FSP Management Plan
Path Forward

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Outline

- Philosophy
- Boundary conditions and constraints
  - DOE O's & G's, S/W process & SQA
- FSP program elements
  - What plans were proposed and how do they fit into the overall FSP management plan?
- FSP management plan
  - What was proposed?
- Leveraging and lessons learned
  - SciDAC, ASCI, NEAMS, …
- Proposed next steps

Philosophy

- FSP needs to have process and formality
  - Adapt/adopt constraints from standards, regulations, best practices
- FSP needs to accommodate, motivate, and facilitate applied R&D
  - Simply re-factoring, re-designing, and re-implementing the existing legacy S/W base won't cut it
- FSP's principal product is quality S/W and the answers and insight provided by that S/W
  - Embrace MS model: "release S/W early and often"
- FSP must be open, inclusive, and embrace the fusion community to succeed
  - What can be learned, e.g., from CCSM?
  - An active and open communication plan is needed
- FSP must leverage existing and past programs as well as motivate new programs
- FSP must have focused deliverables and well-defined requirements to succeed

DOE O 413.3A (& G 413.3-13)

Program Project Mngmt for the Acquisition of Capital Assets

- Critical Decisions
  - CD-0: Mission Need
  - CD-1: Alternative Selection & Cost Range
  - CD-2: Performance Baseline
  - CD-3: Start of Construction
  - CD-4: Start of Operations or Project Completion

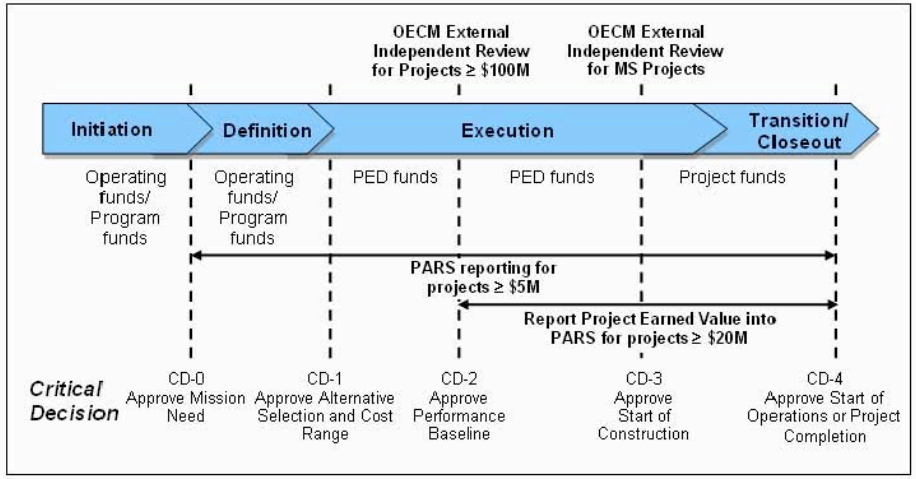


Figure 1. Typical DOE Acquisition Management System for Line Item Projects.

- Adherence to project management principles
  - Line management accountability, up-front planning, sound acquisition strategies, well-defined performance baselines, effective project management systems, integrated safety management, effective communication

See http://www.directives.doe.gov

Definition Phase

From CD-0 to CD-1

- Alternative concepts based on user requirements, risks, costs, and other constraints are analyzed to arrive at a recommended alternative
- Ensures the recommended alternative provides essential functions and capability at optimum life cycle cost
  - Consistent with required performance, scope, schedule, cost, security, ES&H
- More detailed planning is accomplished to further define required capabilities
  - This phase produces detail necessary to develop a range of estimates for project cost and schedule
- CD-1 approval authorizes beginning the project Execution Phase and allows Project Engineering and Design (PED) funds to be used

Execution Phase

From CD-1 to CD-2

- Completion of a preliminary design
- Provides sufficient information for a performance baseline
  - Developed based on a mature design, well-defined and documented scope, resource-loaded detailed schedule, definitive cost estimate, and key performance parameters
- CD-2 approval authorizes a budget request for total project cost

CD-1/2 Requirements

CD-1

- Conceptual design report
- Acquisition strategy
- Preliminary PEP
- Federal Project Director
- Establish Integrated Project Team
- Conduct a design review of the conceptual design
- Project data sheet
- Environmental documents
- Security vulnerability assessment report
- Initial cyber security plan
- Preliminary hazard analysis report
- Quality assurance plan

CD-2

- Preliminary design report and design review
- Establish performance baseline and conduct validation review
- Updated PEP
- Employ an EVMS
- Independent cost assessment and review
- Quality assurance plan
- Updated project data sheet
- Environmental documents
- Security vulnerability assessment report
- Updated cyber security plan

What is in a Project Execution Plan ("PEP")?

- Mission Need
- Project Description
  - Project Scope
  - Technical Objectives
  - Science Drivers
  - Impacts on Science Projects
  - Alternatives Analysis
- Acquisition Strategy
  - Performance Considerations
  - Cost Estimates
  - Operational, Design, and Execution Considerations
  - Acquisition Management
  - Interfaces with Other Projects
- Management Organizations and Responsibilities
  - Integrated Project Team
  - Department of Energy
  - Other DOE Labs
- Work Breakdown Structure
  - WBS Elements
  - Project Milestones
  - Approvals for Project Changes
- Risk Management
- Integrated Safety Management
- Quality Assurance
- Cyber Security

How Might the FSP be Reviewed?

Draw upon DOE Lehman Reviews

- Basis of scope
- Basis of cost
- Basis of schedule
- Funding profile & budget
- Critical path
- Risk and contingency management
- Hazards analysis & safety
- Basis of design
- Integrated Project Team
- Safeguards & security
- New technology and technology readiness
- Contract management
- Preliminary design review
- Start-up planning and operations readiness
- Project controls and EVMS
- Quality control & assurance
- Value management & engineering
- Project execution plan
- Acquisition strategy & plan
- Sustainable design
- Documentation and incorporation of lessons learned

These 21 elements were taken from an External Independent Review (EIR) Lines of Inquiry (LOI) document given to Lehman Review panel members

SQA Constraints & Regulations

Imposed in certain DOE Programs: applicable to FSP?

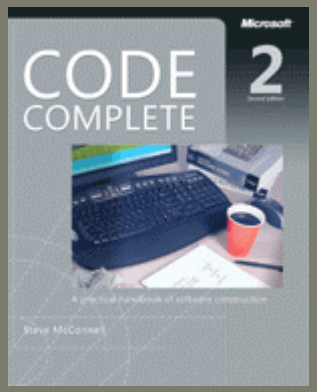
- Various standards and guidelines exist – applicable?
  - 10 CFR 830: Nuclear Safety Management
  - DOE O 414.1C: Quality Assurance
  - DOE/OFES: Is there an equivalent to the DOE NNSA Weapon Quality Policy (QC-1)?
  - DNFSB Recommendation 2004-1
  - Others: ISO, IEC, IEEE, MIL, FIPS, NIST
- S/W developed @ various DOE Labs
  - Are there institutional-specific requirements and regulations to be aware of (e.g., LANL "LIRs")?
- Take away: FSP must have a quality management plan (including SQA) regardless of regulations (or lack thereof)
  - S/W guiding "ITER shot decisions" must have SQA pedigree

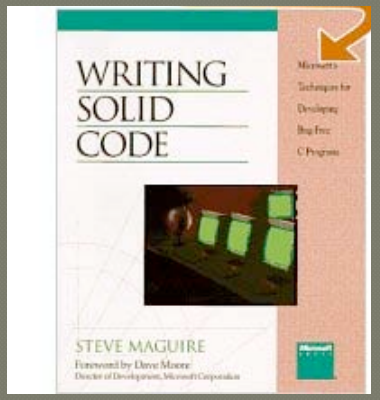
Software Process Improvement

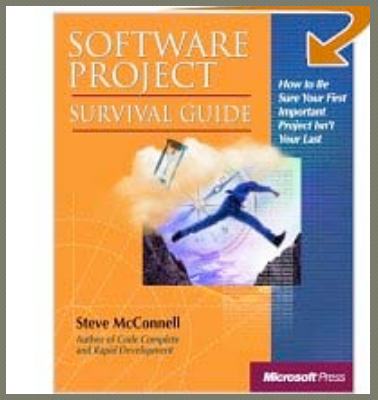
- There is a business case
  - Improved software requirements, efficiency and productivity of software teams, software reliability, management of software safety, and reduction of defects and rework
- Leverage existing knowledge/experience base
  - PMBOK in the Project Management Institute (www.pmi.org)
  - Capability Maturity Model for Software (SW-CMM) (http://www.sei.cmu.edu/cmm/)
  - Capability Maturity Model Integrated (CMMI) (http://www.sei.cmu.edu/cmmi/)
  - Software Engineering Institute (http://www.sei.cmu.edu/)
  - Construx (http://www.construx.com)
- Example CMMI Process Areas
  - Project management assurance: project planning, project monitoring and control, supplier agreement management, risk management
  - Engineering assurance: requirements development, technical solution, product integration, verification, validation
  - Support assurance: configuration management, product and process quality assurance, measurement and analysis, decision analysis and reduction, organization environment for integration, causal analysis and resolution

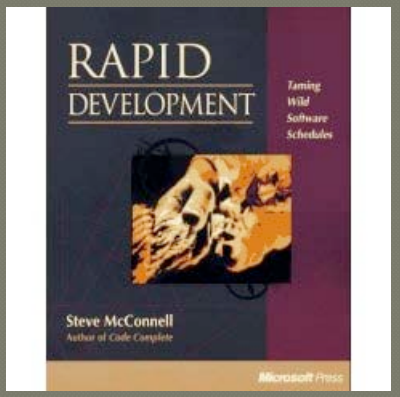
Some SQA Food for Thought

1999 Audit: I Asked an Expert a Question





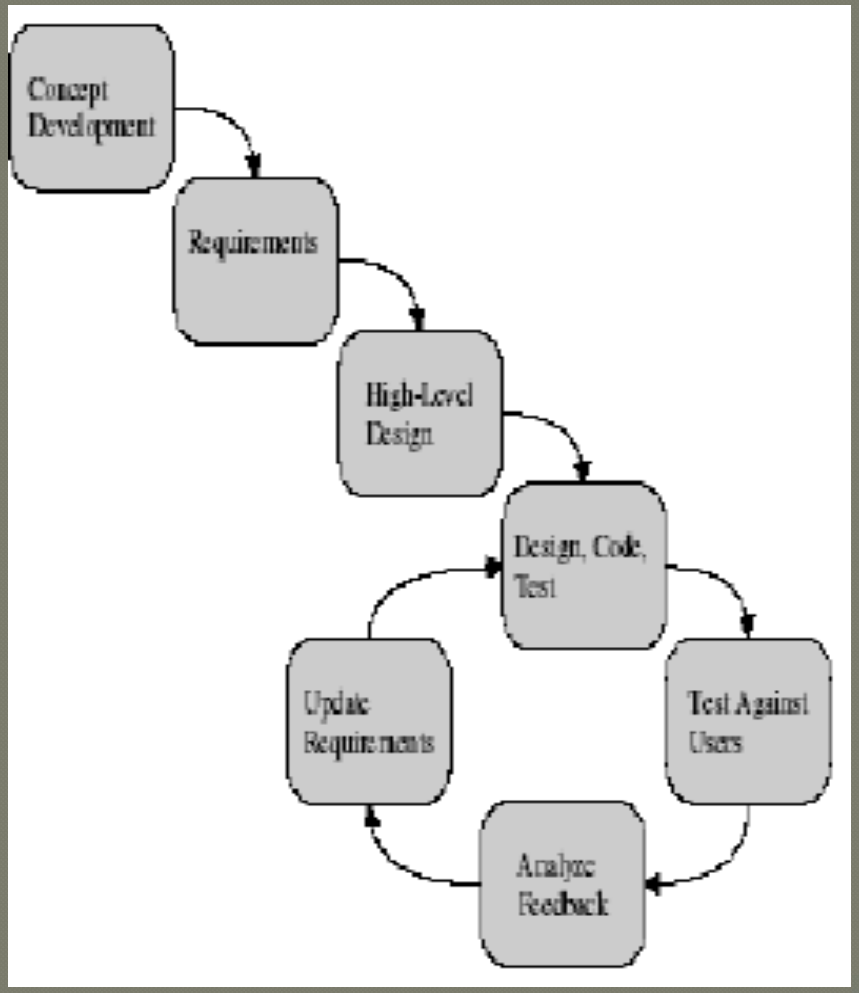




- If as Project Lead I were to change two things tomorrow in our software process, what should they be?
  - Thing1: "Get yourself a Testing Lead"
  - Thing2: "Start doing code reviews immediately"
- We did, and it really made a difference
- Testing lead: took control of all testing
- Code reviews: following McConnell's prescription
  - Moderator, scribe, 2-3 reviewers
  - It's amazing how the review process finds bugs, identifies problems, and evolves the design

Staged-Evolutionary Delivery

- A model for software development with good risk management (Best Practice)
- The idea is to get the full application with basic capability into the users hands quickly
  - Initial capability is simple and not full-featured
  - Follow-on delivery incrementally increases features
- Offers quick user feedback and exercises the full software framework quickly
- Success depends on a good Component (Object) Decomposition



Software Engineering

Lessons Learned

- Design your software for and implement unit testing
  - Can you "make test" in every dir? Ex: buggy pageant
- Be aware of the impact of your choice of data structures – you have to live with it
- Use levelized design (defined interfaces, data hiding) as a mantra
- All your tests should be tied to requirements
- Conduct code and design reviews!
- Have formal releases early and often
- Do not under estimate the large difference between research prototype and production. Resist the urge to view your prototype as production. Embrace throwing away prototypes.
- Pair programming is good thing and really works.
- Assessments are a big pain, but they can help to force culture change (for better or worse)
- Get on as many platforms as possible – it makes your software better

Software Engineering

Lessons Learned

- It doesn't work to worry about performance later
- Unified Build Theory can consume all people cycles; similarly for a testing harness
- Training new team members takes time! Must plan for and institutionalize this
- Frameworks (backplanes, environments, etc.) should evolve
- If you don't test it, it will break ("bit rot")
- Even for large projects, really only see 3-5 active "committers"
- Don't just design tests based on physics/algorithms; think about all use cases!
- Establish and document your software process
- Commit hot spots are usually symptomatic of a bigger problem
- Spending most of your time on testing is not a bad thing
- Writing code is very personal: allow personalities to flourish; don't be too rigid

FSP Plans

What planning activities & deliverables were proposed by FSP program elements?

- Science Drivers
  - Identify and prioritize critical scientific challenges
  - Critical evaluation of components, frameworks, V&V, and management plans to ensure consistency with science drivers
  - Timeline for delivery of needed scientific capabilities ("scientific roadmap")
  - Plan for monitoring progress in delivering on science drivers
- Frameworks/Physics Integration
  - Specification of overall FSP S/W architecture
    - Key physics modules, interfaces, use cases, requirements, SQA/SQE standards
    - Framework design (including proto-FSP assessment)
    - Usability, workflow
  - Clarify R2A2s between frameworks, modules, validation
  - S/W process plan

FSP Plans

What planning activities & deliverables were proposed by other program elements?

- Advanced Physics Modules
  - Plan for identification, improvement, & creation of advanced S/W components to be used as modules
  - Assess mathematical and CS infrastructure component needs
  - Gaps analysis: what's needed and what's present/absent
  - Decision-making process for component criteria and prioritization
  - Verification and UQ plan
  - Plan for component life cycle, SE standards, deliverables, schedules
  - Libraries and tools requirements and plan
  - LCF readiness requirements and plan
- Experimental Validation
  - Review and documentation of lessons learned
  - Identification gaps in capabilities and methodologies
  - Validation requirements and plan (code/component "pedigree"?)
  - Experimental coordination plan
  - Validation documentation strategy

FSP Management Plan

What was proposed?

- Program/Strategic Plan
  - Q409 - initial draft; Q110 - final
- Integration and Outreach Plan
  - Q110 – initial draft; Q210 - final
- Risk Management Plan
  - Q210 – initial draft; Q310 - final
- Requirements Management Plan
  - Q310 – initial draft; Q410 - final
- Program Tracking Plan
  - Q410 – initial draft; Q111 - final
- Change Management Plan
  - Q111 – initial draft; Q211 - final
- Quality Management Plan
  - Q211 – initial draft; Q311 - final
- Implementation Plan
  - Q311 – initial draft; Q411 – final
- Missing pieces
  - Management plan
  - Those delineated in other FSP program elements
  - Release process plan
  - Contractor/MOU plan

FSP Program/Strategic Plan

- Overall direction, policy, work areas in next 10-15 years
- Strategy and deliverables to accomplish stated objectives and goals
- Defines WBS and management team members and responsibilities
- Details principal program elements, their strategies, and performance indicators
- Include L1 milestones and top 10 risks
  - L1 milestone: 1-2 annually, FSP level
    - Ex: demonstrated simulation capability
  - L2 milestone: ~$1-5M per milestone; FSP element level
    - Ex: formal FSP S/W release
  - L3 milestone: <$1M per milestone; FSP sub-element level
    - Ex: document, report
- First draft in Sep, "final" in Dec 2009
  - 3-day "offsite" in mid-late Aug for core FSP team to work thru and propose initial overall plan, milestone set, and risks
  - FSP workshop in Oct to vet proposed plan with larger community
- Emulate program plan format/content of other programs (ASC,…)

FSP Integration & Outreach Plan

- Product delivery and responsiveness of FSP to key stakeholders
- How FSP integrates & coordinates with other US Programs
- Approach for interaction & coordination with integrated modeling efforts abroad as well as with international facilities
- Integration of program elements within FSP and synergy with OFES/SciDAC
- Whole team input; focused writeup

FSP Requirements Management Plan

- Seek input from 3 sets of people
  - Clients (pay for product development)
  - Customers (pay for product)
  - Users (use the product)
- Requirements address 4 questions
  - Why? (business requirement)
  - What? (functional requirement)
  - How? (design requirement)
  - How well? (quality requirement)
- Process includes elicitation, analysis, specification, and validation
- Requirements must be unambiguous, testable, correct, in scope, modifable, feasible, traceable, and *not* a solution
- Envision a hierarchy of documents in a "bulleted list" form (B.1, B.2, F.1, F.2, D.1, D.2, …; Q.1, Q.2, …)
  - Emulate existing useful and actionable documents
  - Start at the high (FSP) level
- At least one requirements review annually
- Define set of clients/customers/users and questions before Sep
- Collect Q&A input over Q1FY10

Other FSP Plans

- Program Tracking Plan
  - Process for tracking progress
  - Define its performance measures (L1/2/3 milestones)
  - Rollup process for conducting internal and external reviews
- Change Management Plan
  - Formal process by which the approved baseline plan can be changed (scope, schedule, or budget)
  - What changes constitute "large", therefore requiring higher approval?
- Quality Management Plan
  - Includes V&V and SQA plans
  - How is the quality of FSP products assured and controlled
  - Definition of explicit and measurable performance metrics for each FSP product

FSP Implementation Plan

- "Who does what when"
- The set of objectives that need to be accomplished along the way to achieve stated goals
- Product descriptions or all FSP program elements, sub-elements, projects
  - Yearly planned activities and deliverables for each product (L2/L3 milestones)
  - Decreasing fidelity in outyears
- Milestone co-dependencies are defined
- Explicit timelines and resources associated with each activity are defined
  - Probably need to use a PM tool like Primavera Enterprise (and a "PMP person")
- The IP is the hardest and last deliverable
  - All FSP activities and efforts will have been articulated, planned, resource-loaded , and ready for execution

Project Management

Lessons Learned

- Establish requirements first
- Have a testing lead
- Fund your competition
- Adopt "alpha users" as part of your project
- Invite and encourage formal peer reviews
- Do not grow too big and too soon (big projects reach a point of diminishing returns)
- Do not over-promise. Set expectations early and often to clients and customers.
- Software culture change is possible – it must be top down
- Seek help from any and every body. But be careful who you bring on board formally

Project Management

Lessons Learned

- Have a good project charter that allows you to say NO – scope creep is just too irresistible in science
- The Project Leader can actually be a hindrance rather than a help; he/she should not be on the critical path
- Milestones can be good
- Documentation is not easy or fun, but it's necessary. You may not find a great product that allows multiple authors simultaneously working
- If you have never done this before, consider the "pi factor" on estimates of time/resources
- Embrace process but not without scrutiny and thought. It must be tailored for your project
- High risk, exploratory research can co-exist within an applied software project. But nourish it
- Record software statistics so informed estimations can be made for time/resources required for future activities

Next Steps

- Define communication plan for FSP team members
  - For FSP team: Mailing lists, common repositories, telecon schedules, face-to-face meeting schedules
  - For broader community: web site (fsp.org), FAQ, bulletin board, blog, wiki?
- Schedule working meetings/telecons. Focus next 3-4 months:
  - Work the program/strategic plan (L1 milestones, risks)
  - Management plan
  - Requirements elicitation, analysis, validation (another workshop?)
  - Work with the other FSP elements in translating their plans into explicit deliverables, actions, owners
    - Science roadmap, components, frameworks
- Coordinate and schedule community involvement
  - How many (and what) extended FSP workshops do we have?
- Develop timeline and deliverables for each FSP program element during this planning phase
  - Who does what when
  - Will find inconsistencies & overlaps that need to be worked out
  - Assess where contingency funds might be useful, needed

Supplementary Material

CMM/CMMI: A Good Thing?

- CMM
  - 1 (*Initial*): Ad hoc, chaotic and non-repeatable heroics (MJs)
  - 2 (*Repeatable*): Reqms mgmt, planning, tracking/oversight, subcontract mgmt, configuration mgmt, quality assurance
  - 3 (*Defined*): Organizational process focus, organizational process definition, training program, integrated software mgmt, software product engineering, intergroup coordination, peer reviews
  - 4 (*Managed*): Quantitative process mgmt, software quality mgmt
  - 5 (*Optimized*): Defect prevention, technology change mgmt, process change mgmt
  - You have a hard time convincing me that CMM/2 is not a good thing
    - What if your hero (MJ) gets hit by a beer truck?
  - Beware of "we need to be at CMM/n in x years". Why, how, how much?
- CMMI
  - Took part in writing a position paper for LANL CIO in 2005
  - Not a process, but describes characteristics of effective processes
  - A good reference; can better adapt to individual projects
- All this requires training and culture change