**LQCD-ext II Project: Risk Register Summary**

| Sum of Risk Rating | Column Labels | | | | | |
|---|---|---|---|---|---|---|
| **Row Labels** | **Cost** | **Schedule** | **Security** | **Service** | **Technology** | **Grand Total** |
| **Exists** | **0.925** | **0.375** | **0.075** | **0.55** | **0.825** | **2.75** |
| **2 - Medium** | **0.25** | **0.375** | | **0.225** | **0.5** | **1.35** |
| 01: Technology/systems may take longer than expected to become available | | 0.375 | | | | 0.375 |
| 02: Cost projections for future years uncertain | 0.25 | | | | | 0.25 |
| 08: Failure of a facility due to natural disaster | | | | 0.225 | | 0.225 |
| 41: Software infrastructure may not be mature enough for newer computing architectures | | | | | 0.25 | 0.25 |
| 42: LQCD sustained performance-per-dollar on commodity hardware may not improve as rapidly as anticipated | | | | | 0.25 | 0.25 |
| **3 - Low** | **0.675** | | **0.075** | **0.325** | **0.325** | **1.4** |
| 03: Unexpected increases in life costs arise after systems are acquired. | 0.125 | | | | | 0.125 |
| 04: Hardware acquired becomes obsolete before expected | | | | | 0.05 | 0.05 |
| 07: Host institutions do not provide necessary infrastructure | 0.125 | | | | | 0.125 |
| 10: Agency personnel changes reduce support for project | 0.125 | | | | | 0.125 |
| 11: Major computer system failure | | | | | 0.125 | 0.125 |
| 13: Changes in funding due to policy changes or new directives | 0.125 | | | | | 0.125 |
| 16: Change in agency mission | | | | | 0.025 | 0.025 |
| 17: Inappropriate use of computer resources | | | 0.05 | | | 0.05 |
| 18: Unauthorized access to computing may disclose private information | | | 0.025 | | | 0.025 |
| 19: Slow networking between sites inhibits productivity | | | | | 0.025 | 0.025 |
| 20: Authentication differences affect inter-site transfers, productivity | | | | | 0.05 | 0.05 |
| 21: Power costs could become substantial | 0.05 | | | | | 0.05 |
| 26: Utility system failure at one of the facilities | | | | 0.125 | | 0.125 |
| 27: Loss of nearline stored data | | | | 0.125 | | 0.125 |
| 28: Stored data may get corrupted or lost | | | | 0.025 | | 0.025 |
| 37: Staff changes have adverse effect | | | | | 0.05 | 0.05 |
| 38: Inaccurate Storage Forecasting | 0.075 | | | | | 0.075 |
| 39: Inadequate Lustre Support | 0.05 | | | | | 0.05 |
| 40: TJNAF Computing Facilities Re-org | | | | 0.05 | | 0.05 |
| **Retired** | **0.225** | **2.475** | | **0.15** | **1.5** | **4.35** |
| **Grand Total** | **1.15** | **2.85** | **0.075** | **0.7** | **2.325** | **7.1** |

Avoid "External Data Connections" warnings after copying file:

Change data source to point back to copy target instead of copy source file via
PivotTable Analyze: Change Data Source

| Risk ID | Risk Title | Risk Area | Description | Probability of Occurrence | Impact of Occurrence | Risk Rating |
|---|---|---|---|---|---|---|
| 1 | 01: Technology/systems may take longer than expected to become available | Schedule | The schedule for achieving LQCD investment milestones might slip for the following reasons: a) Vendors may take longer than anticipated to bring new processors, memory systems, and/or interconnect systems to market; b) It may take longer than expected to bring new systems on-line for production use. | High | Moderate | 0.375 |
| 2 | 02: Cost projections for future years uncertain | Cost | Although cost projections for the current budget year are reasonably precise, projections for subsequent years become progressively uncertain. | Medium | Moderate | 0.250 |
| 3 | 03: Unexpected increases in life costs arise after systems are acquired. | Cost | Unexpected increases in life costs arise after systems are acquired. | Low | Moderate | 0.125 |
| 4 | 04: Hardware acquired becomes obsolete before expected | Technology | Obsolecence: The hardware acquired by this investment becomes obsolete before the end of the planned operations and so does not deliver scientific computing for LQCD calculations in a cost-effective manner. | Medium | Low | 0.050 |
| 7 | 07: Host institutions do not provide necessary infrastructure | Cost | Dependency: Host institutions will not provide space, network connectivity, and mass storage. | Low | Moderate | 0.125 |

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|---|---|---|---|---|---|---|
| 8 | 08: Failure of a facility due to natural disaster | Service | Surity: A major failure of a facility due to natural disaster (destruction of buildings, utility systems) | Low | Severe | 0.225 |
| 10 | 10: Agency personnel changes reduce support for project | Cost | Agency personnel changes, limiting continuity and support for this investment. | Low | Moderate | 0.125 |
| 11 | 11: Major computer system failure | Technology | A major system, such as a cluster or a high performance network, fails to meet performance specifications such that our ability to achieve scientific goals is compromised and the investment does not meet technical goals. | Low | Moderate | 0.125 |
| 13 | 13: Changes in funding due to policy changes or new directives | Cost | Changes in funding, due to alteration in administration policy, or legislative directives. | Low | Moderate | 0.125 |
| 16 | 16: Change in agency mission | Technology | Changes in the mission and plans of the Office of Science. | Low | Low | 0.025 |
| 17 | 17: Inappropriate use of computer resources | Security | Inappropriate use of computer resources by authorized or unauthorized personnel | Medium | Low | 0.050 |

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|---|---|---|---|---|---|---|
| 18 | 18: Unauthorized access to computing may disclose private information | Security | Unauthorized access to computing hardware can disclose private information. | Low | Low | 0.025 |
| 19 | 19: Slow networking between sites inhibits productivity | Technology | Slow Internet data transfer rates among the three labs and external sites may inhibit productivity | Low | Low | 0.025 |
| 20 | 20: Authentication differences affect inter-site transfers, productivity | Technology | Differing authentication schemes among the three labs makes data transfers difficult which limits productivity | Medium | Low | 0.050 |
| 21 | 21: Power costs could become substantial | Cost | The direct (electricity for computers) and indirect (electricity for cooling the computers) costs to the DOE could be substantial in the later years of the project. | Medium | Low | 0.050 |
| 26 | 26: Utility system failure at one of the facilities | Service | Utility system failure at one of the facilities | Low | Moderate | 0.125 |

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|---|---|---|---|---|---|---|
| 27 | 27: Loss of nearline stored data | Service | Reliability: Loss of nearline stored data. | Low | Moderate | 0.125 |
| 28 | 28: Stored data may get corrupted or lost | Service | Data Integrity: Some stored data may get corrupted or lost. Some LQCD data products, such as gauge configurations and very large quark propagators, are very valuable in terms of the computing required to reproduce them in case of loss or corruption. | Low | Low | 0.025 |
| 37 | 37: Staff changes have adverse effect | Technology | Performance: Changes in staff can have adverse effects on the project. | Medium | Low | 0.050 |
| 38 | 38: Inaccurate Storage Forecasting | Cost | Changes in science algorithms or storage use patterns could lead to underestimation of future storage needs which drive up costs or limit the science that can be done with the deployed CPU's. | High | Low | 0.075 |
| 39 | 39: Inadequate Lustre Support | Cost | Lustre may require more site effort than currently expected (for a fixed amount of storage) if vendor support or storage operating characteristics change. | Medium | Low | 0.050 |

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|---|---|---|---|---|---|---|
| 40 | 40: TJNAF Computing Facilities Re-org | Service | TJNAF is re-organizing its computing facilities to meet a PUE goal of 1.4 by about March 2017. This will mean one more full power outage in late 2016 (power transitions, Lustre relocation) plus rolling downtime for compute cluster as racks are moved and/or reconfigured. | Medium | Low | 0.050 |
| 41 | 41: Software infrastructure may not be mature enough for newer computing architectures | Technology | 41: Software infrastructure may not be mature enough for the latest highest-performing architectures to allow the project to exploit the otherwise most cost-effective hardware | Medium | Moderate | 0.250 |
| 42 | 42: LQCD sustained performance-per-dollar on commodity hardware may not improve as rapidly as anticipated | Technology | The performance of commodity hardware components may not improve or their prices may not drop as rapidly as anticipated. New or advancing technologies in commodity hardware, particularly in processors and accelerators, may not perform adequately because of unforeseen bottlenecks that are not adequately addressed in current LQCD software. Realization of these risks may result in the investment failing to meet performance goals in the later years of the project. | Medium | Moderate | 0.250 |

| Risk Priority | Risk Status | Creation Date | Last Review Date | Next Review Date | Last Change |
|---|---|---|---|---|---|
| 2 - Medium | Exists | 7/1/04 | 4/15/16 | 7/15/16 | No change |
| 2 - Medium | Exists | 7/1/04 | 4/15/16 | 7/15/16 | No change |
| 3 - Low | Exists | 7/1/04 | 4/15/16 | 4/15/17 | No change |
| 3 - Low | Exists | 7/1/04 | 4/15/16 | 4/15/17 | 4/8/2015: Mitigation strategy text: typically for 4.5 years (was 3 years) |
| 3 - Low | Exists | 7/1/04 | 4/15/16 | 4/15/17 | No change |

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|---|---|---|---|---|---|
| 2 - Medium | Exists | 7/1/04 | 4/15/16 | 7/15/16 | No change |
| 3 - Low | Exists | 7/1/04 | 4/15/16 | 4/15/17 | No change |
| 3 - Low | Exists | 7/1/04 | 4/15/16 | 4/15/17 | 4/8/2015: Clarify that this risk applies to all systems, even though the mitigation only treats the most likely case. |
| 3 - Low | Exists | 7/1/04 | 4/15/16 | 4/15/17 | No change |
| 3 - Low | Exists | 7/1/04 | 4/15/16 | 4/15/17 | No change |
| 3 - Low | Exists | 7/104 | 4/15/16 | 4/15/17 | No change |

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|---|---|---|---|---|---|
| 3 - Low | Exists | 6/1/05 | 4/15/16 | 4/15/17 | No change |
| 3 - Low | Exists | 6/1/05 | 4/15/16 | 4/15/17 | 4/22/2015: Rewrote mitigation stategy to address improvements in networking in past few years. |
| 3 - Low | Exists | 6/1/05 | 4/15/16 | 4/15/17 | 4/8/2015: Modest text change in mitigation strategy |
| 3 - Low | Exists | 8/8/05 | 4/15/16 | 4/15/17 | No change |
| 3 - Low | Exists | 7/21/09 | 4/15/16 | 4/15/17 | 4/8/2015: Adjusted mitigation strategy text. |

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|---|---|---|---|---|---|
| 3 - Low | Exists | 7/1/04 | 4/15/16 | 4/15/17 | 4/8/2015: Adjusted mitigation strategy text. |
| 3 - Low | Exists | 8/18/09 | 4/15/16 | 4/15/17 | No change |
| 3 - Low | Exists | 7/1/04 | 4/15/16 | 4/15/17 | 4/22/2015: Set to impact to Low, add Notes about variants. |
| 3 - Low | Exists | 8/20/14 | 9/30/15 | 10/15/16 | No change |
| 3 - Low | Exists | 8/20/14 | 4/15/16 | 4/15/17 | No change |

| | | | | | |
|---|---|---|---|---|---|
| 3 - Low | Exists | 8/20/14 | 1/20/16 | 7/15/16 | Added notes |
| 2 - Medium | Exists | 4/22/15 | 4/22/15 | 7/15/16 | 4/22/2015: Added new risk. Similar to 29 (retired) and 25. |
| 2 - Medium | Exists | 8/19/15 | 4/15/16 | 7/15/16 | No change |

| Mitigation Strategy | Notes |
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| For more than a decade now, the LQCD Integrated Project Team has worked on multiple large cluster hardware procurements with significant success. Experienced professional staff follow the commodity market carefully and gain insight by evaluating prototype hardware. They meet with vendors frequently under non-disclosure agreements and are briefed on roadmaps for components such as processors, chipsets, motherboards, network interface cards and switches. In addition to working closely with manufacturers and system integrators, the team has the capability of testing pre-release components. Working with the manufacturers, the team is aware of the strengths and weaknesses in vendor products. The team is able to determine whether new capabilities will actually provide any advantage in future system procurements. The team plans to use past procurement methodologies, fine tuning them as appropriate. | |
| Market information is gathered and prototypes are built throughout the lifetime of the project. Open procurements of commodity components allow for competitive prices. Since hardware is modular in nature, if prices exceed expectations in any given year, it is possible to deploy smaller machines. . A level of performance contingencies are maintained for all procurements. | If conventional clusters remain competitive for next two years, the risks will remain same. |
| Hardware maintenance costs are included in procurement of components for each new system procured (each year). Operations costs are well understood based on years of similar operational experience. Each of the three host institutions (FNAL, TJNAF, and BNL) has operated computing equipment for LQCD computing for more than 10 years. Since the LQCD project is staffed by few key professionals, the loss of any of them is likely to affect the performance of the project; this risk is accepted "as-is" although the project does strive through cross-training and other efforts to maintain expertise across and among the staffs at the three sites. | |
| Clusters purchased by this investment are operated typically for 4.5 years, and subsequently retired. These assumed lifetimes are consistent with historical life cycles observed on similar hardware over the last decade. | |
| The required computer room space is available at each of the host institutions. Only a small fraction of the Internet bandwidth and mass storage of the laboratories is required to support the LQCD computing project. The experiments that are the main users of computer facilities are a high priority for each of the laboratories, and the computer space, and network and mass storage resources will continue to evolve to support these experiments in a way that will also meet the needs of this investment. Further, the project maintains Memoranda of Understanding (MOU) with each institution which detail the resources which are to be committed. In any given year, should one of the three host institutions predict that it would not be able to provide the required resources in a later year; the project will plan to shift deployment of hardware to one of the other host institutions. | |

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| LQCD computer facilities are located within large buildings suitable for large computing installations. These building are not necessarily hardened for natural disasters. To make them disaster-proof would be extremely expensive. The impact of a disaster is severe because this will impact the scientific delivery schedule significantly. However, the probability of occurrence is low. The project accepts this risk. | |
| DOE staff has knowledge of the investment, and have been providing support for over six years. As the investment spans multiple programs, this expertise is not limited to a single individual, and so the impact of a single change is minimal. The existence of an Integrated Project Team, whose composition includes Federal personnel, also mitigate risks due to agency personnel changes. A rigorous review process has been established to mitigate risks, including monthly and quarterly reports and annual reviews. | |
| While this risk applies to all systems in principle, we focus our mitigation strategy on new systems since, in our experience, that is where this is much more likely to occur. The project evaluates prototype machines before procuring and installing production hardware. The project also builds appropriate acceptance criteria into major purchases. During the acceptance testing phase lasting 30 days, the system is tested thoroughly. If the system is deemed to be unacceptable, it can be returned to the supplier under the warranty condition. The project procures systems with a minimum 3 year warranty service. Also, each project purchase represents an addition of <= 50% to the deployed CPU power, which limits the impact of this risk. Even if a new system completely failed to perform despite the aforementioned safeguards, at worst only 1/3 of the post-purchase CPU power is affected. The loss of any one resource for 2-3 months would not result in a major impact on project deliverables. | |
| The investment allocates resources and builds new computing capabilities on a yearly basis, so it is possible to adjust to changing funding levels. This is particularly so because the systems are modular, so reductions in funding can be adjusted for by reducing the size of the systems. Such reductions may delay reaching computational and scientific milestones. A strategy is not available which mitigates the loss of technical computing capability due to substantial decreases in funding. | |
| The computing systems acquired by this investment for LQCD computing have a broad range of applicability in other areas of computational science and could be put into other scientific uses. This is an accepted "as-is" risk. | |
| The computing hardware acquired and operated by this investment is included in enclaves at each of the three sites (FNAL, TJNAF, and BNL). These enclaves have approved C&As according to Federal guidelines (NIST, DOE). Strong authentication is required for access to the systems. The computer resources are on private networks behind these secure systems. The project will coordinate security with the host laboratories. Usage is carefully monitored and controlled by batch systems. Performance is also carefully monitored, so any unauthorized usage would be quickly noticed and terminated. On clusters, batch systems automatically terminate user processes at the end of each job and before each new job starts up. Thus, any unauthorized process would be terminated. | |

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| No classified information, sensitive data, or personally identifiable information is stored on the systems. No privacy risks are present because the lattice QCD systems acquired and operated by the investment contain no personally identifiable information. To enforce this, LQCD users are required to comply with security policies established by respective laboratories. | |
| At FNAL, a dedicated node to be used for intersite transfers (via GlobusOnline) was deployed in 2013 with 10 gigE connectivity to the internet and QDR Infiniband connectivity to the FNAL LQCD Lustre filesystem. When users report slow transfers, Fermilab networking staff have worked with external sites (for example, Globus Online, ANL, NCSA) to determine and repair the causes of any bottlenecks. Similarly, JLab has a dedicated 10 gigE / 40g IB data gateway hosting GlobusOnline, with (shared) 10 gigE to ESnet; network experts work with ESnet to diagnose any slow connections. | Transfer needs between FNAL and TJNAF are minimal. Transfer needs between FNAL and BNL are rare and the connectivity is excellent. Transfer needs between TJNAF and BNL are minimal. Transfer needs are more frequent from Leadership class computing to LQCD computing sites. Although transfer rates between ANL and FNAL are not an issue, there are sporadic issues with transfers from Oak Ridge to FNAL. Oak Ridge to TJNAF: any transfer problem occurs in bursts, mostly with propagators. Transfer problems are often solved by providing better tools to users (e.g. BBFTP, Globus Online) or suggesting procedural changes such as pre-staging from tape to disk. |
| FNAL, BNL, and TJNAF network staff tunes parameters to optimize transfers. Scientific allocations of time on the LQCD computing clusters takes into account the quantity of data which must be transferred between sites; if network performance would limit productivity, allocations are made such that analysis jobs would run at the same site as data are stored (i.e., to minimize transfers). This is an accepted risk for the project since controls for computer security protections are expected to become stricter in near future. Site Managers try to mitigate this risk by addressing helpdesk requests and better documentation. | |
| Project staff uses historical power trends to predict electrical costs. The project also tracks actual power consumption of new systems. The project also specifies power consumption criteria for new procurements to prefer lower power components. The project is always investigating new cost saving and effective computer cooling technologies. | |
| There is a moderate possibility of a single-site utility failure. However, the deployment of SciDAC LQCD software libraries at each site allows end users to shift their scientific production easily from one host institution to another. Should a significant disruption occur, critical scientific production (as determined by the Scientific Program Committee and the Lattice QCD Executive Committee) could continue by such a shift. This may require other less important production to be slowed or delayed. Note that no mitigation strategy is available which could sustain the normal rate of computations should one of the facilities suffer a major utility outage. | Although it is possible to reduce the risk at FNAL by implementing remedial actions, there is no funding available. This is considered as an accepted risk and will remain true during FY12-14. In FY13 Fermilab will site new hardware in a second computing room that is not subject to summer high temperature loadsheds. |

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| The LQCD computing project makes every effort to provide adequate near-line storage to run the simulation jobs. This includes Lustre based storage at FNAL and TJNAF. Related procedures and technologies are refined continuously. Currently, the project has more than adequate near-line storage. A formal decision has been made that LQCD project is not responsible for the archival storage data. The project refreshed all aging storage hardware in FY13, and in FY15 will being migrating from an older Lustre v1.8 to a more stable v2.5 release. | Probability of loss (partial loss) has increased because of the aging of storage hardware at FNAL. |
| The most precious LQCD data products (i.e., the most expensive to reproduce) are gauge configurations. By USQCD policy, overseen by the Executive Committee, to prevent against loss these configurations are stored on tape at two or more geographically diverse sites. The responsibilty for this storage is held by the individual physics collaborations that have generated the particular data ensembles. To guard against silent corruption, by policy these files must be written with checksum (32-bit CRC) data that can be compared on subsequent access to determine whether any data changes have occurred. The USQCD standard I/O library, QIO, can be used to calculate, store, and compare these CRC data. The USQCD user community are also urged in documentation and at the annual collaboration meeting to use this data integrity facility of QIO to guard quark propagator and other data products. Also, single gauge configurations can be regenerated from prior gauge configurations. | TJNAF checks MD-5 checksum of files coming back from tape (and for raw data from experimental program calculates it soon after it is written to disk in the counting house). These checks insure that retrieved data is never corrupted by the tape library. |
| The project maintains staff depth in key roles: Project Manager, BNL Site Manager, FNAL Site Manager, and TJNAF Site Manager. For these roles, an active deputy exists who can fill the role if and when necessary. This should keep the impact of any one key staff member Low, assuming we lose only one key staff member within a period of 6 months. | While the impact of losing more key staff will be greater, the probability of this happening within a 6 month timeframe is lesser. The case of losing two key staff members for example might have a Moderate impact instead of Low, but the probability of this is considered Low instead of Medium. In either case, the Risk Priority is the same. |
| Annual review of storage needs and use patterns. Continue to employ storage "costing" in the allocation model to encourage efficient use of storage, as is done with CPU time, without negatively impacting science production. Discourage storage use not directly related to USQCD science goals. | |
| Annual review of effort expended in Lustre support and revision of forecasted support effort level. In FY15 in particular, we plan to upgrade Lustre systems to v2.5, which could spike the support effort required. We will track the upgrade effort expected/required to determine whether fallback plans are required. We can delay one or both site upgrades, slow one or both site upgrades to reduce effort expended to a tolerable level, or stagger the upgrades across the sits. The real impact is to draw personnel away from other tasks, thus degrading operations, which could have a scientific impact. | |

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| TJNAF has to move to a hot-aisle containment computing center design with a new high efficiency UPS in order to meet a PUE goal value of 1.4 by December 2015. Cooling capacity and efficiency will also be upgraded during this transition. Storage and CPUs will moved a few racks at a time. Chip's plan is to use base-funded computing to augment project computing during this period in order to average 100% up-time for the project site across the year, but some excursions are expected at about the few percent level plus a few days of outages. There is not a lot of contingency in the plan. If a temporary external chiller were to fail, as one did in the past, then this could have a 1-3% impact on the overall average uptime for TJNAF. | The work involved has slipped outside the useful lifetime of the ARRA resources, so less impact. 1/20/2016: The timeline for this has pushed out to 2017. 1 of the 2 UPS's has been replaced per plan. Chiller waterline work underway. Computer room redesign has not been awarded yet. Some modest unit downtime for moving CPU's. Then real system downtime to move storage. |
| It is not necessary to suddenly have 100% of our software able to absorb a new architecture, as we are always running machines as much as 4 years older. Thus, in a single year, the newest machine might be only 25% - 33% of the total project capacity. In each procurement, we optimize the old+new machines to maximize science across a portfolio of applications (some more mature than others with respect to newest hardware). The computing project does not develop application software, and so can only interact with the complementary projects to attempt to optimize the science output across all relevant projects and machines. | April 2015: gains in performance per dollar in the next 2 years are likely to be greatest on NVIDIA's and Intel's next generation chips, both of which will incorporate stacked memory and have even more cores than current chips. If enough software has not evolved to the point of being able to exploit these features well, the project might not be able to achieve project application performance per dollar to meet metrics on cost and schedule. |
| At any given time this risk is low for the current budget year since price/performance is reasonably well known for the coming year. However, the risk increases when planning for the succeeding years, and accordingly performance goals are set more conservatively for the later years of the project. The project strategy is to follow the market carefully to understand emerging processor, accelerator, memory, and network technologies, pricing trends, and performance. Performance of new components is determined through testing with LQCD applications. In general vendors have provided timely remote access to clusters that can be used for these tests and/or early access to engineering or pre-production samples. Disruptive technologies may require building and studying small-scale prototypes before developing large production machines. In all system designs components are carefully selected from the range of available models for cost effectiveness for LQCD applications. To date the available LQCD software has been able to exploit new components cost effectively and technical performance targets have been achieved. However, increasing complexity in commodity components, for example, very wide vector units (Xeon Phi) and heterogeneous memory architectures (Xeon Phi, NVIDIA GPUs) may not be well exploited by LQCD software. Although scientific software development is not in project scope, project staff regularly interact with LQCD software developers and can identify issues that may require adjustments to the project plan. | Moore's Law no longer works on 18 month period, period. We plan on a 24 month period. The risk is still real, as the market may not double on a 24 month period either. Same is true for GPU and Xeon Phi architectures. We can gain most by enabling more software to use advanced architectures. There is also a cost angle to this: we need to see commodity pricing to make architectures cost-effective. In the near-term, we see 16-core parts being available and cost-effective for LQCD (which is optimal on 2^n cores per part) for the next 12-18 months. But will we have to wait "too long" for 32 –core parts? Will the industry stay at 24-cores for an extended period? |

| Probability | Value |
|---|---|
| High | 0.75 |
| Medium | 0.50 |
| Low | 0.25 |

| Impact | Value |
|---|---|
| Severe | 0.9 |
| Moderate | 0.5 |
| Low | 0.1 |

<== 1. Change these values to control Probability, Impact ranges.

**Risk Rating Table**

| **Prob \ Impact** | Severe | Moderate | Low |
|---|---|---|---|
| High | 0.675 | 0.375 | 0.075 |
| Medium | 0.450 | 0.250 | 0.050 |
| Low | 0.225 | 0.125 | 0.025 |

<== 3. Then, manually change the shading in the matrix to represent Priori
Conditional formatting not programmed in the table yet.

**Risk Priorities**

| Prioritization | Low Value | High Value | Risk Planning Level |
|---|---|---|---|
| 1 - High | 0.500 | 1.000 | Detailed Risk Plan |
| 2 - Medium | 0.150 | 0.500 | Modest Risk Plan |
| 3 - Low | 0.000 | 0.150 | Minimal Risk Plan |

<== 2. Change these "2 - Medium" low/high values to alter Prioritization as

^^^ 4. And finally, remake the "Summary Table" pivot table present Prioritization values

oritization assignments in Risk Register.

**LQCD-ext II Project: Risk Register Revision**

| Version | Date | Modifier |
| --- | --- | --- |
| 1 | 8/18/09 | |
| 2 | 3/16/10 | |
| 3 | 7/21/10 | |
| 4 | 4/26/11 | |
| 5 | 4/27/12 | |
| 6 | 4/30/13 | Rob Kennedy |
| 7 | 2/18/14 | Rob Kennedy |
| 8 | 3/27/14 | Rob Kennedy |
| 9 | 4/22/14 | Rob Kennedy |
| 10 | 8/20/14 | Rob Kennedy |
| 11 | 10/15/14 | Rob Kennedy |
| 12 | 10/28/14 | Rob Kennedy |

**er Revision History**

| Description of Change |
|---|
| Initial Risk Items for LQCD-ext (derived from LQCD project) |
| Revised Risk Mitigation Strategies |
| Revised Risk Management Plan V1.2 |
| Revised Risk Register for GPU/Ds extension purchase |
| Revised Risk Register, particularly for Accelerated (GPU) Clusters |
| Reorganize and normalize. Updates by FNAL Site Managers. Include input from JLab, add entries for BG/Q. |
| Update risks based on semi-annual review begun in October 2013 |
| Split Risk Item 12 into technical risk in Risk Item 12 and personnel risk in Risk Item 37. Address succession plan in Risk Item 37. |
| Update risks per LQCD-ext Risk Review 4/9/2014 (see review notes for details) |
| Update risks per LQCD-ext Risk Review 8/20/2014 (see review notes for details) |
| Update risks per LQCD-ext Risk Review 10/15/2014 (see review notes for details) |
| Adapt to the LQCD-ext II Project (changes to risk items themselves are now tracked in entries and in review notes) |

| Risk Areas | DO NOT CHANGE "Risk Areas" |
|---|---|
| Cost | |
| Schedule | |
| Security | |
| Service | |
| Technology | |