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RECRUITMENT EARLY WARNING SYSTEM PHASE II EXECUTIVE  
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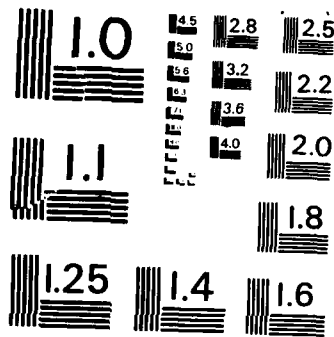
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## RECRUITMENT EARLY WARNING SYSTEM PHASE II

### FINAL REPORT

### EXECUTIVE SUMMARY

September 1985

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AD-A166 569

PROJECT DIRECTOR: Dr. Lawrence Goldberg

PRINCIPAL INVESTIGATOR: Dr. Peter Greenston

RESEARCH TEAM: Sigurd Hermansen, Sherry Andrews, Christine Kennicott

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## RECRUITMENT EARLY WARNING SYSTEM PHASE II

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) <p>The purpose of the Recruitment Early Warning System Project is to provide OSD and the Services with a source of timely, reliable information on the near-term status of the recruiting market. Phase I of the study determined the feasibility of developing and implementing an early warning system for military recruitment; Phase II research has yielded a prototype Recruitment EWS, automated on a microcomputer, which produces monthly forecasts of labor market conditions and enlistments and generates monthly assessment reports.</p> <p>For each Service, enlistment forecasting models have been developed for two cohorts: 1-3A NPS male HSDG's and seniors, and 3B NPS male HSDG's and seniors. Regression models with an ARMA error structure are used for all Services except the Navy. The typical model is estimated using a non-linear, least-squares estimation</p> <p style="text-align: right;">(continued on reverse)</p>			
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procedure with national-level, monthly data for the period January 1979 to May 1985. Explanatory factors include relative military pay, unemployment, recruiters, goals, GI Bill benefits, seasonality, and numerous policies. In out-of-sample testing, the models forecast with 97 or greater percent accuracy over a 12-month period.

*Additional forecasting models have been developed for each*  
The forecasting accuracy of the enlistment models is reduced when a new program or policy changes relationships in the market structure. Research on alternative methods of remediating forecasting errors caused by such "regime change" indicates that it is possible to regain, within three to six months, the level of forecasting accuracy which existed prior to the regime change.

An unemployment forecasting model has been developed for the EWS which is the function of 15 leading economic indicators. ~~The model forecasts the unemployment rate for males and females 16 years and over.~~ It is a regression model with an ARMA error structure, and is estimated with national monthly data from May 1972 to April 1984. In out-of-sample forecasting tests the model quite successfully predicts imminent turning points several months in advance of occurrence. The model's forecasts are relatively accurate, and are used by the EWS as a variable in forecasting enlistments.

The Recruitment EWS was implemented originally in a mainframe environment using TSO and SAS. In Phase II the entire range of automated tasks — database management, statistical procedures, and tabular and graphic generation — are accomplished by a standard microcomputer system, the IBM PC XT and its peripherals, using commercially available software packages. Implementation on a readily accessible microcomputer substantially reduces the costs of operating and modifying the system.

The results of the study indicate that the Recruitment EWS can be used as a valuable source of credible and timely information for evaluating the near-term status of the recruiting market.

**RECRUITMENT EARLY WARNING SYSTEM  
PHASE II**

**FINAL REPORT VOLUMES**

- EXECUTIVE SUMMARY
  
- VOLUME I: RESEARCH AND DEVELOPMENT OF THE  
RECRUITMENT EARLY WARNING SYSTEM
  
- VOLUME II: SYSTEM DOCUMENTATION AND USERS' MANUAL  
FOR THE AUTOMATED EARLY WARNING SYSTEM

THE RECRUITMENT EARLY WARNING SYSTEM  
PHASE II FINAL REPORT

EXECUTIVE SUMMARY

I. The Problem

An enlistment shortfall occurs when a Service cannot meet its recruitment goals in terms of the quantity or quality of accessions. All four Services experienced serious recruiting difficulties or actual shortfalls in FY 1978-79, when the personnel management system failed to recognize and respond to declines in enlistment supply. This study is concerned with preventing a repeat of the FY 1978-79 recruiting experience.

Declines in unemployment, relative military pay, and GI Bill benefits, precipitated declines in enlistment supply beginning in FY 1977. The declines in supply were masked somewhat by a misnorming of the ASVAB, the qualification test given to applicants: it appeared to managers that high-quality enlistment supply was relatively fixed when it was, in fact, declining sharply. The Services' Recruiting Commands first recognized recruiting problems in FY 1978. However, they had difficulty in convincing their own Services that shortfalls were imminent. Credible information on recruiting market trends was unavailable, and requests for additional resources were met with distrust as a result of the gamesmanship prevalent in the operation of the Planning, Programming, and Budgeting System (PPBS). It was not until FY 1979 that the Recruiting Commands could convince the Services and DOD that more resources were needed.

It took two years from the time difficulties began, in FY 1978, before the PPBS first responded by adding recruiters, in FY 1980. Later, in FY 1981 and in FY 1982, military pay was increased. In FY 1982 GI Bill benefits for Army enlistments were sharply increased through the Ultra VEAP Program. But in FY 1982 the economy, a major factor affecting enlistments, had turned downward: increases in unemployment and slow growth in civilian earnings of youth caused high-quality enlistments to increase sharply in FY 1982-83.

The PPBS solution to the recruiting problem of FY 1978-79 resulted in the creation of resource surpluses in FY 1982-83. The planning and budgeting system was out-of-phase with the recruiting market — not only in FY 1978-82, but throughout the period of the All Volunteer Force (AVF). Since FY 1974, at least, recruiting resources have been cut, while civilian unemployment and enlistments declined. Recruiting difficulties have been exacerbated rather than relieved by the PPBS. Why has this occurred?

In the PPBS, decisions concerning future levels of recruiting resources are based on the previous year's recruiting experience, which in turn depends strongly on the previous year's unemployment level. In projecting enlistment supply, planners implicitly assume that unemployment will be more or less constant over the next three years. Unfortunately, fluctuations in the economy play havoc with this assumption. Without information to alert planners to impending short-term changes in the recruiting market, the long-range planning system cannot respond adequately to recruiting difficulties.

## II. Project Objectives

If future recruiting difficulties are to be avoided, the personnel management system of DOD and the Services must reduce lags in the recognition of changes in the recruiting market. To do so, the Services need a source of timely, objective, credible forecasts of trends in the economy and in enlistments. The Recruitment Early Warning System (EWS) has been developed to meet this need. The EWS provides monthly forecasts of high-quality enlistments and unemployment for the next 12 months. Forecasts of enlistments are compared with goals to help planners determine whether there will be shortfalls during the next 12 months. The system also includes other data, such as outside forecasts of unemployment, that are useful in assessing trends in the recruiting market.

## III. Review of Phase I

The Recruitment EWS study began in September 1983. The first year's work, Phase I of the project, was devoted to a feasibility study. A thorough review of existing early warning systems and forecasting methodologies was conducted. Preliminary forecasting models for enlistments and unemployment were developed, as well as a precursory design for an automated recruitment EWS. Phase I concluded that the Recruitment EWS is feasible, and recommended continued research.

## IV. Results of Phase II Research

Phase II research has yielded a prototype Recruitment EWS which produces monthly forecasts of enlistments and unemployment, and generates monthly assessment reports including presentation-quality graphs and tables. This prototype reflects many research advances made in Phase II, both in econometric methodology and microcomputer application systems development.

A. Econometric Research

1. Enlistment Forecasting Models

The success of the recruitment EWS depends critically upon the accuracy of the forecasting models for enlistments. Models have been developed for two cohorts of gross contracts for each Service: 1-3A NPS male HSDG's and seniors, and 3B NPS male HSDG's and seniors. A regression model with an ARMA error structure is used for all Services except the Navy. The typical model is estimated using a non-linear, least-squares estimation procedure, with national-level, monthly data for the period January 1979 to May 1985. Explanatory factors typically include relative military pay, unemployment, recruiters, goals, GI Bill benefits, seasonality, and numerous policies. Values for the unemployment variable are the unemployment forecasts derived from EWS unemployment forecasting models described below. Out-of-sample testing of the enlistment forecasts have been conducted for 12-month periods in FY 1984-85. Test results show that the models forecast with 97 or greater percent accuracy over a 12-month period.

2. Remediation of Forecasting Error Caused by Structural Change

The accuracy of the forecasting models is reduced when a new program or policy, introduced by the Services, changes relationships in the market structure. A major research effort was undertaken to assess alternative methods of remediating forecasting errors that occur during such "regime change." The results indicate that it is possible to regain, within three to six months, the level of forecasting accuracy which existed prior to the regime change. The evidence is strong that good communication between the Services and the EWS forecaster minimizes the time required to take regime changes into account.

### 3. Unemployment Forecasting Models

Accurate unemployment forecasts are an important component of the EWS. Because unemployment has fluctuated in a cyclical fashion, it is desirable to be able to predict turning points. To accurately forecast unemployment one year ahead, the prediction of turning points is a virtual necessity. To develop this capability, the study team has constructed ARMA regression models which are functions of 15 leading economic indicators. The unemployment models focus on the unemployment rate for males and females 16 years and over. They are estimated with national-level monthly data from May 1972 to April 1984. To evaluate their validity, out-of-sample forecasting tests were conducted for four periods during which there were turning points. The models were quite successful in predicting -- several months before the actual occurrence -- that turning points were imminent, and they were moderately successful in pinpointing the exact timing of turning points.

The models forecast unemployment with a satisfactory level of accuracy: on average, the forecasts were approximately within half a point of the actual values. The success of the enlistment forecasting tests, which used these unemployment forecasts, provides evidence that the EWS unemployment forecasting models adequately meet the needs of the system.

#### B. Automation of the Recruitment EWS

Recent developments in microcomputer software have enabled us to implement the entire Recruitment EWS on a microcomputer system. The system was originally implemented in a mainframe environment using TSO and SAS to produce a monthly assessment report. Now, after considerable research, the entire range of EWS tasks --

database management, statistical procedures, and tabular and graphic generation — are accomplished by a standard microcomputer system, the IBM PC XT and its peripherals, using commercially available software packages. This is a significant achievement which has reduced development costs and will reduce operating costs in the future.

The many tasks accomplished by the EWS have been integrated into one comprehensive, yet flexible, system design. The design was developed using a method known as "systematic decomposition of a program function." With this method, system output is treated as a function of data and program input. A complicated program function is broken down into simpler, independent components. The components fit together in a structure that matches the organization of the data to which they apply and the output that they produce. Careful and methodical system design had made possible a system that fully meets the original design objectives, yet can be adapted to the demands of ongoing research.

The automated EWS contains an historical database of monthly observations for enlistment contracts, supply factors, leading economic indicators, and policy variables; models for forecasting civilian earnings, unemployment and enlistments by cohort for each Service; programs to perform statistical analyses; and procedures to generate tabular and graphic output.

The system is highly automated, and can be operated with relatively few keyboard commands. Each month data for the previous month are entered into a program which automatically updates the entire database. When the update procedure is completed, a single command directs the system to: re-estimate the models; forecast earnings, unemployment, and enlistments for each of the next 12 months; and generate report files which provide data trends, summaries, and comparisons. Historical and projected enlistments are compared to goals over the past two and current fiscal years and the next 12 months.

A few additional commands direct the system to use the report files in producing presentation-quality tables and graphs. These documents, together with explanatory material, comprise the monthly Recruiting Market Assessment Reports. A separate report is produced for each Service. The reports provide decision makers with relevant, timely, and reliable information on the current and impending status of the recruiting market.

## V. Conclusions

The current PPBS is well suited for long-range planning in a relatively predictable economic environment. Unfortunately, the recruiting market, as a function of fluctuations in the general economy, is unpredictable. Therefore, it is very difficult to forecast enlistments two to three years in the future. By failing to accommodate to this reality, the PPBS has frequently compounded rather than alleviated recruiting problems.

If future recruiting difficulties are to be minimized, unforeseen changes in the recruiting market must be recognized more quickly by planning and budgeting personnel. The Recruitment EWS provides a regular flow of information for helping to accomplish this objective. At its current level of development, it promises to reduce recognition lags of a year or more down to a very few months. With further improvements, it could provide even greater assistance.

For the Recruitment EWS to be successful, there must be effective communication among all those interested in recruiting and in recruiting budgets. To disseminate objective, credible information it will be necessary for the Services to continue their expeditious provision of data required by the EWS forecasters; and it will be necessary for OSD to distribute the monthly Assessment Reports, generated by the EWS, to all interested parties throughout the government.

We recommend full implementation of the Recruitment EWS. In each of the last six months of the study, we have updated the system and generated prototype Recruiting Market Assessment Reports which have been distributed to the Services and OSD for comments. We recommend that monthly updating and operation of the system continue, and that distribution of the Assessment Reports be expanded to include interested officers throughout the government.

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