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MBA PROFESSIONAL REPORT

Balancing Sea Duty Location Preferences with Assignment Incentive Pay

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December 2005

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**BALANCING SEA DUTY LOCATION PREFERENCES WITH
ASSIGNMENT INCENTIVE PAY**

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Submitted in partial fulfillment of the requirements for the degree of

MASTER OF BUSINESS ADMINISTRATION

from the

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BALANCING SEA DUTY WITH ASSIGNMENT INCENTIVE PAY

ABSTRACT

The goal of sea pay has always been to motivate sailors to go to sea and to compensate the arduous nature of sea duty. This study will take sea pay one step further by analyzing sea pay as a location incentive pay. By offering a premium to sailors who choose less desirable sea duty locations, we hope to motivate more sailors to volunteer for these locations. This study will use data from the current location assignment incentive pay for overseas locations and the sea pay history to determine the reaction of sailors to a location assignment incentive sea pay system.

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I. INTRODUCTION

A. BACKGROUND

Some sea duty billets are more desirable than others.

It is recognized that members do not view all assignments as equally desirable. This can be attributed to factors such as the geographic location, type of job, or nature of the duty. The distribution process attempts to fill all the assignments regardless of desirability, but because of the natural dynamics of the process, less desirable assignments are more difficult to fill.¹

Detailers distribute people throughout the Navy in accordance with the needs of the Navy. The detailer's job is controlled by the available billets. Individual sailors have to choose from the billets available at the time they are open for orders. If the sailor's number one location is not available, the sailor must choose an alternate with no added incentive. The detailer can not offer the sailor any additional compensation for going to a location he or she does not want. The needs of the Navy will always prevail.

The Navy would like to change the distribution process to make it more flexible and reduce the number of sailors that are involuntarily assigned. Billets available will not change and the detailers will still be required to fill all billets. Changing the desirability of billets is one way to reduce the number of involuntarily assigned sailors. Since the arduous nature of sea duty is similar aboard all ships and the type of job an individual will do onboard a ship will be similar for any individual, location is the most likely cause for inequality of sea duty billets. The Navy can change monetary compensation for sea duty locations. Changing monetary compensation for locations may neutralize the desirability of all sea duty billets.

B. PURPOSE

The goal of this paper is to analyze possible pay systems that would produce at least one volunteer for every sea duty billet. Changing pay systems by location of

¹ NPC Web Site-Assignment Incentive Pay – Business Rules p. 1

assignment should establish neutral desirability. The analysis includes the cost of the systems and cost savings due to better retention. To increase retention and create a volunteer for every sea duty billet, the pay system will have to reflect the desirability of each billet.

The pay systems looked at includes Sea Pay, and Assignment Incentive Pay, to determine which system will have the greatest effect on the assignment system. Additional pay may create a volunteer for every sea duty billet. The systems adjust pay by location desirability in an attempt to balance sea duty preference. This analysis tries to determine the cost of each system to the Navy and then recommend the most efficient and effective system.

C. RESEARCH QUESTIONS

Research Questions:

- Can additional pay influence sailors to volunteer for less desirable billet locations?
- What would it cost the Navy to produce a volunteer for every sea duty billet?
- What would the savings be if there were higher retention rates?
- What is the most cost effective way to get a volunteer for every sea duty billet?

D. SCOPE

The Scope includes:

- A brief history and the goal of the sea pay system.
- Description of the current pay system.
- Review of the influence of sea pay on the decisions of the sailors.

- Sea pay as a location incentive pay system. The change required to make this work and the effect on the overall sea pay system.
- The cost of such a system and the cost to create a volunteer for every sea duty billet.
- Types of auctions and auction designs in the assignment incentive pay system foundation.
- The Assignment Incentive Pay system and its possible use as a location incentive for sea duty.
- The Sea Duty Location Assignment Incentive Pay (SDLAIP) system costs are estimated.
- Conclusions, recommendations and areas for further research.

E. ORGANIZATION

The report is divided into four chapters. The first chapter is about sea pay, providing a brief background including the current program and discussion of how the current program would be changed to provide the desired outcome. The impact and effect of the changes are reviewed.

The assignment incentive pay chapter discusses forward and reverse auction theory. Then, it briefly highlights the background of the current assignment incentive pay system. This chapter also explains auction design and the reason for the Navy's choice of design. Different ways to use the Assignment Incentive Pay (AIP) system are discussed. The system is used as a separate location pay added to the current sea pay system and is also looked at as an assignment incentive pay as a percentage of current sea pay.

The third chapter discusses cost savings and expenses of the three different applications of the two systems. The cost of not changing the system is addressed and then compared with the cost of instituting one of the new systems. The savings from

implementing the new systems is compared to determine which system is most cost effective.

The final chapter of the report is the conclusions, recommendations and areas for further research. The conclusions chapter reviews hard points that the research was unable to answer or tackle at this stage. Recommendations are made based on the research that was conducted. The recommendations are consistent with creating a balance in the distribution system. Areas for further research are suggested to increase the accuracy of this research. Further research is needed in the areas that were beyond the scope of this research.

II. SEA PAY

A. BACKGROUND

Sea pay is a form of pay given to sailors assigned to ships. Sailors have received this extra pay as added incentive for the arduous conditions of sea duty. Serving at sea is hard work and sailors have grown to expect extra pay for the responsibility.

Sea pay has a long history. Its beginning can be traced back to the 1800s when sailors were only paid while attached to a ship. When they took leave to go ashore, they did not receive pay. This is said to be the real start of sea pay.²

Most recently, though, sea pay has been given to sailors attached to ships as an addition to their normal pay and benefits. The current sea pay system increases the amount of money an individual will receive according to the amount of sea time the person has served. The more experienced the sailors, the more sea pay they receive. In its current state, sea pay has no impact on the sailors' duty assignment. They have a set sea-shore rotation and when it is time to go to sea, they know they will get sea pay no matter what sea duty assignment is given.

B. CURRENT PROGRAM

1. Sea Pay, Current use and Goals

Sea pay rewards cumulative sea duty. The more sea going experience an individual has, the more money they will make while on sea duty. The sea pay system recognizes experience and provides an incentive for personnel to stay on sea duty longer. A sea pay premium of \$100 per month was instituted to motivate first term sailors to complete their first sea tours at higher rates. First term sailors, typically, join the Navy for an initial four year enlistment. They start out at boot camp and, usually, attend an enlisted 'A' school before being assigned to a ship. By the time they get to their first ship, they have between six months and one year of active duty. The initial sea duty assignment is four years for most sailors, so, there is a mismatch between the sailors End

² Golding, H. and McArther, S. "Navy Sea Pay: History and Recent Initiatives".

of Active Obligated Service (EAOS) and the Projected Rotation Date (PRD). For sailors to finish their first sea duty assignment, they have to reenlist or extend on active duty. Sea pay has been adjusted to provide the proper incentive to get these sailors to extend.

The system and rates being used now have provided the Navy with the outcome the system was designed to create. More first term sailors complete their sea duty than before the system was changed. Some even stay on sea duty longer than their prescribed sea tours. This creates a more experienced work force at sea. As seen in Table 1, the sea pay table increases as pay grade increases and time served on sea duty increases.

Table 1. Sea Pay Table

	Years of cumulative sea duty									
Paygrade	≤ 1	> 1	> 2	> 3	> 4	> 5	> 6	> 7	...	> 18
E-1	50	50	50	50	50	50	50	50	...	50
E-2	50	60	75	75	75	75	75	75	...	75
E-3	50	60	100	100	100	100	100	100	...	100
E-4	70	80	160	280	290	290	290	290	...	390
E-5	70	80	160	280	300	315	325	350	...	450
E-6	135	135	160	280	300	315	325	350	...	550
E-7	135	135	160	305	320	350	350	375	...	600
E-8/E-9	135	135	160	305	320	350	350	375	...	620
a. Career Sea Pay Premium eligibility extended for all sailors under 8 years of cumulative sea duty, whereupon the additional pay becomes embedded in the sea pay table. (additional pay equals \$100 per month)										

2. Sea Pay's Influence on Sailors' Decisions

Sea pay does influence sailors' decisions; but, how much? In one study, the statistical analysis concluded that for every \$50 increase in sea pay 2.9 percent of sailors

extended on sea duty.³ This indicates that sailors will continue to stay on less desired duty for more money. The arduous nature of sea duty creates a need to provide incentives for sailors to volunteer for this duty. It also provides incentives to extend on sea duty.

Sea pay is the incentive package that allows the Navy to fill some sea duty billets through voluntarily extensions on sea duty. Without these voluntary extensions, the billets would be vacated earlier than originally anticipated and the Navy would have to fill them. More sailors are staying after the three year point due to the increase in sea pay associated with the sea pay premium. This helps the Navy by reducing the demand for new sailors at sea. The increased retention of sailors on sea duty has a direct impact on the demand placed on the recruiting community. By reducing this demand, the Navy saves money.

C. COST TO USE SEA PAY AS LOCATION INCENTIVE PAY

1. Sea Pay as a Location Incentive Pay

We have seen that sea pay can influence sailors' decisions. Now, how do we modify the sea pay system to continue to influence sailors to stay on sea duty and to choose the home port locations that are less desirable? First, this requires a look at where the sea duty locations are; how many billets are available in those locations; and, the desirability of the locations.

Initially all surface ships were accounted for and home port locations were determined. Each ship's crew size was determined from published data on the United States Navy's fact file web site.⁴ Total billets per location were determined from this data and then an interview was conducted with an Electrician Mate (EM) detailer to determine desirability of locations. The interview was conducted using pair wise comparisons of all duty locations. The EM detailer was chosen because this rate has

³ Golding, Heidi L. W. and Gregory, David Sailors' "Willingness to Complete Sea Tours: Does Money Matter?" p. 34.

⁴ United States Navy fact file web site www.chinfo.navy.mil/navpalib/factfile/ffiletop.html 15 Nov, 2005

personnel on every ship in the Navy at about the same rate per ship. The Detailer was asked to provide the easiest to fill location when given two locations. When two locations were compared the easiest to fill location was given a one and the other a zero. For example, in the table below, when Everett/Bremerton was compared to Ingleside; Everett/Bremerton was given a one and Ingleside a zero. When summed at the bottom of the table, each location had a desirability score. The highest score indicates the most desirable location. Likewise, the lowest score indicates the least desirable location.

Table 2. Pair Wise Comparison for E-1 to E-5

E-1 to E-5 EM	Everett / Bremerton, WA	Ingleside, TX	Mayport , FL	Norfolk / Little Creek, VA	Pascagoula, MS	Pearl Harbor, HI	San Deigo , CA	Japan
Everett / Bremerton, WA		0	1	1	0	1	1	0
Ingleside, TX	1		1	1	1	1	1	1
Mayport, FL	0	0		0	0	0	1	1
Norfolk / Little Creek, VA	0	0	1		0	1	1	1
Pascagoula, MS	1	0	1	1		1	1	1
Pearl Harbor, HI	0	0	1	0	0		1	0
San Diego, CA	0	0	0	0	0	0		0
Japan	1	0	0	0	0	1	1	
Desirability	3	0	5	3	1	5	7	4

In the initial part of the interview, the Detailer indicated that there are basically two types of individuals; junior and senior. The junior personnel are young, typically first term sailors, not married that want to travel; the senior personnel are typically married and prefer to stay in one location. The interview separated the two groups for the pair wise comparison. The two outcomes were combined with equal value given to each group. The equal value given to each group is an estimate based on the fact that the

dividing point is about when people get married; about 50 percent of the enlisted force is married.

From the pair wise comparison table it was assumed that the two middle locations are neutral and the three highest scoring locations are the most desirable and neither requires added incentive to be ordered to the locations. The three least desirable locations require incentive pay at different amounts. These amounts were determined by an estimated percent of people per location. For simplicity it was assumed that the least desirable location would have a deficit of 1 percent of the total population that would prefer to go to the most desired location. The second least desired location would have a deficit of .67 percent that would prefer to go to the second most desired location and the third least desired location would have a deficit of .33 percent that would prefer to go to the third most desired location. The opposite is true for the three most desirable locations, with positive values of 1.00, 0.67 and 0.33 percent respectively. From this the following table was produced.

Table 3. Percent of Desirability

	Difference E-1 to E-5	Difference E-6 to E-9	Total Difference
Everett/Bremerton, WA	-0.33%	0.00%	-0.33%
Ingleside, TX	-1.00%	-0.33%	-1.33%
Mayport, FL	0.67%	0.67%	1.33%
Norfolk/Little Creek, VA	0.00%	0.00%	0.00%
Pascagoula, MS	-0.67%	0.33%	-0.33%
Pearl Harbor, HI	0.33%	-0.67%	-0.33%
San Diego, CA	1.00%	1.00%	2.00%
Japan	0.00%	-1.00%	-1.00%

The percent location requested block in the Table 4 below is the outcome of the data in Table 3. Table 4 provides the number of billets per location and the total Navy wide. Some of the locations in Table 4 were not included in the pair wise comparison due to one of two factors. La Maddalena and Guam are considered neutral because they are already in the Assignment Incentive Pay program. Gaita, Italy has such a small

number of billets that it is considered neutral. Otherwise, Table 4 provides all of the results used to compute the cost of adjusting sea pay for an incentive location pay.

Table 4. Represents the number of billets per sea duty location and percent of billets per location with percent of sailors selecting locations.

	Enlisted Billets	Percent of total	*Percent location is requested	Desirability Premium
Everett/Bremerton, WA	6718	7.42%	7.09%	-0.33%
Gaeta, Italy	790	0.87%	0.87%	0.00%
Guam	1266	1.40%	1.40%	0.00%
Ingleside, TX	1464	1.62%	0.29%	-1.33%
La Maddalena, Italy	1266	1.40%	1.40%	0.00%
Mayport, FL	7275	8.04%	9.37%	1.33%
Norfolk/Little Creek, VA	37153	41.05%	41.05%	0.00%
Pascagoula, MS	736	0.81%	0.48%	-0.33%
Pearl Harbor, HI	3010	3.33%	3.00%	-0.33%
San Deigo, CA	22462	24.82%	26.82%	2.00%
Japan	8367	9.24%	8.24%	-1.00%
Total billets	90507	100.00%	100.00%	
* Percent is an estimate based on author's interview with EM rating detailee.				

The main issue is not whether one location is less desirable than another location, but whether locations are as desirable as the number of billets available in each location. There needs to be a balance of desirability with the number of billets available throughout the Navy. Take Ingleside for example; with the desirability premium of -1.3 percent, Ingleside would require detailers to slam a person into a billet because too few sailors will volunteer. Is this because Ingleside is less desirable than most other locations, or because it is not desirable to 1.6 percent of the Navy enlisted force? Every billet in Ingleside does not require detailers to slam people into them. The issue is that detailers have more billets available in Ingleside than they have people requesting to go to Ingleside. Ingleside has 1.6 percent of all sea duty billets, but less than 1.6 percent of the personnel want to go to Ingleside. To create neutrality, the number of people requesting a location must be the same as the number of billets available in that location. The question is: Can sea pay be modified to create neutrality among all of the sea duty locations?

Assume that all sailors realize they are going to have to go to sea duty somewhere and are willing to volunteer for orders to at least one location. Money can influence their willingness to stay on sea duty longer, so it should have an impact on their location preference. Assume that every \$50 extra per month a location can pay has a similar effect as with extensions on sea duty; for every increase of \$50 per month in sea pay for a location, one third of one percent of Navy personnel will change their preference to that location. This removes the type of ship and age of ship as factors in sailors' decisions. Based on the Table 4 information for desirability premium, Table 5 shows the required cost increase for each of the less desirable locations.

The sea pay changes would have no negative effect on the current sea pay system. The changes would create a volunteer for every billet available. No sailors would have to be slammed into a billet. The increase in pay would be enough to satisfy the sailors throughout their tour of duty. Sea pay would still influence sailors to extend on sea duty to complete their tours. Therefore, completion rates would remain the same and possibly increase due to sailors not having to be slammed into billets.

Table 5. Represents the cost of increasing sea pay to balance the number of billets per location with the number of sailors selecting each location.

	Enlisted Billets	**Sea pay increase per month	Same Sea Pay for All Sailors
Everett/Bremerton, WA	6718	\$50	\$4,030,800
Gaeta, Italy	790		
Guam	1266		
Ingleside, TX	1464	\$200	\$3,513,600
La Maddalena, Italy	1266		
Mayport, FL	7275		
Norfolk/Little Creek, VA	37153		
Pascagoula, MS	736	\$50	\$441,600
Pearl Harbor, HI	3010	\$50	\$1,806,000
San Deigo, CA	22462		
Japan	8367	\$150	\$15,060,600
Total	90507		\$24,852,600

However, this would not create neutrality among all sea duty billets. This model presumes that the balance was automatically obtained by providing extra money to the less desirable billets. There may still be a problem with the model. What if you now have less people requesting Mayport than you have billets? The analysis presented here

is based on a basic understanding of how money could influence sailors to voluntarily fill all sea duty billets in the Navy.

The concept is simplified in order to make generalizations, holding other unknown variables fixed. These variables are class of ship and age of ship preference, coast preference and job preference. There are also other factors that will influence sailors' decisions, such as, willingness to move and desire to travel. This project holds all variables fixed, while changing monetary compensation in order to determine the impact and feasibility of offering more money for less desirable billets. This model leaves very little room for error. The model has no flexibility, therefore, the next chapter will look at auctions as a possible monetary compensation system to alleviate the sea duty preference problem.

This system does not guarantee a volunteer for each billet, and may produce more than one volunteer for each billet. The market clearing price is not known for every location, therefore, the price that is set may be too high, producing several volunteers for a location, or too low, not producing enough volunteers for a location. Also, it provides sailors all the surplus value by paying everyone the cost to attract the marginal sailor. This is equitable, in that all sailors receive the same pay, but some will receive far more surplus value than others, and surplus to sailors is at the Navy's expense. The Navy needs to capture some of this surplus value while creating a volunteer for each billet. Auctions can provide a means to attract a volunteer for each billet and transfer some of the surplus value back to the Navy.

III. SEA DUTY LOCATION ASSIGNMENT INCENTIVE PAY

A. TYPES OF AUCTIONS

1. Forward Auction Theory

Auctions differ depending on the number of buyers and sellers. This information will determine the design of the auction. There are many designs which try to create the highest or lowest price for the person conducting the auction.

The most popular auction is the English forward auction. This is when one person has an item for sale and there are many potential buyers. The auctioneer continues to raise the price until only one buyer is left bidding. All the winning bidder has to do is bid one level higher than the next highest bidder's reservation price.⁵ "Thus the winner earns a profit: the winner pays less than the item is worth to him or her (because generally there will be a gap between the second-highest valuation and the highest valuation)."⁶ As long as the maximum bid is over the seller's reserve price, he will receive surplus value from the sale.⁷ Any bid between the seller's reserve price and the winning bidder's reservation price will produce surplus value to both the seller and bidder.

The Dutch Forward auction may be used when there is one seller and few potential buyers. With this style, the auctioneer starts with a price that is well over the reservation price of any of the potential bidders. As the price comes down, the bidder with the highest reservation price will presumably bid first and win. This style attempts to capture more surplus from the highest bidder. The highest bidder will try to estimate the other bidders' values and insure that he bids before they will. As long as the bid is over the seller's reserve price the seller will perceive surplus value from the sale. The bidder will receive surplus value that he or she was willing to except by bidding a predetermined amount under their reservation price.

⁵ Reservation price is the maximum price a bidder is willing to pay for an item.

⁶ McMillan, John. "Games Strategies and Managers" p. 136

⁷ Reserve price is the minimum price a seller is willing to take for the item.

First price sealed bid auctions are used to try to capture the maximum reservation price. The sealed bids are submitted during a specified time period and then they are all opened at the same time and the highest bid wins. This does not always generate the maximum price outcome desired. Some people shy away from sealed bid auctions or they don't actually bid their maximum reservation price by trying to guess what the other person's maximum reservation price is and bidding just over that amount. One way to insure that everyone bids their own maximum reservation price is the second price sealed bid auction. With this method, all the bids are collected and the highest bidder wins, but only has to pay the second highest price bid for the item. The optimum strategy is for each bidder to bid their true reservation price. This implies all bids are at their reservation price, but allows the highest bidder to retain some of the surplus value.

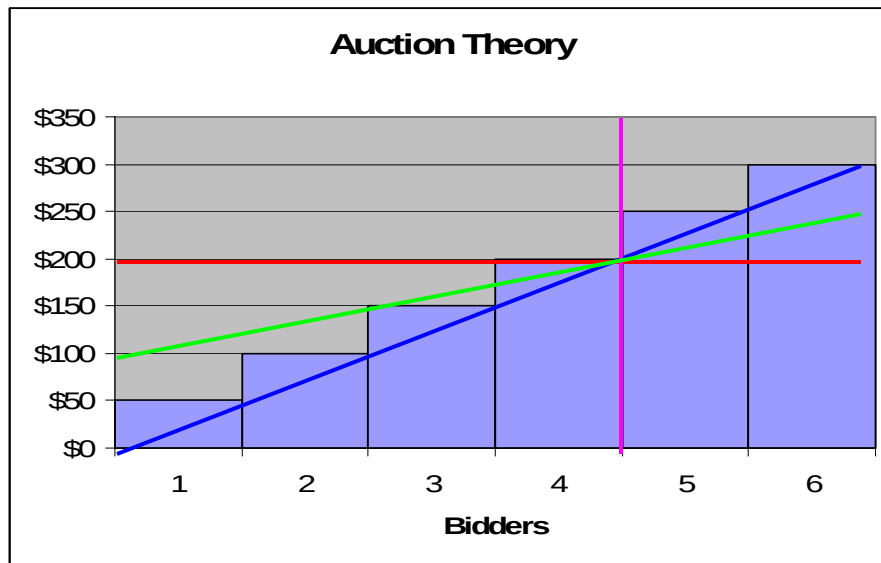


Figure 1. Auction bidding scenario.

Figure 1 shows the results from the different auction formats. A second price sealed bid auctions and English auction where everyone is paid the closing bid, the only workable solution for multi-item auctions gives you a result equivalent to the horizontal red line; everyone receives a payoff of 200 dollars. A first price sealed bid auction, where everyone is paid their bid would produce the diagonal blue line or the stair steps depending on the bid increments if everyone bids their reservation price. However, with a multi-item auction, bidders are not likely to bid their reservation price. In fact,

everyone will try to guess where the closing bid will fall (i.e. the diagonal blue line), and bid that. With perfect information, it would fall along the horizontal red line. All auctions would have the same outcome. With risk aversion, participants will bid closer to the diagonal/stair step. The real bidding should fall somewhere between the red and blue line, as depicted by the green line.

2. Reverse Auction Theory

In the reverse English auction, there are many sellers and only one buyer. Reverse auction reservation price is the lowest price a bidder is willing to take for the item or service and reserve price is the highest price the buyer is willing to pay for the item or service. The buyer will continue to lower the price until there is only one seller remaining. The object of the reverse auction is to get the lowest price for the buyer. Like the forward English auction, both the seller and buyer will perceive surplus value from this format.

The Dutch reverse auction is similar to the Dutch forward auction. The bidding starts well below the reservation price of any of the bidders and the first bidder wins. The first person to bid will win and receive the predetermined surplus value that they computed with the information they had. The seller will get surplus value as long as the winning bid is lower than their reserve price.

First price sealed bid reverse auctions are run the same way as forward first price sealed bid auctions. The exception is that reverse auctions take the lowest bidder. This is one of the ways in which the Navy does its contract bidding. The contractors will all be given the same information from which to create their bids and they have a specific time period to submit bids; the lowest bidder will win the contract.

Second price, sealed bid, reverse auctions try to take out the guessing factor that goes into the first price auctions. Most people involved in first price auctions don't want to bid at their reservation price. They receive no extra value from bidding in that manner. With the second price auction, they can bid at their reservation price and know that if they win, they will still receive some surplus value as they will receive the second lowest bidder's price, not their own.

3. Auction Design

When discussing auction design the first question is what are the goals of the auction? Auction designs are chosen based on their efficiency, effectiveness, equity and practicality. Efficiency is achieved if the auction is designed in a manner to create the best value for the auctioneer. This would mean assigning the most willing sailors to the less desirable billets. Effectiveness means that the Navy is paying the minimum price to fill all of the less desirable billets. Equity has two meanings; people going to the same less desirable location are getting the same pay is one way to view equity and the other is that people going to the same less desirable location are getting the same surplus value. The second meaning is the one economists use to view auctions and is the one in which this format should be viewed. Practicality is the question of whether the auction format will work in the real world.

Looking at the circumstances under which the auction would take place, the English and Dutch style auctions are not practical. The potential bidders are all over the globe and it would be nearly impossible to conduct an auction that requires all participants to be present simultaneously, even by getting them all in one chat room at the same time. Without guaranteeing that every interested party could participate, these auction formats would not be feasible.

The second price sealed bid auction would probably be good, but would require some auction education throughout the Navy. This format is not familiar to all people and may confuse them enough to not participate. The bidders might receive more surplus from this auction style, but the Navy would have higher costs, not just in the amount paid to the bidders but in the education and training costs associated with the auction format. This format would most likely not be as effective due to the lack of participation.

The first price sealed bid auction is the easiest to implement. The format is very understandable to all participants. The fact that there is a time frame in which to submit bids allows all interested parties to participate. The bidders understand that if they win they get what they bid. This format is simple and straight forward. This format is the best fit given all the criteria. Figure 1 shows the First price sealed bid is the best choice.

Figure 2 is set up as a red light chart. Green means the system is optimal for the category, yellow means it will produce good result for the category and red means it is not designed for this category. The AIP system is set up the same way and is working well.

	Efficient	Cost Effective	Equitable (Pay)	Equitable (Surplus)	Practical
Dutch (Ascending)					
English (Descending)					
<u>First-Price Sealed Bid</u>					
Second-Price Sealed Bid					

Figure 2. Auction Format Considerations⁸

B. CURRENT ASSIGNMENT INCENTIVE PAY PROGRAM

1. Assignment Incentive Pay Program Goals

Type 3 duty is, “duty performed in a land-based activity, which does not require members to be absent more than 150 days per year, but is credited as sea duty for rotational purposes only due to the relative undesirability of the geographic area.”⁹ This allows sailors to go overseas, instead of to a ship for sea duty. Sea duty credit has been used to attract personnel to overseas billets that otherwise would be difficult to fill. The Navy did not want to slam people into these jobs. The assignment incentive program was set up to convert overseas type 3 to type 6 duty. Type 6 duty is, “duty performed in

⁸ Coughlan, P., Dizon, R. and Gates, B. “Analysis of Separation Pay Options (Brief)” p. 18

⁹ MILPERSMAN 1306-102, BUPERS Web Site
“buperscd.technology.navy.mil/bup_updt/508/milpers/1306-102.htm” p. 1 20 Oct, 2005

overseas land-based activities, which are credited as shore duty for rotational purposes. Members are not required to be absent from corporate limits of their duty station in excess of 150 days per year.”¹⁰ By changing these billets, the Navy could get volunteers to fill the overseas shore duty billets without counting the billets as sea duty and would save money in the process.

“Assignment Incentive Pay has been initiated to ‘balance the playing field’ and attempt to make all assignments desirable to at least one qualified volunteer.”¹¹ With this in mind, the Navy set up reserve prices for different locations and allowed eligible candidates to bid for billets based on the amount of extra money per month the person would require to go to the billet. This system is set up like a reverse first price sealed bid auction. Eligible sailors can bid during the normal requisition cycle. No assignments are made to AIP billets during the requisition cycle. Results are posted on the Job Advertising and Selection System(JASS) following selection.

The Detailer will review all applications/bids at the end of the requisition cycle. He/she will take into account all the applicants’ qualifications, take-up month of the job, NEC reutilization, cost relative to other applicants for a particular job (including PCS costs and AIP total costs), and make a selection based on all factors. The general guidance is that the qualified member with the lowest bid will be selected. In cases where the Detailer feels there is a compelling reason not to follow these guidelines, he/she will be required to obtain Branch Head approval.¹²

2. Assignment Incentive Pay in Action

Assignment Incentive Pay (AIP) first started in June of 2003. Currently, 111 units have been changed from type 3 to type 6 duty. “AIP has been very successful. Since the pilot program began last June, more than 1,100 AIP bids have been processed, resulting in 238 sailors receiving an average of \$245 extra pay each month.”¹³ In November of 2003, the USS EMORY S. LAND in La Maddalina and the USS FRANK

¹⁰ MILPERSMAN 1306-102, BUPERS Web Site
“buperscd.technology.navy.mil/bup_updt/508/milpers/1306-102.htm” p. 1

¹¹ NPC Web Site “Assignment Incentive Pay – Business Rules.” p. 1

¹² NPC Web Site “Assignment Incentive Pay – Business Rules.” p. 3

¹³ CNO, “Force Shaping—Assignment Incentive Pay Expansion and Reclassification of Enlisted Type 3 Duty for Commands in Guam.” p. 1

CABLE in Guam were added to the AIP system. In Jan of 2005, some rating billets onboard the USS KITTY HAWK in Yokosuka, Japan were added to AIP. AIP is already being used in overseas sea duty location incentive situations.

The AIP system has proven capable of producing volunteers for less desirable billets. All billets are not created equal and the AIP system allows for a flexible incentive plan to augment the desirability of billets with increased monetary compensation. The flexibility of this system allows the Navy to produce one volunteer for every billet at the lowest possible price. As long as each billet has at least one qualified bidder, the system will be effective.

C. SEA DUTY LOCATION ASSIGNMENT INCENTIVE PAY METHODS

1. Sea Duty Location Assignment Incentive Pay (SDLAIP)

The system could be set up in many ways. There are two ways to bid on sea pay, one is to bid as a percent of sea pay and the other is to bid a dollar amount. Both systems would normally be set up to bid more than the normal amount of sea pay for less desirable locations; however, these systems could also be set up to bid less than a person's current sea pay for the more desirable billet locations. The bid increments could also be controlled; in the current AIP system, bids are collected in 50 dollar increments. This creates a step distribution. A step distribution could be set up with the percent of sea pay method by limiting bids to percent increments. Alternatively, bids could be set up to provide a continuous distribution by allowing bids of any dollar or percent increment. Figure 3 shows the step, continuous and straight sea pay method comparisons for one location with positive bids only.

The straight sea pay method requires that 200 dollars be paid to all sailors in the location to attract the marginal sailor and is depicted by the horizontal red line. This assumes that the marginal price is known and this will not create too many or too few volunteers for the location. The diagonal blue line is what sailors must receive to accept the billets. The area below this line is the minimum DoD must pay to get enough volunteers. The area between these two lines is the amount DoD can save if they find a

way to “price discriminate” and pay the reservation prices. The stair step shows what the Navy loses if they don’t fine tune and only allow bidding increments.

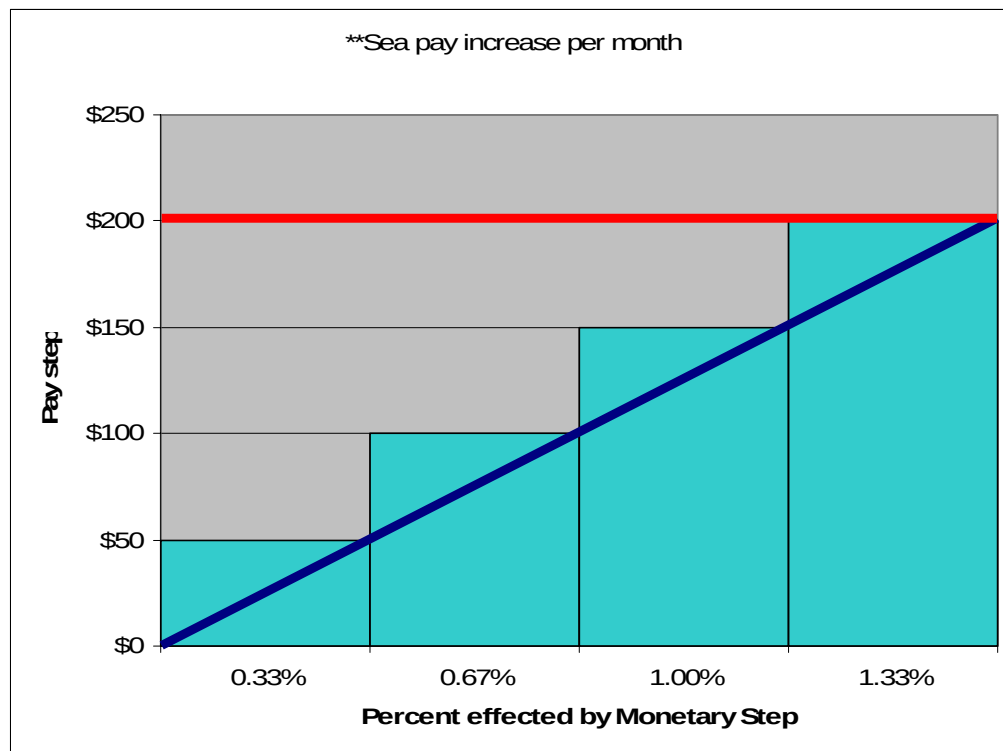


Figure 3. Step vs. Continuous vs. Straight Sea Pay For One Location
 Red line = Equal Pay for All sailors Blue line = Continuous Light Blue = Step

The system designs shown in this project fit the two extremes of the possible designs. The Sea Duty Location Assignment Incentive Pay – Lump Sum (SDLAIP-LS) method is set up as a step system with only positive dollar amounts in steps of 50 dollar increments and the Sea Duty Location Assignment Incentive Pay – Percent of Sea Pay (SDLAIP-%) method is set up as a continuous bid from 0 percent and up of sea pay (a bid of less than 100 percent would reduce the member’s sea pay to obtain a desirable billet). These two methods are chosen to show the two extremes of the possible system design choices. Figure 2 shows the SDLAIP systems as step and continuous should look according to the auction theory. In real world practice it is anticipated that the distribution will be close to this but not necessarily the same.

2. Sea Duty Location Assignment Incentive Pay – Lump Sum Method (SDLAIP-LS)

This method of assigning personnel to sea duty locations would offer a premium to the current sea pay system. The system would be similar to the current AIP system in that each location would set a maximum bid and candidates would be able to bid to the maximum bid level on a sea duty billet in that location. The bidders could bid only for the least desirable billets and only in \$50 increments. Just like the AIP system, the lowest bidder would win and receive orders with the extra pay that he or she bid.

With this system, the less desirable billet locations would have to be identified and only those billets would be eligible for with SDLAIP-LS. The most desirable billets would not be affected. There would still be a discrepancy between the most desirable billets and the average billets. This system would not balance the distribution system across all sea duty billets. This would not create neutrality throughout the distribution system. However, it would create a volunteer for every sea duty billet available.

3. Sea Duty Location Assignment Incentive Pay - Percent of Sea Pay Method (SDLAIP-%)

The system could be set up as a bid from 0 percent and up of the current sea pay table. This system would allow individuals who want the more desirable sea duty locations to forfeit some or all of their sea pay to get the location by bidding between 0 and 100 percent. An individual that is trying to homestead in Mayport, FL may be willing to give up all of his or her sea pay in order to get orders to Mayport. This system could be set up for every sea duty location in the Navy. The added benefit is that it should act as an automatic balancing of the distribution system across all sea duty billets. This would create a neutral distribution system which would allow the Navy to know which locations are most and least desirable.

This system would also have the added benefit of not letting sea pay diminish in its ability to keep sailors in sea duty billets. Over the years, a set sea pay compensation system is diminished by inflation. “In the late 1990s, two factors led the Navy to reevaluate sea pay. First, sea pay was becoming less effective as a distribution tool. Sea

pay had lost about 40 percent of its value to inflation since the last pay change.”¹⁴ The value of a dollar today is more than the value of a dollar tomorrow. The percent of sea pay system should automatically adjust with the perceived value. Hypothetically, the percentages of sea pay bid would increase as the value of money decreases. Eventually, the base table would have to be adjusted up as less and less bidders are received on some of the most desirable billets. Otherwise, the system would self adjust with the market fluctuations.

This system provides the best of both worlds, as pointed out in one article:

Sea pay and AIP are not directly comparable, and sailors’ response to sea pay could be higher because of its design. Sea Pay depends on cumulative years of sea duty. Extending a sea tour today leads to higher income today and in the future. Consequently, sailors are responding not only to today’s sea pay income but to the future stream of sea pay. AIP, however, is a set monthly amount, not dependent on whether a sailor filled an undesirable billet previously.¹⁵

By having sailors bid as a percent of sea pay means that sailors will be bidding on today’s sea pay income and future stream of sea pay. As a location incentive, this would provide a volunteer for every sea duty billet and an added incentive to stay in that billet as sea pay increases based on total sea duty served. A sailor would always receive the same percent of his or her sea pay as the sea pay adjusts to the amount of time the sailor has accumulated on sea duty.

D. COST TO USE SDLAIP TO BALANCE SEA DUTY PREFERENCES

1. Cost of Sea Duty Location Assignment Incentive Pay – Lump Sum Method (SDLAIP-LS)

Based on the analysis conducted for sea pay changes, the billets requiring more pay will be the same. The difference is that with SDLAIP, only a small percentage of the billets at each location will have to be paid extra money. For every duty location, there are some people who will volunteer with no extra incentive. SDLAIP will be able to

¹⁴ Golding, H and McArver S “ Navy Sea Pay: History and Recent Initiatives.” p. 23

¹⁵ Golding, H and Gregory, D “Sailors’ Willingness to Complete Sea Tours: Does Money Matter?” p. 37

capture these people at no extra cost. It will also be able to obtain all other volunteers at their lowest value.

Figure 1 shows that with this method the first .33 percent of people requiring extra money to take orders to the location will only be paid \$50 per month extra. If all of the billets for this location are still not filled, the amount should automatically adjust up at \$50 increments for every .33 percent of personnel needed. This allows the Navy to pay the minimum amount to fill each billet voluntarily.

Table 6. Cost of applying AIP to the harder to fill sea duty locations.

	Enlisted Billets	Difference	**Sea pay increase per month	Step AIP Cost
Everett/Bremerton, WA	6718	-0.33%	\$50	\$179,204
Gaeta, Italy	790	0.00%		
Guam	1266	0.00%		
Ingleside, TX	1464	-1.33%	\$200	\$1,808,330
La Maddalena, Italy	1266	0.00%		
Mayport, FL	7275	1.33%		
Norfolk/Little Creek, VA	37153	0.00%		
Pascagoula, MS	736	-0.33%	\$50	\$179,204
Pearl Harbor, HI	3010	-0.33%	\$50	\$179,204
San Deigo, CA	22462	2.00%		
Japan	8367	-1.00%	\$150	\$1,084,998
Total	90507			\$3,430,939

This system assumes that the first .33 percent of billets needed can be produced by the first 50 dollar increment. The rest of the billets needed to be filled will be in one .33 percent per 50 dollar increment. SDLAIP is computed by multiplying the total sea duty billets by the percent per increment, then by the amount per increment and, finally, by 12 to covert cost into an annual cost. The following equation is an example for Ingleside, TX.

$$((.0033 * \$50) + (.0033 * \$100) + (.0033 * \$150) + (.0033 * \$200)) * 90507 * 12 = \$1,808,330$$

The location premium for Ingleside is negative 1.3 percent. This means that less people request a billet in Ingleside than the amount of billets available. This requires a

SDLAIP incentive to balance the location premium. With the estimated influence of monetary compensation, the cost is computed for the first 0.33 of a percent at 50 dollars, the second 0.33 of a percent at 100 dollars, the next 0.33 of a percent at 150 dollars and the last 0.33 of a percent at 200 dollars. The estimates are then adjusted to annual amounts by multiplying by 12. The final estimate is the annual cost to balance the available billets with the billets requested.

2. Cost of Sea Duty Location Assignment Incentive Pay Percent of Sea Pay Method (SDLAIP-%)

Using this system may create complications with the estimation of cost. The first assumption is that it would be more cost effective than even the SDLAIP-LS. This system would not only allow personnel to compete for hard to fill billets, but it would allow them to compete for highly desired billet locations. When bidding from 0 to 200 percent on all sea duty jobs, the sailors may actually create a neutral bidding system. This type of system may not cost the Navy any extra money at all. However, it is less likely that a sailor would be willing to give up money to get a location of choice when there is another location available that would not require any sacrifice of money or would pay a premium. The hypothetical cost is estimated in Table 7.

There are two ways that SDLAIP-% improves cost efficiency. By allowing sailors to bid for more desirable locations by forfeiting some sea pay the Navy saves money. The system would also lower the overall cost of people bidding up their sea pay for less desired billets because they will not be locked into a step bidding system. The ability to bid in percentages allows the system to be more flexible. The system would become a straight line from zero dollars to whatever the maximum bid is to get the last billet filled, as shown in Figure 1.

Table 7. Hypothetical Cost for Percent of Sea Pay Method

	Enlisted Billets	Difference	**Sea pay increase per month	Continuous Percent of Sea Pay
Everett/Bremerton, WA	6718	-0.33%	\$50	\$90,416
Gaeta, Italy	790	0.00%		
Guam	1266	0.00%		
Ingleside, TX	1464	-1.33%	\$200	\$904,165
La Maddalena, Italy	1266	0.00%		
Mayport, FL	7275	1.33%		-\$452,082
Norfolk/Little Creek, VA	37153	0.00%		
Pascagoula, MS	736	-0.33%	\$50	\$90,416
Pearl Harbor, HI	3010	-0.33%	\$50	\$90,416
San Deigo, CA	22462	2.00%		-\$949,373
Japan	8367	-1.00%	\$150	\$542,499
Total	90507			\$316,458

By adjusting and reducing the value of the incentive in the equation to half, it captures the average value needed by all persons in the relevant range of the step. In the SDLAIP-LS system, this is a step bid of 50 dollars. Any person that requires 51 dollars to take a billet will have to bid 100 dollars. With SDLAIP-%, the person can bid a percent of sea pay that will increase the sea pay by 51 dollars. In order to estimate the average cost per step, assume a uniform distribution per step; dividing the step cost by two captures the most likely cost of the SDLAIP-% method. With this assumption, the previously used equation for SDLAIP-LS would be changed to the following.

$$((.0033 * \$25) + (.0033 * \$50) + (.0033 * \$75) + (.0033 * \$100)) * 90507 * 12 = \$904,165$$

For the most desirable billets, the amount of money that would be forfeited is estimated to be less than the amount people are willing to accept for less desirable billets. The thinking is that half as many people would be willing to forfeit money to get the location of choice. Hence, the following equation pertains to Mayport, FL.

$$[(.0033 * \$25) + (.0033 * \$50) + (.0033 * \$75) + (.0033 * \$100) * 90507 * -12] / 2 = \$ - 452,082$$

The equation is similar to the one for Ingleside. The equation is changed to make it negative by multiplying by a negative 12 to convert to an annual amount. The equation

is then divided by two in order to account for the assumption that half as many people would forfeit money to get choice orders as would be willing to receive extra money to receive less desirable orders. This is a cost benefit to the Navy. By allowing some sailors to forfeit money to compete for the most desirable billets the Navy can offset the cost of assigning people to the less desired billets. The overall outcome is a cost lower than that for sea pay adjustment and SDLAIP-LS.

IV. COST COMPARISONS AND ESTIMATED SAVINGS

A. RETENTION COSTS ASSOCIATED WITH INVOLUNTARY ASSIGNMENT

In a study conducted by the Center for Naval Analyses, the retention costs for involuntary assignment to shore duty locations were computed. For the purposes of this paper, adjustments were made for the number of total applicable billets. Otherwise, all other calculations are the same. The study looked at the required Selected Reenlistment Bonuses (SRB) needed to offset the drop in retention of people sent involuntarily to billets. The number of billets considered in the study for scenario 1 and 3 was 28,850 and for scenarios 2 and 4 was 34,500. Scenarios 2 and 4 include overseas type 3 billets. The number of billets for this study is 90,507. The data from the study is a straight ratio based on the number of billets available. The following table is the adjusted data from the CNA study.

Table 8. Cost of Involuntary Assignment¹⁶

Cost scenario	SRB cost to alleviate retention effect		
	Initial enlistee	Careerist	Total
1: Least preferred locations (CONUS shore duty)	0	\$24,200,000	\$24,200,000
2: Least preferred locations (all duty types)	\$9,400,000	\$28,100,000	\$37,500,000
3: Involuntary assignment (CONUS shore duty)	\$42,700,000	\$25,700,000	\$68,400,000
4: Involuntary assignment (all duty types)	\$64,500,000	\$38,000,000	\$102,600,000

¹⁶ Christensen, Eric, Golding, Heidi and Houck, Lynda. "Hard-to-Fill Billets, Individual Assignment Preferences, and Continuation." p. 40

Scenario 1 calculates retention costs of sailors ordered to the least preferred CONUS locations. Scenario 2 calculates retention costs of sailors ordered to the least preferred CONUS locations plus the type 3 overseas shore duty locations. Scenarios 3 and 4 are the same as scenarios 1 and 2 respectively, except they assume that all sailors selected for billets at 6 months are getting assignments that they do not prefer to have. Essentially, the number of involuntarily assigned personnel has gone up drastically in scenario 3 and 4.¹⁷

This table provides an estimate of what it would cost to eliminate retention reductions due to involuntary assignment. Using this data as a starting point, all other costs will be compared and assessed. Each of the assignment systems in this study would produce a volunteer for every available billet. With the implementation of any of these systems, there would be no involuntary assignment, eliminating the reduction in retention.

The study has four sections, least preferred locations (CONUS shore duty), least preferred locations (all duty types), involuntary assignment (CONUS shore duty), and involuntary assignment (all duty types). The involuntary assignment (all duty types) is the most applicable section for use with this study. The costs associated with this section will represent the savings from producing at least one volunteer for every available billet in the less desirable sea duty locations.

B. TOTAL SAVINGS FROM ALL INCENTIVE PAY SYSTEMS

1. Savings from Location Sea Pay

Estimated savings will be based on scenario 2 numbers. This scenario best mirrors the sea duty locations available in this study. Scenario 4 over estimates the number of people receiving orders they do not prefer.

The cost of adjusting sea pay is estimated to be approximately \$24.9 million. The estimated savings would be approximately $\$37.5 - \$24.9 = \$12.6$ million. This scenario

¹⁷ Christensen, Eric, Golding, Heidi and Houck, Lynda. "Hard-to-Fill Billets, Individual Assignment Preferences, and Continuation." p. 39-41

predicts that retention will be the same for preferred billets as for the less desirable billets after all billets are filled with volunteers. This may not be the true outcome of the change.

There is a savings from adjusting sea pay to create volunteers for every sea duty assignment. This savings is based on a study that shows sailors who volunteer for assignments will have higher retention. Increased retention produces savings through reduced recruiting demands, reduced training of new personnel and eliminates out processing of personnel leaving the Navy.

2. Savings from SDLAIP-LS

The SDLAIP costs are estimated to be approximately \$3.4 million if sailors bid their reservation price. This would create a net savings of approximately \$33.1 million. The savings is larger than that of the location sea pay system. SDLAIP can produce volunteers more efficiently than the location sea pay system. The retention savings are the same. The cost of the incentive system is where SDLAIP has the advantage over location sea pay.

3. Savings from SDLAIP-%

The cost of the SDLAIP-% is approximately \$0.3 million again if sailors bid their reservation price. This produces a net savings of approximately \$37.2 million. This is \$24.6 million better than the location sea pay system and \$3.1 million better than the SDLAIP-LS system. Hypothetically, this is the most efficient system design. This system produces its savings from eliminating the step bidding system of the two former systems and allowing people to compete for the most desirable billets by forfeiting all or part of their sea pay.

This is obviously the most economical of all of the systems. The problem is that this is hypothetical. No research has been conducted on how people would react to paying for a preferred billet. They may not be willing to pay anything for any billet. The Navy's ability to institute a system similar to this is also an issue. The current pay system

is not very flexible and may not be able to handle computing sea pay as a percent for multiple people.

V. CONCLUSIONS, RECOMMENDATIONS AND AREAS FOR FURTHER RESEARCH

A. CONCLUSION

SDLAIP is the most efficient means to get at least one volunteer for every sea duty billet. The current AIP system proves that people will select a less desirable location in order to make more money. This provides evidence that people can be influenced to choose orders based on monetary incentives.

The estimate that .33 of a percent of all sailors could be influenced to change homeport selection based on a \$50 a month increase in sea pay is based on results for extending sea duty; this may or may not hold for sea duty location preferences. This estimate was used to illustrate the effectiveness of the system. Keeping this assumption the same for Location Sea Pay, SDLAIP-LS and SDLAIP-% allows for a fair comparison. The SDLAIP-% provided the most cost effective means to capture a volunteer for every billet. The AIP concept can be applied to this situation.

The fact that people will react to monetary compensation is clear. The amount of monetary compensation is in question. Each person has a different utility level for money and location desired. These differences can be readily adjusted with SDLAIP and cannot be readily adjusted with direct changes to sea pay by location. Not only is Location Sea Pay inflexible, but there is no way to know the amount of pay required to capture a volunteer for every billet. The system could under or over value the billets and create an imbalance. This system would not work because once a price is set for a location it would be very hard to change.

B. RECOMMENDATION

Design a SDLAIP-LS system for all hard to fill sea duty billets. Base the research for this system on the AIP billets onboard the USS KITTY HAWK; USS EMORY LAND; and the USS FRANK CABLE. These ships can provide information on how the current system is working for sea duty. This would be the quickest way to implement a

location sea pay system. The sailors are familiar with the system and would easily accept this type of system.

C. AREAS FOR FURTHER RESEARCH

Further research is recommended prior to trying to implement a system for the most desired locations. There is no data currently available to indicate that sailors would be willing to give up sea pay to receive orders to a more desirable billet location. This would require some research to establish limits and thresholds. The impact on retention and morale would have to be analyzed. During the course of this research no data has been found to imply that the Navy has ever asked people to give up money to receive their location of choice. This would seem to be a whole new area to research.

The cost savings analysis would need to be reworked with real data for retention of individuals involuntarily assigned to sea duty billets. The data used from the shore duty research should be close but may not be perfectly accurate. Due to the arduous nature of sea duty the savings may be more when sea duty data is used.

Duty location preference data could be better acquired by submitting a Navy wide survey. A survey would be the best way to determine duty preferences and the required monetary compensation to change those preferences. A survey would be the best way to get both monetary levels of compensation for less desirable locations and forfeit of pay to receive orders to the most desirable locations.

LIST OF REFERENCES

Christensen, Eric W., Golding, Heidi L. W. and Houck, Lynda G. "Hard-to-Fill Billets, Individual Assignment Preferences, and Continuation." Alexandria, Virginia: Center for Naval Analyses (2002)

CNO. "Force Shaping—Assignment Incentive Pay Expansion and Reclassification of Enlisted Type 3 Duty for Commands in Guam." Washington DC: NAVADMIN Message 012119Z MAR (2004)

Coughlan, Pete, Dizon, Reggie and Gates, Bill. "Analysis of Separation Pay Options" (power point brief). Monterey, California: Naval Postgraduate School (2005)

Gardner, Roy. "Games for Business and Economics." New York, New York: John Wiley & Sons, Inc. (1995)

Golding, Heidi L. W. and Cox, Gerald E. "Design and Implementation of AIP." Alexandria, Virginia: Center for Naval Analyses, 2003.

Golding, Heidi L.W. and David Gregory. "Sailors' Willingness to Complete Sea Tours: Does Money Matter?" Alexandria, Virginia: Center for Naval Analyses, 2002.

Golding, Heidi L.W. and David Gregory. "Sea Tours and Sea Pay: Patterns in Sailors' Completion and Extension of Sea Duty." Alexandria, Virginia: Center for Naval Analyses, 2001.

Golding Heidi L.W. and Henry S. Griffis. "Analysis of Proposed Sea Tour Extension Program. Alexandria, Virginia: Center for Naval Analyses, 1999.

Golding, Heidi L.W. and Henry S. Griffis. "Options for Sea Pay Reform." Alexandria, Virginia: Center for Naval Analyses, 1998.

Golding, Heidi L.W. and Henry S. Griffis. "Outsourcing Initiatives, Tour Lengths, and a Sea pay Premium." Alexandria, Virginia: Center for Naval Analyses, 1998.

Golding, Heidi L.W. and McArver, Susan C. "Navy Sea Pay: History and Recent Initiatives." Alexandria, Virginia: Center for Naval Analyses, 2001.

Golfin, Peggy A, Lien, Diana S. and Gregory, David. "Evaluation of the Assignment Incentive Pay (AIP) System." Alexandria, Virginia: Center for Naval Analyses, 2004.

Hattiangadi, Anita U. and Martha E. Koopman. "Do the Services Need a Deployment Pay?" Alexandria, Virginia: Center for Naval Analyses, 2001.

Klemperer, Paul. "What Really Matters in Auction Design." Oxford, England: Journal of Economic Perspectives-Volume 16, Number 1-Winter 2002-pages 169-189.

Logemann, Karsten. "Sensitivity analysis for an assignment incentive pay in the United States Navy enlisted personnel assignment process in a simulation environment." Monterey, California: Naval Postgraduate School, 2004.

Mainor, Walter C., Moreno, Jesus S. and Pinkston, Antonio. "Alternative Assignment Incentive Pay Formats." Monterey, California: Naval Postgraduate School, 2005.

McAfee, Preston R. and McMillan, John. "Auctions and Bidding. Ontario, Canada: Journal of Economic Literature Vol. XXV" (June 1987), pp. 699-738.

McMillan, John. "Games Strategies and Managers." Oxford, England: Oxford University Press, 1992.

Milgrom, Paul. "Auctions and Bidding: A Primer." Stanford California: Journal of Economic Perspectives-Volume 3, Number 3-Winter 1989-pages 3-22.

Naval Web Site Publication. "MILPERSMAN 1306-102"
www.buperscd.technology.navy.mil/bup_updt/508/milpers/1306-102.htm

Naval Web Site Publication. "Assignment Incentive Pay Business Rules." Bupers Pers401 Web Site. www.staynavy.navy.mil 12 Oct, 2005

Pinkston, Antonio, Mainor, Walter C. and Moreno, Jesus S. "Alternative Assignment Incentive Pay Formats" Monterey, California, 2005.

Secretary of the Navy. "SECNAV Instruction 7220.77D: Career Sea Pay and Career Sea Pay Premium." Washington DC: Office of the Secretary of the Navy, 1996.
http://www.neds.daps.dla.mil/Directives/7220_77d.pdf 10 Sep, 2005

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