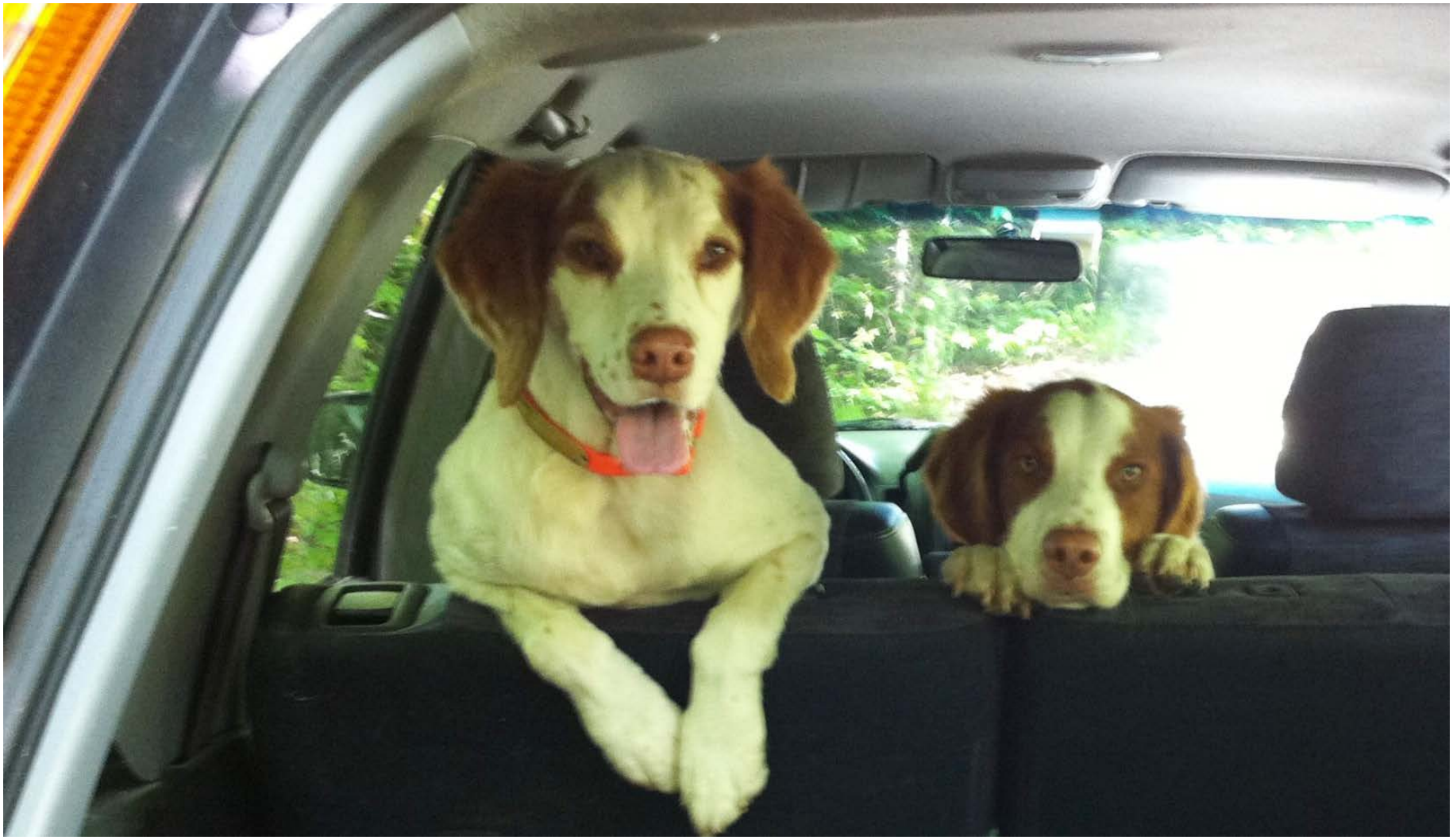
Computing All-Hands Meeting
Rob Roser

March 2016

Outline of Presentation

- Computing Strategy
- Major Computing Initiatives
- Lab Priorities
- New Core Competency
- Fermilab Computational Science Building
- Cyber Security
- ES&H
- Other Stuff
- Questions

Pete and Maggie



Preface

- Why Develop a Computing Strategy?
  - Aren't you just repeating the "Gottschalk exercise"?
  - You don't have enough to do?

- The computing strategic plan will:
  - Connect computing's alignment with the laboratory's strategic plan
  - Communicate a unified vision of where we want to be as an organization in the future and how we will get there (over the next 5 years; with a 3 year focus)
    - To both to Senior Management and our employee's!
  - Provide a guide for making tactical decisions in the context of the strategic goals and objectives.

Preface (2)

The strategic plan will, in non-technical terms, identify

- the main strategic themes
- Technologies we will leverage to go forward
- Describe the high level approach(s)

that we will employ in order to deliver on mission outcomes.

- This plan is not an overhaul of Computing, it's a plan for moving forward!
- it is a change in emphasis as we shift from locally developed computing solutions to modern cloud-based applications and drive innovative, agile scientific computing solutions with broad applicability to our program.

Computing Strategic Plan Drivers

1. Computing's role as a core enabler of science
   - Cutting edge science experiments and research from Fermilab requires innovative, state of the art computing technologies
2. An ever increasing demand for new and improved computing solutions
   - Computing technologies change rapidly and the laboratory continues to demand modern computing solutions in order to streamline the current processes (e.g., HR, Finance, Project, Engineering Management) and improve efficiency
   - Users expect robust, consumer friendly computing services (e.g., Google, Amazon) to be available from the laboratory
3. Regulatory cyber security mandates
   - The new mandate for cyber security requires dramatic changes in how Fermilab operates, potentially resulting substantial additional efforts and budget
4. Budget and resource limitations
   - Limited computing budget and resources have accentuated the need to plan and invest strategically

Guiding Principles

- Enable mission and resiliency while managing risk
- Instill the right level of cyber security to protect our information and reputation while maintaining the laboratory's open science mission
- Manage information as a critical laboratory asset
- Use technology to enhance our competitive advantage for researchers
- Maintain an applications architecture strategy of preferring commercial and/or cloud solutions over custom developments
- Recognize science is collaborative and never stops
- Focus on the end-user experience and leverage, where possible, mobile devices to empower people to be productive wherever they are
- Simplify and reduce the overall legacy application portfolio
- Focus on our greatest assets—our employees
- Make doing the right thing the easy choice

7 Underlying Themes of the Strategic Plan

1. We will continue to innovate our scientific solutions.
2. We will leverage industry best processes to deliver and support our solutions in order to ensure the overall consistency, efficiency and speed of our performance.
3. We will significantly increase our cyber security program to ensure we are excellent custodians of the digital data we are entrusted with.
4. We will strive to simplify the end-user experience by providing tools, interfaces and mobility applications so that our employees' work experiences are similar to what they are used to at home.
5. We will continue to modernize our systems and infrastructure to better support the laboratory's mission.
6. We will provide a work environment that makes it easy to attract top talent and retain the talent that we employ.
7. We will build stronger partnerships with industry as well as the other areas within the Office of Science with an emphasis on ASCR.

Mission and Vision….

Computing Mission

- Deliver timely, innovative computing solutions and services that enable Fermilab to achieve its scientific mission; efficiently execute the business of the laboratory and provides a modern user experience.

Computing Vision

- Provide secure and reliable access to information and services, any time, any place, on any device, in full collaboration with our scientific community

Driver: Increasing demands of computing solutions (e.g., Finance)

- In many area's we have fallen behind in terms of products and services.
- Laboratory continues to demand computing solutions that promote efficiency gains by enabling business functions and processes. In particular, many opportunities exist in Finance functional area in FY16.

Capabilities	Start Year	SWF [FTE-Months]	Duration [Months]	NOTES
ESHTRK	~1990	n/a	n/a	Platform
CAS/BI/Analytics(FermiDash)	2008	104	32	worked stopped in 2009. $400k from U of C. Work restarted with new tools in 2011
Engineering Data Mgmt	2010	48	33	
Project Mgmt Tools	2011	19	24	
CAS/BI/Analytics(iTrack)	2012	4	6	
Human Capital Mgmt	2013	79	14	includes $400k from IT Infrastructure and $200k for backfill of operational personnel
BPS - Multi Release	2015	102 ~ 127	15 ~ 19	v11 costs. Contingency: 0% Low, 25% High
Payroll w/o Pay Freq Change	2016	50 ~ 70	17 ~ 20	
Source 2 Pay		132 ~ 199	42 ~ 53	Deploy in Sequential Releases
S2P - Release 1 - Staff aug.	2015	20 ~ 30	8 ~ 10	Self-Service Req + Auto-PO
S2P - Release 2 - Baseline	2016	19 ~ 28	6 ~ 8	Approvals Mgmt Engine
S2P - Release 3 - Baseline	2018	23 ~ 34	6 ~ 8	OBIEE and Analytics
S2P - Release 4 - Baseline	2018	26 ~ 40	8 ~ 10	Sourcing and iSupplier
S2P - Release 5 - Baseline	2019	23 ~ 34	7 ~ 8	Procurement Contracts
S2P - Release 6 - Baseline	2020	23 ~ 34	7 ~ 9	Services Procurement
Oracle eBS - Baseline	2018	32 ~ 41	12 ~ 14	Less contingency due to past experience
MOSRC	2016	3 ~ 5	7	Compliance requirements
Infrastructure	on-going			Database instances, snap storage, VMs, etc.
Total variant w/o Pay Freq Change		320 ~ 442	95 ~113	* total does not include completed projects

Driver: Computing as core enabler of science

- Supporting the current program and preparing for the future requires significant investment, but manpower is limited. Leveraging resources and expertise is essential. Common solutions paramount!
- Provide state of the art, reliable facilities and computing services

Scientific Software

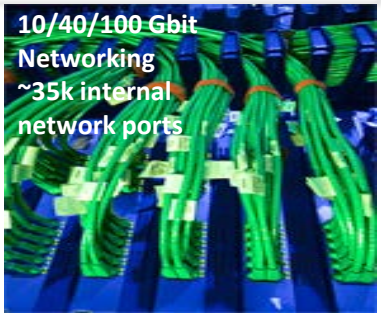
Scientific toolkits:
- User analysis.
- Simulation and modeling.
- Common reconstruction algorithms.
- Access control.
- etc.

Software application frameworks:
- Configured and used by individual experiments across data acquisition, processing and analysis.
- Software development environments including build, continuous integration and testing, code repositories.

Services and software for large-scale distributed computing:
- Access to local, remote, CLOUD and HPC systems.
- Support for scientific databases and collaborative tools.

R&D on advanced technologies, methods new hardware:
Fermilab LDRDs
- GPUs for network packet analysis
- DAQ & the internet of things
- Automata Processors for next generation pattern recognition

DOE SciDAC and Computational HEP program
Advanced computing and network fabrics



Facility

CMS Tier 1
-Compute and storage resources
-Services stack

Intensity Frontier and Cosmic Frontier
-Compute and storage resources
-Services stack

HEP Cloud Facility
-Cloud, on demand resources
-Commercial & local
-Virtualization services stack

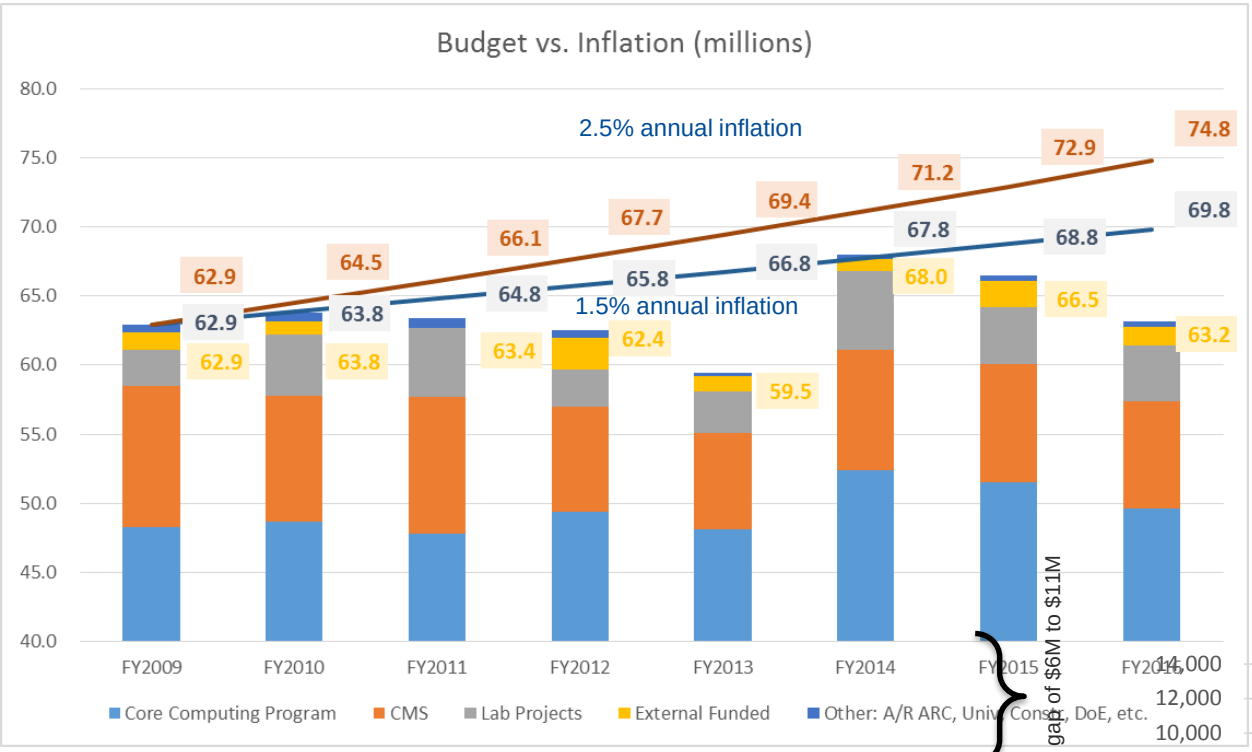
High Performance Computing (HPC)
-LQCD, accelerator modeling, and cosmology compute and storage resources
-HPC services
-New computing architectures

Driver: Cyber Security

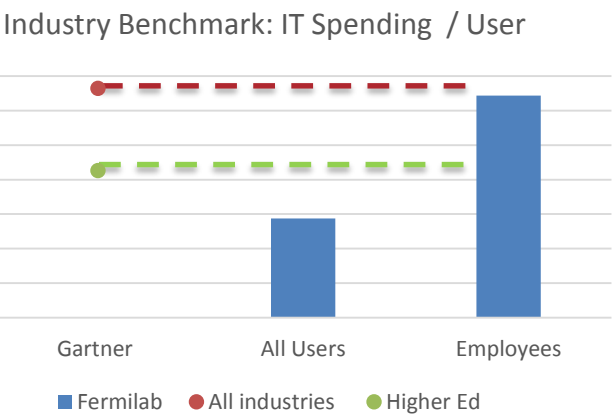
- The cyber “game” is changing as countries use cyber to gain an advantage (knowledge).
- We need to respond – its not business as usual!
- Cyber security should not get in the way of the scientific mission
- We must maintain agility and flexibility to respond to an ever changing threat environment.
  - Yesterday’s tools and techniques will not win today’s battles.
  - A compliance based checklist approach will not provide adequate protection
- US government sites (and DOE in particular) are an increasingly attractive targets to cyber adversaries, who are constantly adopting new and subtle infiltration techniques designed to compromise systems and exfiltrate data
- New technologies and increased use of cloud service providers require re-evaluation and upgrades of our security toolkit

Maggie as a Puppy

Driver: Budget and resource limitation



Produces an effective gap of $6M to $11M



Computing Strategic Plan Implementation

LAB Agenda

Preparing to host the world for neutrinos

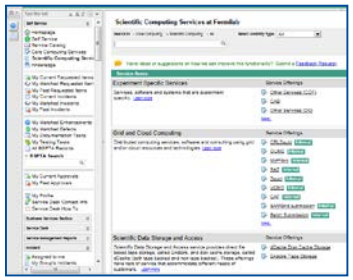
Our vision is to solve the mysteries of matter, energy, space, and time for the benefit of all. We strive to:

- Lead the world in neutrino science with particle accelerators
- Lead the nation in the development of particle colliders and their use for scientific discovery
- Advance particle physics through measurements of the cosmos

Business Capabilities

Computing strategic plan is aligned to support lab agenda and evolving business capabilities by providing robust computing services that are implemented through industry best practice

Computing Strategic Plan

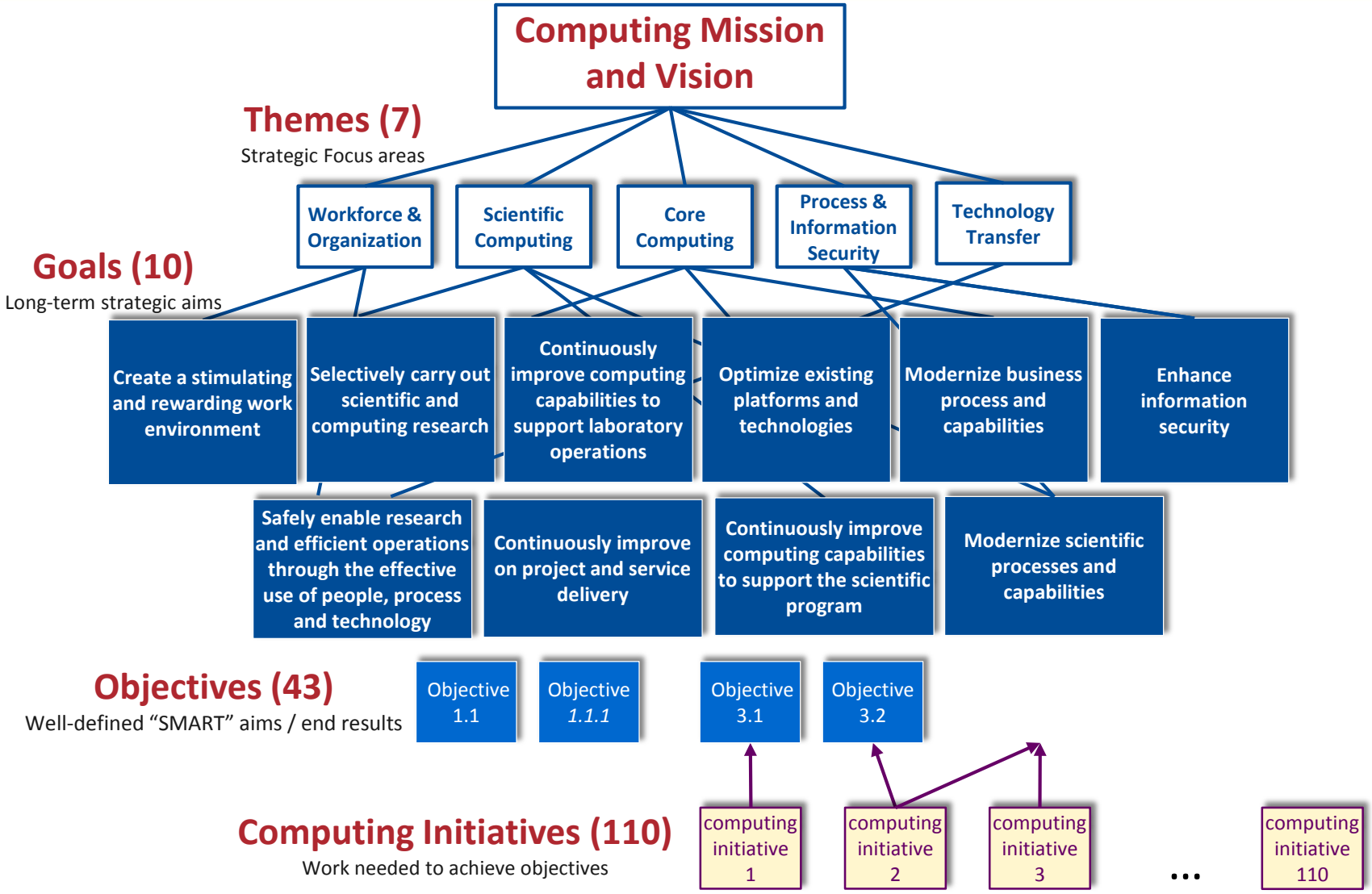


Computing Services

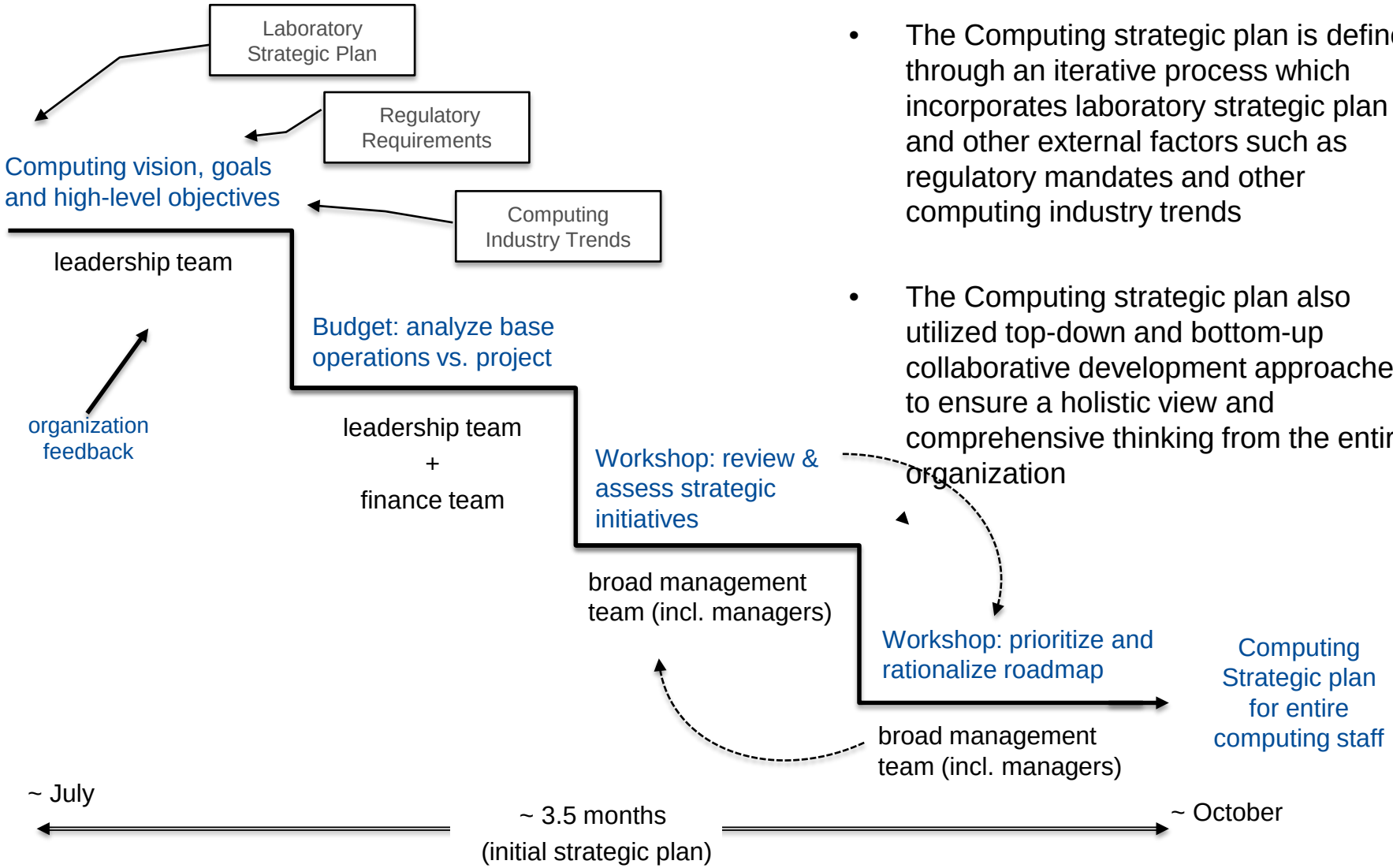
- Workforce & Organization
- Scientific Computing
- Core Computing
- Process & Information Security
- Technology Transfer

Computing Strategic Focus Areas

Computing Strategic Plan Structure



Computing Strategic Plan Process



- The Computing strategic plan is defined through an iterative process which incorporates laboratory strategic plan and other external factors such as regulatory mandates and other computing industry trends
- The Computing strategic plan also utilized top-down and bottom-up collaborative development approaches to ensure a holistic view and comprehensive thinking from the entire organization

The Plan!

- About 40 pages total
- In final edit now
- Expect to release it soon.

Pete the day I got him home…

Computing Strategic Plan Focus Areas

Focus Area	Theme	Enablers
Scientific Computing*	• Lead and innovate • Explore state-of-the-art technologies • Collaborate effectively with Experiments, Scientific Programs and International Partners	**Accelerator Modeling, DAQ & Engineering, Detector Simulation, Distributed Computing, Software Frameworks, Scientific Facilities, Advanced Networks, IoT, Big Data**
Core Computing*	• Leverage mature technology • Adopt proven platforms and applications • Partner with key vendors and pursue evolving technologies to improve efficiency	**Microsoft (Office, Exchange, SharePoint, onedrive), Oracle (E-Business Suite, Primavera), Cisco (network routers and switches, VOIP), Workday, property mgmt (sunflower) Open source (e.g., MySQL)**
Workforce Management	• Talent and skill planning • Encourage women and minority participation	**Training, Succession Planning, Focus Groups**
Organization	• Retaining and attracting top talent • Best place to work for	**Flex work schedule, Wide variety of projects and technologies.**
Cyber Security*	• Support mandate & mitigate risk • Balance between control and flexibility	**MFA, Firewall, Scanning & Monitoring, IDS, Virus Scan**
Process*	• Adopt industry best practice • Continuous improvement & efficiency gain	**Service Management** **PMO, QA, Enterprise Architecture**
Technology Transfer	• Apply technologies that enable science to industry	**SDN, IoT, Big Data**

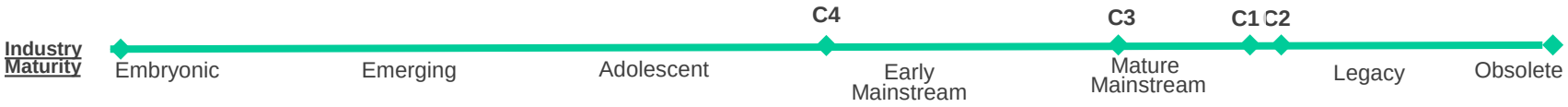
Cyber Security Objectives

- Provide the appropriate level of security to safeguard enterprise information against unauthorized access, modification, disclosure, and use.
- Aside:
  - Due to recent cyber security incidents, the Federal government accelerated its efforts to secure the Enterprise. The Office of Management and Budget (OMB) defined a set of cybersecurity sprint action items that all departments and agencies (D/As) must address
  - I assume this is just the camel's nose wrt cyber. We will get further action items in the coming year…

Focus Area: Cyber Security

Theme	Enablers
• Support mandate & mitigate risk • Balance between control and flexibility	**MFA, Firewall, Scanning & Monitoring, IDS, Virus Scan**

ID	Description	$
C1	Install upgraded firewalls to improve border protection	--
C2	Migrate independently managed web servers to a centrally managed system to increase web server security	--
C3	Implement 2-factor authentication for all privileged account access to prevent data loss	--
C4	Implement 2-factor authentication for all access to sensitive data including cloud based solutions per DOE mandate, to prevent data loss.	--



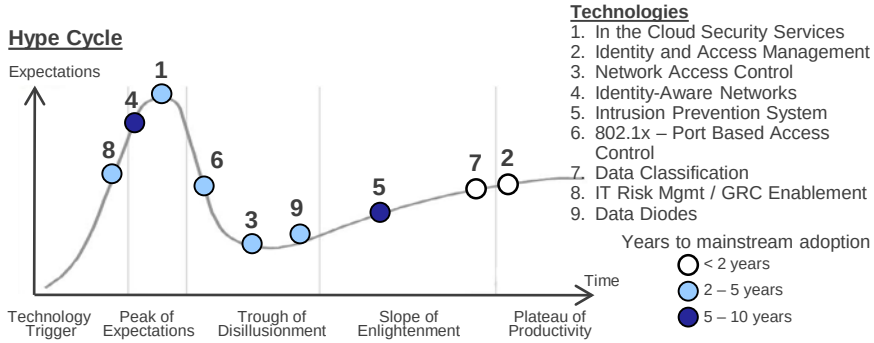
MFA and Intelligent Firewall

Description

This project includes the purchase of two Palo Alto (or equivalent) 60Gb intelligent firewalls (architecturally similar to the lower bandwidth Palo Alto devices we already own that are deployed to protect business applications); and 2 FTEs for one year to re-architect our network design to accommodate the firewall, conduct testing to ensure the firewall does not interfere with the lab mission, and fully install the device

Industry, Research, Technology Maturity

Intelligent firewalls are a mature widely used technology. We have pricing and specifications from two commercial vendors (Palo Alto and Fortinet) who have equipment that would satisfy our need.



Aspirational State and Gap

Aspirational State:

Use an intelligent firewall to restrict network traffic to and from the lab network, using the firewall to regulate traffic based on IP protocol regardless of port. Move to a default deny network policy, where types of traffic not previously in use are not allowed unless specifically authorized. Have a redesigned network architecture that segregates high bandwidth scientific data transfer traffic (which will bypass the firewall) from standard lab internet and business traffic

Gap:

Presently we can only restrict traffic with acls forbidding or allowing traffic to particular IP ports. This means we cannot regulate services or protocols when they run on non standard ports, and can provide no restriction for services that choose arbitrary port numbers (like BitTorrent).

Investment Strategies

Short Term Strategy:

This project requires roughly $500K in supplemental funding for hardware/software acquisition and 2FTE years of network architect services for network redesign and firewall installation

Strategic Direction:

Installation of the firewall will currently reduce necessary expenditures on site web proxy and intrusion detection hardware and software since some of this functionality will be performed by the firewall, resulting in savings of roughly $150k/year. The firewall itself will need hardware replacement of end-of-life systems every 3-5 years, requiring periodic budget increments to support these upgrades.

More on Cyber

- MFA is not the only thing we are doing this year to improve our cyber presence
- We are adding firewalls to further protect/separate our critical business
- We have made a big effort at looking at all of the web sites, turning off those that are no longer active, bringing many into our centrally managed web servers and paying close attention to the scans of those not centrally managed.

Our priority is to protect and safeguard our critical information while still maintaining an open science network

Core Computing High Level Objectives

- Improve our users experiences both at the lab and when they use our services remotely
- Modernize and automate the lab's business processes
- Mobility – any device anywhere
- Improve Cyber Security to effectively protect our data and reputation

Focus Area: Core Computing

Theme	Enablers
• Leverage mature technology • Adopt proven platforms and applications • Partner with key vendors and pursue evolving technologies to improve efficiency	**Microsoft (Office, Exchange, SharePoint, onedrive), Oracle (E-Business Suite, Primavera), Cisco (network routers and switches, VOIP), Workday, property mgmt (sunflower) Open source (e.g., MySQL)**

ID	Description	$
CC1	Implement enterprise-wide Budgeting and Planning System	--
CC2	Implement next generation Source to Pay system	--
CC3	Replace the existing payroll system	--
CC4	Replace the legacy voice infrastructure	--
CC5	Establish web modernization infrastructure and process	--

CC1: Budget & Planning System (BPS)

Description	Industry and Technology Maturity*
Fermilab currently completes its budget and planning activities using multiple, disconnected processes, tools, and systems. This creates a lack of consistency that makes aggregating the data for analysis and planning complicated and time consuming, and hinders required interactions between organizational units and consistent reporting. The objective of this initiative is to deliver an integrated budget and planning capability that will unite strategic and resource planning with budget formulation and serve as the single version of the truth for reporting. The end result will provide a single, modern system and common processes that will result in budget and planning activities that are streamlined, more robust, and easier to use.	Existing corporate performance management (CPM) applications are used to support the core financial processes of consolidation, reporting and budgeting; to help link strategic and operational plans; to provide wider access to financial analytics; and to help develop strategies for long-range plans. CPM applications serve two needs. The first is tactical; they support more-efficient financial processes, enable greater control and transparency, and promote regulatory compliance. The second is strategic; they facilitate a broader approach to organization-wide performance management. The CPM application suite market is mature and composed of vendors offering comprehensive solutions that are widely adopted by both large and midsize organizations. (Source: Gartner Magic Quadrant for Corporate Performance Management Suites).
Current and Aspirational State	**Investment Strategies**
Current State: Budget and planning is done across the lab in disparate and inefficient ways. Each line organization uses different processes to complete annual budget formulation, which are time consuming and labor intensive. Some organizations have developed complex budget planning tools while most rely on Excel spreadsheets. Version control is a constant problem. Resource negotiations between O413 projects and line organizations are complicated, inefficient, and oftentimes poorly documented. Changes in time-phased project resource needs are challenging for line organizations to absorb. What-if scenario planning is extremely time-consuming and prone to inaccuracies. Because data is spread across the laboratory, there is no single source of truth and timely responses to DOE data calls can be challenging. **Aspirational State:** Budgeting and planning will be performed in a single labwide system that will provide a single source of truth for planning data, incorporate industry best practices to improve consistency and transparency, reduce the level of effort and time required for budget formulations, facilitate efficient resource planning and management, provide advanced capabilities for what-if scenario planning and multi-year forecasting projections, and provide advanced reporting and budget analysis capabilities.	**Short Term Strategy**: Working jointly with the CFO and Budget Office, engage lab senior management, O413 project managers and the financial community to identify shortcomings and pain points in current processes; refine functional and technical requirements for an improved future state; and develop business use cases outlining improved future budgeting and planning processes. Where possible, incorporate improvements to improve current processes. This work is well underway. **Strategic Direction**: Work with key laboratory stakeholders to refine an ideal future end state for an effective, efficient budgeting and planning system. Select and implement a cloud-based commercial state-of-the-art corporate performance management (CPM) system that will enable the laboratory to achieve the desired future state. Use an agile-based delivery methodology to begin introducing new processes and system functionality to the laboratory in a phased approach to begin realizing improvements as early as possible. The phased approach will allow the laboratory to start utilizing new functionality and improved capabilities as soon as possible. Over time, continue to implement enhanced functionality and capabilities; and fully integrate the new system into the Fermilab Strategic Planning System to support the One Lab objective.

Budget and Planning System – Top Priority

- Goal is to improve efficiencies and standardize the way budgeting and planning is done across the laboratory
- New End State will
  - provide a single source of truth for planning data
  - incorporate industry best practices to improve consistency and transparency
  - reduce the level of effort and time required for budget formulations
  - facilitate efficient resource planning and management
  - provide advanced capabilities for what-if scenario planning and multi-year forecasting projections, and provide advanced reporting and budget analysis capabilities.
- Julie Marsh, Bill Boroski, Cindy Conger and Mark Kaletka have point on this project.

Source To Pay -- Priority

- Goal – providing an “amazon-like” web based shopping experience for Fermilab commodity items.
  - Pro-card on steroids
  - Automating the PO process

- Attempting to manage this project to schedule and NOT best effort.

- Santo Campione Gordon Bagby and Michelle Quinn have lead on this.

Scientific Computing High Level Objectives

- Deliver a New Paradigm for HEP Computing Facilities
  - HEP Cloud Facility
  - Active Archival Facility
- R+D for Advanced Computing and Computing Fabric Solutions
  - SND and NDN network research (with ASCR)
  - Establish terabit link between FNAL and ANL (With ASCR)
- Common Experiment Analysis and DAQ Frameworks
  - Art, LArSoft Phase II, and artDAQ
- Improve in the effectiveness, timeliness, and productivity of HEP analyses
- Improve Partnership with ASCR and help drive NCSI through exascale

Focus Areas : Scientific Computing

Theme	Enablers
• Lead and innovate • Explore state-of-the-art technologies • Collaborate effectively with Experiments, Scientific Programs and International Partners	**Accelerator Modeling, DAQ & Engineering, Detector Simulation, Distributed Computing, Software Frameworks, Scientific Facilities, Advanced Networks, IoT, Big Data**

ID	Description	$
S1	Fermilab HEP Cloud Facility (FermiHEPCloud)	--
S2	Advanced Networking to enable TeraBit networks for exascale computing	--
S3	LArSoft Phase II, Common Reconstruction Group	--
S4	Common Toolkits across existing and future scientific collaborations (including research into technologies, modern hardware architectures, for scientific computing solutions)	--
S5	Integrate appropriate big data technologies into HEP & astrophysics analysis solutions.	--
S6	Establish a center of excellence for computational theoretical studies and numerical simulations	--
S7	Improve and extend the common DAQ toolkit	--
S8	Improve processing operations through automation and intelligence	--

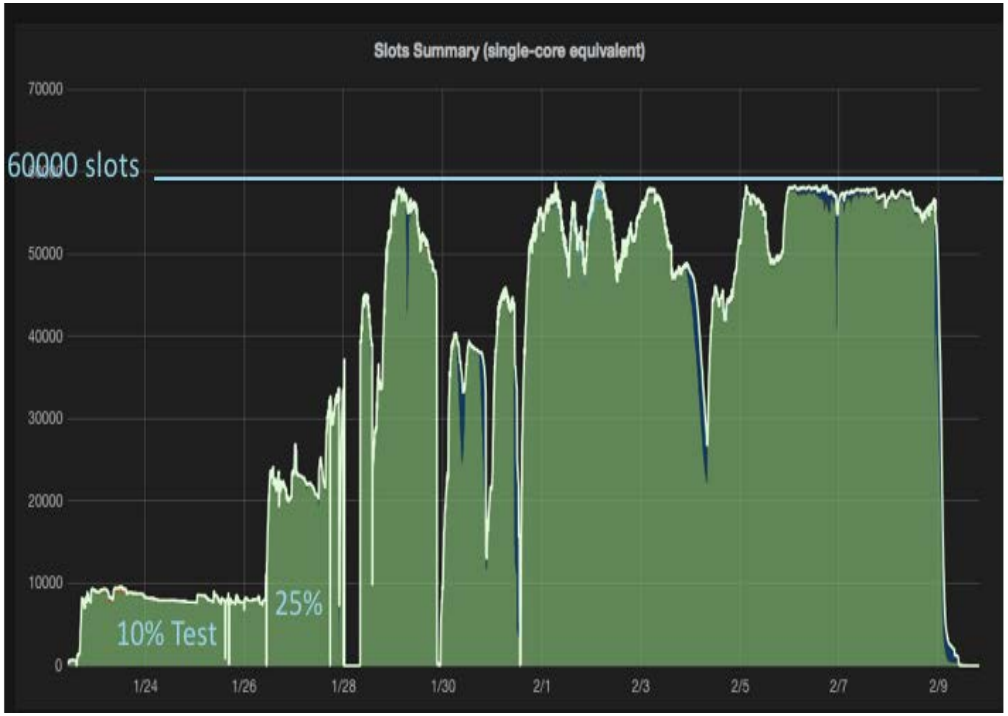
S1: Fermi HEP Cloud Facility

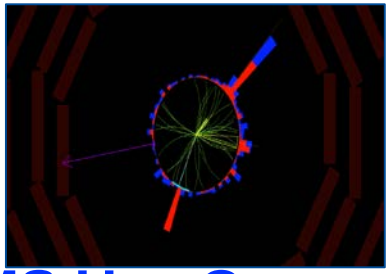
Description	Industry, Research, Technology Maturity*
Develop, extend and support a single portal to a distributed ecosystem of computing resources of all kinds – local, commercial and academic, including DOE's High Performance Computing (HPC) facilities, experiment university compute clusters, and commercial cloud providers such as Amazon, Google and Microsoft. Provide "complete solutions" to all scientific users, with agreed upon levels of service and the ability to elastically expand or contract the resources uses based on demand. Include support for active tape archiving, distributing and caching for a broad range of customers and access needs.	Industry trend is to use Cloud services: Infrastructure, Platform & Software as a Service, to reduce cost of provisioning and operating; provide redundancy or failover; rapidly expand and contract resources; pay only for the resources needed/used. DOE focusing on deployment, support and access to peta- and exa-scale HPC facilities in support of data intensive science.
Aspirational State & Gap	**Investment Strategies**
Aspirational State: Provide leadership and access to resources in provisioning a large pool for offerings of archival capabilities, compute, database services, data management, etc. potentially linking all US-HEP computing. Complete solutions for users, where they don't have to decide on target compute engine or manage resources. Resources used based dynamically on efficiency, cost and workflow requirements for "owned" or "rented" resources **GAP:** Achieving the goal requires significant development in several new key areas of work: • Detailed understanding, procurement, and use of commerical cloud resources from Amazon, Google and Microsoft (reduce risk and increase cost effectiveness through competition) • Decision making to determine what are the most cost effective resources to use at any given time for particular user workflows, processing and analysis. • Providing the needed data handling, transfer and access protocols and technologies to ensure seamless provisioning of data for the computations to be executed. • Extending the current distributed computing "administrative services" – e.g. accounting, monitoring, error reporting – to work seamlessly in the new environment. • Development of user friendly interfaces for all services provided.	Short Term Strategy: Deliver releases of FermiHEPCloud Facility for production use by targetted experiments – initially US CMS, NOvA and DES. Based on the experiences gained extend the use to other experiments and scientific users. Deploy and support for common and shared facility services across many scientific computing customers. Strategic Direction: Collaborate with US CMS, Neutrino and Cosmic experiments to ensure effective, appropriate solutions as they are developed and evolve. Partner with computer science and DOE ASCR facility peers to enable use of HPC systems today and in the future. Focus on flexibility to avoid technology "lock-in" and parochial solutions that prevent migration to new compute architectures and offerings.

Pete as a puppy

HEPCloud

- The future HEP program demands computing resources beyond the ability of current computing models to scale within realistic budget constraints
  - HL-LHC will start the Exabyte era for HEP
- HEPCloud, a new facility paradigm, to provide “elastic” deployment of resources.
  - A single portal to a heterogeneous set of computing resources (clouds, grids, HPC), both local and “rental” (commercial or academic)





CMS Use Case

Generation, detector simulation, digitization, and reconstruction of simulated events in time for Moriond conference.

56000 compute cores, steady-state.

Demonstrates scalability

Lab Priorities: Ranking of “importance(s)” (T. Myer Slide)

1. LBNF/DUNE (CD-1->/CD-3a must succeed) + SBN
2. LCLS-II (we must deliver… and we are)
3. PIP-II (India collaboration)
4. LHC upgrades (CMS Phase I, LARP, CD-0 Phase II soon)
5. Muon g-2 and associated AIPs
6. Mu2e (go go go)
7. UUP project
8. Operations in order:
    1. NOvA (500 kW->700 kW)
    2. MicroBooNE
    3. Everything else
9. Cosmic projects and pps

Fermilab Core Competencies

DOE Office of Science Mission

Accelerator Science and Technology	Advanced Computer Science, Visualization, and Data	Large-Scale User Facilities / Advanced Instrumentation	Particle Physics
Major Initiatives: • Accelerator Science • LCLS-II • PIP-II • HL-LHC	**Major Initiatives:** • Computational Science • Active Archival Facility • *art* workflow • HEP Cloud	**Major Initiatives:** • LBNF/DUNE • CMS Upgrades	**Major Initiatives:** • Neutrino Science • LHC Science • Precision Science • Cosmic Science

People and Infrastructure

Major Initiatives:
Diversity & Inclusion, Integrated Engineering Research Center, Global Accelerator Center

Fermilab Computational Institute

We are starting to plan for the lab's next computing facility

- Will be needed to meet lab's needs in the '20s
- Coordinating with campus master plan
- Building will house data center and have facilities to foster partnerships with industry and other labs

Seeking Private Funding!

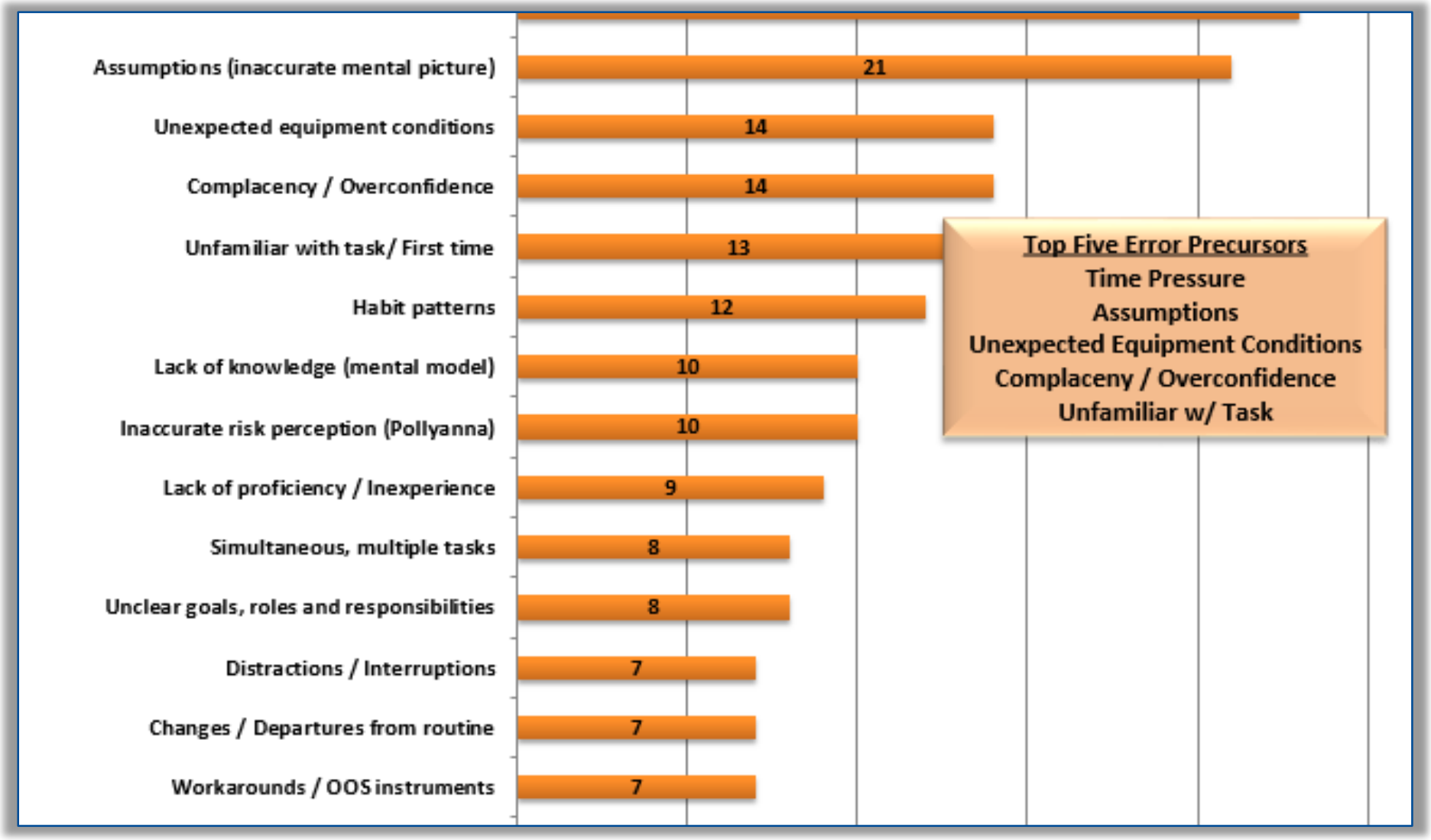
Fermilab Computational Institute

Fermilab Computational Institute

Enterprise Risks Held by me…

- Cyber-security incident results in embarrassment to the lab.
  - Web site or email hijacked and used to spread false public information
- Lab IT systems are used by staff, contractors, or visitors for illegal activities.
- Major cyber-security incident results in large-scale disruptions that impact lab operations.
- Theft or loss of sensitive data such as:
  - Personally Identifiable Information (PII) of Laboratory employees, users and/or contractors.
  - Project-related data
  - Technical or commercial data covered by NDA
  - Confidential procurement data
  - Export controlled or proprietary information

HPI Error Precursors -- Fermilab



LBNF / DUNE – An International mega-science project

Your Reward!

Thank You for ALL Your Hard Work and Commitment

Back Up Slides

Focus Area: Process

Focus Area	Theme	Enablers
Process	• Adopt industry best practice • Continuous improvement & efficiency gain	**Service Management** **PMO, QA, Enterprise Architecture**

The primary goal of process is to enable a service oriented "computing" organization that demonstrates excellence through effective and efficient management practices supported by "governance" processes, including financial management, enterprise architecture, service management, project management and organizational change. Computing will continue to *emphasize continuous improvement* in the areas of process, and ensure that investments are made in a manner that maximizes the use of limited resources to deliver computing capabilities aligned with the strategic goals of the laboratory.

ID	Description	$
P1	Define and track Key Performance Indicators (KPI's) and performance metrics to demonstrate Computing effectiveness	--
P2	Develop and Document Strategic Roadmaps to ensure alignment of computing capabilities with strategic needs	--
P3	Improve customer interfaces to ensure efficient access to services.	--
P4	Implement demand management processes to effectively capture needs and establish a higher level of involvement with customers on setting priorities and selecting work to be performed.	--
P5	Employ tailored project management methodologies to ensure consistent practices and successful delivery of computing projects.	--

P2: Strategic Roadmap Development

Description	Industry and Technology Maturity*
Computing currently provides a large array of computing services that enable Fermilab's scientific research and world renowned projects, and support business operations. Notwithstanding, there are a number of computing capabilities and needs that could be met more effectively or efficiently. As the direction of the lab and the technology landscape evolve, Computing is committed to help drive the laboratory to better leverage digital technologies to meet demands. The objective of this initiative is to engage the laboratory in a discussion of critical needs and the development of a set of roadmaps that will be used to plan and communicate the delivery of key computing capabilities required to meet Fermilab's strategic objectives.	Through numerous channels, Computing aggressively tracks trends in advanced computing methods, techniques, tools, and services. We are constantly seeking out and exploiting technology advances, such as multichannel processing, cloud computing, and mobility to enhance the level, user experience, and cost-effectiveness of the services we provide. These technologies and services are reaching levels of maturity that makes them viable solutions to meet needs and user expectations.
Current and Aspirational State	**Investment Strategies**
Current State: In 2012, a strategic planning workshop with Laboratory senior management identified 21 computing capabilities necessary to meet current and future Laboratory needs. A high-level 3-year roadmap was then initiated to chart a course forward for seven of these capabilities. While incomplete, this roadmap informed investment decision-making by the Information Systems Portfolio Management Team (IS-PMT), which resulted in the execution of the HCM and BPS initiatives, among others. In 2015, a more focused strategic computing roadmap was developed for Finance and is being used to guide computing initiatives to improve finance and procurement capabilities. **Aspirational State:** Strategic roadmaps would exist for all critical computing capabilities needed to support the Laboratory's strategic mission and objectives. These roadmaps would inform decision-making to ensure that the highest priority capabilities were in place when needed, to guide resource skills planning, and to identify resource gaps that put the timely delivery of capabilities at risk.	**Short Term Strategy**: Revisit the computing capabilities matrix with senior lab leadership and update it to ensure continued alignment with laboratory needs. Prioritize the capabilities list and begin the development of strategic roadmaps by focusing on the most critical needs first. **Strategic Direction**: Working with laboratory functional areas, develop strategic roadmaps for building out the computing capabilities necessary to support Fermilab's mission and strategic objectives. Develop a process for 1) managing the portfolio of roadmaps and guiding decision-making to ensure that critical capabilities are in place when needed; and 2) periodically revisiting and re-prioritizing the roadmaps to ensure continued alignment with lab needs.

P1: Key Performance Indicators (KPI's) and Metrics

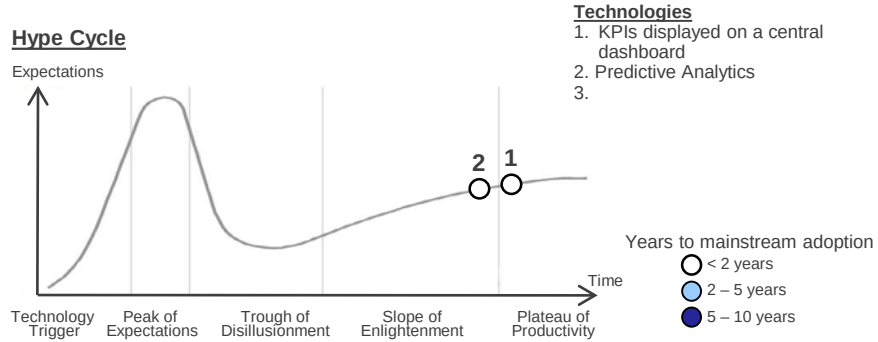
Description

This initiative involves improving the key performance indicators used to monitor, improve, and communicate Computing's effectiveness at delivering services and capabilities to the Laboratory.

"When performance is measured, performance improves. When performance is measured and reported, the rate of improvement accelerates" -T. S. Monson

Industry, Research, Technology Maturity

Key performance indicators displayed on dashboards are mature concepts. The Laboratory has Fermidash as a platform for communicating KPIs, but it doesn't currently contain all of the KPIS that would be beneficial.



Aspirational State and Gap

Aspirational State:

To have a central facility that communicates the state of the computing organization and that allows Laboratory management to quickly determine if and when changes need to be made to ensure the needs of the Laboratory are being met

Gap:

There are a variety of formats and locations to see performance metrics communicating current computing status. This needs to be consolidated into a centrally available format. In addition, the ability to predict issues before they become problems and make corrections is at a mature stage, and it would benefit the organization to have this capability.

Investment Strategies

Short Term Strategy:

The laboratory has the technology to deliver the capabilities required. Therefore, this initiative only requires SWF resources to meet the objectives. On a regular basis, add KPIs to Fermidash, and look for opportunities to provide "predictive" information, and potentially recommendations for actions to take and correct potential issues before they happen.

Strategic Direction:

Add up-to-date key performance indicators to the Fermidash system, and enhance the communication capability to include actionable indicators that communicate when changes are required to ensure the ability to deliver required service and capablities are being met.

P3: Improve User Interface (Service Management)

Description	Industry, Research, Technology Maturity*
Improve customer and service provider interfaces to ensure efficient access to services.	As organizations are maturing, they are moving from an IT centric technology model for delivering value to the customer. IT organizations are moving to a customer/user centric view of delivering services. They are providing easy ways for users to access services in a way they understand. Many DOE laboratories are adopting this concept. Argonne has already implemented this approach and are receiving overwhelming response from science and business areas. *(need information from outside sources…)*

Aspirational State & Gap	Investment Strategies
Aspirational State: A modern service experience, that will engage and delight our users. Create a simple, intuitive user interface to its service management tool for its customers to report issues, request and receive computing services or provide feedback. Provide service owners interface improvements that streamline their work, making it easier to do their jobs. Deliver and manage an extensible and easy to manage service taxonomy framework. **GAP:** 1. Minimally defined service taxonomy that is sustainable and easy to manage. 2. Current interface is not intuitive for users to enter incidents and requests and have them categorized and routed without Service Desk intervention. 3. Knowledge is not easy to find and use. 4. Feedback from user and service provider community is that the interface is has too much information and is does not provide for a satisfying experience with Computing services.	Short Term Strategy: 1. Perform an assessment of our service management tools and interface that will result in a recommended service taxonomy and roadmap to achieve a modern interface that improve user satisfaction. 2. Implement the service taxonomy and user interface improvements with input from user groups across the laboratory. 3. Implement Knowledge processes to ensure information is accessible, searchable and usable with the new interface. 4. Streamline processes for service providers and provide new interface to enable effective and efficient management of their services. Strategic Direction: *Still working on this section.*

P4: Demand Management

Description	Industry, Research, Technology Maturity*
This initiative is intended to integrate Computing's planning processes and tools in order to: • Monitor and control the intake of IT demand so that all incoming requests are collected, prioritized, scheduled, and fulfilled based on objective, consistent criteria according to business priority • Create a complete picture of all the requests made to Computing—past, present, and future; tactical, operational, and strategic—in order to make better decisions and to support the Lab's goals.	According to Principal Analyst Craig Symons of **Forrester Research**, demand management is "an IT governance process that enables IT and the business to optimize the investment in IT through fact-based decisions." Simply put, it is an automated process for capturing, evaluating, and prioritizing all of the demands or requests placed on IT—from high-volume routine service requests to deploying changes across core applications.

Aspirational State & Gap	Investment Strategies
Aspirational State: An operating model which includes an iterative cycle of planning and execution with objectives to: • Improving visibility and control over IT costs, risk, and resources • Improving alignment between IT priorities and business/science objectives to maximize the value delivered by Computing **GAP:** • No consolidated view of all requests (i.e., demand) made to Computing • Multiple request in-take, prioritization, approval, and scheduling methods for managing IT work • Low visibility of requests made to Computing	Short Term Strategy: • Integrate and orchestrate disparate planning and tracking processes • Leverage the ServiceNow Demand Management module and start tracking all incoming IT demand for awareness, visibility, and tracking purposes. Strategic Direction: Implement demand management process and integrate it into all aspects of computing's planning and execution activities.

P5: Continuous Improvement of Project Delivery

Description

The Computing Project Management Office (PMO) has established and is using a tailored approach to manage enterprise-level computing projects. Following PMBOK and other industry best practices, a formal project management methodology is in place to help ensure that projects are completed according to plan and that expected outcomes and value are realized. The goal is to put just enough structure and process in place to help complete projects more effectively, without being overly burdensome. The PMO has also established a PM-Lite methodology to aid in the successful delivery of small to mid-size projects that benefit from lightweight planning, tracking and reporting processes.

The goal of this initiative is to continue to improve the effectiveness with which projects are completed and expected value is delivered.

Industry and Technology Maturity*

Project management is a very mature discipline, with a universally accepted methodology defined in the Project Management Institute (PMI) Project Management Book of Knowledge (PMBOK). Techniques such as Agile are also quite mature and are effective in situations involving significant end user engagement, such as software, user interface, and report development.

There are also a number of readily-available software tools to support project management activities. Economical tools such as Microsoft Project, ServiceNow, and Redmine are used to effectively support project management activities. More complex tools are also available, but their added complexity and cost is unnecessary for the level of computing projects we execute.

Current and Aspirational State

Current State:

Formal project management processes are in place at various levels of maturity. A project planning reference guide and numerous artifact templates have been developed. A defined methodology is being used to manage enterprise level projects. A defined methodology has been developed for scientific computing projects and adoption is in progress. Progress is tracked on a performance dashboard and status is reported at a weekly status report meeting. Lessons Learned and Project Closeout Report documents are prepared at the completion of all large computing projects.

Aspirational State:

The defined project management methodology will be matured and followed more consistently to further improve project delivery. The methodology will include agile techniques to reduce project delivery cycles and allow end users to realize benefits sooner in the development life cycle. Performance metrics will effectively measure benefits and the value realized at project completion. Time-phased resource requirements and availability will be managed to mitigate delays due to the unavailability of necessary resources. The PM-Lite methodology will be used across the organization to improve project effectiveness. The Computing PMO will become a recognized Center-of-Excellence.

Investment Strategies

Short Term Strategy:

We will continue to leverage Microsoft Project, ServiceNow, SharePoint, and Redmine platforms to support project management activities. We will finalize the Computing Project Planning Reference Guide and develop a process for socializing the Guide and its associated procedures to gain broader adoption. We will continue to refine the performance tracking dashboard and identify ways to improve the effectiveness of the weekly progress reporting process.

Strategic Direction:

We will become a project management center-of-excellence recognized for regularly completing projects according to plan and delivering expected results. We will accomplish this by 1) improving processes for developing realistic and achievable plans; 2) executing projects according to plan; 3) taking prompt corrective action to meet target completion dates; and 4) ensuring that expected outcomes and value are realized.

We will work with the Computing senior leadership team to establish a set of performance metrics to measure and assess the effectiveness of our project management approach. A project governance board will be established to periodically review project performance and make necessary adjustments to achieve desired outcomes. An agile software development approach will be incorporated into the project management suite of tools. Tailored training will be developed and delivered to integrate improved project management techniques throughout the Computing organization.

C2: Enhanced Web Server Security

Description	Industry, Research, Technology Maturity
This project will enhance the security of lab web servers through a series of steps: 1) Ensure we have contact information for the content managers of all web sites 2) Require all web services running on non standard ports to be registered and apply for web exemptions 3) Configure for only local visibility or remove entirely many hundreds of web sites no longer needed to be visible off site 4) Migrate the vast majority of servers running independently to the central web server	The new central web server used industry standard hardware and software packages for both the server itself and for content management and other functionality required by web site owners
Aspirational State and Gap	**Investment Strategies**
Aspirational State: All lab web sites will have regularly updated content owners, and will only run on non central web servers after an exemption process that clearly demonstrates the need for functionality not support on the central server (this should reduce ghte number of such sites by at least an order of magnitude). Ongoing processes will detect and block any web services offered on non standard ports. **Gap:** The content owners listed for many web sites are either unknown or assigned to individuals no longer at the lab; many servers are running on independent sites due to functionality not being available on the old central web server; no process is in place to regulate web services offered on non standard ports	Short Term Strategy: This project primarily requires labor, as the new central web site hardware has already been acquired and is in production. Staff labor (roughly 6 FTE months) is needed to update the web exemption process (which will use ServiceNow, the process for detection nof web servers running on non standard ports, and the CMDB to include information about web sites. In addition, roughly 2 FTE years ($400k) of consultant effort will be needed to assist maintainers of several hundred web sites not currently on he central server to migrate Strategic Direction: This project is the first step in an overall strategy to significantly restrict the overall number of web sites hosted at the lab to allow better management of security vulnerabilities in web servers. This project is also part of the ongoing strategy to impose web governance on web sites visible to the general public

C3: Multi factor Authentication

Description	Industry, Research, Technology Maturity
This project will implement multi factor authentication solutions for both privileged and standard users in accordance with DOE mandates	MFA technology will be widely shared across the DOE complex, so it is expected that we will adopt standard implementations in use at other sites and labs.
Aspirational State and Gap	**Investment Strategies**
Aspirational State: 100 % of privileged users and 85% of standard users will be required to use multi factor authentication, using the DOE definitions of which user populations can be excluded from the requirement. **Gap:** Presently roughly 20% of privileged users require MFA, and our current implementation uses RSA one time password tokens which are currently not acceptable for the DOE mandate. The only standard users using MFA are business users who access systems from off site, and they also use the RSA tokens.	Short Term Strategy: The current DOE mandate requires implementation to be complete by Sep 30, 2016, and requires use of level of assurance 4 (L4) authentication tokens (typically PIV or PIV-I certificate containing cards. We currently have no infrastructure in place to issue, manage and utilize such cards, nor do we have a network and authentication architecture that appropriately segregates scientific traffic from those networks that will require MFA. so current cost estimates include roughly $2,5M, mostly in labor, to design, prototype, test and fully implement in production such an infrastructure, as well as between $500K and $1M in hardware costs for issuing authentication credentials and devices to read credentials and enforce MFA (uncertainties due to continuing evolution of definitions of which user populations can be excluded or excepted). Strategic Direction: This project is not consistent with lab strategic directions for either security or authentication, but is a response to a DOE mandate that comes directly from he White House as part of the response to recent massive government data breaches

S2: Advanced Networking to enable TeraBit networks for exascale computing

Description	Industry, Research, Technology Maturity*
Utilize Software Defined Networks (SDN) and Named Data Networking (NDN) technologies to the benefit of Fermilab's scientific program (experiments and scientific computing projects(. Leverage existing research projects to deploy and operate these networks as needed by the Fermilab HEP Cloud Facility.	Research networks rapidly advancing to a Terabit fabric to meet global data intensive science needs. Research Networks being developed to support data transfer to and from the new Exa-scale high performance computing systems being developed by the DOE as well as the petascale systems supported by DOE and NSF. Significant R&D being sponsored by DOE and NSF in order to support software controlled and managed end-to-end network use. Exabyte-scale data challenge of HL-LHC (as well as Belle-II, DUNE and other experiments) in the 2020 decade drive needs for continuous advance in data transfer and handling capabilities.
Aspirational State & Gap	**Investment Strategies**
Aspirational State: Seamless provisioning, usage, and support for networking fabrics that deliver the most value to our users needs, wherever the users reside, whatever their data transfer and usage patters, and the flexibility to advance to use more modern technologies as they become available. **GAP:** Sufficient effort to contribute to the needs of the HEP Cloud Facility to ensure emerging network fabrics can be used effectively to meet the needs of the users and projects.	Short Term Strategy: Continue the cross-computing (SCD, CCD) research and development collaborations in network research and developments; Successfully propose new projects that are funded by the DOE Office of Advanced Scientific Computing Research. Strategic Direction: Continue to support and extend the network R&D team active in the Computing Organizations at Fermilab and facilitate and foster active partnerships (e.g. with Caltech, LBNL) and future activities.

S3: LArTPC /LArSoft Processing Phase II/Reconstruction group.

Description	Industry, Research, Technology Maturity*
Establish a sustainable data simulation, reconstruction and analysis eco-system for each experiment to integrate, deploy and operate as necessary to extract physics results from the Liquid Argon Time Projection Chamber (LArTPC) detectors they use. The eco-system includes: human interactions, collaboration and responsibilities; computing hardware and software; scientific workflows, processes, interfaces and communications; needed to deliver validated physics results.	The Snowmass 2013 community report and the P5 panel recommend increasing collaborative and shared approaches to HEP experiment software and computing to address resource constraints, cross-training and sustainability of the current and future workforce, and agility in response to new hardware and software technologies.
Aspirational State & Gap	**Investment Strategies**
Aspirational State: A fully fledged eco-system that delivers timely, complete, validated, accurate outputs for simulation, reconstruction and analysis of LArTPC detector data for experiments. An sustained, productive collaboration across all experiments benefiting from the eco-system, with ongoing development to address new requirements, enhanced algorithms, new technologies, and new computing hardware **GAP:** An adequate, sustained team of sufficiently skilled, experienced and dedicated scientific developers, testers, support teams and users to reach the goals in a timely manner and to ensure the excellence and usability of the final products.	Short Term Strategy: Use the outcomes of the upcoming Requirements Workshop and the Review in early FY16 to inform the LArSoft Steering Group and enable the experiment spokespeople involved together with the Lab Divisions providing core development and support to make good decisions on work to be defined and executed. Strategic Direction: Ensure effective collaboration between the experiments and Laboratory partners on ensure physics reconstruction and analysis output from Neutrino Experiments.

S4: Ensure Common Toolkits across existing and future scientific collaborations.

Description	Industry, Research, Technology Maturity*
Plan and execute a program of research and development projects to increase the availability, adoption and use of common software frameworks, promising technologies and methods and new hardware architectures for scientific computing solutions. Execute this program so as to continue Fermilab's well regarded contributions to the US CMS software and computing, as well as to contribute to the development of the DUNE computing model.	TBA
Aspirational State & Gap	**Investment Strategies**
Aspirational State: An eco-system of toolkits and software components that are reused by multiple experiments and scientific collaborations at Fermilab, together with the communication, interaction and collaboration that enables a sustained and coordinated approach to the adoption and support of new tools and computing hardware. **GAP:** An adequate, sustained team of sufficiently skilled, experienced and dedicated scientific developers, testers, support teams and users to reach the goals in a timely manner and to ensure the excellence and usability of the final products.	Short Term Strategy: Define short term deliverables for common modules and/or approaches (computing patterns and methods) across the art and CMSSW frameworks, to demonstrate the benefit of such an approach. Strategic Direction: Continue the current program of integrating development and support teams in cross-cutting development and support projects for US CMS, Neutrino experiments, astrophysics and g-2 and mu2e experiments.

S5: Integrate appropriate big data technologies into HEP and astrophysics analysis solutions.

Description	Industry, Research, Technology Maturity*
Improve the effectiveness, timeliness, and productivity of experiment and collaboration analyses through the adoption and deployment of big data technologies for experiments including NoVA, US CMS, g-2, Mu2e, DES. Investigate, adopt, integrate and then deploy solutions using NoSQL databases such as Couchdb, data management solutions such as Hadoop, public domain analysis toolkits such as R to the benefit of the end users.	TBA
Aspirational State & Gap	**Investment Strategies**
Aspirational State: New and extended toolkits which demonstrate increased productivity and effectiveness of the end user and collaborative analysis for Fermilab users. **GAP:** Sufficient resources with the right skills and experience to do the needed development and collaborative work.	Short Term Strategy: Work with NoVA to deploy by mid-2016 a well-defined, small project that can show the value of the approach. Provide a forum of scientists in SCD to document analysis use cases that can benefit from Big Data approaches and choose one or two additional prototypes that can demonstrate value in a well-defined timeline. Strategic Direction: Coordinate within SCD a judiciously chosen program of projects in collaboration with Fermilab scientists, DOE data scientists at other labs and universities, to develop, integrate and deploy improved and usable solutions for data analysis.

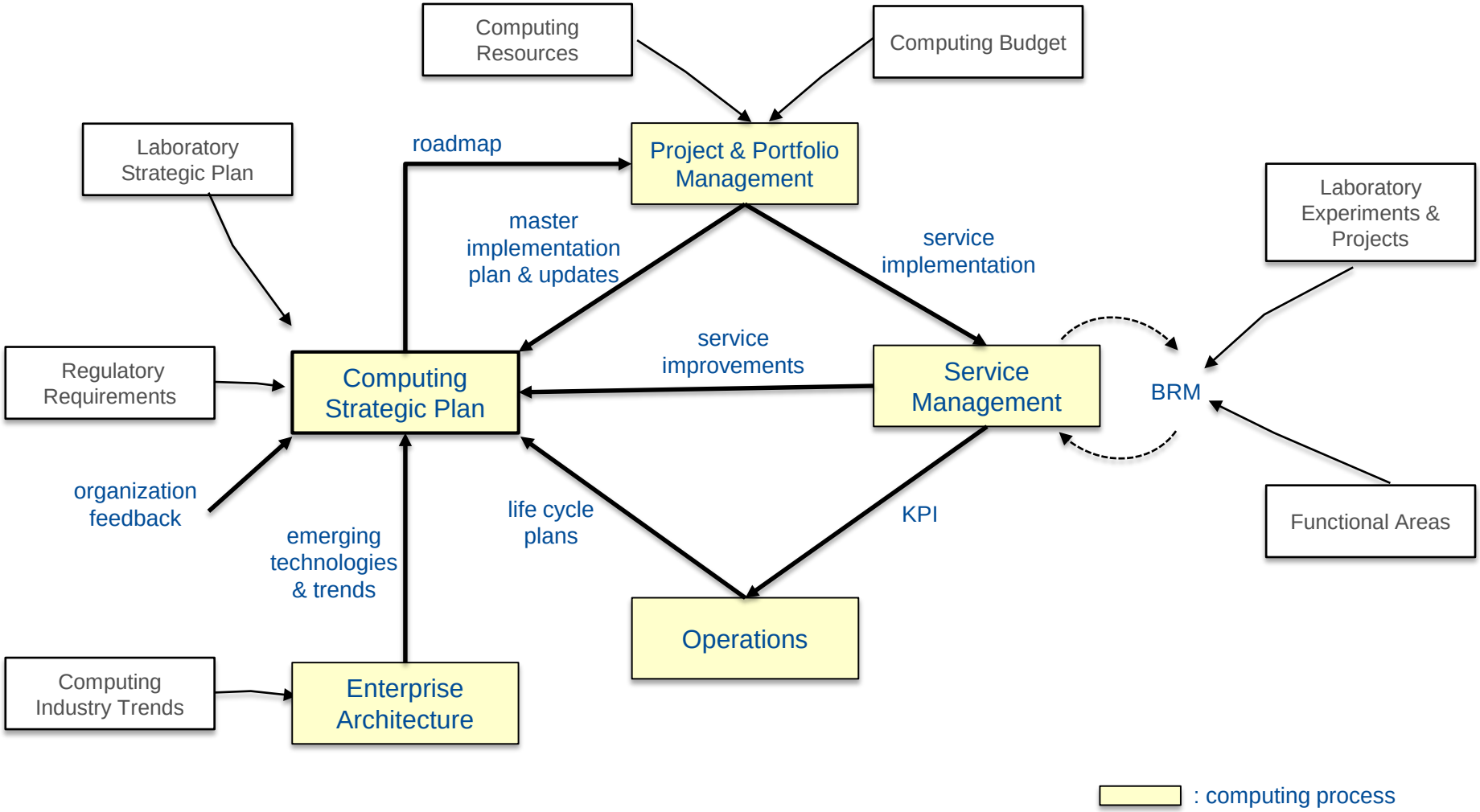
S6: Establish a center of excellence for computational theoretical studies and numerical simulations

Description	Industry, Research, Technology Maturity*
Evolve the current, well regarded, Lattice QCD, Pythia and other theoretical and simulation activities into a Center for such computations. Include applied mathematics and computer science colleagues from ANL, UCLA and other groups.	Mathematically based simulation and modeling is increasingly the basis for commercial data analytics and interpretation.
Aspirational State & Gap	**Investment Strategies**
Aspirational State: Establish recognized center of excellence in the HEP environment for theoretical physics calculations (including Lattice QCD and accelerator and particle simulation and modeling that includes a partnership with the DOE ASCR exascale and other High Performance Computing computer science and applied mathematics communities. **GAP:** Sufficient skilled and expert resources to be available to build the center.	Short Term Strategy: Continue to build collaborations with ANL and LBNL computer science and applied mathematics communities, as well as university groups such as at UCLA. Strategic Direction: Participate as part of the HEPCFE and HSF collaborations. Ensure HEP and Fermilab are a full partner in the DOE ASCR high performance and applications computing roadmaps.

S7: Improve and extend the common DAQ toolkit

Description	Industry, Research, Technology Maturity*
Design, develop, deploy and support common DAQ components in collaboration with experiments and Fermilab scientific programs (e.g. Test beam facility) end-to-end integrated solutions. These experiments currently include MicroBoone, NOvA, DUNE35ton, Mu2e, ProtoDUNE, Icarus, SBN.	Commercially available off the shelf components are increasingly available that meet some of the needs of HEP. Intelligent read-out controllers, hardware managers and networking available in the research and vendor communities are increasing in performance and cost-effectiveness.
Aspirational State & Gap	**Investment Strategies**
Aspirational State: Make available an extensible, flexibly, community driven common DAQ toolkit that is adopted, contributed to, and provided for a broad range of current and future experiments and scientific programs. **GAP:** The resources needed for operating, consulting, and end-to-end integration and support of running and commissioning experiments results in insufficient skilled development effort to develop needed new capabilities, plan and design for new experiments, and research and incorporate newly available technologies and components.	Short Term Strategy: Make judicious choices on which experiments to support based on commonality of needs. Encourage contributions and collaborations. Strategic Direction: Move forward on IoTDAQ using commercial components. Evaluate making common DAQ an open source available toolkit.

S8: Improve processing operations through automation and intelligence.

Description	Industry, Research, Technology Maturity*
Deliver effective, usable, efficient Production Operations across all resources used to all Experiments who have agreements for support by Computing for running their production operations processes and applications.	Industry standards for Service Level agreements, delivery and monitoring are being applied through implementation of an ITIL service model. Industry as well as high throughput and high performance end-to-end user support peers to Fermilab are paying increased attention to workflow automation and automated recovery/alert/response to achieve fault tolerance
Aspirational State & Gap	**Investment Strategies**
Aspirational State: Demonstrate value of the centralized Offline Production Operations Service model through acknowledged improvements to the experiments throughput and effectiveness of their production processing. **GAP:** Each experiment is on-boarded to OPOS (Production Operations Support) using mainly their existing, experiment specific scripts and workflow and job monitoring tools. Need to rationalize and make these common and then extend the existing monitoring and operations scripts to reduce the operational load, increase usability and efficiency of production processing.	Short Term Strategy: Collaborate with the FIFE project to ensure synergy in development of monitoring, alerting and response tools. Especially use and propose extensions to FIFEMON monitoring and POMS – processing management system, and expand the Continuous Integration capabilities and processes to as many experiments as possible. Complete ITIL on-boarding lite and use operational KPIs to monitor improvements. Strategic Direction: Strengthen the collaboration between the Operations Support Groups and the experiments production teams to best support the full life-cycle of production operations.

Computing Strategic Plan Operating Model