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The West Point Housing Assignment System

Anthony Bianchi, James Callaway, Nolan Cockrill, Markus Hartman, Tyler Olbrich, and Gunner Philipp

Department of Systems Engineering
United States Military Academy
West Point, NY 10996

Corresponding author's Email: anthony.bianchi@westpoint.edu

Author's Note: Cadet Callaway, Cadet Cockrill, Cadet Hartman, Cadet Olbrich, and Cadet Philipp are seniors at the United States Military Academy (USMA) participating in a year-long capstone project under the direction of Colonel Anthony Bianchi. These Cadets will commission into the United States Army as Second Lieutenants on May 21st, 2022. Cadets Callaway, Cockrill, and Hartman will commission into the Infantry branch and Cadets Olbrich and Philipp will commission into the Field Artillery branch. The client for this project is the United States Army Garrison, West Point, with the main point of contact being the Garrison Commander, Colonel Evangeline Rosel. The team is very thankful for the support they received from the client, the various stakeholders across West Point, and their advisor.

Abstract: West Point is the longest continuously occupied military post in the United States. As an active Army installation, West Point must provide housing options for assigned uniformed and authorized civilian personnel. Due to West Point's small cantonment area size in comparison to other Army installations, a limited number of houses, and the increasing personnel demand over time, West Point struggles with allocating on-post housing efficiently resulting in lengthy waitlist times. The garrison at West Point asked the Cadet capstone team to provide a housing assignment system recommendation that positively impacts the efficiency of the housing assignment process at West Point. After a thorough analysis, the capstone recommends reducing the key and essential list size and expanding the field grade officer housing rank band. In lieu of building more on-post housing, the team's recommendation provides the Garrison with an immediate course of action to slightly alleviate waitlist time for personnel awaiting on-post housing.

Keywords: Garrison, On-Post Housing Allocation, Installation Management, West Point Housing

1. Introduction

U.S. Army Garrison West Point (USAGWP) is the longest continuously occupied military post in the United States. First occupied by George Washington's Continental Army on January 27th, 1778, West Point is home to the United States Military Academy (USMA), a four-year federal service academy (Crackel, 1991). The United States Military Academy's mission is "to educate, train, and inspire the Corps of Cadets so that each graduate is a commissioned leader of character committed to the values of Duty, Honor, Country and prepared for a career of professional excellence and service to the Nation as an officer in the United States Army." Since the Academy's founding in 1802, the Garrison's support allowed the Academy's faculty and staff to fulfill this mission. In addition to USMA and the West Point Garrison, other major tenants that have housing requirements for their personnel are the USMA Preparatory School (USMAPS), Keller Army Community Hospital (KACH), Dental Activity Clinic (DENTAC), and the Army West Point Athletic Association (AWPAA).

As an active Army installation, West Point must provide housing options for assigned uniformed and authorized civilian personnel. Due to West Point's small cantonment area size in comparison to other Army installations, a limited number of houses, and the increasing personnel demand over time, West Point struggles with allocating on-post housing efficiently resulting in lengthy waitlist times. Many other factors affect this problem, including the poor off-post housing market, increased demand of military personnel wanting to send their children to the on-post Department of Defense Education Activity (DoDEA) school, the geographic location and the winter weather locale of West Point and its adverse effect on commuting, Residential Communities Initiative (RCI) Partnership rules, Permanent Change of Station (PCS) and House Hold Goods (HHG) delivery timelines, Army and USMA regulations, and the designation of key and essential (K&E) personnel. This article will summarize the capstone team's work culminating with a final recommendation for the client.

2. Problem Statement

Provide U.S. Army Garrison West Point with a near-term housing assignment system recommendation that reduces the amount of time a prospective resident remains on the waitlist.

3. Background

The capstone team's client for this project is USAGWP's Commander, Colonel (COL) Evangeline Rosel. As the Garrison Commander, COL Rosel is ultimately responsible for managing and providing base operations support (BOS) to West Point, including housing, infrastructure maintenance, utilities, security, and quality of life programs. As the integrator of resources across the West Point, COL Rosel must balance the guidance she receives from USMA's Superintendent, Lieutenant General (LTG) Darryl Williams, who is the Senior Mission Commander (SMC), with the directives she receives from the Commander, U.S. Army Installation Management Command (IMCOM). With an emphasis on bettering the housing assignment process, COL Rosel asked the capstone team to determine a more efficient method of housing allocation that enables more personnel the opportunity to live on post and reduce a service member's time on the housing waitlist.

Army Regulation (AR) 420-1 Housing Management provides the regulations that govern housing operations across the Army enterprise. This regulation gives the Garrison Commander the authority to designate housing for personnel by pay group (Department of the Army [DA], 2012). The term "rank bands" refers to the grouping of these pay groups into specified neighborhoods. Additionally, Chapter 3-99 states that the Garrison Commander may designate specific homes to key positions on the installation. Finally, Chapter 3-16 gives the Garrison Commander the authority to establish a waiting list for housing (DA, 2012). West Point currently utilized a housing waitlist based on seniority by rank. However, certain positions hold a "key and essential" designation that gives those positions priority on the waitlist. Currently, West Point's K&E list includes 227 positions.

Many outside factors drive on-post housing demand at West Point, creating an on-post housing shortage. To help frame this problem, the capstone team researched several areas affecting on-post housing demand. First, prospective tenants seek to live on post due to the high-quality education provided through West Point's DoDEA schools. According to the Department of Education, the Army pays approximately $24,919 in tuition for each student that attends a West Point DoDEA school (DoEd, 2021). West Point personnel must either live on-post or be listed on the on-post housing waitlist to send their children to West Point's DoDEA schools. Another major factor that drives West Point's on-post housing demand is Orange County's highly contested and expensive real estate market. According to Redfin, a reputable online real estate brokerage company, home prices in Orange County rose 13.6% since September of 2020. Additionally, the median price of a home in Orange County is $350,000 (Redfin, 2021). One final factor that drives West Point's on-post housing is the area's mountainous terrain and winter weather. These conditions often prevent off-post personnel from commuting to West Point during snowstorms, thus increasing the desire to live on post.

In 2008, West Point signed a $207 million contract with community development contractor Balfour Beatty Communities (BBC) as part of the US Army's initiative to privatize housing on installations. This contract turned over the Garrison's housing landlord management and maintenance responsibility to Balfour Beatty ("Balfour Beatty Communities", 2008). Currently, Balfour Beatty oversees 820 houses on the post. While the company generally operates as intended, many on-post tenants complain about Balfour Beatty's reliability with maintenance services and low-quality construction. Additionally, in December of 2021, BBC pleaded guilty to committing fraud against the U.S. government by falsifying performance data to earn incentive fees from the Department of Defense (DoD). BBC now operates under a three-year probation status and receives increased scrutiny through government oversight (Roza, 2021). BBC's ability to "turnover" a house between tenants in a timely manner is another factor that contributes to increased time on the housing waitlist.

4. Methodology

The capstone team used the West Point Department of Systems Engineering's Systems Decision Process (SDP) to frame the West Point Housing Assignment System. The SDP is a collaborative, iterative, and value-based decision process that can be applied in a system life cycle stage (Parnell et al., 2010). Displayed in Figure 1, the SDP consists of four steps: problem definition, solution design, decision making, and solution implementation.

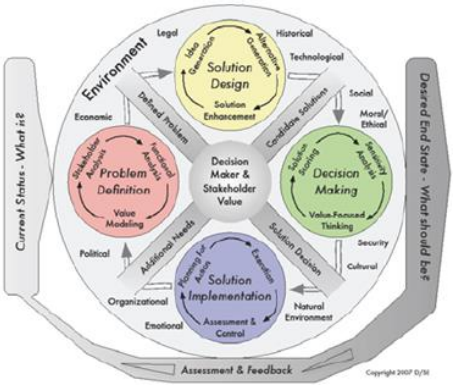

Figure 1. The Systems Decision Process

The problem definition phase consists of conducting stakeholder analysis, functional analysis, and value modeling to develop a redefined problem statement. For this phase, the capstone team held interviews with various key stakeholders and conducted a literature review to develop a thorough understanding of the problem. With this research, the team briefed Colonel Rosel on the redefined problem statement. Additionally, the capstone team generated several values measures with associated value functions and weights to assess potential candidate solutions. The value functions quantify the various units of measure of the value measures into one single metric, value, based on the stakeholder's needs. Additionally, the team generated weights for each of these value measures based on COL Rosel's priority of importance, displayed in Figure 2. Colonel Rosel's approval of the outputs of the problem definition phase enabled the team to transition into the solution design phase.

Value Measure	Less or More is Better	Swing Weight	Measure Weight
Waitlist Time (Days)	Less	95	0.49
Key and Essential List Size (# Positions)	Less	70	0.36
Field Grade Rank Band (# Houses)	More	30	0.15

Figure 2. Swing Weight Matrix

The solution design phase includes idea generation, alternative generation, and solution enhancement. This phase's goal is to develop multiple candidate solutions for the client to review. In the solution design phase, the team developed a Zwicky's morphological box, Figure 3, for mixing and matching system attributes into multiple candidate solutions.

K&E List Size	Non-K&E Civilian Eligibility for On-Post Housing	Field Grade Eligible Housing Capacity	Mixed Rank Housing Number
Status Quo (227)	Status Quo (Yes)	Status Quo (621)	Status Quo (347)
Half of TAC Officers & NCOs and no ELDP (173)	No	Old Brick FGO Eligible (645)	Stony 1 Mixed Rank (502)
No TAC Officers, TAC NCOs, or ELDP (134)			

Figure 3. Zwicky's Morphological Box

After finalizing the candidate solutions, the capstone team used ProModel to construct a simulation of the system. This simulation included accurate arrival rates of tenants, housing inventory by neighborhood, and several other factors that constrain the current environment. The initial model resembled a baseline of the current environment, providing accurate

baseline data for examining how the candidate solutions impact the overall environment. By adjusting the baseline model, the capstone team created several alternative models that resemble each candidate solution and its differences from the baseline.

The next phase of the process, decision making, includes solution scoring, sensitivity analysis, and value-focused thinking. During this phase, the capstone team used the collected data from each candidate solution's simulation and gave the solution an overall score using the value measures approved by Colonel Rosel. Decision making concluded when the capstone team selects the best candidate solution to recommend to Colonel Rosel. The last step of the process is Solution Implementation, which includes planning, execution, and control of solution implementation. The scope of this project did not involve the capstone team completing this step of the SDP.

5. Analysis & Results

The group used ProModel, a simulation-based predictive and prescriptive analytic software, to create a representative simulation of West Point's housing assignment system. With these simulations, the team chose to minimize the waitlist time as the primary objective. The team used data provided by Ms. Teri Brown of the West Point Housing Office to determine housing inventory, tenant occupancy duration by rank band, and demand by rank band. The team created a "status quo" simulation that shows that system in its current state. Based on the output from the status quo simulation, the team determined the largest cause of delay occurs due to the field grade rank band demand and the K&E list size. Based on these issues, the team generated several candidate models to test against the status quo model. Figure 4 contains all candidate solutions the team used, including the status quo, along with their simulation's output.

When constructing the model, the capstone team assumed the West Point Housing Office's data accurately reflects the system in its current state. The group used this data to set the model's baseline personnel distribution by rank band, average tenant occupancy time, and housing availability parameters. The model ignored general officers' quarters due to their negligible effect on the overall system. Additionally, the model assumes that West Point's single soldier barracks are habitable, given their expected renovation completion date of December 2022. Finally, the model cannot account for delayed departure time due to the extraneous circumstances involved when tenants stay in their on-post house longer than their PCS departure date; the model assumes that all tenants depart the system when ordered. The team used ProModel to run 100 replications for each candidate solution to reduce the model's uncertainty due to the random distributions that govern arrival time.

Candidate Solution #	K&E List Size	Non-K&E Civilian Eligibility for On-Post Housing	Field Grade Eligible Housing Capacity	Mixed Rank Housing Number	Simulation Average Time on Waitlist per Arrival (100 Replications)
1: Status Quo	Status Quo (227)	Status Quo (Yes)	Status Quo (621)	Status Quo (347)	72.25 Days
2: Oak Leaf	Status Quo (227)	Status Quo (Yes)	Old Brick FGO Eligible (645)	Status Quo (347)	69.97 Days
3: Half TACs, no ELDP K&E	Half of TAC Officers & NCOs and no ELDP (173)	Status Quo (Yes)	Status Quo (621)	Status Quo (347)	68.77 Days
4: No TACs or ELDP K&E	No TAC Officers, TAC NCOs, or ELDP (134)	Status Quo (Yes)	Status Quo (621)	Status Quo (347)	66.61 Days
5: Expand Mixed Rank	Status Quo (227)	Status Quo (Yes)	Status Quo (621)	Stony 1 Mixed Rank (502)	72.25 Days
6: No Non-K&E Civilians	Status Quo (227)	No	Status Quo (621)	Status Quo (347)	77.89 Days
7: Optimal	No TAC Officers, TAC NCOs, or ELDP (134)	Status Quo (Yes)	Old Brick FGO Eligible (645)	Status Quo (347)	64.50 Days

Figure 4. Candidate Solutions

Candidate Solution 2: Oak Leaf, increases the number of rank-designated houses for field grade officers by upgrading Old Brick, an on-post neighborhood, to field grade designation. Taking the average of 100 replications reduced the waitlist time by 2.28 days. Candidate Solutions 3 and 4 explore reducing the Garrison's K&E list size by removing all Eisenhower Leader Development Program (ELDP) officers and either half or all West Point tactical (TAC) officers and noncommissioned officers (NCOs). ELDP officers are one-year graduate students studying at Columbia University in preparation for their time as TAC officers. The removal of TACs and ELDP personnel was the team's way of reducing the K&E list size. The Garrison

could explore removing other options. Removing half of the TAC officers and NCOs reduces the K&E list size by 54 and wait time by 3.48 days. Removing all TACs reduces the K&E list size by 93 and wait time by 5.64 days. Candidate Solution 4: Expand Mixed Rank, explores redesignating Stony Lonesome I, an on-post neighborhood, to mixed rank designation. This candidate solution does not affect waitlist time. Candidate Solution 5 removed all civilians not on the K&E list from on-post housing eligibility. This increased the overall waitlist time. Finally, for Candidate Solution 6, the group combined the best candidate solution combinations, expanded field grade eligibility and no TACs on the K&E list, for a total waitlist time reduction of 5.64 days. Candidate Solutions 5 & 6 are worse than the Status Quo and discarded going forward.

Using the model's outputs from the candidate solutions and the weighted scoring matrix, the capstone team conducted a total value analysis. Figure 5 shows all eligible candidate solutions along with their overall value. From this analysis, the team concludes that Candidate Solution 7 provides the system with the greatest overall value.

Candidate Solution	Wait List Time	K&E List Size	Field Grade Rank Band	Total Value Score
Status Quo	30 (72.25)	50 (227)	0 (621)	32.56
Oak Leaf	32 (69.97)	50 (227)	48 (645)	40.92
Half TACs, no ELDP K&E	34 (68.77)	73 (173)	0 (621)	42.77
No TACs or ELDP K&E	39 (66.61)	88 (134)	0 (621)	50.59
Optimal	42 (64.50)	88 (134)	48 (645)	59.44

Figure 5. Total Value Analysis [Value Score (Raw Data)]

In addition to total value analysis, the capstone team conducted a sensitivity analysis of the value measures by increasing and decreasing each swing weight by 10%. Figure 6 displays the graph for the K&E list size's sensitivity analysis. Additionally, none of the other value measures' sensitivity analysis resulted in a change to the overall recommendation. The capstone team concludes that value measure sensitivity does not change the final recommendation. Finally, the capstone team did not conduct a cost versus value analysis because none of the proposed candidate solutions impose significant costs on the Garrison.

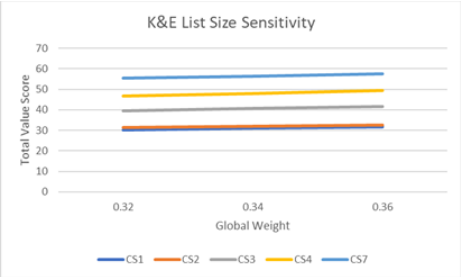

Figure 6. Key & Essential List Size Sensitivity Analysis

The capstone team recommends that the Garrison Commander should reduce the K&E list to 134 slots or fewer, expand the field grade housing rank band to 645 homes, maintain the mixed rank housing numbers at 347 and continue to allow non-K&E civilians the ability to live on post if available. For future work, the capstone team believes that the Garrison must look at the possibility of building more on-post housing, promotion and incentivization for living off-post, and the possibility of removing the DoDEA school from West Point or allowing off-post service members the ability to send their children to the on-post DoDEA school. West Point's 2035 modernization project should include expanding on-post housing to accommodate West Point's increasing personnel demand. Additionally, the capstone team believes that the concept of a K&E list needs re-examination by West Point's senior leadership. Finally, these capstone project's findings could apply to other DoD installations with on-post housing shortages.

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6. Conclusion

In progressing through the stages of the SDP, the capstone team recommends that the Garrison reduce the key and essential list size and expand field grade officer housing rank band. Although the obvious solution to West Point's housing problem involves building more on-post housing, the team's recommendation provides the Garrison with an immediate course of action to slightly alleviate West Point's on-post housing shortage and decrease a prospective on-post resident's wait list time.

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