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Optimally Locating MARFORRES Units

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MONTEREY, CALIFORNIA

OPTIMALLY LOCATING MARFORRES UNITS

by

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Prepared for: MARFORRES

POC: Mr. Gerald Ormerod

EXECUTIVE SUMMARY

Project Summary

The U.S. Marine Forces Reserve (USMCR, MARFORRES) is conducting realignment studies where discretionary changes may benefit from formal mathematical analysis. This study has developed an optimization tool to guide and/or support Commander, MARFORRES (CMFR) decisions. A prototype of the optimization tool has been tested with data from the units and Reserve Training Centers (RTCs) in the San Francisco, CA and Sacramento, CA areas.

Background

The siting of MARFORRES units and the potential regional consolidation of existing RTCs is critical to ensuring long-term sustainability of the units from both an economic and a readiness perspective. Realignment decisions rely on four main pillars: existence of adequate facilities; access to training areas; how realignment affects the people in each unit; and cost effectiveness. As stated in a recent CMFR Information Brief, related primary considerations also include demographics, specific RTC features required by a unit, and a variety of costs involved in siting a unit at a new RTC such as operational costs of the facility (e.g. utilities), improvements costs (e.g. reconfiguration, upgrading, or expansion of existing facilities) and the cost of new military construction (MILCON).

Findings and Conclusions (to include Process)

Data

Initially, we (the Principal Investigators, PIs) anticipated that the optimization tool could employ all of the following inputs:

- A listing of supported USMCR units by unit identification code (UIC).
- A listing of current RTC locations.
- A listing and characteristics of supporting training areas within the region normally used by the units (e.g., live fire ranges, maneuver areas, military operations in urban terrain facilities, swim qualification pools, etc).
- A listing and characteristics of supporting base and installations (e.g., Military treatment facilities, Commissaries, military housing, family housing, etc).
- Current table of organization composition by UIC for each USMCR unit.
- Current personnel home address by UIC.
- Time and distance plots between RTCs and supporting training areas.
- Plots of all principle supporting road and highway networks in the region.
- Specific basic facility requirements (BRFs) and facility characteristics (e.g., size, age, condition, etc.) for each RTC (e.g., privately owned vehicle parking, tactical vehicle parking, Vehicle Maintenance Facilities, drill halls, classrooms, gyms, administration offices, command suites, equipment warehouses, armories, etc.).
- Historical usage and cost breakdown for commercial billeting in the region by unit.
- Historical usage and cost breakdown for commercial messing in the region by unit.

- Historical usage and cost breakdown for commercial transportation in the region by unit.
- Current RTC occupancy/utilization capacity rates.
- Current planned facility improvements and funding status by fiscal year.
- Historical annual operating costs by RTC.
- Planning figures for determination of facility expansion options (e.g., MILCON, Facilities, Sustainment, Restoration, and Modernization, etc)
- Planning figures for equipment transportation within the region.
- Notional retraining costs, if applicable.
- Indicator of disruption to existing commitments or battle rhythm, by unit, if relocated.
- Indicator of value for certain groups of units to be collocated (e.g., to enhance command and control between a company and its parent battalion).
- Indicator of risk of collocating certain units (e.g. due to friction from battalions from different Major Subordinate Commands)
- Demographic data: Recruiting ratios achievable at each RTC (e.g. one in each 300 members of the recruitable population: 17-24 year-old, high-school graduates). This number may be the same for all RTC if they are in close proximity, but different otherwise.

In May 2015, the Principal Investigators (PIs) joined a MARFORRES team on a trip to RTCs in the San Francisco, CA and Sacramento, CA areas, to conduct a site visit and collect part of the above data. Additional data was received through September 2015.

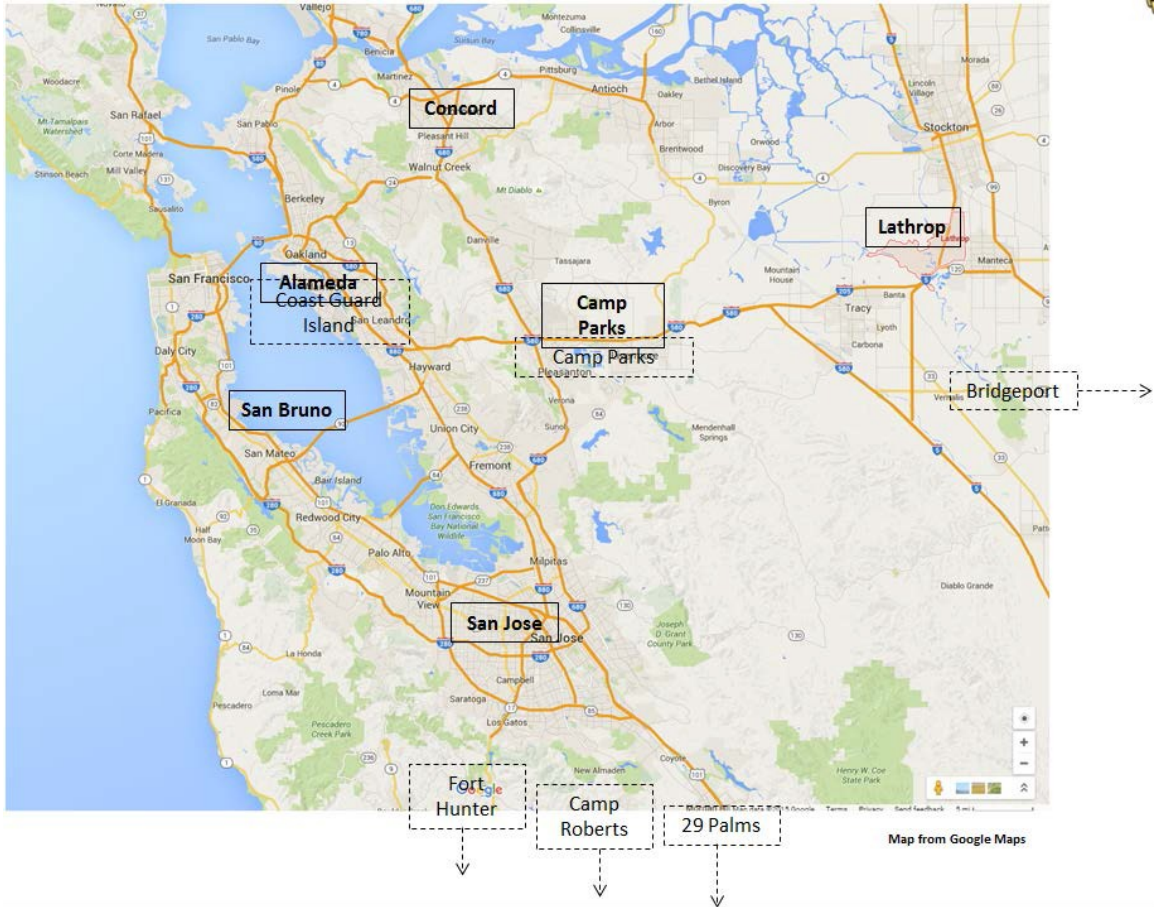


Figure 1. RTCs in the San Francisco, CA and Sacramento, CA areas

Optimization model

The PIs used the available data to build a prototypic version of Marine Corps Reserve Realignment Optimization Model (MCROM), with results based on several assumptions.

Decision Variables (i.e., MCROM prescriptions):

- What RTCs remain open?
- How much expansion of each facility in each RTC?
- What UICs move?

As objective functions, we considered:

- Minimize total annual operating cost, composed of:
 - o Fixed cost by RTC (we used annual services cost as a surrogate)
 - o Variable cost by RTC (we used the current costs of the UICs in the RTC divided by military service personnel in the UICs as a surrogate)
 - o Expansion cost of facilities (notional \$1/unit of expansion across the board)
- Maximize total value
 - o Value of co-locating units
 - o Value of command and control and operations and training opportunity
 - o Quality of life
- Minimize total distance to training areas

Constraints

We have included the following constraints in MCROM:

- Each UIC must be assigned to a unique RTC, and an RTC closes only if no UICs are stationed in it
- Total facility space (initial plus expanded) needed by UICs in each RTC is not exceeded
- Facility expansions in each RTC are within limits
- Limit the number of moves

MCROM results

MCROM was tested using the available data and a notable number of surrogates to complete unavailable data. Figures 2-7 show the prototypic results.

RTC	Overhead	SMCR cost	BFR exp. cost	Total
SANBRUNO M14101 M14126	164198	822492 (168 Marines) (204 Marines)	20742 Armory (952) DH (8451) VMF (111) POV (11228)	1007432
CAMPARKS M14814	70615	73440 (20 Marines)	36067 DH (20663) VMF (1414) POV (5152) Armory (1551) WH (615) DH (24908) VMF (3075) POV (4368) TVP (1530)	180122
LATHROP M29423	10437	461988 (164 Marines)	25703 Armory (635) DH (17995) POV (5040) TVP (2033)	498128
SANJOSE M29463 M29484	15245	1845360 (133 Marines) (87 Marines)	40886 Armory (652) DH (30249) VMF (2838) POV (6272) TVP (875)	1901491
			Grand Total	4407994

With current stationing BFR shortages exist for provided data
(e.g., 952 for the Armory at San Bruno)

Figure 2. MCROM results with no moves

RTC	Overhead	SMCR cost	BFR exp. cost	Total
SANBRUNO M14101 M14126	164198	822492 (168 Marines) (204 Marines)	20742	1007432
			Armory (952) DH (8451) VMF (111) POV (11228)	
ALAMEDA M28352	22698	479584 (112 Marines)	34231	536513
			Armory (1986) DH (24622) POV (7532) TVP (91)	
CONCORD M21629 M29463 M29484	140495	260434 (174 Marines) (133 Marines) (87 Marines)	80856	481785
			Armory (2078) WH (1637) DH (59128) VMF (6589) POV (11424)	
CAMPPARKS M14814	70615	73440 (20 Marines)	36067	180122
			Armory (1551) WH (615) DH (24908) VMF (3075) POV (4368) TVP (1550)	
LATHROP M29423	10437	461988 (164 Marines)	25703	498128
			Armory (635) DH (17995) POV (5040) TVP (2033)	
			Grand Total	2703980

Two units move from San Jose (assumed highest cost per Marine, see below) to Concord (assumed lowest cost per Marine)

RTC	cost Per SCMR
SANBRUNO	2211
ALAMEDA	4282
CONCORD	661
CAMPPARKS	3672
LATHROP	2817
SANJOSE	8388

Figure 3. MCROM results with two units moving

Cost vs units moved

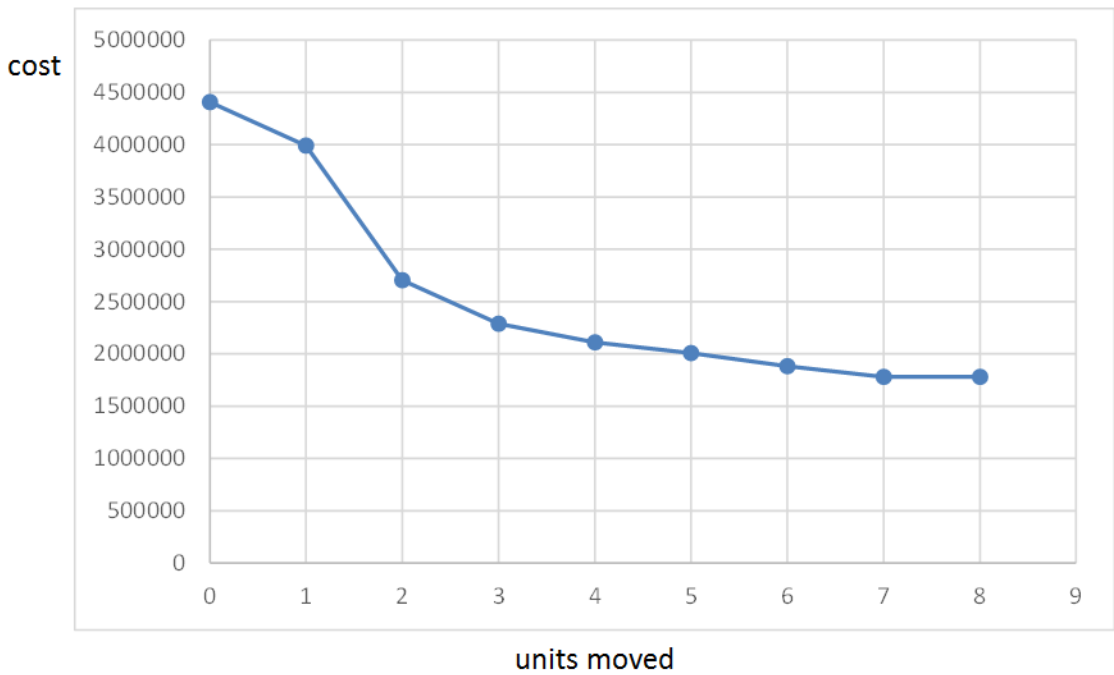


Figure 4. Cost as a function of units moved

RTC	Overhead	SMCR cost	BFR exp. cost	Total
SANBRUNO M14101 M14126	164198	822492 (168 Marines) (204 Marines)	20742	1007432
			Armory (952) DH (8451) VMF (111) POV (11228)	
ALAMEDA M28352	22698	479584 (112 Marines)	34231	536513
			Armory (1986) DH (24622) POV (7532) TVP (91)	
CONCORD M21629	140495	115014 (174 Marines)	28799	284308
			Armory (886) WH (684) DH (20663) VMF (1414) POV (5152)	
CAMPPARKS M14814	70615	73440 (20 Marines)	36067	180122
			Armory (1551) WH (615) DH (24908) VMF (3075) POV (4368) TVP (1550)	
LATHROP	0	0	0	0
SANJOSE M29423 M29463 M29484	15245	3220992 (164 Marines) (133 Marines) (87 Marines)	80921	3317158
			Armory (1287) DH (55851) VMF (8013) POV (11312) TVP (4458)	

UIC	UIC	value
M14101	M14126	5
M14101	M29463	1
M14101	M29484	1
M29423	M29463	5
M29423	M29484	5
M29463	M29484	5
M21629	M14814	3
1 = Co-location Detrimental		
3 = Co-location Neutral		
5 = Co-location Beneficial		

UIC	C2		Ops/Training Opportunity Index
	Opportunity Index	Opportunity Index	
M14101	1	1	1
M14126	1	1	1
M28352	1	1	1
M21629	5	5	5
M14814	5	5	5
M29423	3	5	5
M29463	1	5	5
M29484	1	5	5
1 = no opportunity			
3 = Moderate opportunity			
5 = Significant opportunity			

Figure 5. Different objective: Maximizing total value, with one move allowed

UIC	Range	KDRange	Maneuver	MOUT	Pool	CBRN	Amphib	Dive	Jump	JTAC/CFE
M14101	X	X	X		X	X	X			
M14126	X	X	X	X	X	X	X			X
M28352	X	X	X	X	X	X	X	X	X	X
M21629	X	X	X	X	X	X	X		X	X
M14814	X				X	X				
M29423	X				X	X				
M29463	X				X	X				
M29484	X				X	X				

Training Area	Code	Y/N
Camp Parks	Range	N
Camp Parks	Maneuver	N
Camp Parks	MOUT	Y
Camp Parks	Pool	Y
Camp Parks	Amphib	N
Camp Parks	Dive	N
Camp Parks	CBRN	Y
Camp Roberts		
Fort Hunter Liggett		
29 Palms		
Coast Guard Island		
NAS Fallon, NV		

RTC	Camp Parks	Camp Roberts	Fort Hunter	Bridgeport	29 Palms	Coast Guard Island
SANBRUNO	40	184	130	272	508	2.7
ALAMEDA	23	181	163	260	509	1.8
CONCORD	35	194	176	243	492	27
CAMPPARKS	0	173	155	231	489	23
LATHROP	44	207	192	195	470	61
SANJOSE	38	144	126	260	481	38

Figure 6. Data for minimizing travel distance for training. The top table indicates what UIC require certain training. The table on the right indicates where each type of training is available. The bottom table shows distances from RTCs to training areas.

RTC	Overhead	SMCR cost	BFR exp. cost	Total
SANBRUNO	164198	1454838	105132	1724168
M14101		(168 Marines)		
M14126		(204 Marines)		
M28352		(112 Marines)		
M21629		(174 Marines)		
			Armory (3824)	
			DH (70402)	
			VMF (6261)	
			POV (23912)	
			TVP (733)	
ALAMEDA	0	0	0	0
CONCORD	0	0	0	0
CAMPPARKS	70615	1483488	129603	1683706
M14814		(20 Marines)		
M29423		(164 Marines)		
M29463		(133 Marines)		
M29484		(87 Marines)		
			Armory (3378)	
			WH (2137)	
			DH (88975)	
			VMF (13425)	
			POV (15680)	
			TVP (6008)	
LATHROP	0	0	0	0
SANJOSE	0	0	0	0

Figure 7. Minimizing travel distance. For example, unit M29484 requires “Range”, “Pool” and “CBRN” training facilities. By moving to Camp Parks, it does “Pool” and “CBNR” at Camp Parks and Range at Fort Hunter Liggett (155 miles away). From its current location (San Jose), it does “Pool” and “CBNR” at Camp Parks (38 miles away) and Range at Fort Hunter Liggett (126 miles away).

Further Research

We recommend MARFORRES validates the existing data and collects requested data to enhance MCROM’s fidelity. All the data available could be incorporated into a future version. MARFORRES planners would also benefit from a graphical user interface to improve usability of MCROM by non-optimization experts.