

BACKGROUND

The Army has been an all-volunteer force since 1 July 1973 when the draft was finally discontinued due to the controversy surrounding the Vietnam War. According to Simpson (1994), the last draftee entered basic training in June 1973. In FY 1997, for only the second time since its conversion to an all-volunteer force, the Army came very close to not meeting its annual recruiting goal of 89,700 new recruits. This situation reflects a recent trend in which fewer young people are choosing an Army career, opting instead to look for positions in the civilian workforce.

Several factors contribute to the difficulties that are inhibiting the Army's ability to meet the requirements of its force projections. For one, the rather large increase of 26,700 in the recruiting quota from 1995 to 1997 has not been offset by a corresponding increase in personnel authorizations at the stations. This has in turn undermined the Army's ability to meet its mission goals (Kennedy, 1997). Another has been the national attention focused on recruiting personnel over allegations of behavioral impropriety in the stations, basic training camps and on the job. Image problems, and even the strength of the national economy, have likewise contributed to the relative sparseness of the recruit pool.

The current methods and capabilities of the U.S. Army Recruiting Command (USAREC), while sufficient during previous recruiting years, have proven unsatisfactory to meet these challenges. USAREC has not substantially increased its personnel at the station level, and consequently, existing recruiters have to cope with increasing mission demands. Thus, as has been the theme in the civilian workplace during the past decade, the Army must consider changes that will allow it to "do more with less." This, in turn, implies that greater efficiencies in time management must be introduced at the station level.

To this end, the Army commissioned the Air Force Institute of Technology in the summer of 1997 to conduct a simulation study of station-level activities in the Third Brigade of the U.S. Army Recruiting Command (USAREC). The purpose of this study was not to suggest a strategic solution to the leadership of the Army, but rather to build a tool that would enable others to study the effects of changes at the recruiting station level. Our team responded with a comprehensive program of recruiting station visits for process study and data gathering, which was followed by

a computer simulation development phase. Arguably the most important six months of the study was occupied by data gathering excursions to stations in the Dayton, Ohio and Cincinnati, Ohio/Covington, Kentucky areas. This sampling of locations permitted the formulation of a consensus view of the recruiting process that provided the framework for the digital model. Upon completion of the study, we provided the Army with a tactical-level model that analysts could use to study the impacts of changes made by Army leadership.

The level of detail required for this task could not have been captured were it not for the input of the many recruiters that we interviewed. They assisted with the validation of process flows and model output and provided insight into conditions at the stations. It was recognized early on that, to successfully meet the goals of the study, we needed to focus primarily on recruiter-level issues—in effect, to see recruiting from the perspective of the recruiter at the station. Since recruiters are ultimately responsible for putting official policy into practice, the recruiter must be considered a critical element of any move to counteract the economic and social pressures on the national recruiting effort.

THE RECRUITING PROCESS

Army regulations (USAREC, 1996) delineate the recruiting process into five major sub-tasks: Planning, Prospecting, Sales, Processing and Delayed Entry Program (DEP) and Delayed Training Program (DTP) maintenance. The subsequent process flow diagrams and model structure is based upon this modular design shown in Figure 1. In this section, we will give a brief introduction to each task in order to convey a sense of the recruiting process. The next section will show how these task descriptions were translated into our computer simulation model.

Planning and Lead Generation

Planning and Lead Generation is the first of the five critical recruiting tasks, and it is here that the influence of a station commander is most pronounced. Because time management is so crucial to maximize productivity, every hour of a recruiter's day is accounted for in a recruiter's daily planner. The station commander reviews each recruiter's daily planning guide during what is termed a daily performance

Using Simulation to Model Time Utilization of Army Recruiters

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APPLICATION AREAS:
Manpower & Personnel
OR METHODOLOGY:
Computer simulation

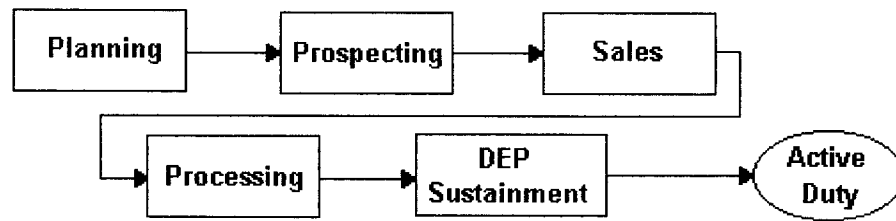


Figure 1. Recruiting Process Top-Level Diagram

review. This allows the commander to pinpoint potential problem areas and formulate a corrective plan of action if necessary.

Another important function in this stage is lead generation. This includes any method through which a recruiter obtains potential applicants' names, addresses, and/or telephone numbers. The more conventional methods of lead generation are gathering information for high school junior and senior class lists, collecting Armed Services Vocational Aptitude Battery (ASVAB) testing rosters, and utilizing sources of referrals within the community. The recruiter uses the information gathered during lead generation to conduct prospecting.

Prospecting

The primary goal of the recruiter in this stage is to entice eligible applicants into meeting the recruiter for a sales interview, preferably at the recruiting station. Although prospecting would be a simple matter if applicants simply walked into the station, most recruiters find that they must actively and aggressively pursue the "leads" that they have obtained through one of the means described previously. Accordingly, the recruiter has the option of picking up the telephone or heading out to the local area for face-to-face contact. Productivity that can be attributed to a particular method varies depending on the regional demographics, station commander effectiveness, recruiter ability, and a number of other factors.

Recruiters rely primarily on using the telephone since one can reach a relatively large number of people in a much shorter time than it takes to leave the recruiting station to meet prospective applicants. On the other hand, aggressive face-to-face prospecting combined with excellent salesmanship skills can reap potentially greater rewards. Ideally, a recruiter must tailor a suitable combination of both

methods. This becomes particularly crucial for those stations that are located in areas that do not have a high number of interested or qualified potential applicants.

Sales

Once an applicant appears at the station for an interview, the recruiter seeks to draw an enlistment commitment from the individual. However, the recruiter may not be certain about the person's qualifications or military eligibility at this early stage. To screen out applicants who may not be able to pass the ASVAB, the recruiter will administer a pre-ASVAB examination. The recruiter will also screen those with past convictions or disqualifying medical conditions. Depending upon the area in which the station is located, a certain proportion of applicants (sometimes more than 50%) do not meet the Army's high enlistment standards.

Those that pass the screening tests often do not enlist. Applicants may fail to enlist due to many reasons such as a fear of the unknown or parental pressure. Other, possibly higher paying, job opportunities are key factors in times of low unemployment. The recruiter's ability to sell or persuade often plays a crucial role in tipping the balance in favor of a secured enlistment contract, a fact that the Army well recognizes (USAREC, 1994).

Processing

After the sales interview, the applicant will be in one of three states: (1) decided against enlistment or disqualified (2) undecided or having less than perfect qualifications or (3) committed and qualified. If the applicant has passed the screening criteria in the sales interview and has expressed a strong desire to enlist, the recruiter may attempt to arrange an

ASVAB test date and a Military Entrance Processing Station (MEPS) physical. The recruiter will also complete the administrative requirements for the enlistment.¹ This course of action is what we shall term "Immediate Processing." However, many applicants may require that the process proceed more slowly (i.e. those in category (2)), in which case all of the steps are performed in sequential manner. We shall call this method "Normal Processing."

If the process has been problem-free or the waiver process has been successfully completed, the applicant will then visit a guidance counselor at the MEPS location. The counselor will assist the applicant in matching his or her qualifications and desires to the available military occupational specialties (MOS). The oath then seals the bargain (not decisively at this stage of the process) and initiates the applicant into the Delayed Entry Program.

Delayed Entry Program (DEP) Sustainment

The Army instituted the Delayed Entry Program (DEP) in order to regulate the flow of recruits to training camps and follow-on technical schools, and to increase the chance that a recruit will receive his or her desired MOS due to added flexibility in training dates. The often-lengthy (up to 12-month) delay between the enlistment oath and training does, however, make it more likely that applicants may renege on the enlistment agreement.² According to one study, the risk of a "DEP loss" increases on average by approximately 3.5 percent for each month in the program (Kearl, p. 261).

Long-term experience with DEP losses has prompted USAREC to institute a DEP Sustainment process to mitigate the situation. The goal of a recruiter during DEP Sustainment process is to keep an individual motivated to enlist, a task that involves regular and sustained contact between recruiter and applicant. These meetings may involve anything from a mere status report to a large social function occupying the resources of an entire battalion of recruiters. One fact, however, is undisputed: an applicant who feels ignored will become a greater DEP loss risk. Hence it is paramount that a recruiter recognizes this situation and acts accordingly to prevent the loss of what could amount to a year's worth of recruiting effort.

BUILDING THE SIMULATION

A crucial first step in model design is to understand the process being modeled. We accomplished this through consultation with experts (visiting recruiting stations), additional training (attending the Army Recruiting School at Ft. Jackson S.C.), literature review (reading Army regulations, DA pamphlets, Army Recruiting Policies, and Battalion operating documents) and the subsequent construction of process flow diagrams. These diagrams eventually must be refined to include only the level of detail and complexity necessary to meet the simulation requirements. We refined a series of process flow diagrams that captured recruiters' perceptions of the workings of the Army recruiting process. The final product was an aggregated process flow diagram suitable as a framework for constructing the digital model. The process flow diagrams were also briefed to the experts at Headquarters Army Recruiting Command. We identified the following key input parameters:

1. The number of applicants lost at each stage in the recruitment process.
2. The time it takes a recruiter to generate an appointment through telephone prospecting.
3. The time it takes a recruiter to generate an appointment through face-to-face prospecting.
4. Frequency of arrival of walk-in applicants.
5. Percentage of walk-in applicants who fail the pre-sales interview.
6. The average number of applicants who need waivers.
7. Waiver process throughput time.
8. The percentage of applicants who are immediately processed.
9. The percentage of applicants who are normally processed.
10. The percentage of DEP losses at each successive month for a particular recruiter.
11. The time between and the duration of DEP meetings.

Durations for various processes listed above were based upon data gathered from recruiters in the field. Recruiters were specifically asked for the minimum, maximum, and most likely time to complete a given task. These data were incorporated into the simulation using a separate triangular distribution for individual recruiter processes and applicable sta-

USING SIMULATION TO MODEL TIME UTILIZATION OF ARMY RECRUITERS

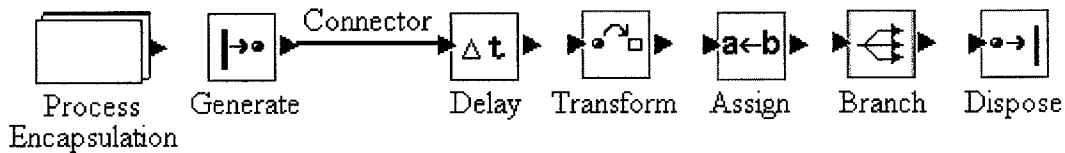


Figure 2. SimProcess Node Types

tion processes. For example, the time an average recruiter spends on the telephone to get one interview was modeled using a triangular distribution with a minimum of 1.2 hours, mode of 4.8 hours, and a maximum of 6 hours. See Cordeiro and Friend (1998) for the specific parameters used to model other processes. The use of triangular distributions to model these processes was appropriate because of the limited amount of data available. In addition, recruiters in the field were comfortable characterizing task completion times in terms of a minimum, a maximum, and a most likely.

How a recruiter uses his or her limited time directly impacts productivity. As stated previously, a major objective of the simulation study was to provide decision-makers with the capability to perform "what if" analysis. They could then explore the effects of varying the time and priority given to a number of recruiting tasks. Accordingly, several of the simulation characteristics were driven by this requirement.

We eventually chose SIMPROCESS to be the modeling environment for the recruiting station simulation. SIMPROCESS is a graphical and hierarchical event-driven simulation language and integrated process tool developed by CACI, Inc. Entities utilize resources as they flow through activities structured using the node types depicted in Figure 2.

The hierarchical nature of SIMPROCESS reduces visual clutter and imparts flexibility to the simulation. The top level of the Army recruiting simulation, as shown in Figure 3, contains process encapsulation nodes for four major recruiting tasks. Each one of these nodes contains additional sublevels of programming detail grouped in a logical manner. Should a recruiting procedure represented by one of these nodes change, the program may be easily modified by simply replacing the contents of the node. The process encapsulation nodes, though not necessarily self-contained, serve the purpose of categorizing processes according to

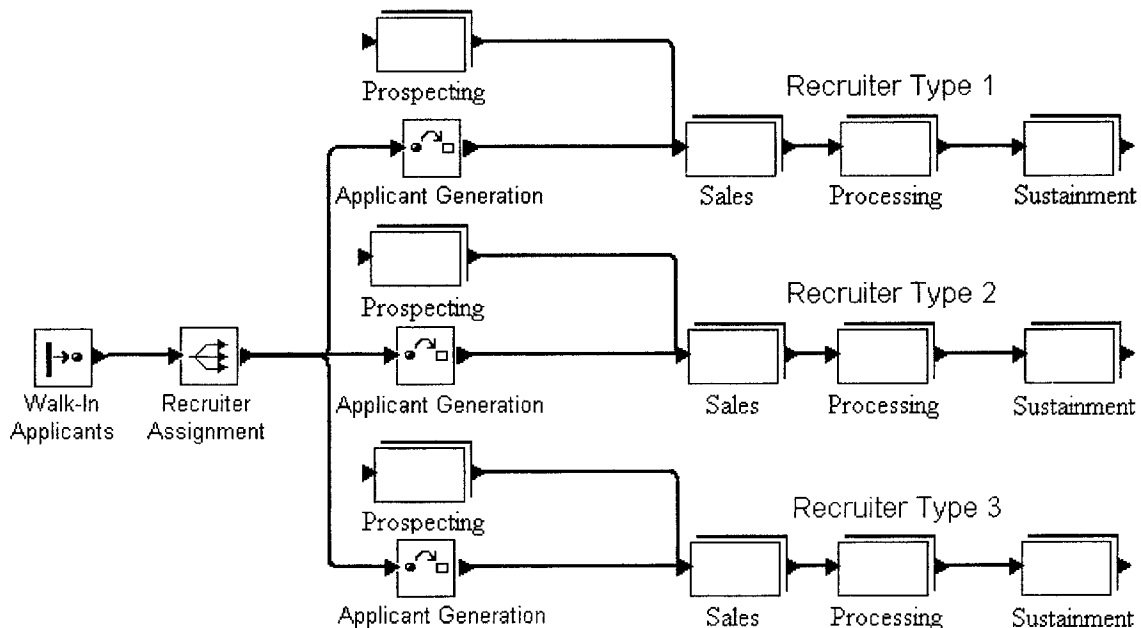


Figure 3. Top level of SimProcess Army Recruiting Station Simulation

the system being modeled. This modular design facilitates the modification of an existing model and enhances ease of understanding for those not involved in its construction.

By capitalizing on the structural flexibility of SIMPROCESS, the baseline recruiting station model was developed to allow output to be gathered on three different recruiters, each with unique capabilities and priorities. The “recruiters” (actually three processes—see Figure 3) work in parallel and generate their own entity flow (in addition to processing walk-in applicant entities generated by a separate process). This parallel processing allows the analysis of recruiter dependent as well as independent factors, thus imparting the ability to investigate the net productivity of a station with recruiters of varying abilities.

VERIFICATION AND VALIDATION

Every effort was made to apply the tasks listed in Table 1 throughout all major steps of the Army Recruiting simulation study. We considered verification to refer to the simulation model and validation to be of the process being simulated.

Verification

The modularity of the Army recruiting process model, driven by the underlying object-oriented language of SIMPROCESS, caused us to structure the model, using procedures, functions, and objects each of which could be easily tested individually. The model was developed

gradually by writing modules and immediately debugging and verifying them. This made for an easy division of labor among the team members, the sharing of re-usable code, and an ability to cross-verify each other’s work.

Intensive examination of the simulation output was one of our primary means for discovering the existence of program bugs. We also used SIMPROCESS animations of the modeled recruiting process to allow recruiters from the field to verify that the path of applicants through the recruiting process was appropriate. Entity count displays during the animation also facilitated the discovery of anomalies. This visualization helped detect such anomalies as faulty process branches (e.g. an applicant that is sent directly to the waiver process without being checked for his qualifications), or excessive queues (e.g. too many applicants waiting for testing when in reality testing is never a bottleneck).

Validation

The goal of the Validation step is to ensure that the model reflects the real-world system accurately enough to make effective decision based upon model output (Law and Kelton, 1991, p. 301). However, it is not feasible to assume that every aspect of the actual system can be incorporated into the model, or to expect a one-to-one correspondence between model and system output.

Data Validity

Before the operational validity of the model could be tested, we first needed to obtain reliable input data. We sought to obtain input distribution parameters through two means: official USAREC historical data and questionnaire data from actual recruiters. While the experts involved in the study were confident in the data originating from US Army Recruiting Command Headquarter, they were less confident in the data obtained directly from the recruiters due to the various pressures on the individual recruiter and the different environments in which the survey would be administered. Our solution was to administer the questionnaire in electronic spreadsheet form. The spreadsheet contained built-in functions that calculated various parameters (such as the av-

Table 1. Tasks Accomplished for Verification and Validation

Verification	Validation
Writing and Debugging	Conversations with Experts
Code Verification by Multiple Experts	Observations of the System
Checking Consistency of Output	Existing Theory
Tracing	Experience and Intuition
Animation	Turing Test
Use of Simulation Package	Model Calibration

erage length of a workday) based upon the responses. This capability allowed instance feedback to the recruiter as well as the proctor. It indicated logical error and impossibilities, thus preventing the incorporation of fallacious data into the simulation model.

Process Validity

Since a goal of validation is to make the simulation behave as closely as possible to the system modeled, the model should be calibrated throughout development. We implemented this process by responding to suggestions for improvement that we received from several sources of validation including recruiters, instructors, and USAREC analysts. This iterative calibration process encompassed many validation techniques and allowed us to implement validation efforts during, rather than after model development.

From the model conception phase to the analysis, we used data feedback and visualization to conduct face validity checks (Sargent, 1996). The official Army recruiting regulations were transformed into process flow diagrams reflecting the official version of the recruiting process. Since the official version is often not an accurate reflection of what is carried out, we also consulted with recruiters who actually implement the process in the field. They provided valuable feedback about flows of applicants, how processing occurs at the station, and how the recruitment numbers from the simulation compare to an actual recruiting station tally. They helped us expand our vision of the recruiting process past the idealized representations in the official regulations and focused our efforts more upon actual recruiting station operations. This, of course, translated into a more credible and valid simulation model.

USING THE MODEL

With a workable digital simulation model in hand, we wanted to demonstrate to USAREC its utility in predicting recruiter output. We sought to present USAREC analysts and leadership with an example of the type of analysis that they might perform using this tool. With this in mind, we chose to test the relationship of three model parameters to the output—the number of enlistment contracts obtained in a

three-recruiter station in a year. The three parameters tested were:

- 1) amount of prospecting time available to each recruiter (time used for telephone calls and school visits),
- 2) collateral time (time for additional duties, lunch, and other activities not officially a part of the recruiting process), and
- 3) processing time (time used to complete mandatory paperwork related to the processing of an applicant).

Our goal was to determine which, if any, of these factors have a significant effect upon the number of signed contracts in a year.

Experimental Design

Tables 2 and 3 show the single center-point design based on prospecting, collateral duties, and additional processing³ times that formed the basis of the experimental design that we used. This design allowed us to test each of our factors at a low and a high level, as well as at a level centered between these extremes. Use of the center-point provided a test for curvature in the regression model relating the three factors to the output (the number of enlistment contracts).

At each experimental design point, we made 30 replications, each simulating two years of recruiting. The first experiment using this design involved no initialization period and became our control. The second experiment used the first year as a warm-up period for eliminating initialization bias.

We used the same random number stream for all design points and in both experiments to

Table 2. Design Points

Design Point	Prospecting Time	Collateral Time	Processing Time
1	—	—	—
2	—	—	+
3	—	+	—
4	—	+	+
5	+	—	—
6	+	—	+
7	+	+	—
8	+	+	+
9	0	0	0

Table 3. Factor Level Definitions

	Prospecting Time	Collateral Time	Processing Time
Low Level (-)	15 Hours/Week	0 Hours/Week	0 Hours/Week
High Level (+)	25 Hours/Week	15 Hours/Week	4 Hours/Week
Center Point (0)	20 Hours/Week	7.5 Hours/Week	2 Hours/Week

reduce any random variation between the design points and experiments. With two identical experiments, we had a means to compare the effects of initialization bias on the output.

Results

The entire experiment was conducted on nine Pentium-based PC platforms running each of the nine design points simultaneously. Output data was collected and formatted automatically by SIMPROCESS and written to ASCII files. These files were then imported into a spreadsheet and SAS Institute's JMP statistical software for analysis.

Our goal for the analysis was to conduct to a sensitivity study of the three selected factors with respect to the number of enlistment contracts obtained in a typical year of recruiting. We first compared the mean number of contracts in both sets of runs (biased vs. non-biased) in Table 4. What becomes immediately apparent from the data is the fact that the averages are noticeably larger in the system with the initialization bias removed. This effect can be attributed to the fact that at the end of the first year of the simulation, there may already be a number of applicants going through DEP

Sustainment. Clearly, there will be no applicants in DEP Sustainment at the start of the simulation for replications without the one-year warm-up period. The difference can be verified statistically using a paired t-test to construct confidence interval for the mean difference in contracts between the two systems at each design point (nine separate confidence intervals). Our remaining discussion uses results from the unbiased experiment.

Sensitivity Studies

Graphical presentation of the mean number of contracts by design point reveals an interesting trend. As seen in Figure 4, one can observe that the mean number of contracts is higher when prospecting times are at their high level. This result corresponds to USAREC's own observations about the importance of prospecting to contract production. We thus have an initial indication as to the relevance of the prospecting factor. We then performed least-squares regression on the data to determine how well one can predict output based on the three design parameters. The significant factors were revealed to be Prospecting and Collateral time, in addition to their first-order interaction term. These regression results are shown in Table 5.

Table 4. Average Annual Number of Recruits (Station)

Design Point	Without Bias	With Bias
1	43.233	36.117
2	44.733	36.467
3	42.667	34.383
4	42.600	34.484
5	65.667	55.317
6	68.667	55.267
7	57.700	46.167
8	58.233	47.183
9	53.100	43.483

Effect Screening

Given the significance of the Collateral-Prospect parameter in the suggested model, we deemed it worthwhile to investigate the nature of this interaction further. Interaction plots do indeed reveal a noticeable effect on the output with regard to the high and low values of both factors, as seen in Figure 5. Each of the lines here represents a different level of one of the factors in question. In our case, they represent the amounts of time that the recruiters are required to expend on collateral duties. The slopes of the

USING SIMULATION TO MODEL TIME UTILIZATION OF ARMY RECRUITERS

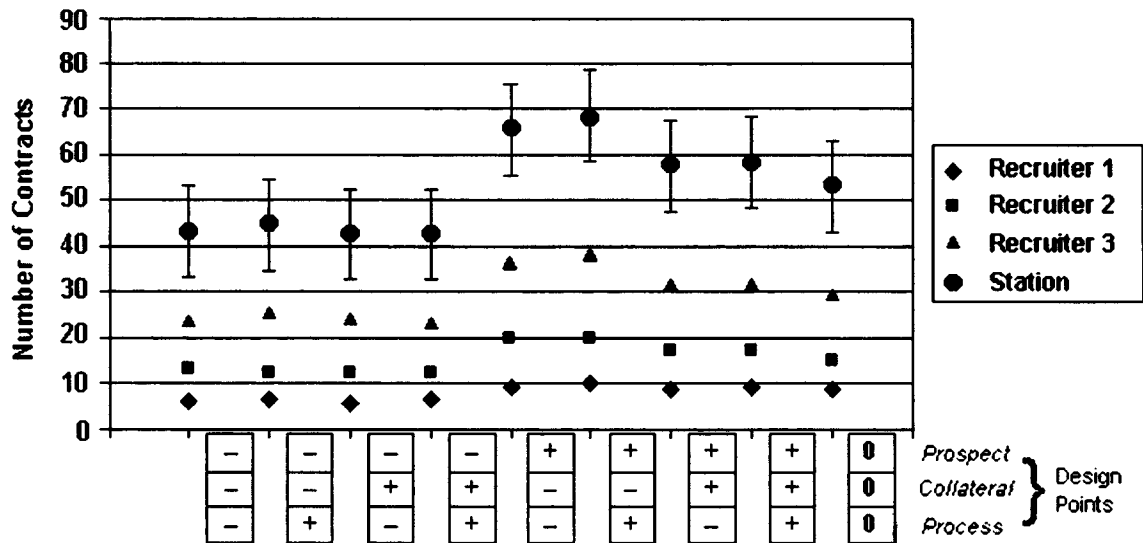


Figure 4. Average Number of Contracts vs. Design Point (With 80% Confidence Intervals)

Table 5. Regression Results

Parameter	Estimate	Std Error	t*	Prob > t*
Intercept	52.9556	0.3971	133.34	<0.0001
Prospect	9.6292	0.4212	22.86	<0.0001
Collateral	-2.6375	0.4212	-6.26	<0.0001
Processing	0.6208	0.4212	1.47	0.1417
Collateral*Prospect	-1.9625	0.4212	-4.66	<0.0001
Processing*Prospect	0.2625	0.4212	0.62	0.5337
Processing*Collateral	-0.5042	0.4212	-1.2	0.2324
Prospect*Collateral*Processing	-0.1125	0.4212	-0.27	0.7896

lines are determined by the sensitivity of the output to the change in the second factor (the number of hours a recruiter spends prospecting in a week). Thus the interpretation of the graph is straightforward in that the greater the difference in slope from the second factor's low level to high level, the greater the interaction between the two factors in question. In light of this observation, it becomes apparent that the number of hours spent on collateral duties has a greater effect on the number of contracts produced when prospecting is at the high level. Numerically, at our low level of prospecting (15 hours/week), a decrease from 15 to no hours/week for collateral duties results in a modest increase of 1.35 annual recruits. At the high level of prospecting (25 hours/week), the same change in collateral duties results in a more dramatic increase of 9.2 annual recruits.

In practical terms, this suggests that additional collateral duties for a recruiter who spends more prospecting time in his or her daily schedule, is more likely to have a negative impact on the number of monthly contracts. On the other hand, for a recruiter who spends less time prospecting, additional collateral duties have a much smaller impact on his or her number of monthly contracts. For the policy maker, these results may suggest a separation of duties at a recruiting station. In other words, letting recruiters who perform more prospecting (and are most likely better at it) to concentrate their efforts here, while recruiters who do less prospecting pick up more of the collateral duties.

These results provided credibility of the Army Recruiting Model and gained model acceptance into USAREC's repertoire of analytical tools.

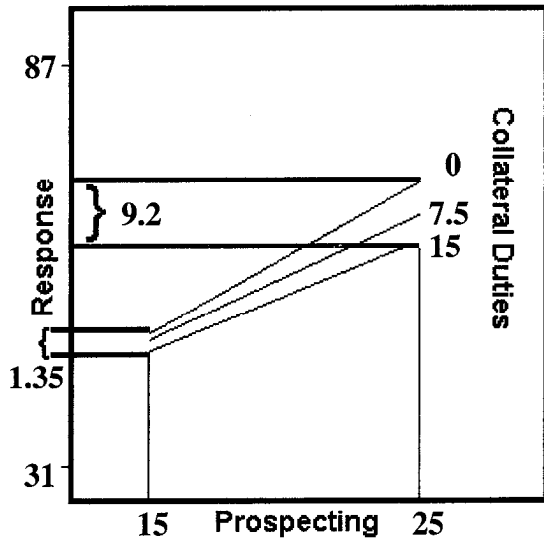


Figure 5. Interaction Between Collateral Duties and Prospecting

CONCLUSION

We conclude this report of the simulation study of the Army Recruiting Process with a few insights about what we learned and what an analyst using the model might focus upon during future investigations. We sought to provide upper-level decision-makers with a tool that they could use to factor in the characteristics and relative importance of recruiter-level tasks in their planning efforts. The rationale underlying this objective is that the ability of USAREC to meet its goals is based upon the performance of individual recruiters in the various recruiting stations. Consequently, we feel that any improvements to output must be accomplished by helping recruiters to focus on those tasks that have the most impact on their productivity.

The model derives much of its utility through its flexibility. There are a large number of parameters that can be modified to include varying the percentage of waivers accrued in a particular station, increasing or decreasing the DEP loss in the system, varying the times needed to perform administrative and recruiting tasks, etc. Each proposed change to the way a recruiting office is run could be assessed as to how it may affect the parameters available in this model, which in turn may have an impact of the quantity of high quality recruits.

Although the model was commissioned initially to address specific 3rd Brigade issues,

the homogeneity of recruiting polices across the entire USAREC command may well support its applicability to the problems of other brigades as well. Multiple version of the model running simultaneously may be used to simulate output at company, battalion, and even brigade levels. In effect, this application transforms the single-station tactical model into a multiprocessing strategic one. On a less ambitious scale, the output from single stations may be used to generate input for another higher-level manpower model used to plan force requirements. Due to the great flexibility imparted by the use of the single-PC platform upon which the Army Recruiting Process simulation model operates, the possibilities are limited only by resources and imagination.

While we have stressed the problems confronting military recruitment thus far, we cannot ignore the enormous success of the Army—and the entire Armed Forces in general—in building the exceptionally dedicated and competent corps of professionals who comprise the all-volunteer forces that exist today. The performance of soldiers, sailors, airmen, and marines, even during the recent period of personnel drawdowns and large cutbacks to military funding, during operational missions such as Desert Storm and peacekeeping efforts in Haiti, Bosnia, and Kosovo attest to this fact. The station recruiters are inherently important, even crucial, due to their potential to affect the performance of this strong and capable military force. We are challenged with assisting the leadership in systematically and continually improving the processes and products of the military recruiter.

NOTES

1. The Enlistment Processing Worksheet is used as a checklist to ensure that all steps have been followed. It also contains pertinent information about the applicant.
2. The applicant is allowed to terminate the enlistment contract at any time before departing for basic training.
3. Processing time during the weekdays was already factored into each simulation run. Two hours of additional processing time on Saturdays were added to certain runs as part of the experimental design.

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