Response to Technical Questions

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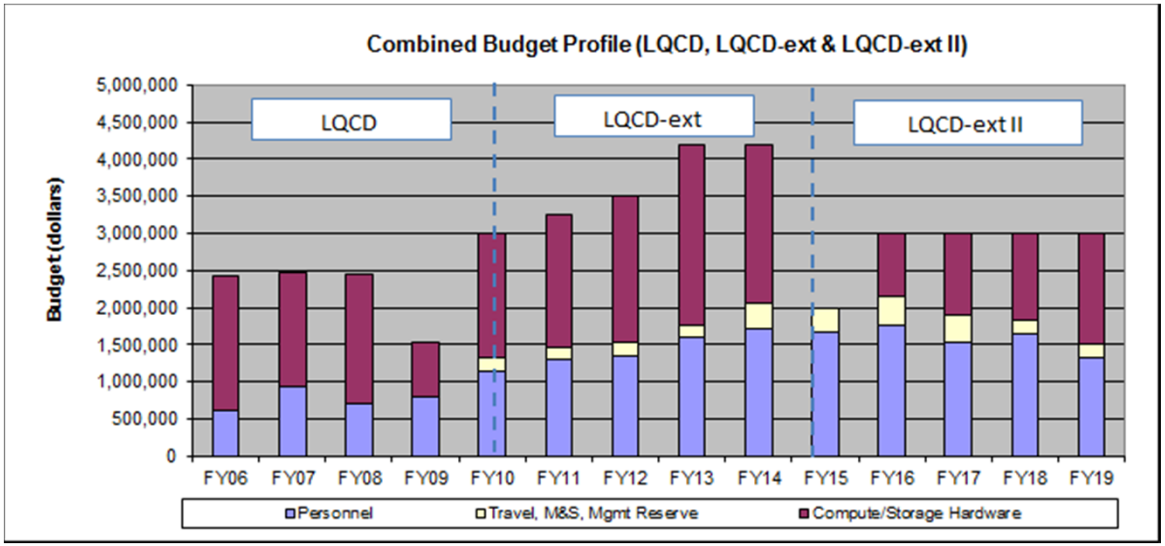
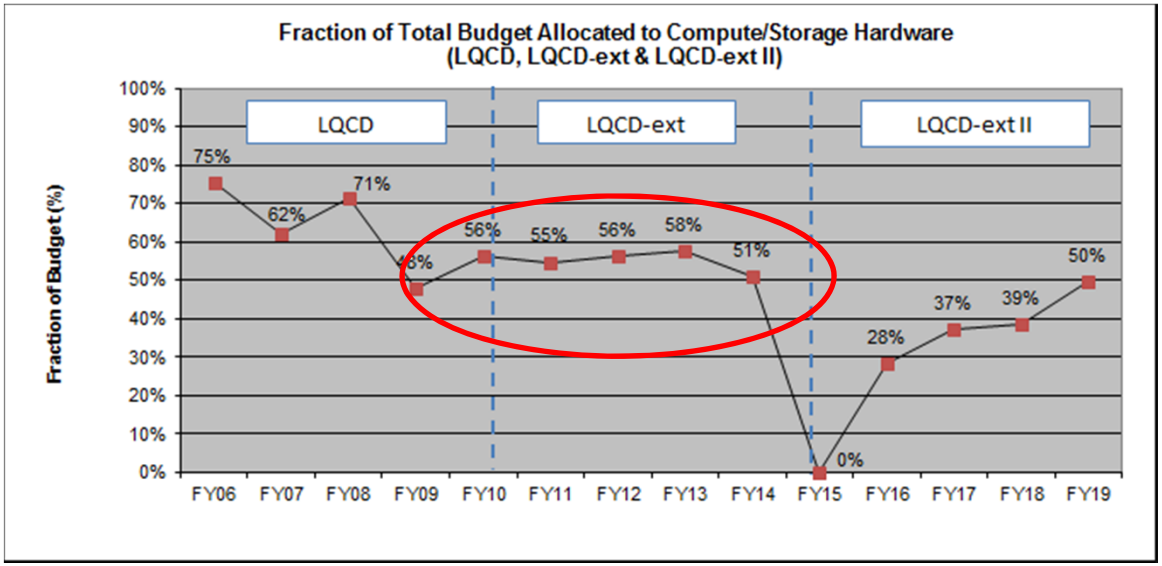
May 16, 2014

DOE Annual Progress Review of the LQCD-ext Project
May 15-16, 2014

11) What is the optimum ratio between the hardware and operations support budgets?





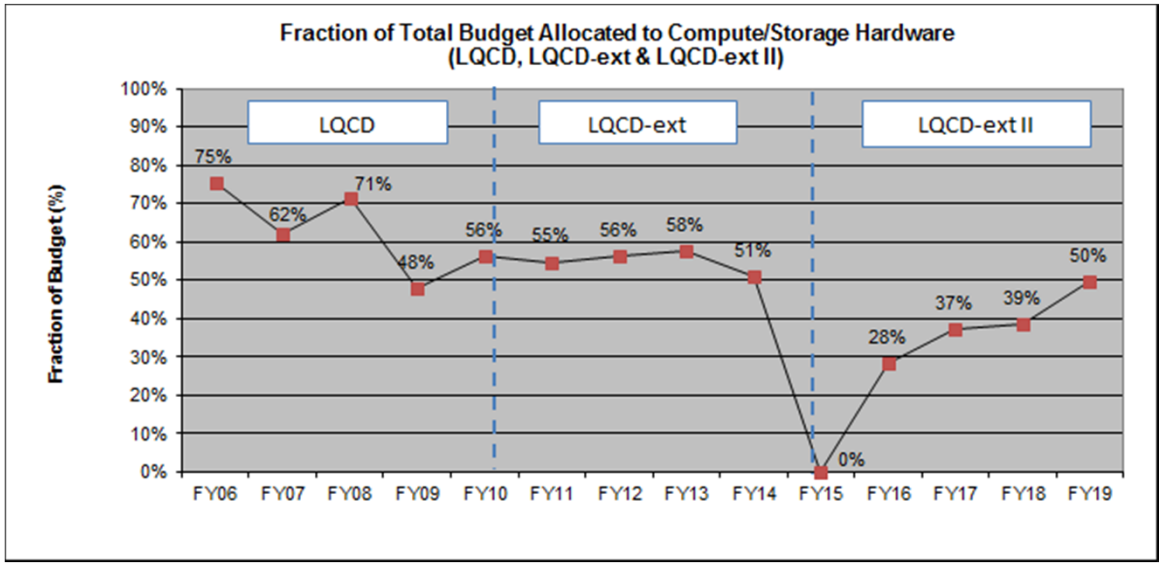
"Optimum" may not be the correct term.

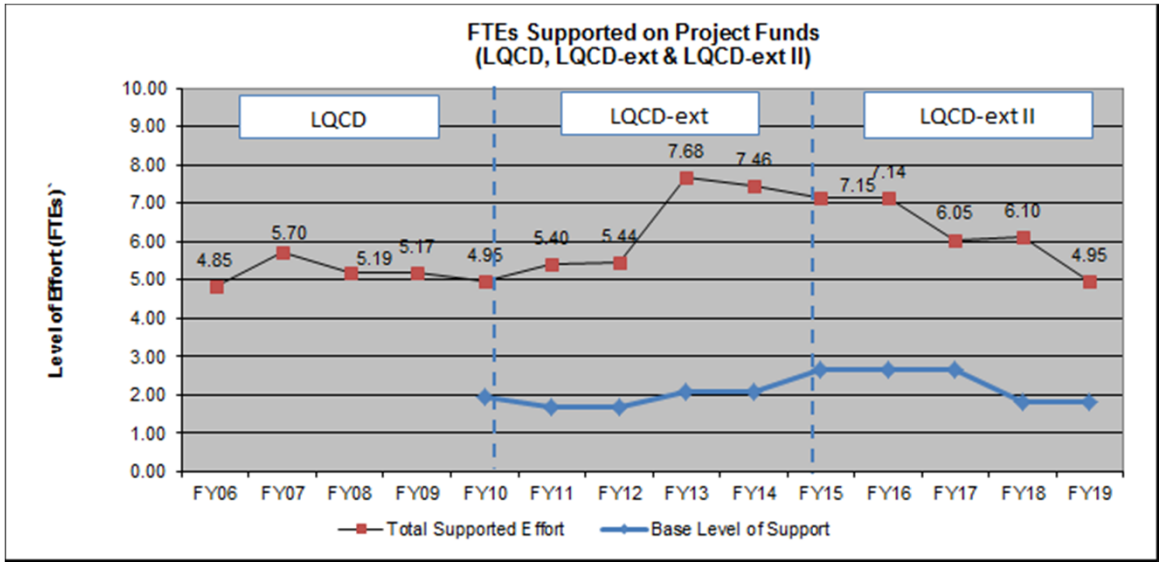
The ratio changes as we adjust the staffing profile to fit into the funding profile while also providing the necessary level of support for the production systems.

The level of support required is driven by the number of systems in production . There is a base level of support required (fixed LOE) and a variable level based on number and type of systems being supported.

Average fraction of budget allocated to hardware = 54% (FY09-FY14)

Comparison of % of Budget Allocated to Hardware to Number of FTEs Supported by Project



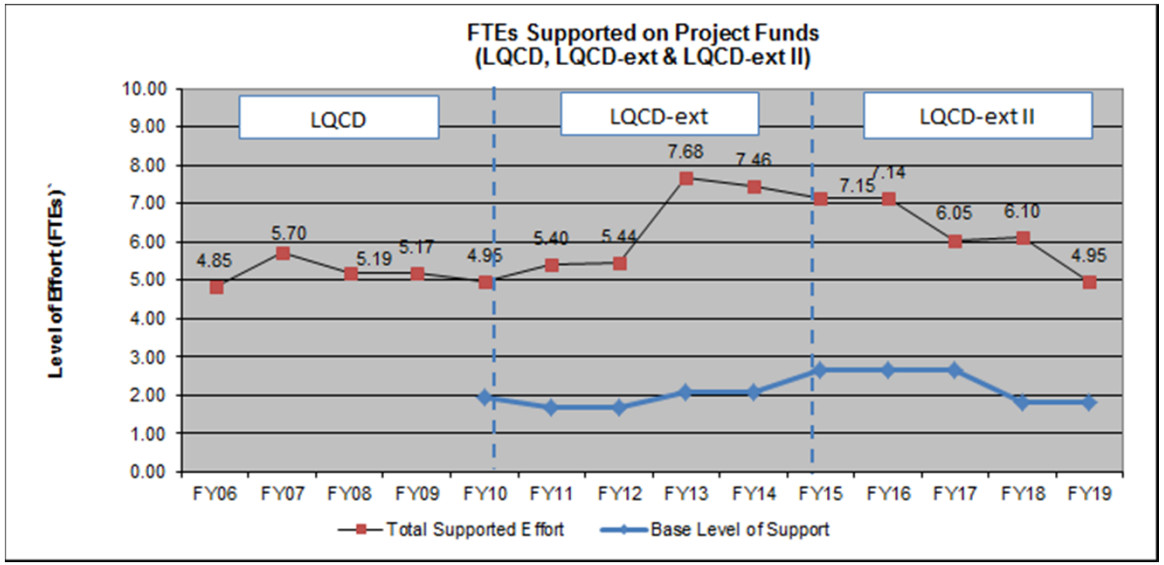


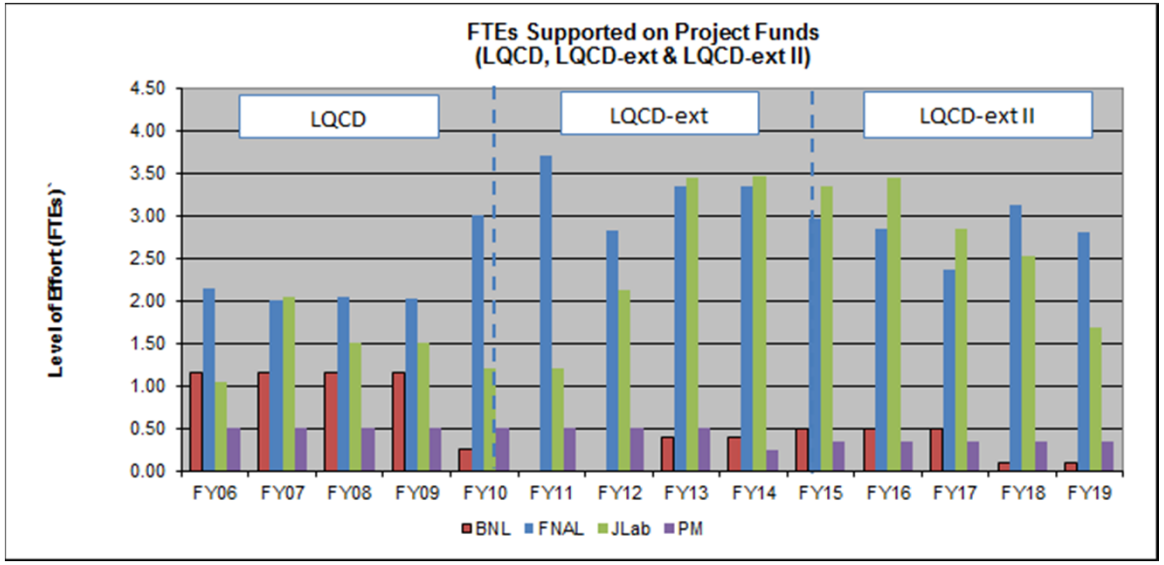
Base Level of Support (FY15-19)

Labor Category	FTEs
BNL Site Mgmt	0.10
BNL Sys Admin	0.40
FNAL Site Mgmt	0.20
FNAL Sys Admin	0.20
JLab Site Mgmt	0.70
JLab Sys Admin	0.70
Project Mgmt	0.35
Base level of support	2.65

Increase in FTEs in FY13 and beyond due to added support for BG/Q and LQCD-ARRA hardware

FTE Profile by Site





Comparison by site shows increased level of support at JLab and BNL for LQCD-ARRA and BG/Q machines beginning in FY13.

Basis of Estimate for Planned Staffing Levels

A detailed staffing model is used as a guide to determine staffing levels based on the type and quantity of hardware in production use at each site.

The staffing model has been developed based on 8 years of operating experience.

The model is periodically reviewed and parameters adjusted as needed to better align the model output with operational realities.

Assumptions:		Basis:
0.35	fte for overall project management	*Based on operating experience*
0.1	fte to manage BNL site	*Based on operating experience*
0.2	fte to manage cluster site (FNAL, JLab)	*Based on operating experience*
0.2	fte to plan, manage deployment	*See assumptions tab*
0.5	fte to deploy new hardware	*See assumptions tab*
0.0	fte of additional support for GPU deployment	*No additional incremental effort to deploy new GPU cluster (Jan '14 ->)*
0.5	fte/site of base admin support for ops & maintenance, and to maintain expertise	*Based on operating experience*
0.5	Steady-state file server admin support	*Based on operating experience (same level as budgeted in FY12-14)*
900	Number of cluster nodes that can be supported by one FTE	*Based on operating experience; updated 01/14/14*
450	Number of GPUs that can be supported by one FTE (FNAL)	*GPUs at FNAL require on average 2x more support than cluster nodes*
225	Number of GPUs that can be supported by one FTE (JLab)	*GPUs at JLab require on average 4x more support than cluster nodes*
283	Number of cluster nodes purchased with $1M in equipment funds (per year)	*Based on recent cost data; see assumptions tab*
249	Number of GPUs purchased with $1M in equipment funds (per year)	*Based on recent cost data; see assumptions tab*
21%	M&S G&A rate at FNAL (% on the first $500K of the purchase)	
60%	M&S G&A rate at JLab (% on the first $50K of the purchase)	
5%	Fraction of total equipment budget allocated to storage hardware (FY10-12)	*Based on approved hardware baseline plan*
8%	Fraction of total equipment budget allocated to storage hardware (FY13-19)	*Storage budget increased to reflect growing needs*
75%	Fraction of storage budget allocated to deployment site (FY13-19)	
25%	Fraction of storage budget allocated to non-deployment site (FY13-19)	
60%	Fraction of remaining compute hardware budget allocated to cluster hardware	*Assumes 60/40 split between conventional and GPU hardware*
827	JLab # of conventional nodes - starting point (9q @ 328; 10q @ 224; 12s @ 275 nodes)	
660	JLab # of GPUs - starting point (9g @248 GPUs ;10g @ 212 GPUs; 11g @ 32 GPUs;12k @ 168 GPUs)	
985	FNAL # of conventional nodes starting point (Ds @ 421 nodes; Bc @ 224 nodes; FY14c @ 340 nodes)	
304	FNAL # of GPUs - starting point (Dsg @ 152 GPUs; FY14g @ 152 GPUs)	

	FY15	FY16	FY17	FY18	FY19	Total	
Calculated remaining compute hardware budget	0	0	0	0	0	0	
Compute hardware budget ($)	-	609,245	827,135	1,138,135	1,306,175	3,880,690	
BG/Q compute hardware budget ($)	-	-	-	-	-	-	*BG/Q deployment site*
Cluster compute hardware budget ($)	-	560,505	760,964	1,047,084	1,201,681	3,570,235	*Cluster deployment site*
Storage hardware budget ($)	-	36,555	49,628	68,288	78,371	232,841	*BG/Q or Cluster deployment sit*
Storage hardware budget ($)	-	12,185	16,543	22,763	26,124	77,614	*Non-deployment site*
Storage hardware budget ($)	-	-	-	-	-	-	*Storage increment*
Total equipment budget ($)	-	609,245	827,135	1,138,135	1,306,175	3,880,690	
% of compute budget allocated for IB clusters	100%	60%	60%	60%	60%		
Allocation for conv. cluster hardware ($)	-	336,303	456,579	628,251	721,009	2,142,141	
Direct portion of conv. cluster budget	-	306,303	426,579	521,851	721,009	1,975,741	
Overhead portion of conv. cluster budget	-	30,000	30,000	106,400	-	166,400	
Allocation for GPU hardware ($)	-	224,202	304,386	418,834	480,672	1,428,094	
DIrect portion of GPU budget	-	194,202	274,386	329,706	480,672	1,278,966	
Overhead portion of GPU budget	-	30,000	30,000	89,128	-	149,128	
Estimated # of cluster nodes purchased	-	87	121	147	204	558	
Estimated # of GPUs purchased	-	48	68	82	120	318	
Actual cluster nodes purchased	-	-	-	-	-	-	
Actual GPU nodes purchased	-	-	-	-	-	-	
Actual GPUs purchased	-	-	-	-	-	-	

Basis of Estimate –

FNAL Planned Level of Effort Example

- Basis of Estimate derived using staffing model and assumptions
- Takes into account acquisition of new hardware and retirement of systems at end-of-life
- Average count per year assumes new systems brought online in Q3 of each fiscal year.
- Changing parameter values in the Assumptions table automatically updates these tables.

						Level-of-Effort					
	Hardware Deployments						SS Operations Support (FTE-yrs)				
FNAL		#nodes	<#nodes>	# GPUs	<# GPUs>	**Site mgmt**	Base ops sys admin support	Additional cluster ops support	Additional GPU ops support	File server admin support	**Total operations effort**
FY15	start year	985	985	304	304	0.2	0.5	1.1	0.7	0.5	2.8
	acquired	0		0							
	retired	0		0							
	end year	985		304							
FY16	start year	985	880	304	266	0.2	0.5	1.0	0.6	0.5	2.6
	acquired	0		0							
	retired	421		152							
	end year	564		152							
FY17	start year	564	564	152	152	0.2	0.5	0.6	0.3	0.5	2.0
	acquired	0		0							
	retired	0		0							
	end year	564		152							
FY18	start year	564	553	152	138	0.2	0.5	0.6	0.3	0.5	1.9
	acquired	180		97							
	retired	224		152							
	end year	520		97							
FY19	start year	520	492	97	130	0.2	0.5	0.5	0.3	0.5	1.8
	acquired	226		133							
	retired	340		0							
	end year	406		230							
					TOTAL	**1.0**	**2.5**	**3.9**	**2.2**	**2.5**	**11.1**

Level of Effort Summary

The Level of Effort summary was developed based on the staffing model, deployment assumptions, the hardware deployment plan defined in the *LQCD-ext II Acquisition Strategy,* and over 8 years of operating experience.

Level of effort shown is associated with the $14M budget scenario

LEVEL OF EFFORT (FTE-yrs)

	FY15	FY16	FY17	FY18	FY19	Total
Brookhaven						
Site Management	-	-	-	-	-	
Steady-state Operations Support	0.40	0.40	0.40	0.10	0.10	
Deployment Planning	-	-	-	-	-	
Deployment Support	-	-	-	-	-	
Project Management	-	-	-	-	-	
Sub-total (BNL)	0.40	0.40	0.40	0.10	0.10	1.40
Fermilab						
Site Management	0.20	0.20	0.20	0.20	0.20	
Steady-state Operations Support	2.77	2.57	1.96	1.92	1.84	
Deployment Planning	-	-	-	0.20	0.20	
Deployment Support	-	-	-	0.50	0.50	
Project Management	0.35	0.35	0.35	0.35	0.35	
Sub-total (FNAL)	3.32	3.12	2.51	3.17	3.09	15.21
Thomas Jefferson National Accelerator Facility						
Site Management	0.20	0.20	0.20	0.20	0.20	
Steady-state Operations Support	3.14	2.97	2.36	1.94	1.72	
Deployment Planning	-	0.20	0.20	-	-	
Deployment Support	-	0.50	0.50	-	-	
Project Management	-	-	-	-	-	
Sub-total (JLab)	3.34	3.87	3.26	2.14	1.92	14.53
Total						
Site Management	0.40	0.40	0.40	0.40	0.40	
Steady-state Operations Support	6.31	5.94	4.73	3.96	3.66	
Deployment Planning	-	0.20	0.20	0.20	0.20	
Deployment Support	-	0.50	0.50	0.50	0.50	
Project Management	0.35	0.35	0.35	0.35	0.35	
Total	7.06	7.39	6.18	5.41	5.11	31.14

Effort and Budget Summary

Summary shown for $14 million funding scenario

LEVEL OF EFFORT (FTE-yrs)

	FY15	FY16	FY17	FY18	FY19	Total
Site Management	0.40	0.40	0.40	0.40	0.40	
Steady-state Operations Support	6.31	5.94	4.73	3.96	3.66	
Deployment Planning	0.00	0.20	0.20	0.20	0.20	
Deployment Support	0.00	0.50	0.50	0.50	0.50	
Project Management	0.35	0.35	0.35	0.35	0.35	
Total	7.06	7.39	6.18	5.41	5.11	31.14

BUDGET ($K)

	FY15	FY16	FY17	FY18	FY19	Total
Total Project Cost						
Personnel	1,655	1,809	1,566	1,457	1,360	7,846
Travel	17	17	17	17	17	84
M&S	283	283	283	102	102	1,053
Equipment (compute)	-	743	992	1,242	1,333	4,310
Equipment (storage)	-	65	65	108	116	353
Management Reserve	45	84	77	75	73	353
Total	**2,000**	**3,000**	**3,000**	**3,000**	**3,000**	**14,000**
CD-1 Planning Budget Guidance Profile	2,000	3,000	3,000	3,000	3,000	14,000
Additional funding for larger budget	-	-	-	-	-	-
Total CD-1 Planning Budget Profile	2,000	3,000	3,000	3,000	3,000	14,000

Notes:

1) Management reserve set at 20% of unspent deployment personnel budget and 3% of unspent steady-state ops personnel

Summary

- Based on past operating experience and a preliminary analysis, it appears that the "optimum" ratio between hardware and operations support is 54:46, where 54% of the budget is allocated to compute/storage hardware and 46% is allocated to support personnel and M&S costs
- A detailed staffing model is used to determine the level of personnel support required to support the quantity and type of hardware deployed at each site.
- As funding levels drop, we approach the minimum level of support required to support our production systems. Of course, the minimum level of support is proportional to the systems in operation.
- In FY15, our staffing model indicates that 7.15 FTEs are required to support the hardware in production. Budgeting for this level of effort, as well as a modest budget for travel and an M&S budget to cover the IBM BG/Q maintenance, spares, tape, etc. leaves $29K for management reserve when we fit the budget into the $2 million funding guidance envelope.