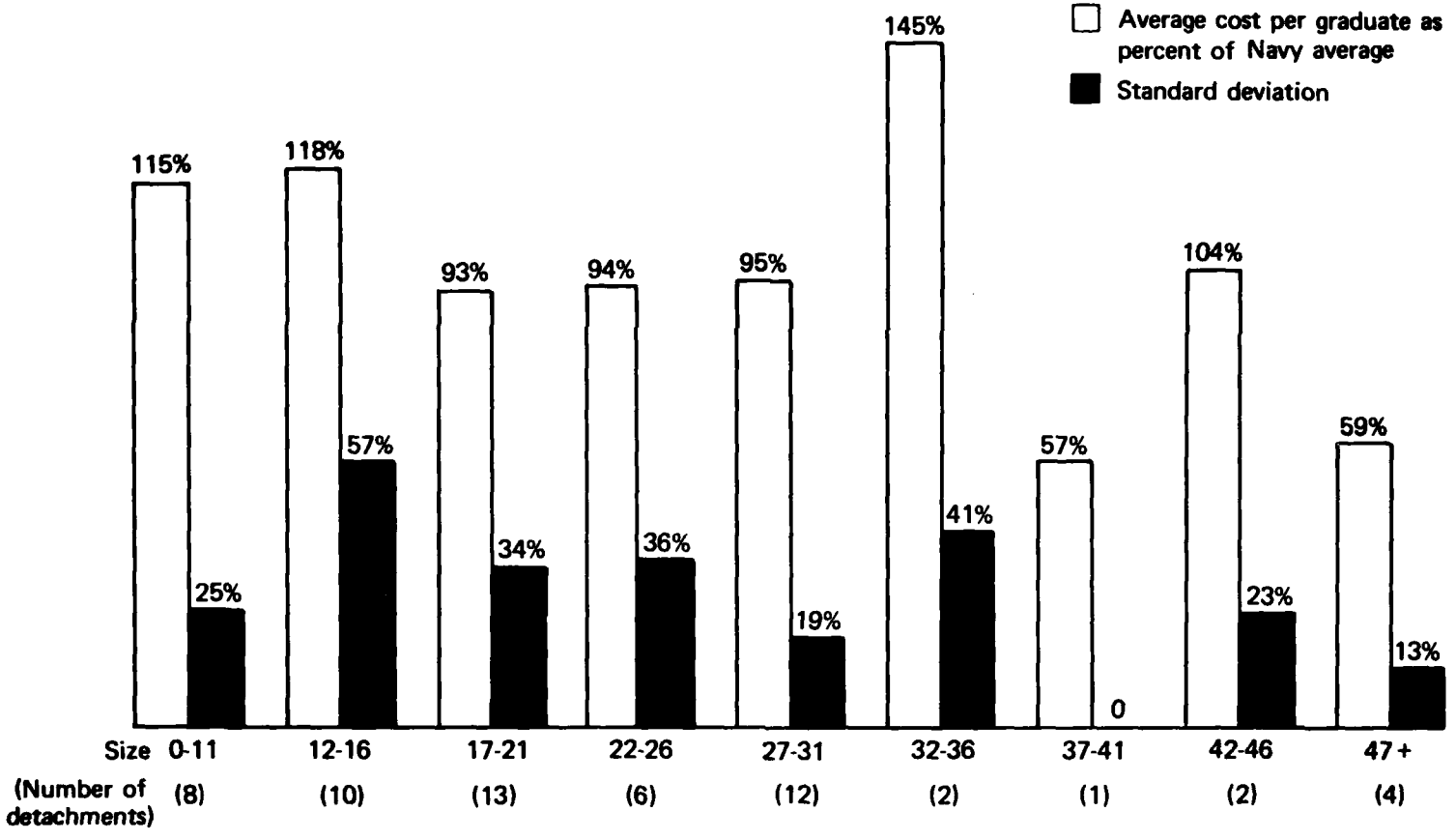

Fig. 2A — Relative average cost of a Navy ROTC graduate by size of third-year ROTC class (AY 1976-1977)

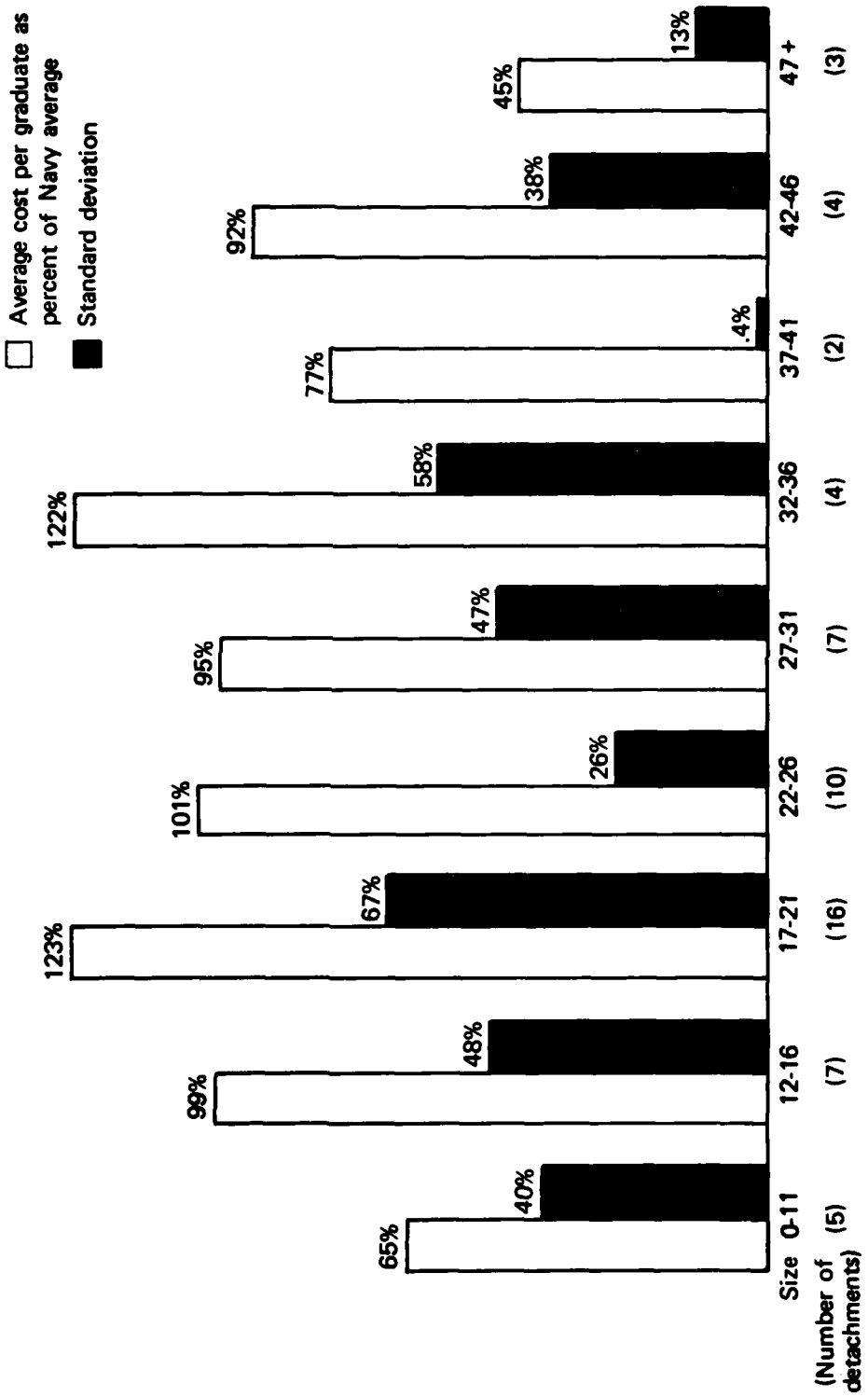

Fig. 2B — Relative cost of a Navy ROTC graduate by size of third-year ROTC class (AY 1977-1978)

Second, detachments at every enrollment level (not just at the smallest) may be able to reduce costs by increasing enrollments. The DoD standard, however, does not give incentives to ROTC managers to increase enrollments once the minimum level has been met.

We can examine the relationship between junior year enrollments and midshipmen's academic quality, as measured by SAT scores, in a similar manner.[1] The Navy provided us with the average SAT scores for midshipmen entering the freshman year of NROTC during Academic Year 1977-1978. Figure 3 shows these averages distributed by different ranges of junior year enrollments, as before. The overall mean for the Navy program was 1210 in this year. The figure suggests, and regression analysis confirms, that there is no evident relationship between enrollments and quality as measured by SAT scores.

A display of the joint relationship between cost and quality of NROTC detachments is the most revealing context in which to analyze the DoD standard. This is done in Fig. 4, which shows the relationship between cost per graduate and average academic quality for the Navy detachments in Academic Year 1977-1978. On the horizontal axis, SAT scores range from an average of 1010 to 1354. On the vertical axis, costs range from 29 percent to 305 percent of the Navy-wide average cost per graduate.[2] (The same detachments account for both

[1] We present the combined verbal and math scores rather than percentile equivalents because we do not have a table for conversion to percentiles at hand. In 1978 the Educational Testing Service informed us that a combined score of 1000, 1100, 1200, and 1300 represented the 67th, 81st, 91st, and 97th percentiles, respectively.

[2] Two detachments that seem to be in the process of being disestablished have been omitted from the figure.

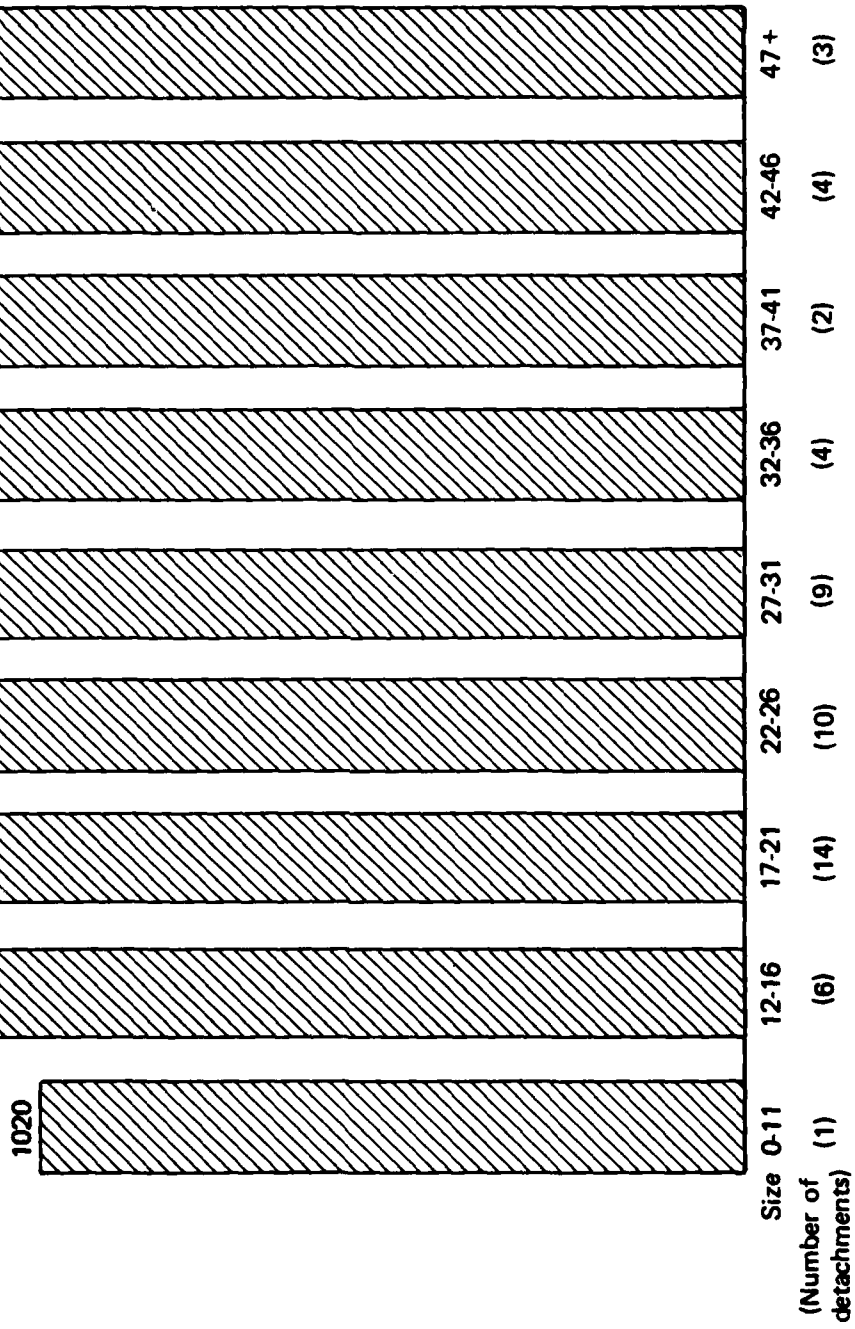

Fig. 3 — Average SAT scores of Navy freshman midshipmen by size of third-year ROTC class (AY 1977-1978)

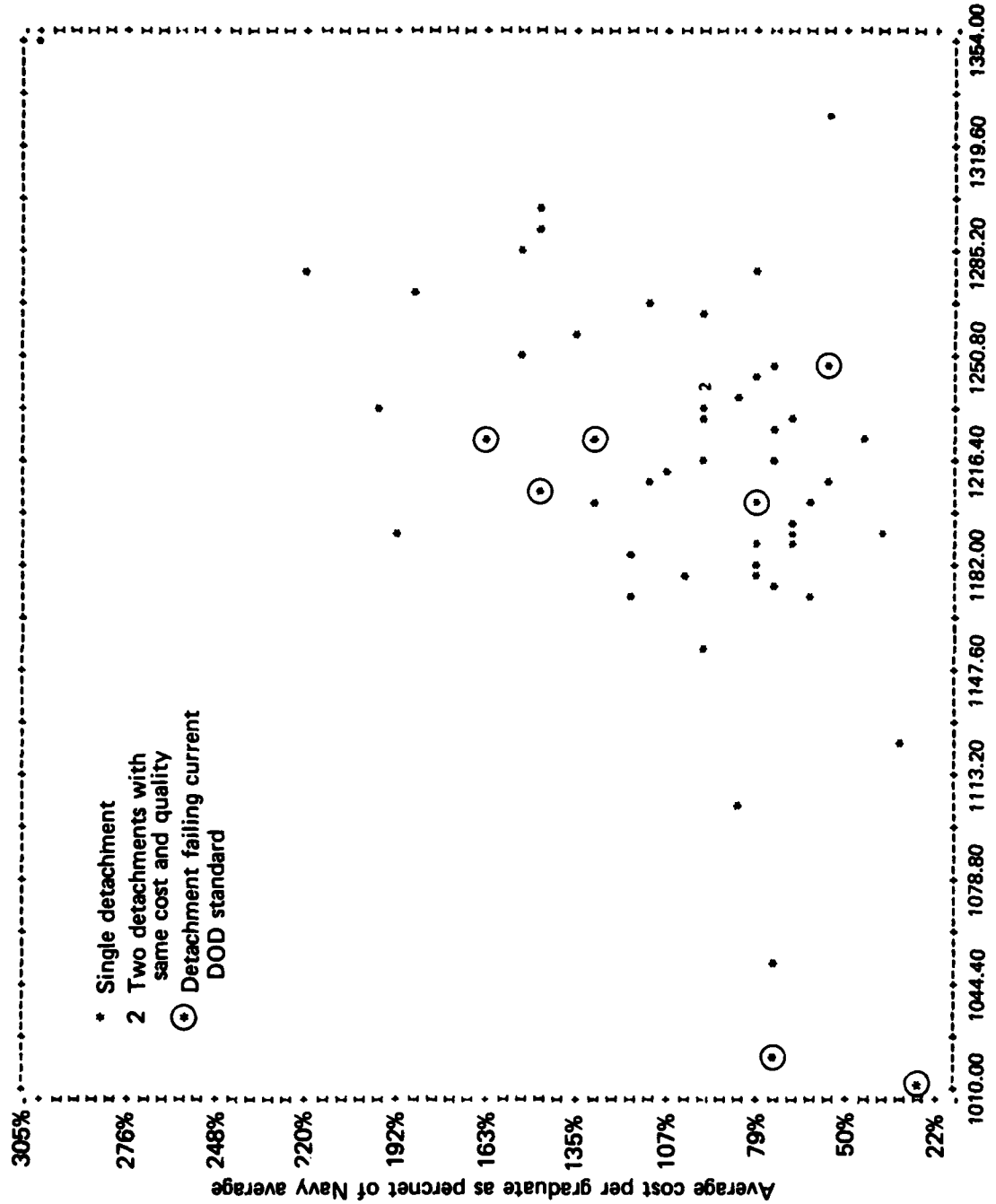

Fig. 4 — Relation between cost and quality for Navy ROTC detachments, AY 1977-1978

extremes.) The figure clearly shows that the positive (and statistically significant) relationship in the Navy program between cost per graduate and quality, first noted by Barrow, still holds.

We can label detachments as inefficient whenever their costs are higher and quality measures are lower than those of the rest of the program, such as those in the upper left portion of the figure. A well-designed standard would assist ROTC managers in the identification and elimination of such units.

The points circled in Fig. 4 represent the detachments that enrolled fewer than 17 midshipmen at the junior level. These points seem to be almost randomly distributed in terms of both quality and cost; detachments failing the standard appear almost indistinguishable from the others. In fact, one currently failing detachment (the University of California at Berkeley) has a cost per graduate only 59 percent of the Navy-wide average and an average SAT score of 1248, and could well be the most efficient in the Navy program.

Before drawing final conclusions about the relationship of the DoD standard to the efficiency of Navy ROTC, we must distinguish short term fluctuations from long term trends. The standard exempts detachments which, for reasons beyond their control, may have low enrollments for only one or two years. There are only three detachments in the Navy program that have enrolled fewer than 17 midshipmen in the junior year in each of the past four academic years. They are shown below.

NAVY DETACHMENTS, AY 1977-1978, FAILING
THE STANDARD FOR FOUR YEARS

Detachment	Junior-year Enrollment	Average SAT (Freshman Midshipmen)	Relative Cost per Graduate
Illinois Tech	13	1222	162 %
Univ. of Utah	14	1205	133 %
Maine Maritime	14	N/A*	86 %

*N/A: Not available.

Although Maine Maritime's detachment is mandated by law, its average cost per graduate was less than the overall Navy average. The other two detachments lie to the upper left of most Navy detachments, as shown on Fig. 4. They are not, however, clearly different from many detachments which lie in their immediate proximity. Moreover, one detachment (the University of Texas at Austin) that has enrolled 17 or more midshipmen in the past four years has lower quality (1192 SAT) and higher average relative cost per graduate (194 percent) than either Utah or Illinois Tech.

AIR FORCE ROTC

We begin by analyzing the cost of Air Force ROTC detachments in Academic Year 1975-1976.[1] Figure 5 shows the average cost per graduate for AFROTC detachments with AS300 (Aerospace 300, given in the junior year of ROTC) enrollments falling in various ranges. As was the case for the Navy, costs per graduate declined as enrollments

[1] The Air Force is revising its cost accounting system and has been unable to provide cost by detachment for Academic Years 1976-1977 and 1977-1978.

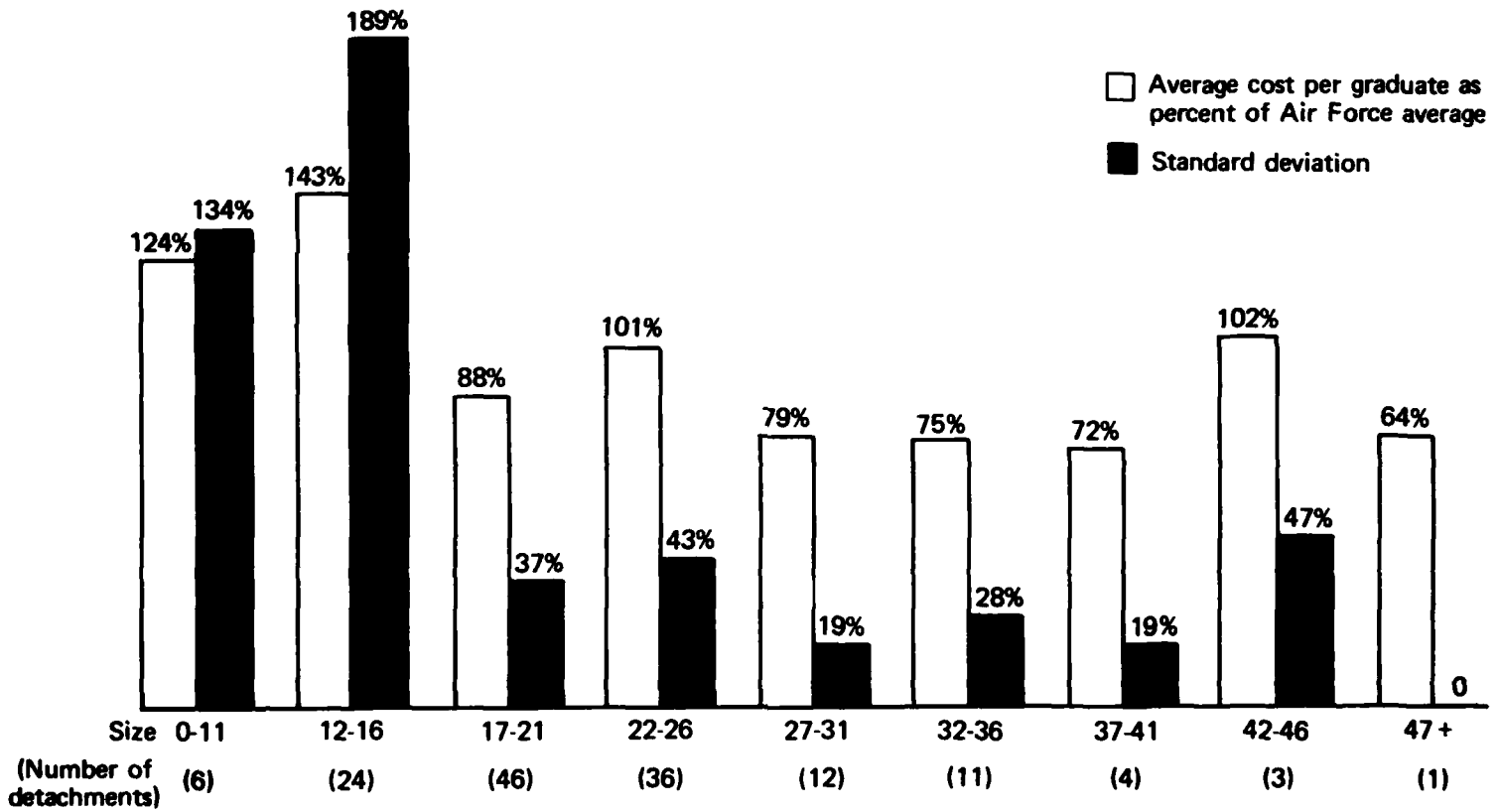

Fig. 5 — Relative average cost of an Air Force ROTC graduate by size of third-year ROTC class (AY 1975-1976)

increased.[1] In each of the smallest two classes, the standard deviation in costs per graduate exceeds the mean.

Figure 6 shows the relationship between detachment size and a proxy measure of cadet quality. Here the SAT score is the median for all freshmen entering the institution at which the detachment resides, rather than the mean for the cadets themselves. The overall mean for universities with Air Force ROTC detachments was 971. Both Fig. 6 and regression analysis show no relationship between enrollment and quality within the Air Force program.

The relationship of the DoD standard to costs and quality taken jointly, displayed in Fig. 7, again proves illuminating. The SAT scores of universities with AFROTC units range from 600 to 1370; average costs per graduate are from 43 to 396 percent of the Air Force-wide average.[2] Units with fewer than 17 cadets in AS300 are circled as before, and, as before, they do not seem appreciably different from their neighbors. Certainly, they do not lie to the upper left of the set of AFROTC detachments, on average. One detachment at the University of Michigan enrolled only 16 cadets but drew from a school with a SAT average of 1110, which exceeded 91 percent of all AFROTC universities and had an average cost per graduate that was less than 63 per-

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[1] We have deleted the proration of headquarters costs to detachments in constructing this figure. We have also eliminated 21 detachments for which costs were unavailable. The regression analysis results in a negative correlation, but it is not statistically significant.

[2] To improve the accuracy of the display in Fig. 7, we have eliminated one detachment which had only one graduate in AY 1975-1976. The regression analysis cited above included this unit.

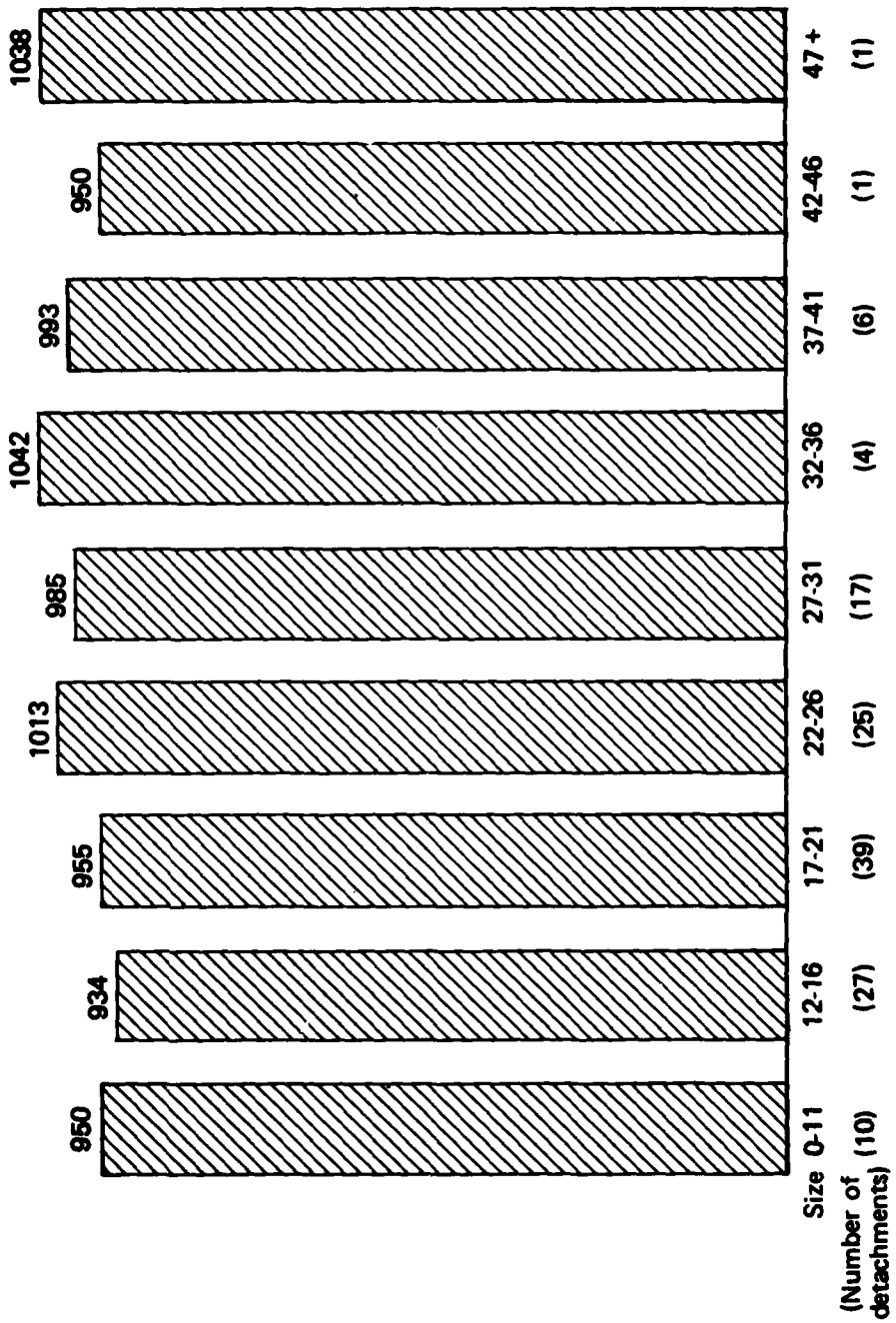

Fig. 6 — Average freshman SAT scores of universities with Air Force ROTC by size of third-year ROTC class (AY 1977-1978)

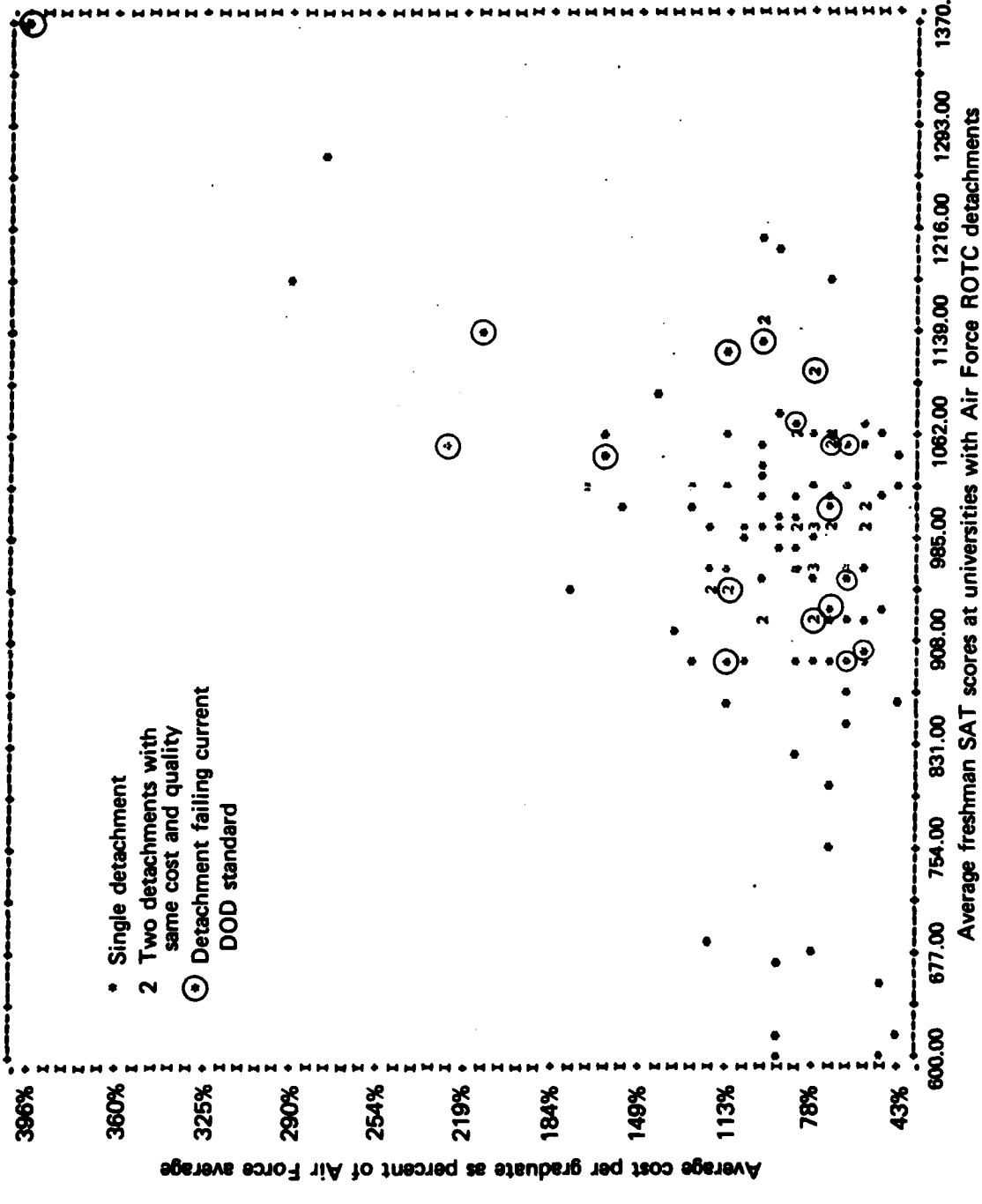

Fig. 7 — Relation between cost and quality for Air Force ROTC detachments, AY 1975-1976

cent of AFROTC detachments. Nearly 55 percent of the Air Force units had both lower quality and higher costs than the University of Michigan detachment.

An examination of AS300 enrollments over time heightens our belief that the DoD standard does not systematically identify inefficient units. Data availability limits us to the three consecutive academic years starting in 1975-1976. Over this period, five AFROTC detachments, including the University of Michigan, failed to enroll 17 cadets in any year. Three of these candidates for disestablishment had above average quality and three had below average costs, as shown below.

AIR FORCE DETACHMENTS FAILING THE STANDARD FOR THREE YEARS

Detachment	AS300 Enrollment (1977-1978)	Median SAT (University Freshmen, 1977-1978)	Relative Cost per Graduate (1975-1976)
Mississippi	15	1000	118 %
North Dakota	11	1027	77 %
Central Washington	11	N/A*	52 %
Michigan	12	1110	77 %
North Dakota State	8	924	122 %

*N/A: Not available.

ARMY ROTC

The Army does not record cost data by ROTC detachment. Because such data are essential to analysis of detachment efficiency, we have constructed costs from authorized staffing (by grade), standard tables of pay and allowances, the number of cadets on scholarship, and the number of cadets in MS III and MS IV (Military Science III and IV, given in the junior and senior years of ROTC).[1] The resulting costs capture the bulk of ROTC expenditures and probably represent most of the real differences among the detachments.

Figure 8 shows our estimates of the average cost per graduate for Army ROTC detachments for different ranges of enrollments in MS III in Academic Year 1977-1978. Detachments with fewer than 21 cadets in MS III have above average costs, whereas detachments with more than 37 have below average costs. The variation in cost is also quite large--in most cases the standard deviation exceeds 50 percent of the mean.

Unlike the Navy and Air Force, Army data show a slightly negative relation between SAT scores and detachment size. Figure 9 displays our results. The SAT scores shown in Fig. 9 represent the median SAT scores for all university freshmen, rather than for ROTC cadets.[2]

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[1] Costs omitted include the cost of cadet travel to and from summer camp, cadet subsistence at summer camp, uniforms, scholarship costs beyond tuition, detachment supplies and administrative travel, and other miscellaneous costs.

[2] As noted earlier, the Army provided data on cadet SAT scores for only the first ROTC region.

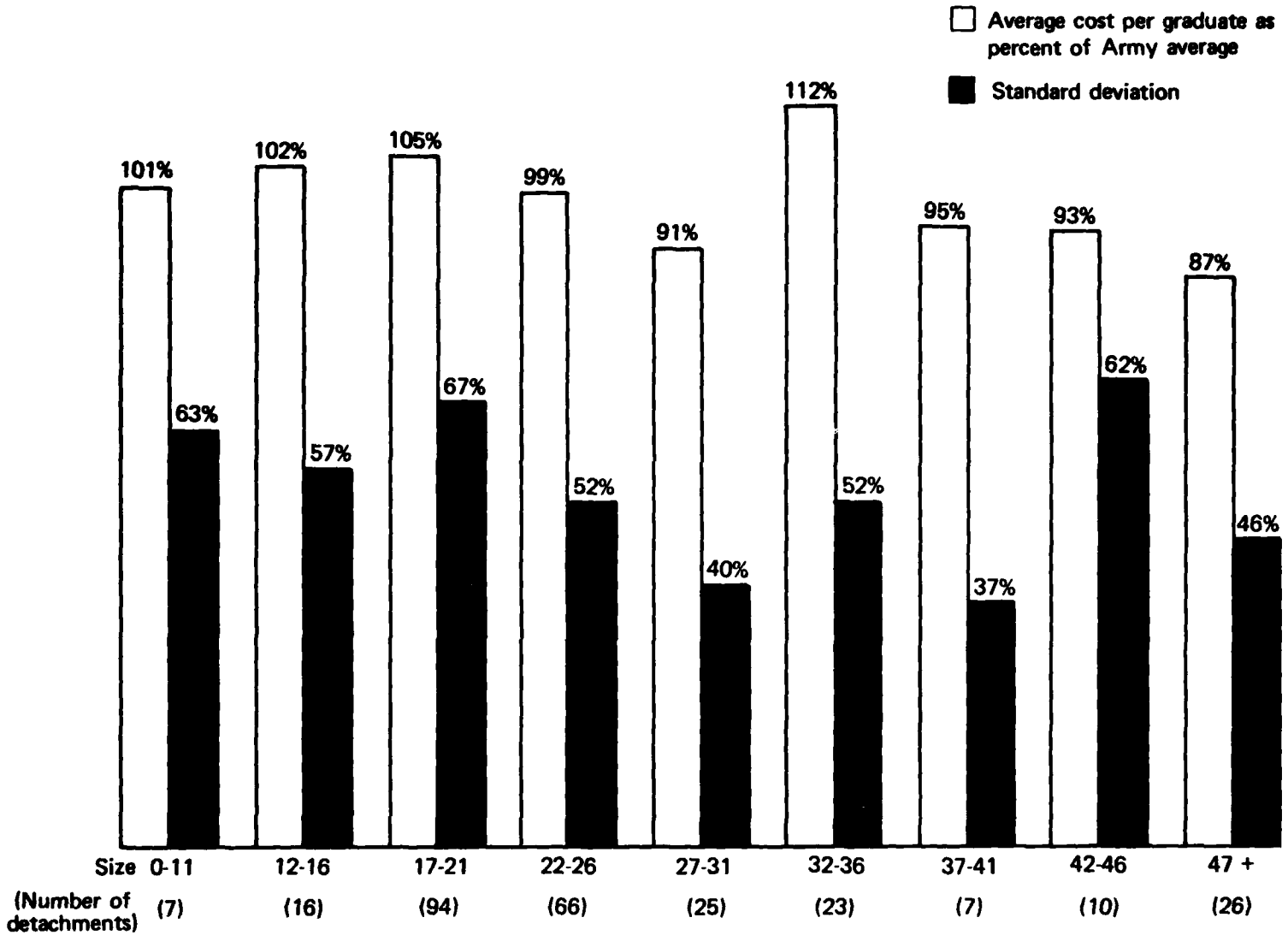

Fig. 8— Relative average cost of an Army ROTC graduate by size of third-year ROTC class (AY 1977-1978)

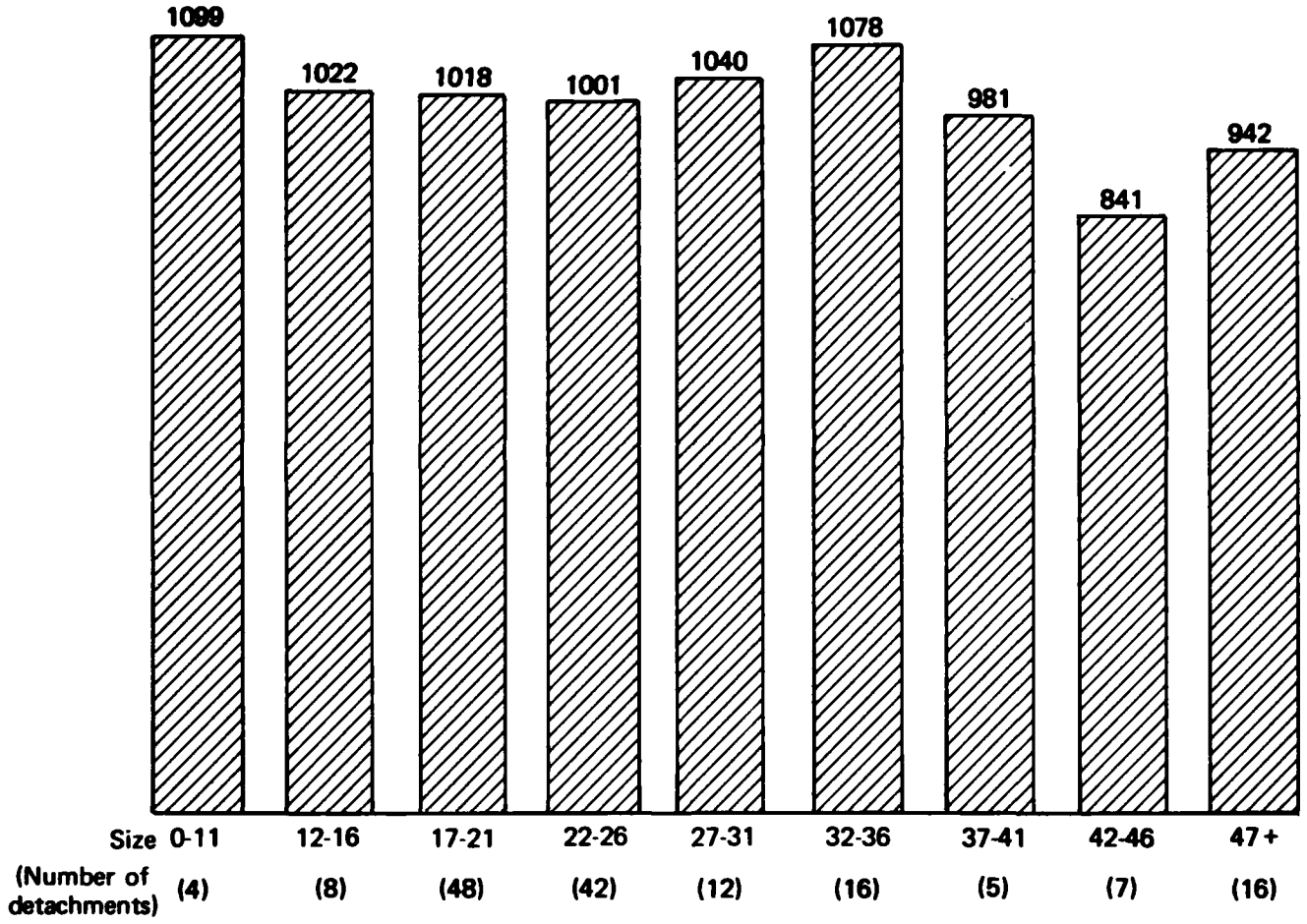

Fig. 9 — Average freshman SAT scores at universities with Army ROTC by size of third-year ROTC class (AY 1977-1978)

Figure 10 shows the relation of the DoD standard to estimated detachment cost and quality taken jointly. Quality ranges from 570 to 1355; cost, from 19 to 325 percent of the Army-wide average. Again, cost and quality are have a statistically significant positive relationship.

As Fig. 10 shows, the DoD standard picks out one detachment that seems to be operating inefficiently (in the upper left quadrant of the figure). Its estimated costs are higher than all but four detachments in the Army program, yet its SAT average is a mere 860, far below the Army average. Unfortunately, one of the Army's most efficient detachments, at the University of Missouri at Rolla, also failed the standard. Its cost per graduate was low--only 46 percent of the Army-wide average--and its quality was high--median SAT was 1175. As before, the detachments identified by the standard appear to be randomly distributed across the cost-quality spectrum.

Because we are still building our data base for the Army ROTC program, our multiyear analysis is confined to a two-year period. Even so, only six detachments enrolled fewer than 17 cadets in MS III in both years. (In all three Services, very few detachments seem to operate below the standard for several years running.) The characteristics of the Army detachments failing the standard for two years are shown below. Each of the six was located at a university with above average SAT scores and three of the six produced graduates at an estimated cost below the Army average.

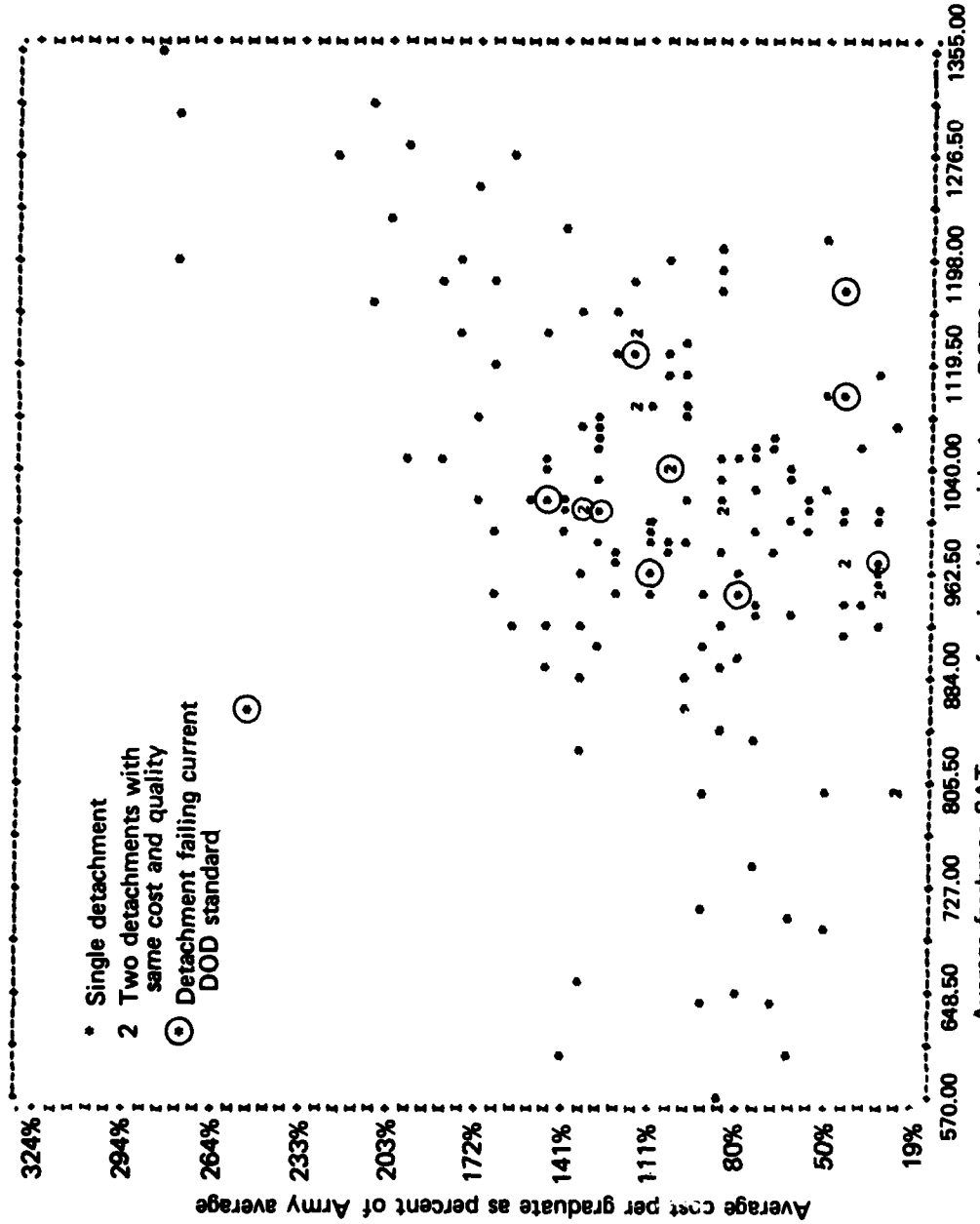

Fig. 10 — Relation between cost and quality for Army ROTC detachments, AY 1977-1978

ARMY DETACHMENTS, AY 1977-1978, FAILING
THE STANDARD FOR TWO YEARS

Detachment	MS III Enrollment	Median SAT (University Freshmen)	Estimated Relative Cost per Graduate
Knox College	9	1097	44 %
Missouri at Rolla	14	1175	46 %
Widener College	16	1010	136 %
Rice University	8	1316	209 %
Texas Christian	11	1020	150 %
Ripon College	15	1045	88 %

PRODUCTION AS A MEASURE OF EFFICIENCY

The foregoing discussion has emphasized cost and quality as measures of efficiency, partly in response to Congressional concern with the need systematically to examine these issues and partly because there is evidence that ROTC is regaining its earlier capability to produce officers in the numbers required. Table 3, showing aggregate requirements and production for ROTC during FY 1978 and 1979, appears to support the second point. The Army did suffer a severe shortfall in ROTC production during FY 1978, which meant that vacancies in the Selected Reserves could not be filled with ROTC graduates. The Air Force also fell short of their goal during that year. These problems, however, seem to have virtually disappeared in FY 1979.

Table 3

REQUIREMENTS FOR AND PRODUCTION OF ROTC GRADUATES
FY 1978 and 1979*

	Army	Navy	Air Force
FY-78 Requirement	5835	1207	2980
FY-78 Production	4423	1260	2614
Percent Shortfall	24	--	12
FY-79 Requirement	5991	1280	2650
FY-79 Production	5890	1285	2546
Percent Shortfall	2	--	4

If the Services continue to experience significant shortfalls, it would seem on the face of it that detachments should not be disestablished. However, ROTC resources, both people and money, are limited, and it is likely that even in this circumstance alternative allocations of resources to more productive detachments (whether already in the program or new to it) would result in greater output per resource than would the current mix. Decisions to disestablish or establish units, should, ideally, be made on the basis of potential productivity, rather than on the basis of past productivity, as is the case with the current standard. Past production would discriminate only to the extent that it predicted future performance. Other predictors of future performanace would be institution and detachment characteristics, which might not have been taken full advantage of to increase production in the past.

*Data provided by OASD, MRA&L, March 1979. Air Force requirements have risen to 2980 for FY79, with accessions estimated to be 2588 and a resulting shortfall of 13 percent.

In addition, if the level of ROTC production falls significantly below requirements in the early 1980s, as some Service planners predict, it is total ROTC production that is of concern. Minimum standards for enrollment, however, do not encourage increased enrollments at all levels, whereas program-wide policies may well do so. An important issue for further investigation is whether, as seems likely, total production is more strongly influenced by program-wide policies, such as the number of scholarships available, than it is by the elimination or addition of relatively small numbers of detachments.

VI. CONCLUSIONS AND RECOMMENDATIONS

It is indeed difficult to escape the conclusion that the current DoD standard is not an effective tool for ROTC management. First, because of the length of the grace period, it has placed very few detachments at risk; most detachments manage to enroll enough people in the junior class once every four years to stave off DoD scrutiny. More important, the standard fails to identify as candidates for disestablishment those detachments performing poorly on the basis of the quality of the participants or the cost of producing graduates; worse, in some cases the standard discriminates against detachments with below average cost and above average quality.

The inadequacy of the DoD standard is obviously the major finding of our work to date. We have also verified that cost and quality are positively related in all three Services, not only in the Navy program. This implies that a standard based on cost alone would be detrimental to ROTC programs.

We have found some evidence in each of the Services that ROTC detachments exhibit economies of scale, but in each Service for virtually any given level of enrollment in the junior year we can find detachments that cost less per graduate than the Service-wide average. Similarly, for virtually any given level of enrollment, we can find detachments with academic quality greater than the Service-wide average. In fact, a major finding is that detachments that are similar with respect to one measure of efficiency may be quite disparate with

respect to others.

We have discovered some serious gaps in the Services' ROTC program data, particularly in the areas of quality, attrition, and Army detachment costs. Although we may describe the data needed in general terms, it is a different matter to specify in detail what data routinely must be gathered for management analysis. Specifications of this type depend on resolution of a number of issues, including the cost of gathering the data, barriers to obtaining the data (such as privacy issues), and its value in day-to-day management of the ROTC program. We expect that it will cost more to gather some data than they are worth; other essential data may be relatively inexpensive to obtain.

The most important question for further analysis is, What should the DoD standard be? At this point, we believe that any any standard based on only a single criterion would be inadequate to account for essential measures of ROTC efficiency--production, quality, cost, and diversity. We hope to pursue this important question in the near future.

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