



# Identification and Evaluation of Resource Constraints: Optimization of AFTAC's Configuration Management Process



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### Abstract

Resource constraints impact the cost effective and timely execution of seismic sustainment activities. An analysis of configuration management processes identified deficiencies in baseline plan development, monitoring procedures, and resource allocation. Through decomposition of work scope into its lowest management level, project engineers and configuration managers were able to assess the time phased labor cost of their efforts supporting Engineering Change Orders (ECOs). The time phased labor budget constituted the performance measurement baseline (PMB), which serves as the basis for monitoring past performance and developing predictive metrics. Resource loaded project schedules modeled critical resource constraints affecting installation schedules with the potential to impact data availability rates. Future resource demand rates were also tracked across project lifecycles to facilitate management efforts to mitigate resource bottlenecks and monitor workflow. Prior performance against the PMB is a basis for more reliable estimates of future project performance. This metric-based process for monitoring and controlling project execution will decrease lifecycle costs by helping management mitigate inefficient resource allocations, forecasting accurate installation and procurement schedules, and identify engineering process optimization.

## Understanding Scope

### ECO Phases

- Create
- Open
- Work
- Quality Check
- Review
- Approve
- Close

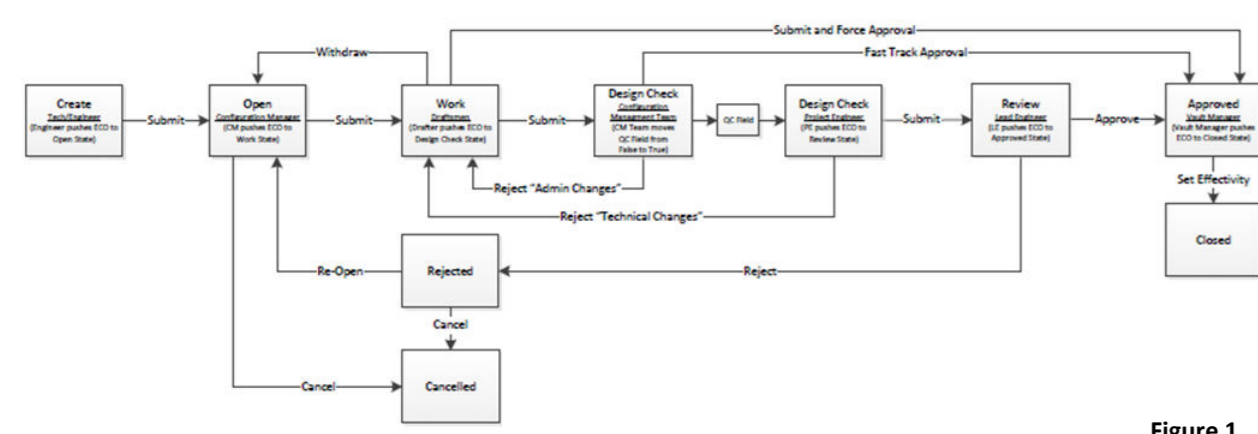


Figure 1

Figure 1 illustrates the current process for approving engineering change orders (ECO).

Figure 2 demonstrates the decomposition of the required scope into the lowest manageable level of work.

- Define Activities
- Sequence Activities
- Estimate Resources
- Estimate Durations

Unique ID	IPT	Project Name	Task Name	Baseline Finish	Finish	Qtr 1	Qtr 2	2017
3	Engineering	TXAR	Create	2/24/17	2/24/17			
4	CM	TXAR	Open	2/28/17	3/3/17			
5	Drafting	TXAR	Work	5/19/17	3/22/17			
15	CM	TXAR	Initial Check	5/22/17	3/21/17			
16	Drafting	TXAR	Drafter Check	5/23/17	3/28/17			
17	Engineering	TXAR	Engineer Check	5/24/17	3/29/17			
7	Engineering	TXAR	Review	5/25/17	3/30/17			
157	Engineering	TXAR	Approve	5/26/17	3/31/17			
8	Engineering	TXAR	Close	5/26/17	3/31/17			

Figure 2

## Evaluating Resource Requirements

AFTAC evaluated current ECO project planning processes and identified resource planning deficiencies.

- Resources drive schedule performance
- Planning stovepipes generate resource bottlenecks (see Figure 3)
- Over allocated resources cause schedule slips

Current Engineering Projects



Figure 3

### Where are the hours going?

- Engineering, technical documentation, and drafting resource hours tracked over a 12 week period, > 7,000 hrs. (see Figure 4)

- Hours tracked by cost center

- Past performance improves future projection accuracy

### Tradeoff between priorities and resource availability

Project Name	2/12-2/18	2/19-2/25	3/5-3/11	3/19-3/25	3/26-4/1	4/2-4/8	4/9-4/15	4/16-4/22	4/23-4/29	5/7-5/13	5/14-5/20	5/21-5/27	Total	Percentage				
Mongolia—Radio Upgrade	5	5	5	5	5	5	5	5	5	5	5	5	126	1.8%				
Alaska—Documentation Clean Up	16	20	14	20									70	1.0%				
Alaska—Radio Upgrade	4	1	26	57	49	11							54	264.3%				
Romania—Guralp Swap-out	2	1	11	12	17	23	31	1	40	56	22		216	3.1%				
Kazakhstan—Guralp Swap-out													13	0.2%				
Hydroacoustic—Recapitalization	2	4	3	1									113	1.6%				
Kazakhstan—Documentation Clean Up													1	0.0%				
Pinedale—Guralp Swap-out													122	1.7%				
Multiple—Power Box Upgrade	77	52	36	40	20	9	30	53	23	45	57	71	12	38	14	576	8.2%	
Thailand—Documentation Clean Up													28	27	42	24	121	1.7%
TXAR—Guralp Swap-out	10	14	71	42	46	13							4	22	34	260	3.7%	
VNDA—Test & Evaluation													6				59	0.8%
Project Work	85	89	105	193	138	163	109	105	114	96	143	156	141	149	157	1840	27.8%	
Non Project Work	357	363	337	257	311	314	368	399	363	390	341	331	348	331	341	5067	72.8%	
Grand Total	442	451	441	449	448	477	477	444	476	486	484	487	488	480	458	7027	100%	

TT Project Allocation	19%	20%	24%	43%	31%	34%	23%	24%	24%	20%	30%	32%	29%	31%	32%	28%
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	2/12-2/18	2/19-2/25	3/5-3/11	3/19-3/25	3/26-4/1	4/2-4/8	4/9-4/15	4/16-4/22	4/23-4/29	5/7-5/13	5/14-5/20	5/21-5/27	Total	Percentage			
Evaluation (Trade Study, T&E, Parts Qualification)	3	2	15	8	9	3	4	25	22	31	9	11	4	5	1	153	3%
IMS Support	17	12	13	12	10	9	10	10	15	15	12	48	24	43	19	268	5%
Leave (Holiday, Personal, Etc.)	52	70	62	35	33	69	52	34	63	34	23	56	62	46	92	782	15%
Meetings / Overhead / Level of Effort / TDY	96	90	57	61	48	64	88	68	92	77	127	58	87	135	85	1309	26%
Nagios - Status of Health	21	18	22	8	1	6	1	2	1	2	2	2	1	1	1	119	2%
Next Generation Development	66	70	66	61	53	74	16	15	23	12	68	4	40	21		588	12%
O&M Engineering	102	102	103	72	157	82	192	157	161	165	158	123	81	126	85	1866	37%
Totals	357	363	337	257	311	314	368	339	363	390	341	331	348	331	341	5087	100%

Figure 4

## Analyzing Schedule Performance

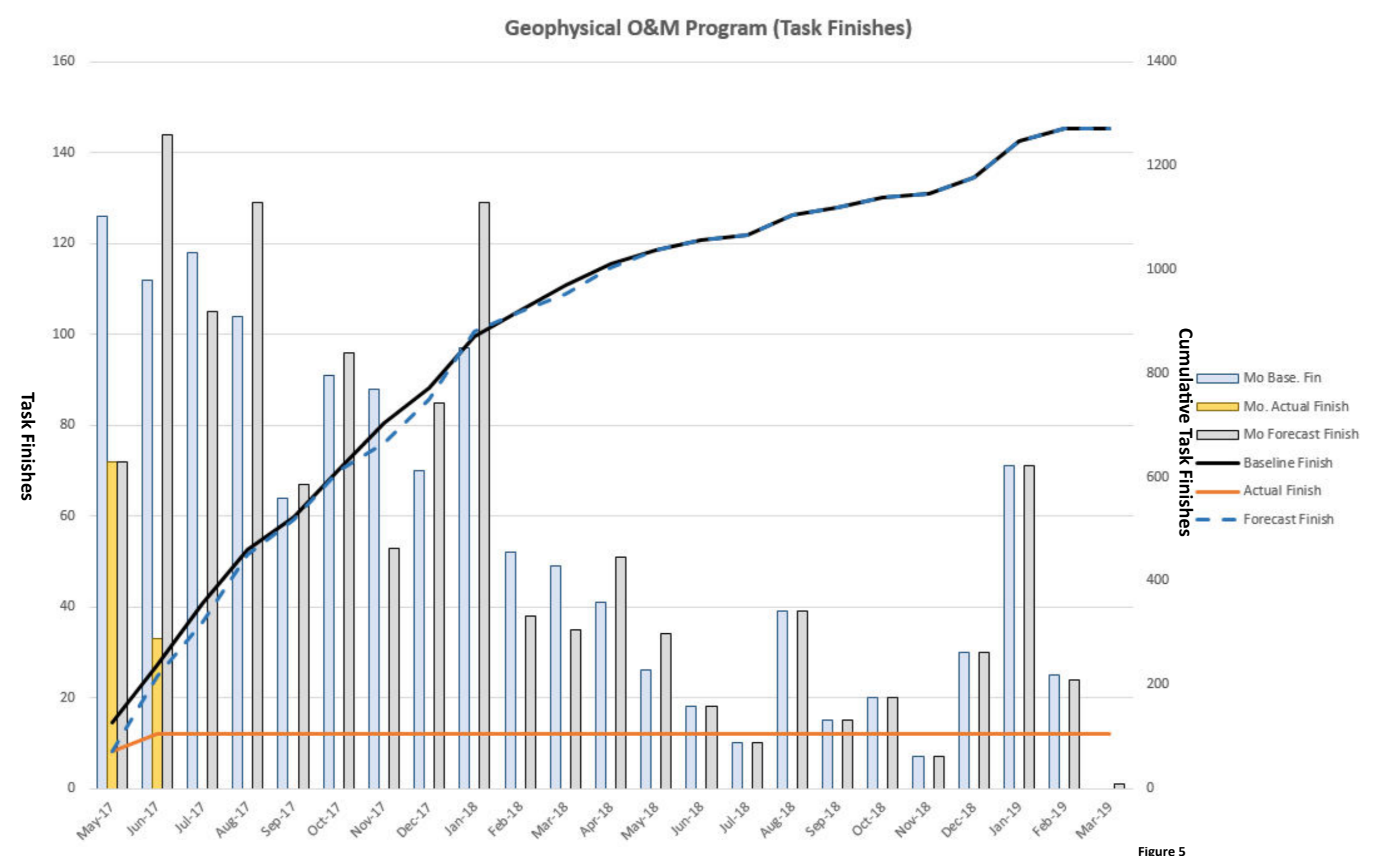


Figure 5

Geo O&M IMS	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	
Baseline Finish	126	238	356	460	524	615	703	773	870	922	971	1012	1038	1056	1066	1105	1120	1140	1147	1177	1248	1273	1273	
Actual Finish	72	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
Forecast Finish	72	217	313	460	511	595	663	748	874	920	955	1004	1038	1056	1066	1105	1120	1140	1147	1177	1248	1272	1273	
Mo Base. Fin	126	112	118	104	64	91	88	70	97	52	49	41	26	18	10	39	15	20	7	30	71	25	0	
No. Actual Finish	72	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
No. Forecast Finish	72	145	96	147	51	84	68	85	126	46	35	49	34	18	10	39	15	20	7	30	71	24	1	
Previous Forecasted Finish	84	251	317	458	515	600	678	767	861	917	955	1004	1038	1056	1066	1105	1120	1140	1147	1177	1248	1272	1273	
Actual BEI	0.57	0.32	0.22	0.17	0.15	0.13	0.11	0.10	0.09	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	
Forecast BEI	0.57	0.91	0.88	1.00	0.98	0.97	0.94	0.97	1.00	1.00	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Target BEI	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

Figure 6

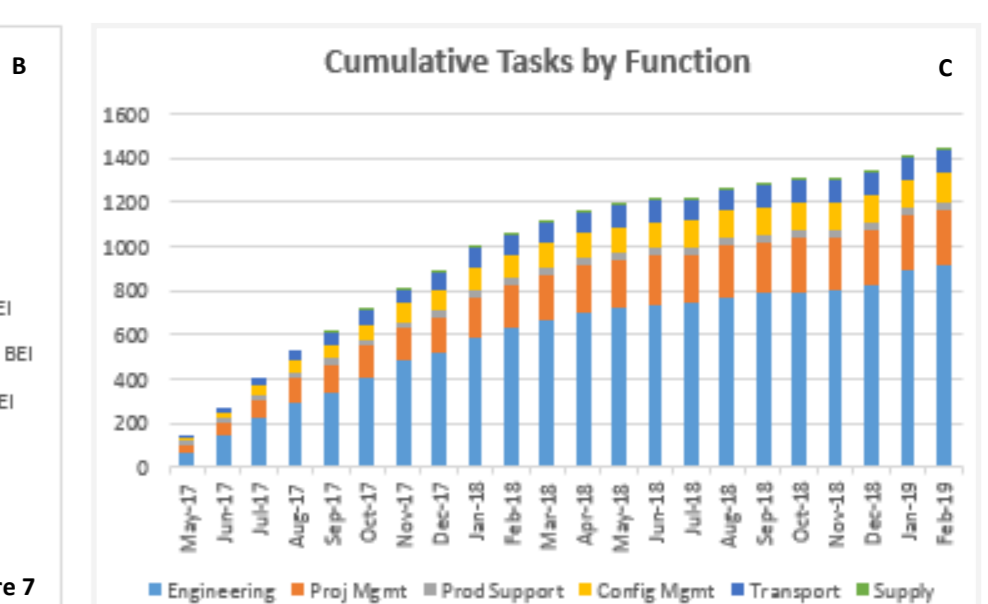
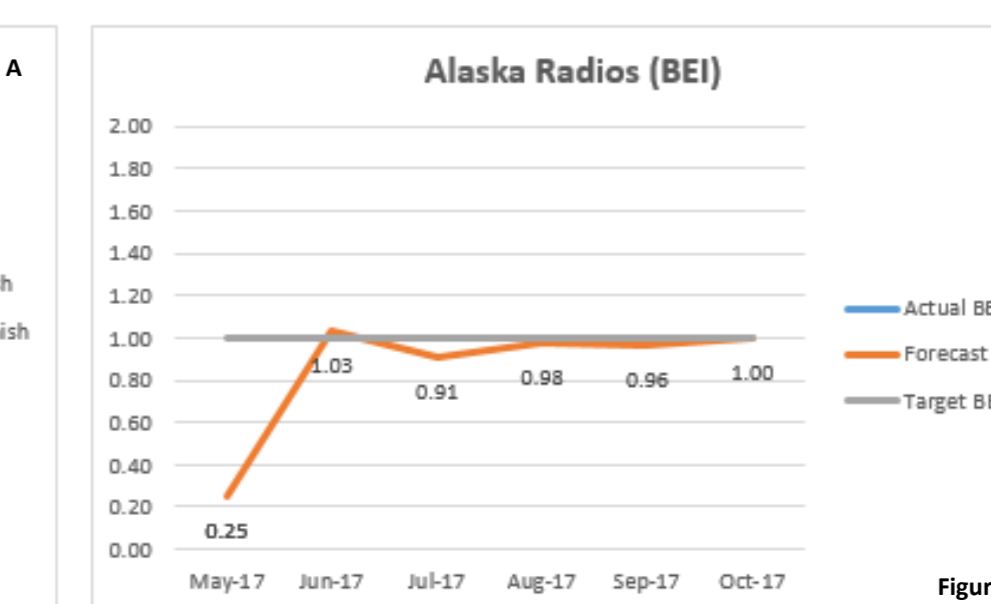
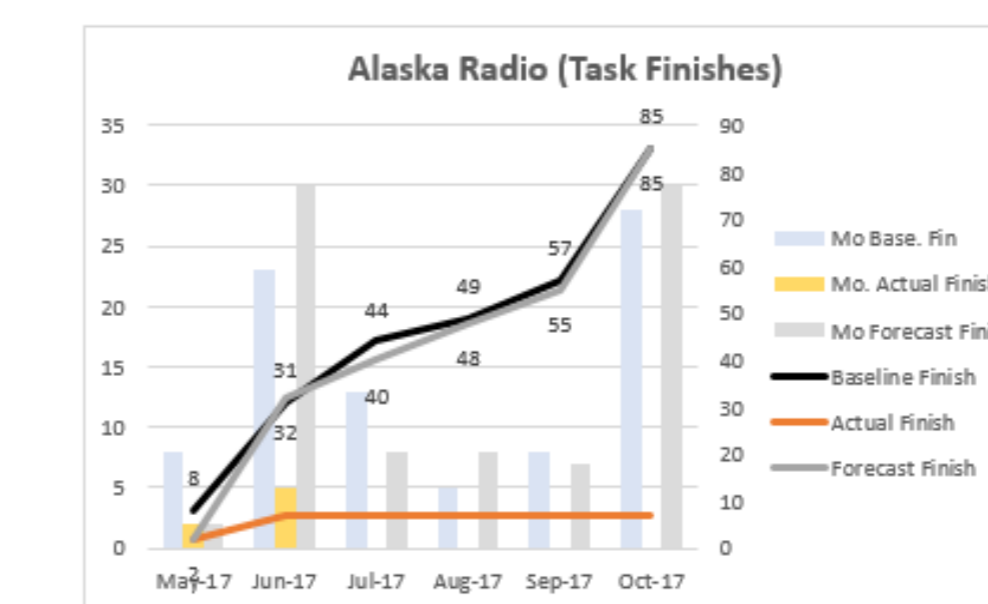


Figure 7

Figure 7.a shows current, projected, and planned performance for the Alaska radio upgrade by month.

Figure 7.b identifies the baseline execution index (BEI) for the Alaska radios project. The BEI is a measure of performance efficiency. This figure illustrates an actual BEI of .25 through May, however resource managers project a return to plan by June 2017.

Figure 7.c breaks down monthly tasks by resource group. The graph demonstrates the time phased task requirements for all planned engineering projects.

## ECO Process Monitor and Control

- As of 1 June – 240 total open ECOs (We had 400+ in Jan)
- Create - 79
- Open - 59
- Work – 61
- Check – 34
- Review - 7

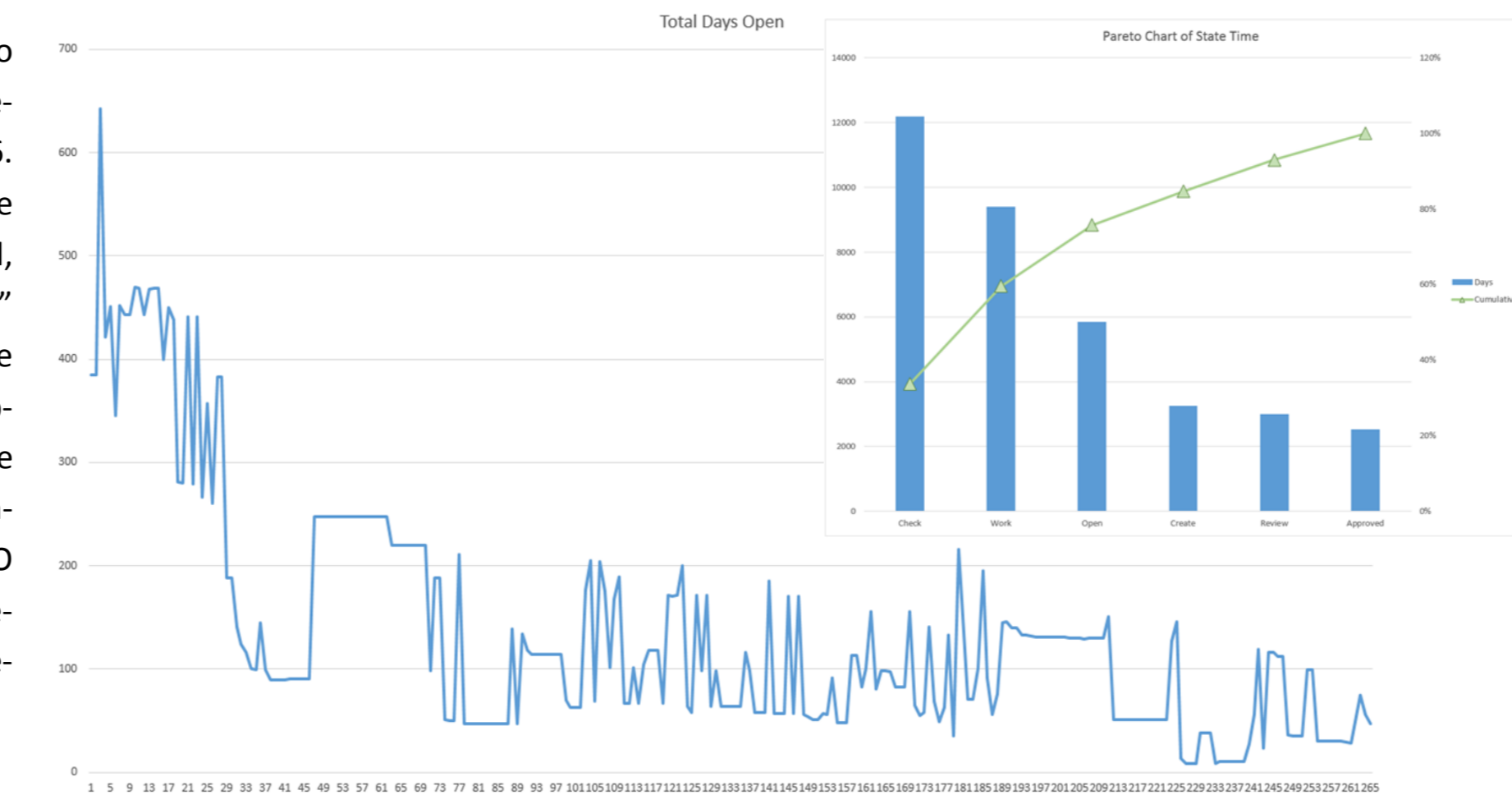


Figure 8

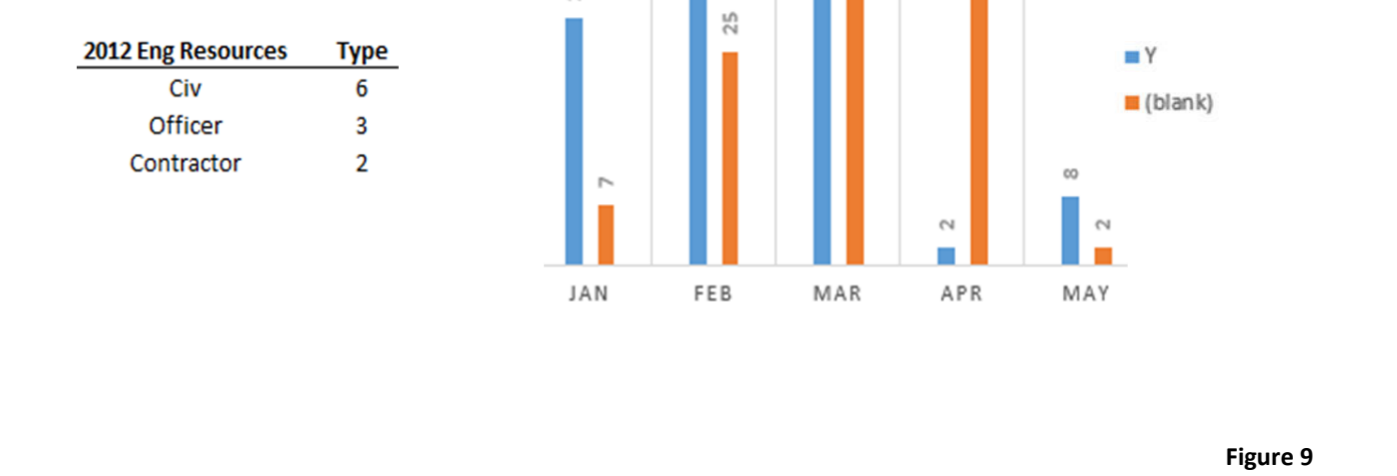


Figure 9

Figure 9 illustrates the total number of ECOs reviewed per month between January 2017 and May 2017. The chart compares the total number of ECOs reviewed with quality defects against those with no defects detected. Additional engineering resources were tasked with performing quality control prior to drafting activities. Catching documentation defects earlier in the process reduced the duration of the ECO process and the average hours to complete ECO work. The monthly issues per check over this time period decreased to .074 in April. ECOs spent less time in the "Check" or rework state over this interval..

## Conclusions

### Resource-loaded schedules showed planning deficiencies

Resource-based schedules identified planning failures resulting in bottlenecks and inaccurate baselines. New baselines were developed to reflect current resource availability and eliminate production bottlenecks.

### Analysis quantified the impact of ECO process variance

Planning tools quantified the schedule impact of process variance and identified key drivers of project performance. Engineering leadership implemented metrics to monitor and control the ECO process, resulting in impactful corrective actions.

### Process control reduced ECO rework

Monitoring the ECO process identified technical and administrative errors resulting in additional engineering work (waste). A quality check was implemented prior to ECO submittal to the work state, ensuring technical and administrative accuracy. The result was a streamlined process with a reduction in errors.