LARGE SYNOPTIC SURVEY TELESCOPE

Large Synoptic Survey Telescope (LSST)

Data Management Organization and Management

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LDM-294

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Abstract

This is the DM plan updated from the v2 of 2014. It covers the organisation and management of DM for LSST.

Change Record

Version	Date	Description	Owner name
1	2004-06-23	Initial version	JK
2	2015-03-11	Updated with new RFC process, realignment of TCT, SAT, DMLT - other versions in between	JK
2	2017-01-09	Update in TeX	WOM,MJ

Contents

Data Management Organization and Management

1 Introduction

1.1 Purpose

This document defines the mission, goals and objectives, organization and responsibilities of the LSST Data Management Organization (DMO). The document is currently scoped to define these elements for the LSST Design and Development, Construction, and Commissioning phases. It does not presently address any ongoing mission for the DMO during LSST operations.

1.2 Mission statement

Stand up operable, maintainable, quality services to deliver high-quality LSST data products for science and education, all on time and within reasonable cost.

1.3 Goals And Objectives

The Data Management Organization will:

- Define the data products, data access mechanisms, and data management and curation requirements for the LSST
- Assess current and LSST-time frame technologies for use in providing engineered solutions to the requirements
- Define the computing, communications, and storage infrastructure and services architecture underlying LSST data management
- Select, implement, construct, test, document, and deploy the LSST data management infrastructure, middleware, applications, and external interfaces
- Document the operational procedures associated with using and maintaining the LSST data management capabilities

- Evaluate, select, recruit, hire/contract and direct permanent staff, contract, and in-kind resources in LSST and from partner organisations participating in LSST Data Management initiatives.

The DM organization goals in selecting and, where necessary, developing LSST software solutions are:

- Acquire and/or develop solutions: To achieve its mission, LSST DM subsystem prefers to acquire and configure existing, off-the-shelf, solutions. Where no satisfactory off-the-shelf solutions are available, DM develops the software and hardware systems necessary to:
  - Enable the generation of LSST data products at the LSST Archive and Satellite processing center, and
  - Enable the the serving of LSST data products from the two LSST DACs (one in the U.S., and one in Chile).
- Maintain coherent architecture: DM software architecture is actively managed at the subsystem level. A well engineered, and cleanly designed codebase is less buggy, more maintainable, and makes developers who work on it more productive. Where there is no significant impact on capabilities, budget, or schedule, LSST DM prefers to acquire and/or develop reusable, open source, solutions.
- Support reproducibility and insight into algorithms: Other than when prohibited by licensing, security, or other similar considerations, DM makes all newly developed source code public, especially the Science Pipelines code. Our primary goal in publicising the code is to simplify reproducibility of LSST data products, and provide insight into algorithms used. The software is to be documented to achieve those goals.
- Opportunities beyond LSST: LSST DM codes may be of interest and (re)used beyond the LSST project (e.g., by other survey projects, or individual LSST end-users). While enabling or supporting such applications goes beyond LSST's construction requirements, cost and schedule-neutral technical and programmatic options that do not preclude them and allow for future generalisation should be strongly preferred.

2 Data Management Organization Structure

This section defines the organization structure for the period in which the DM System is developed and commissioned, up to the start of LSST Observatory operations. (Appendix C gives historical Pre-Construction Phase Organization).

The DM Project Manager (William O'Mullane), Deputy Project Manger (John Swinbank) and DM Project Scientist (Mario Jurić), who are known collectively as DM Management, lead the DM Subsystem. The Project Manager has direct responsibility for coordination with the overall LSST Project Office, the LSST Change Control Board, the LSST Corporation, and LSST partner organisations on all budgetary, schedule, and resource matters. The Project Scientist has primary scientific and technical responsibility in the DM and responsibility for ensuring that the scientific requirements of the LSST are supported, and is a member on the LSST Project Science Team (PST).

As shown in Figure 1, the organization now features lead institutions, each with responsibility for major element of the DM System (Level 2 Work Breakdown Structure elements). For example, during Final Design, the Process Control and Archive Site Manager and Team at NCSA will be conducting prototyping activities in computing, data communications, and data storage to select and verify the ability of System technologies to support the LSST requirements. They will also be involved in creating a supporting infrastructure for the DM Systems. During Construction before the LSST first light time frame, these resources will be focused on implementation of the selected technologies. In order to ensure that team functions as one integrated project, the institutions coordinate support by other lead institution team members directly through this organisational structure, as well as via a number of cross-organisational bodies (described later in this document).

2.1 Document Management

DM documents will follow the System Engineering Guidelines of LSST. PDF versions of released documents shall be put in Docushare in accordance with the project Document management plan LPM-51.

The Document Tree for DM is shown in Figure 2, it is not exhaustive but gives a high level orientation for the main documents in DM and how they relate to each other.

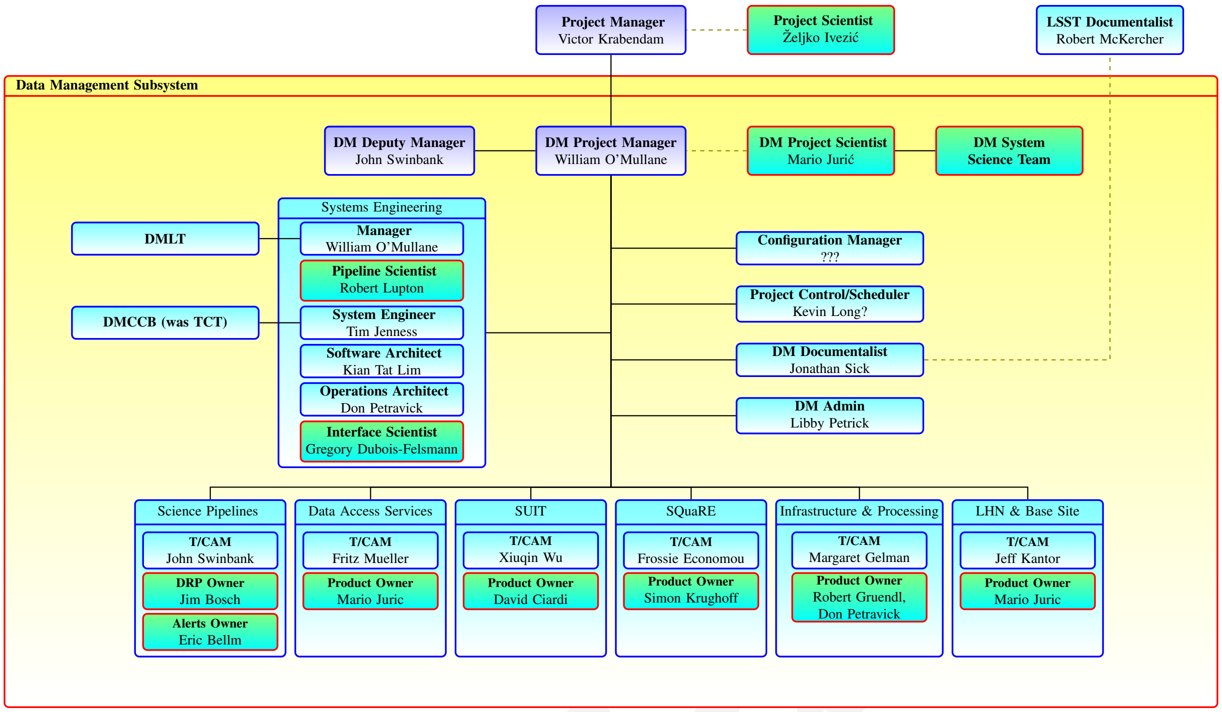

FIGURE 1: DM organisation with Scientists in Green.

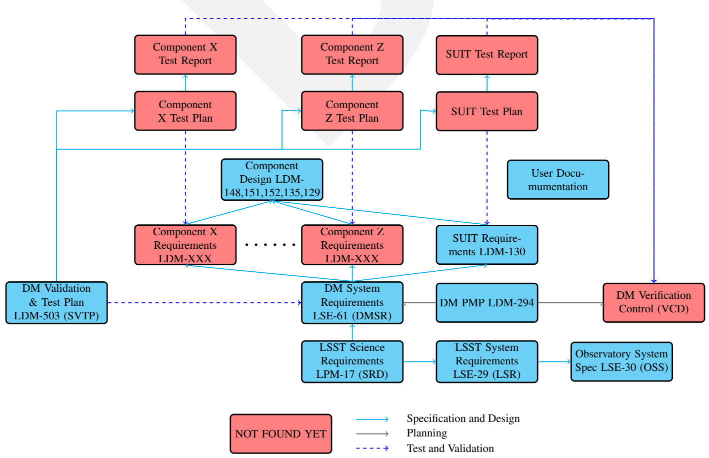

FIGURE 2: Outline of the documentation tree for DM software relating the high level documents to each other.

Need a DOC tree for End User DOcumentaiton - Johnathon ?

Need a DOC tree for Hardware/Services - Margaret

2.1.1 Draft Documents

Draft DM documents will be kept in GitHub. A single repository per document will be maintained with the head revision containing the *released* version which should match the version on docushare.

In addition each repository will be included as a *submodule* of a single dm-docs git repository namely`https://github.com/lsst-dm/dm-docs`. [1]

An LSST document class for LaTeX is provided for TeX documents, to use this texmf must be set up to include the texmf folder form the repository. See `https://github.com/lsst/lsst-texmf/` to set this up.

End user documentation will most likely and appropriately be web based and the scheme for that is described in [LSE-493].

2.2 Configuration Control

Configuration control of documents is dealt with in Section 2.1. Here we consider more the operational systems and software configuration control.

2.2.1 Software Configuration Control

We should have a configuration management plan covering this.

DM follows a git based versioning system based on public git repositories and the approach is covered in the developer guide `https://developer.lsst.io/`. The master branch is the stable

[1] Use of Google Docs or confluence is tolerated but final delivered documents should look like LSST docs so either done with TeX or Word Templates. The Google doc or Confluence page should then be erased with a pointer to the baseline document. This should be in github.

code with development done in *ticket* branches (named with the id of the corresponding Jira Ticket describing the work. Once reviewed a branch is merged to master.[2]

As we approach commissioning and operations DM will have a much stricter configuration control. At this point there will be a version of the software which may need urgent patching, a next candidate release version of the software, and the master. A patch to the operational version will require the same fix to be made in the two other versions. Th's role of the Configuration Control Board (CCB) becomes very important at this point to ensure only essential fixes make it to the live system as patches and that required features are included in planned releases.

We can not escape the fact that we will have multiple code branches to maintain in operations which will lead to an increase in work load. Hence one should consider that perhaps more manpower may be needed in commissioning to cope with urgent software fixes while continuing development. The other consideration would be that features to be developed post commissioning will probably be delayed more than one may think, as maintenance will take priority.[3]

2.2.2 Hardware Configuration Control

On the hardware side we have multiple configurable items, we need to control which versions of software are on which machines. These days tooling like Puppet make this reasonably painless. Still the configuration must be carefully controlled to ensure reproducible deployments providing correct and reproducible results. The exact set of released software and other tools on each system should be held in a configuration item list. Changes to the configuration should be endorsed by the CCB.

2.3 Risk Management

Risks will be dealt with within the project framework defined in LPM-20, the specific DM process for risk assessment is defined in LDM-512.

[2] LSE-14 seem out of date and should be updated or revoked - titled a guideline it seems inappropriate as an LSE.

[3] WOM identifies this as the maintenance surge.

2.4 Quality Assurance

In accordance with the project QA plan LPM-55 we perform QA on the software products, this work is carried out mainly by SQuARe (Section 7.1.1.

2.5 Verification and Validation

We intend to verify and validate as much of DM as we can before commissioning and operations. This will be achieved through testing and operations rehearsals/data challenges. The Verification and Validation approach is detailed in [LDM-503]

3 WBS Elements

DM WBS is fully defined in LSE-43 with definitions provided in LSE-44. LSE-472 defines the project controls for DM. The LSST Project Controller is Kevin Long. He is responsible for the PMCS and, in particular, for ensuring that DM properly complies with our earned value management requirements. He is the first point of contact for all questions about the PMCS system.

The WBS provides a hierarchical index of all hardware, software, services, and other deliverables which are required to complete the LSST Project. It consists of alphanumeric strings separated by periods. The first component is always "1", referring the LSST Construction Project. "02C" in the second component corresponds to Data Management Construction. Subdivisions thereof are indicated by further digits. Subdivisions at this level correspond to teams within the DM project. Thus:

The various groups involved in the WBS are briefly described in Section 8.

4 Products

The products of DM are not the data products defined in LSE-163, rather the are the artefacts, systems and Services, we need to produce those produces. Figure 3 is an initial attempt to define the product tree for DM.

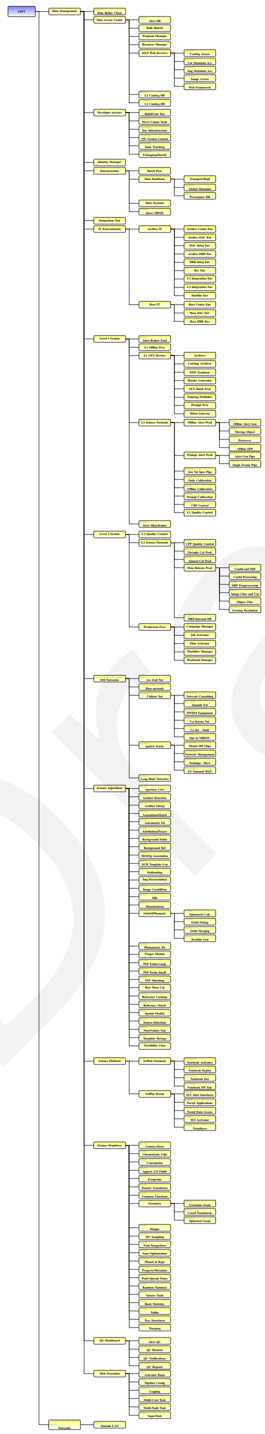

FIGURE 3: DM product tree.

TABLE 2: DM top level Work Breakdown Structure

WBS	Description	Lead Institution
1.02C.01	System Management	LSST
1.02C.02	Systems Engineering	LSST
1.02C.03	Alert Production	University of Washington
1.02C.04	Data Release Production	Princeton University
1.02C.05	Science User Interface	Caltech IPAC
1.02C.06	Science Data Archive	SLAC
1.02C.07	Processing Control & Site Infrastructure	NCSA
1.02C.08	International Communications. & Base Site	NCSA & LSST
1.02C.09	Systems Integration & Test	NCSA & LSST
1.02C.10	Science Quality & Reliability Engineering	LSST

5 Roles in Data Management

There are many roles listed in Figure 1, this section enumerates responsibilities going with those roles.

5.1 DM Project Manager

The DM Project Manager is responsible for the efficient coordination of all LSST activities and responsibilities assigned to the Data Management Subsystem. The DM Project Manager has the responsibility of establishing the organization, resources, and work assignments to provide DM solutions. The DM Project Manager, serves as the DM representative in the LSST Project Office and in that role is responsible for presenting DM initiative status and submitting new DM initiatives for approval consideration. Ultimately, the DM Project Manager, in conjunction with his / her peer Project Managers (Telescope, Camera), is responsible for delivering an integrated LSST system. The DM Project Manager reports to the LSST Project Manager. Specific responsibilities include:

- Manage the overall DM System
- Define scope and funding for DM System
- Develop and implement the DM project management and control process, including earned value management

- Approve the DM Work Breakdown Structure (WBS), budgets and resource estimates
- Approve or execute as appropriate all DM outsourcing contracts
- Convene and/or participate in all DM reviews
- Co-Chair the DM Leadership Team

5.2 DM Deputy Project Manager

The DM Project Manager will keep the Deputy Project Manager informed of all DM situations such that the deputy may effectively act in place of the Project Manager when absent. The PM and deputy will work together on the general management of DM and any specific PM tasks may be delegated to the deputy as needed and agreed. In the absence of the PM the deputy carries full authority and decision making powers of the PM.

5.3 DM Project Scientist

The DM Project Scientist has ultimate responsibility for ensuring DM initiatives provide solutions that meet the overall LSST scientific and technical requirements. The DM Project Scientist must ensure correct specification of DM Scientific Requirements and proper translation of those requirements into derived information technology requirements and ultimately, into implemented solutions. The DM Project Scientist must ensure that the DM subsystem is properly scoped and integrated within the overall LSST system. The DM Project Scientist is also a member of the LSST Project Science Team (PST) and reports to the LSST Director. Specific responsibilities include:

- Responsible for the science deliverables of the DM System
- Set requirements for the DM that:
  - Ensure that the design and operational flow of the data products meet the needs of the science community
  - Ensure that the quality requirements of the data products will be / are being met by the DMS, with a particular emphasis on choice of appropriate application algorithms

- Set requirements for and assess/validate results of Data Challenges and other precursor experiments
- Set requirements and assess/validate results for Data Releases
- Convene and/or participate in all DM reviews
- Co-Chair the DM Leadership Team and Science/Architecture Team

5.4 Project Controller/Scheduler

Keep AGILE plan in sync with the overall LSST planning (primavera), track milestones from TCAMS Section 5.5. Help TCAMS with building the plan from the milestones tracking dependencies and keeping it up to date.

Help set up sprint - points available (start/end day, account for holidays etc.) Bug team in general about story status in sprints and their tracking status (points spent).

Create reports and gannt charts for the DM Project Manager as needed Section 5.1

5.5 Technical Control/Account Manager (TCAM)

Accountable for planning and execution in their area. Reporting to the DM Project Manager Section 5.1. In AGILE could also be seen as the SCRUM Master for the local team.

5.6 Product Owner

The product owner, aka. the X scientist (where X is the product e.g. Alerts Production), is responsible for the product quality and acceptance. The product owner should sign off on the requirements to be fulfilled in every delivery and therefore also on any descopes or enhancements. The Product owner should define tests which can be run to prove a delivery meets the requirements due for that product.

5.7 Pipeline Scientist

Several DM products come together to form the LSST pipeline. The Pipeline Scientist is the product owner for the overall pipeline. The Pipeline Scientist should :

- Provide guidance and test criteria for the full pipeline including how QA is done on the products.
- Keep the big picture of where the codes are going in view. Predominantly the algorithms, but also the implementation and architecture (as part of the System Engineering Team Section 8.2).
- Advise on how we should attack algorithmic problems, providing continuing advice to subsystem product owners as we try new things.
- Advise on calibration issues, provide understanding of the detectors from a DM point of view.
- Advise on the overall (scientific) performance of the system, and how we'll test it. Thinking about all the small things that we have to get right to make the overall system good.

5.8 System Engineer

With the system engineering team Section 8.2 the System engineer owns the DM entries in the risk register and is generally in charge or the *process* of building DM products.

The System engineer is responsible for the requirements work:

- E.g., updating the DMSR, OSS, LSR (including traceability)
- Ensure we're appropriately modelling and recording information about the system (e.g., drawings, design documents, etc.)
- Overseeing work on ICDs, lower level requirements documents, etc.
- Ensuring we have a solid verification plans/standards across the board in DM

The System Engineer is responsible for the process to define & maintain DM interfaces

- Defining standards for and ensuring internal interfaces are identified and worked out
- Direct Interface Scientist's work on external ICDs

The System Engineer shall Chair the DM Configuration Control Board Section 8.4

- Organise DMCCB processes so our change control process runs smoothly
- Shepherd RFCs through change control
- Monitor + Flag RFCs requiring DMCCB attention
- Call up meetings, make sure decisions are made, and recorded

The System Engineer represents DM on the CCB

- Shepherd DM's CRs through the CCB
- Serve as the Point of Contact for DM on the CCB

5.9 Requirements Engineer

With the system engineering team Section 8.2 and in close coordination with the software architect (Section 5.11 and the system engineer Section 5.8 look after the baseline requirements for DM..

5.10 Operations Architect

Margaret or Don perhaps some text here .. How do we deploy and run everything .. Ops Architect will help us find out.

5.11 Software Architect

The software architect looks after the software we are building. How does it all fit together are their techniques/technologies we should be using. How can we minimise dependencies.

With the Section 5.8 the Software architect should also agree how to track requirements to code and verify requirements are i.e. are hooks required in the code ?

5.12 Operations Architect

The DM System Architect is responsible for ensuring that all elements of the DM systems, including operations teams, infrastructure, middle ware, applications, and interfaces, i come together to form an operable system. Specific responsibilities include:

- Setting up and coordinating Operations Rehearsals
- Ensuring Readiness of procedures and personnel for Operations
- Set standards for operations e..g procedure handling and operator logging
- Participate in stakeholder and end user coordination and approval processes and reviews
- Member of the LSST System Engineering Team

6 Lead Institution Senior Positions

Each Lead Institution has a Project Manager and Scientific/Engineering Lead, who jointly have overall end product responsibility for a broad area of DM work, typically a Work Breakdown Structure (WBS) Level 2 element. They are supervisors of the team at that institution. Their roles and responsibilities are similar to the DM Project Manager, DM Project Scientist, and DM System Architect, and DM QA and Test Lead, but within the scope of work assigned to that institution. These leaders are bound to acknowledge and implement direction from the DM leadership in all matters pertaining to the DM project. The DM Project Manager and DM Project Scientist have direct input into the performance appraisals of the Institution Project Manager and Scientific/Engineering Lead. The lead institutions are covered in Section 7.

7 Lead institutions in DM

7.1 LSST Tucson

LSST in Tucson hosts the LSST project and for DM it hosts the DM Project Manager (Section 5.1) and the DM System Engineer (Section 5.8). The largest group for DM in Tucson is SQuaRE described below.

7.1.1 DM Science Quality and Reliability Engineering (SQuaRE) Leads

The DM SQuaRE Leads are the SQuaRE Lead Scientist and the SQuaRE Technical Manager. The primary organisational responsibility for this Tucson-led group is to provide scientific and technical feedback to the LSST DM Manager that demonstrates LSST/AURA DM is fulfilling its responsibilities as charged by the NSF with regards to quality and software performance and reliability. They are responsible for monitoring the reliability and maintainability of software developed by DM and the quality of the data products produced by the DM software in production. SQuaRE's activities span processes and environments for software development, integration test and distribution. SQuaRE also assumes responsibility for delivering any work in this area, though in many cases this may involve effort across the DM team. As such, areas of activity include:

- Development of algorithms to detect and analyse quality issues with data
- Infrastructure development to support the generation, collection, and analysis of data quality and performance metrics
- DM developer support services to ensure DM is using appropriate tools to aid software quality
- Support of publicly released software products, including porting and distributing it according to the scientific community?s needs.

In the event that SQuaRE identifies issues with the performance or future maintainability of the DM codebase, it brings them to the attention of the DM System Architect, who is ultimately responsible to decide who will address them and how. In the event that SQuaRE identifies issues with the quality of the data, it brings them to the attention of the DM Project Scientist.

7.2 Princeton University

Princeton University hosts the Pipelines Scientist (Section 5.7) and the Data Release Production group, described below.

7.2.1 Data Release Production

The Data Release Production (DRP) group has three major areas of activity within DM.

- Definition and implementation of the scientific algorithms and pipelines which will be used to generated LSST's annual data releases;
- Definition and implementation of the algorithms and pipelines which will be used to produce the "calibration products" (for example, flat fields, characterization of detector effects, etc) which will be used as inputs to the photometric calibration procedure in both nightly and annual data processing. This includes the development of the spectrophotometric data reduction pipeline for the Auxiliary Telescope;
- Development, in conjunction with the Alert Production team (AP; Section 7.3.1), of a library of re-usable software libraries and components which form the basis of both the AP and DRP pipelines and which are made available to science users within the LSST Science Platform.

Development of software in support of annual data releases and of reusable software components are carried out under the direction of the DRP Science Lead, who acts as product owner for this part of the system. The DRP Science Lead is ultimately responsible to both the Pipelines Scientist (Section 5.7) and DM Project Scientist (Section 5.3).

The product owner for calibration products product is the LSST Calibration Scientist (who doubles as the Pipelines Scientist, Section 5.7). The Calibration Scientist liases with other LSST subsystems and with the products owners of the annual and nightly data processing pipelines to ensure that appropriate calibration products are available to those pipelines to enable them to meet specifications.

Management of the group is the responsibility of the Science Pipelines T/CAM, reporting to the DM Project Manager (Section 5.1).

The DRP group is responsible for delivering software which adheres to the architectural and testing standard defined by the Software Architect (Section 5.11). In addition, the DRP group is responsible for testing each major product delivered to demonstrate its fitness for purpose, and working with the DM Project Scientist and DM System Science Team (Section **??**) to define, run and analyze "data challenges" and other large scale tests to validate the performance of the data release production syste.

7.3 Washington University

7.3.1 Alert Production

7.4 Caltech IPAC

7.5 SLAC

7.6 NCSA

8 Data Management Groups/Bodies

Since the DM team is distributed in terms of geography and responsibility across the LSST partner and lead institutions, mechanisms are needed to ensure that the project remains on track at all times. There are three primary coordinating bodies to ensure the management, technical, and quality integrity of the DM project. All DM institutions have membership on these bodies, and all meet at least once per month during construction and commissioning.

8.1 DM System Science Team

Mario please update .. The DM Science team is run by DM PS and brings together the DM Subsystem Scientist, the DM System Science Staff (Melissa Graham, Colin Slater), and various Institutional Scientist roles (AP Scientist, DRP Scientist, SUIT Scientist, SQuaRE Scientist, NCSA Science Lead). The team works together to define, maintain, and communicate to the DM construction team a coherent vision of the LSST DM system responsive to the overall LSST Project Goals, and ensure the DM System is scientifically validated. In addition the team should investigate problems an analyse commissioning data.

8.2 DM System Engineering Team

The System engineering team is lead by the DM Project Manager and looks after all aspect of system engineering. It is comprised of not only a System Engineer (Section 5.8) but also the Requirements Engineer (Section 5.9, Software Architect (Section 5.11), Operations Architect (Section 5.10) and the Pipeline Scientist (Section 5.7).

While the product owners help DM to create the correct product , fit for purpose, the System engineering team must ensure we do it correctly. This group concerns its self with system wide decisions on architecture and software engineering.

Within this group we must:

- Formalise the Product list/tree for DM, these are not the data products but the DM software and systems which produce the products.
- Formalise the documentation tree for DM - which documents need to be produced for each product.
- Agree how to trace the baseline requirements verification and validation status.
- . . .

Some of these tasks are obviously delegated tot he individuals in the group. These individuals also are the conduit to the rest of the DM team to raise ideas/issues with the engineering approach.

8.2.1 Communications

The System engineering team will only physically meet to discus specific topics there will not be a regular meeting of the group outside for the one to one meetings with the DM project manager for the individuals in the group. Discussions will be held via email until in person talks are required.

8.3 DM Leadership Team

The DM Leadership Team (DMLT) purpose is to establish scope of work and resource allocation across DM and ensure overall project management integrity across DM. The following mandate established the DMLT:

- Charter/purpose
  - Maintain scope of work and keep within resource allocation across DM
  - Ensure overall project management integrity across DM
  - Ensure Earned Value management requirements are met
- Membership
  - Co-Chaired by the DM Project Manager and DM Project Scientist
  - Core members are Lead Institution Technical/Control Account Managers (T/CAMs or CAMs)
- Responsibilities
  - Prepares all budgets, schedules, plans
  - Meets every week to track progress, address issues/risks, adjust work assignments and schedules, and disseminate/discuss general PM communications
  - Creates and publishes monthly, quarterly, annual progress reports
  - Meets at start of each software development phase with SAT to establish detailed scope/work plan
  - Meets with SAT for change control (DMCCB)

The DM Leadership Team and the System Engineering Team (Section 8.2) work in synchrony. The DMLT makes sure the requirements and architecture/design are estimated and scheduled in accordance with LSST Project required budgets and schedules.

8.3.1 Communications

A mailing list[4] exists for dmlt related messages. On Mondays the DMLT hold a brief telecon(30 to 45 minutes) , this telecon serves to :

[4] lsst-dmlt@listserv.lsstcorp.org

- Allow the Project manager and DM Scientist to pass on important project level information and general guidance.
- Raise any blocking or not well understood issues across DM - this may result in calling a splinter meeting to further discuss with relevant parties.
- Inform everyone one of any LCRs in process at LSST level which may be of interest to or have impact on DM
- Check on outstanding actions on DMLT members.

Face to Face meetings of DM are held two times a year these are opportunities to:

- Discuss detailed planning for the next cycle
- Discuss technical topics in a face to face environment
- Work together on critical issues
- Help make DM function as a team

8.4 DM Configuration Control Board

The DMCCB has responsibility for issues similar to those of the LSST Configuration Control Board, but restricted to those contained within the DM subsystem. The DMCCB reviews and approves changes to all baselines in the LSST Data Management System, including proposed changes to the DM System Requirements' (DMSR), reference design, sizing model, i.e. any LDM-xxx baseline document. The DMCCB makes sure these changes don't get into the baseline without proper change control. Note that the DMCCB does not author the Technical Baseline and has no specific technical deliverable charter, but it does validate that the form and content of the Technical Baseline is consistent with LSST project standards such as the System Engineering Management Plan (SEMP). Specific responsibilities for development of the Technical Baseline and evaluation of the content versus LSST and DM requirements are elsewhere in this document.

- Charter/purpose

  - Ensure that the DM Technical Baseline (LDM-xxx) documents are baseline and once baselined only changed when necessary, according to LSST and DM configuration control processes

- Membership
  - Chaired by the System Engineer
  - Members include the DM System Architect, DM System Interfaces Scientist, DM SQuaRE Technical Manager and DM Project Manager
  - For on-line virtual meetings, if a quorum is not reached within one week, the DM Project Manager will make a unilateral decision

- Responsibilities
  - Determines when specification and deliverables are of sufficient maturity and quality to be baselined (placed under configuration controlled status) or released. The DMCCB reviews and approves proposed changes to baselined items.
  - Reviews and approves/rejects proposed changes to baselined items

9 Development Process

DM is essentially a large software project, more we are developing scientific software with the in uncertainties that brings with it. An agile [8] is particularly suited to scientific software development. The development follows a six month cyclical approach and DM products are under continuous integration using the application software Jenkins. All code is developed in the GitHub open source repository under an open source license.

How this fits with the Earned Value System is described in **?** .

10 Data Management Problem/Conflict Resolution

The above organisational structure allocates significant responsibility to lead institutions. As such, when problems arise that cannot be solved with the responsibility and scope allocated to an institution, the path of escalation and resolution of such problems must be clear.

Any intra institutional problem should be bought as early as possible to the DM Project manager. The PM will attempt to mediate a resolution. The PM will consult with DMLT, DM System Science Team and DM System engineering if there are Scientific or technical impacts to be considered.

Should an issue need to be escalated the PM will bring it up in the weekly LSST project managers meeting. In that forum a way forward will be agreed with the LSST project manager and other sub system managers.

A DM Product List

WBS	Product	Description	Manager	Owner
	LSST			
	Data Management	Data Management System	.	
1.02C.06.02.01	Data Butler Client	Data Butler data access client library	DAX	FritzM
	Data Access Center	DAC Software	.	
1.02C.03.03	Alert DB	Alert database	AP	SimonK
	Bulk Distrib	Bulk Distribution System	NCSA	JoelP
	Proposal Manager	Proposal Manager	NCSA	JoelP
	Resource Manager	DAC Resource Manager	NCSA	JoelP
	DAX Web Services	DAX Web services including VO interfaces	.	
1.02C.06.02.05	Catalog Access	Catalog access	DAX	FritzM
1.02C.06.02.05	Cat Metadata Acc	Catalog metadata access	DAX	FritzM
1.02C.06.02.05	Img Metadata Acc	Image metadata access	DAX	FritzM
1.02C.06.02.04	Image Access	Image access	DAX	FritzM
1.02C.06.02.02	Web Framework	Web services framework	DAX	
1.02C.06.01.01	L1 Catalog DB	L1 catalog database	DAX	FritzM
1.02C.06.01.01	L2 Catalog DB	L2 catalog database	DAX	FritzM
	Developer services	Developer services	.	
1.02C.10.02.03.01	Build/Unit Test	Build and unit test service	SQuaRE	FrossieE
1.02C.10.02.03.04	Devel Comm Tools	Developer communication tools	SQuaRE	FrossieE
1.02C.10.02.03.03	Doc Infrastructure	Documentation infrastructure	SQuaRE	FrossieE
1.02C.10.02.03.01	SW Version Control	Software version control system	SQuaRE	FrossieE
1.02C.10.02.03.05	Issue Tracking	Issue (ticket) tracking service	SQuaRE	FrossieE

1.02C.10.02.03.02	Packaging/Distrib	Packaging and distribution	SQuaRE	FrossieE
	Identity Manager	Identity (Authentication and Authorization) Manager	NCSA	JoelP
	Infrastructure	Infrastructure Software Systems	.	
	Batch Proc	Batch Processing System	NCSA	JoelP
	Data Backbone	Data Backbone System	.	
	Transport/Repl	File and database transport and replication	NCSA	JoelP
1.02C.06.02.05	Global Metadata	Global metadata service	DAX	FritzM
1.02C.06.01.01	Provenance DB	Provenance database	DAX	FritzM
	Infra Systems	Filesystems/ provisioning/monitoring systems and system management	NCSA	JoelP
1.02C.06.02.03	Qserv DBMS	Qserv distributed database system	DAX	FritzM
	Integration Test	Automated integration and test services	?	
	IT Environments	Computing and Storage Infrastructure including provisioning	.	
	Archive IT	Archive IT Environments	.	
	Archive Center Env	Archive Production Center environment	NCSA	JoelP
	Archive DAC Env	Archive DAC environment	NCSA	JoelP
	DAC Integ Env	DAC Integration environment (PDAC)	NCSA	JoelP
	Archive DBB Env	Archive Data Backbone endpoints and storage	NCSA	JoelP
	DBB Integ Env	Data Backbone Integration environment	NCSA	JoelP
	Dev Env	Developer environment	NCSA	JoelP
	L1 Integration Env	Level 1 Integration environment	NCSA	JoelP
	L2 Integration Env	Level 2 Integration environment	NCSA	JoelP
	Satellite Env	Satellite compute environment	NCSA	JoelP
	Base IT	Base IT Environments	.	
	Base Center Env	Base Production Center environment	NCSA	JoelP
	Base DAC Env	Base DAC environment	NCSA	JoelP

	Base DBB Env	Base Data Backbone endpoints and storage	NCSA	JoelP
	Level 1 System	Level 1 System	.	
1.02C.03.03	Alert Broker Feed	Alert broker feed service	AP	SimonK
	L1 Offline Proc	L1 Offline Processing System	NCSA	JoelP
	L1 OCS Devices	Level 1 Online (OCS-connected)	.	
	Archiver	Archiving Device	NCSA	JoelP
	Catchup Archiver	Catch-up Archiving Device	NCSA	JoelP
	EFD Tranform	EFD Transformation Device	NCSA	JoelP
	Header Generator	Header Generator Device	NCSA	JoelP
	OCS Batch Proc	OCS-Driven Batch Processing Device	NCSA	JoelP
	Pointing Publisher	Pointing Prediction Publishing Device	NCSA	JoelP
	Prompt Proc	Prompt Processing Device	NCSA	JoelP
	Telem Gateway	Telemetry Gateway Device	NCSA	JoelP
	L1 Science Payloads	L1 science payloads	.	
	Offline Alert Prod	Offline Alert Production payload	.	
1.02C.03.03	Offline Alert Gen	Offline alert generation pipeline	AP	SimonK
1.02C.03.06	Moving Object	Moving object pipeline	AP	SimonK
1.02C.03.04	Precovery	Precovery and forced photometry pipeline	AP	SimonK
1.02C.03.01	Offline SFP	Offline single frame processing pipeline	AP	SimonK
	Prompt Alert Prod	Prompt Processing Alert Production payload	.	
1.02C.03.03	Alert Gen Pipe	Alert generation pipeline	AP	SimonK
1.02C.03.01	Single Frame Pipe	Single frame processing pipeline	AP	SimonK
1.02C.04.02	Aux Tel Spec Pipe	Offline Auxiliary Telescope spectrograph pipeline	DRP	JohnS
1.02C.04.02	Daily Calibration	OCS-Controlled batch daily CPP payload	DRP	JohnS
1.02C.04.02	Offline Calibration	Offline calibration single frame processing pipeline	DRP	JohnS
1.02C.04.02	Prompt Calibration	Prompt Processing calibration frame payload	DRP	JohnS

1.02C.04.02	CBP Control	OCS control scripts for collimated beam projector control	DRP	JohnS
	L1 Quality Control	L1 QC measurement generators	AP	SimonK
1.02C.03.03	Alert Mini-Broker	Alert mini-broker service	AP	SimonK
	Level 2 System	Level 2 System	.	
	L2 Quality Control	L2 QC measurement generators	DRP	JohnS
	L2 Science Payloads	L2 science payloads	.	
1.02C.04.02	CPP Quality Control	CPP QC measurement generators	DRP	JohnS
1.02C.04.02	Periodic Cal Prod	Periodic CPP payload	DRP	JohnS
1.02C.04.02	Annual Cal Prod	Annual CPP payload	DRP	JohnS
	Data Release Prod	Annual mini-DRP and DRP payload	.	
1.02C.04.04	Coadd and Diff	Image coaddition and differencing	DRP	JohnS
1.02C.04.05	Coadd Processing	Coadd processing	DRP	JohnS
1.02C.04.06	DRP Postprocessing	DRP Postprocessing	DRP	JohnS
1.02C.04.03	Image Char and Cal	Image characterization and calibration	DRP	JohnS
1.02C.04.06	Object Char	Multi-epoch object characterization	DRP	JohnS
1.02C.04.05	Overlap Resolution	Overlap resolution	DRP	JohnS
1.02C.06.01.01	DRP-Internal DB	DRP-internal database	DAX	FritzM
	Production Exec	Production Execution System	.	
	Campaign Manager	Campaign Manager	NCSA	JoelP
	Job Activator	Job Activator	NCSA	JoelP
	Pilot Activator	Pilot Activator	NCSA	JoelP
	Workflow Manager	Workflow Manager/Orchestrator	NCSA	JoelP
	Workload Manager	Workload Manager	NCSA	JoelP
1.02C.07.04.03 1.02C.0704.06 1.02C.08.03	DM Networks	Data Management Provided Networks	DM	Kantor J/ Petravick D
1.02C.07.04.06	Arc Extl Net	Archive External Network	NCSA	Petravick D
1.02C.07.04.03 (moving to 1.02C.08)	Base network	Base Local Area Network	NCSA (moving to AURA)	Petravick D (moving to Kantor J)

1.02C.08.03.01	Chilean Nat	Summit - Gatehouse La Serena - Gatehouse/ La Serena - Santiago Networks DWDM Equipment	AURA REUNA Liello Telefonica	Kantor J
1.02C.08.03.01.02	Network Consulting	Network Consulting	REUNA Liello	Kantor J
1.02C.08.03.01.03	Summit Net	Summit - AURA Gatehouse Network	AURA Telefonica	Kantor J
1.02C.08.03.01.04	DWDM Equipment	DWDM Equipment	AURA	Kantor J
1.02C.08.03.01.01A	La Serena Net	La Serena - AURA Gatehouse Network	REUNA Telefonica	Kantor J
1.02C.08.03.01.01	La Ser - Santi	La Serena - Santiago Network	REUNA Telefonica	Kantor J
1.02C.08.03.05	Ops in MREFC	Operating Costs during MREFC	AURA	Kantor J
1.02C.08.03.02	Int/US WANs	International WAN/US WAN	AURA FIU/AmLight	Kantor J
1.02C.08.03.02.01	Miami 100 Gbps	Santiago - Miami 100 Gbps Ring	AURA FIU/AmLight	Kantor J
1.02C.08.03.02.02	Network Management	Network Management	AURA FIU/AmLight	Kantor J
1.02C.08.03.02.03	Santiago - Boca	Santiago - Boca Raton Spectrum	AURA FIU/AmLight	Kantor J
1.02C.08.03.02.01	US National WAN	US National WAN	AURA FIU/AmLight	Kantor J
1.02C.08.03	Long-Haul Networks	Summit - Base/ Base - Archive/ US Networks	AURA	Kantor J
	Science Algorithms	Common science algorithmic components	.	
1.02C.04.05	Aperture Corr	Aperture correction	DRP	JohnS
1.02C.03.01	Artifact Detection	Artifact detection	AP	SimonK
1.02C.03.01	Artifact Interp	Artifact interpolation	AP	SimonK
1.02C.04.05	Association/Match	Association and matching	DRP	JohnS
1.02C.03.07	Astrometric Fit	Astrometric fitting	AP	SimonK
1.02C.03.06	Attribution/Precov	Attribution and precovery	AP	SimonK
1.02C.04.03	Background Estim	Background estimation	DRP	JohnS
1.02C.04.03	Background Ref	Background reference	DRP	JohnS

1.02C.03.02	DIAObj Association	DIAObject association	AP	SimonK
1.02C.03.04	DCR Template Gen	DCR-corrected template generation	AP	SimonK
1.02C.04.05	Deblending	Deblending	DRP	JohnS
	Img Decorrelation	Image decorrelation	AP	SimonK
1.02C.04.04	Image Coaddition	Image coaddition	DRP	JohnS
1.02C.03.01	ISR	ISR	AP	SimonK
1.02C.04.05	Measurement	Measurement	DRP	JohnS
	Orbit/EPhemeris	Orbit tools	AP	SimonK
1.02C.03.06	Ephemeris Calc	Ephemeris calculation	AP	SimonK
1.02C.03.06	Orbit Fitting	Orbit fitting	AP	SimonK
1.02C.03.06	Orbit Merging	Orbit merging	AP	SimonK
1.02C.03.06	Tracklet Gen	Tracklet generation	AP	SimonK
1.02C.03.08	Photometric Fit	Photometric fitting	AP	SimonK
	Proper Motion	Proper motion and parallax	AP	SimonK
1.02C.04.03	PSF Estim Large	PSF estimation (visit)	DRP	JohnS
1.02C.03.01	PSF Estim Small	PSF estimation (1 CCD)	AP	SimonK
1.02C.04.04	PSF Matching	PSF matching	DRP	JohnS
	Raw Meas Cal	Raw measurement calibration	DRP	JohnS
1.02C.03.01	Reference Catalogs	Reference catalogs	AP	SimonK
1.02C.03.02	Reference Match	Matching to reference catalogs	AP	SimonK
1.02C.03.01	Spatial Models	Spatial models	AP	SimonK
1.02C.04.05	Source Detection	Source detection	DRP	JohnS
1.02C.04.05	Star/Galaxy Sep	Star/galaxy classification	DRP	JohnS
1.02C.03.04	Template Storage	Difference template storage/retrieval	AP	SimonK
	Variability Char	Variability characterization	AP	SimonK
	Science Platform	Science Platform	.	
	SciPlat Notebook	Science Platform notebook component	.	
1.02C.10.02.02.05	Notebook Activator	Notebook Activators	SQuaRE	FrossieE
1.02C.10.02.02.06	Notebook Deploy	Notebook deployment	SQuaRE	FrossieE
1.02C.10.02.02.01	Notebook Env	Basic notebook environment	SQuaRE	FrossieE
1.02C.10.02.02.04	Notebook SW Env	Notebook software environments	SQuaRE	FrossieE
	SciPlat Portal	Science Platform portal component	.	
1.02C.05.09	SUI Alert Interfaces	Portal alert interfaces	SUIT	XiuqinW

1.02C.05.08	Portal Applications	Portal applications	SUIT	XiuqinW
1.02C.05.07	Portal Data Access	Portal data access Interfaces	SUIT	XiuqinW
1.02C.05.07	SUI Activator	SUI Activators	SUIT	XiuqinW
1.02C.05.06	Visualizers	Client-server query/visualization framework	SUIT	XiuqinW
	Science Primitives	Science software primitives	.	
1.02C.03.05	Camera Descr	Camera descriptions	AP	SimonK
1.02C.03.05	Chromaticity Utils	Chromaticity utilities	AP	SimonK
1.02C.04.01	Convolution	Convolution kernels	DRP	JohnS
1.02C.03.05	Approx 2-D Fields	Interpolation and approximation of 2-D fields	AP	SimonK
1.02C.04.01	Footprints	Footprints	DRP	JohnS
1.02C.03.05	Fourier Transforms	Fourier transforms	AP	SimonK
1.02C.03.05	Common Functions	Common functions and source profiles	AP	SimonK
	Geometry	Geometry gathering	.	
1.02C.03.05	Cartesian Geom	Cartesian geometry	AP	SimonK
1.02C.03.05	Coord Transforms	Coordinate transformations	AP	SimonK
1.02C.06.04.03	Spherical Geom	Spherical geometry	DAX	FritzM
1.02C.04.01	Images	Images	DRP	JohnS
1.02C.04.01	MC Sampling	Monte Carlo sampling	DRP	JohnS
1.02C.04.01	Num Integration	Numerical integration	DRP	JohnS
1.02C.04.01	Num Optimization	Numerical optimization	DRP	JohnS
1.02C.04.01	PhotoCal Repr	Photometric calibration representation	DRP	JohnS
1.02C.06.02.01	Property/Metadata	Multi-type associative containers	DAX	FritzM
1.02C.03.05	Point-Spread Funcs	Point-spread functions	AP	SimonK
1.02C.04.01	Random Numbers	Random number generation	DRP	JohnS
1.02C.04.01	Science Tools	Science tools	DRP	JohnS
1.02C.04.01	Basic Statistics	Basic statistics	DRP	JohnS
1.02C.04.01	Tables	Tables	DRP	JohnS
1.02C.03.05	Tree Structures	Tree structures (for searching)	AP	SimonK
1.02C.04.01	Warping	Warping	DRP	JohnS

	QC Dashboard	QC measurement collection/storage/dashboard service	.	
1.02C.10.02.01.04	Alert QC	Alert stream QC harness	SQuaRE	FrossieE
1.02C.10.02.01.01	QC Harness	QC harness	SQuaRE	FrossieE
1.02C.10.02.01.02	QC Notifications	QC threshold notification framework	SQuaRE	FrossieE
1.02C.10.02.01.03	QC Reports	QC verification reporting	SQuaRE	FrossieE
	Task Execution	Task execution framework	.	
1.02C.06.03	Activator Bases	Activator base and Command Line Activator	DAX	FritzM
1.02C.06.03	Pipeline Config	Pipeline configuration	DAX	FritzM
1.02C.06.04.01	Logging	Logging	DAX	FritzM
1.02C.06.03	Multi-Core Task	Multi-core Task API	DAX	FritzM
1.02C.06.03	Multi-Node Task	Multi-node Task API	DAX	FritzM
1.02C.06.03	SuperTask	SuperTask	DAX	FritzM
1.02C.07.04.03 1.02C.0704.06 1.02C.08.03 1.04C.12.05	Networks	All Networks	DM TS	Kantor J
1.04C.12.05	Summit LAN	Summit Local Area Network	AURA	Kantor J

B DMO Discussion and Decision Making Process

The Escalation process only occurs when the issue cannot be resolved within the DMO, i.e. when the following internal discussion and decision making process has failed to yield a decision. Empowerment All DMO team members are empowered by the DM Project Manager (PM) and Project Scientist (PS) to make decisions on any DM-internal matter, including technical/algorithm issues, process improvements, tool choices, etc., when: A) they are willing and able to do the work to implement the decision or with people who agree with the team memaber, B) they (collectively) are willing and able to fix any problems if it goes wrong, and C) they believe that all affected parties (including your immediate manager) would not seriously object to your decision and implementation. RFC Process If the above three criteria are not met, perhaps because the team member doesn't know all the affected parties or because they don't know their positions, the team member should publish the proposed decision and implementation as a JIRA issue in the Request For Comments (RFC) project with a component of "DM".

It is usually difficult to determine all the affected parties for published package interfaces. Changes to interfaces should thus typically go through this process.

It's a good idea to contact any known affected parties before starting this process to check that the resolution is sensible. The institutional technical manager is always affected, as she or he is responsible for tracking the work schedule. If work for others is being proposed, they are obviously affected. The institutional scientist, the DM System Architect (SA), the DM Interface Scientist (IS), and the DM Project Scientist (PS) are also valuable resources for determining affected parties.

The purpose of an RFC is to inform others about the existence and content of the proposed decision and implementation in order to allow them to evaluate its impact, comment on it, refine it if necessary, and agree (implicitly or explicitly) or object (explicitly) to its execution.

The discussion of the RFC takes place in the medium of the requestor's choosing (e.g., a specific mailing list, the RFC JIRA issue itself, a HipChat room, a convened videocon, some combination of those, etc.), but the requestor should be open to private communications as well.

In the RFC process, the opinions of those who will be doing the work (and fixing any problems if something goes wrong) are given more weight. In some cases, this may mean that the RFC issue's Assignee passes to someone else. The opinions of more senior people or people more experienced in the area should also be given more weight and may also result in the Assignee changing.

The Assignee is responsible for determining when no serious objections remain. In particular, there is no need to call for a formal vote on the (refined) resolution. If no explicit objections have been raised within, typically, 72 hours for "ordinary" issues and 1 week for "major" issues, the Assignee should assume that there are none. This is known as "lazy consensus". When this state has been reached, the Assignee is responsible for ensuring that the final consensus has been recorded in the RFC issue before closing it and proceeding with implementation of the decision.

The requestor must be especially careful about not making irreversible changes in the "lazy consensus" time period unless they are absolutely certain there's a general agreement on the stated course of action. If something is broken, the requestor must be be ready to fix it. It is critical to apply sound reasoning and good judgement about what may be acceptable and what might be not. Mistakes will happen; accept that occasionally there will be a requirement to revert an action for which it was thought agreement existed. Exceptions and Appeals Some proposed resolutions may require changes to one or more of the baselined, change-controlled documents describing the Data Management system (those in DocuShare with an LDM- handle or marked as change-controlled in Confluence). Note that major changes to budget or scope will almost certainly affect one or more LDM- documents. In this case only, the DM Technical Control Team (TCT), consisting of the DM PM, PS, SA, and IS, may empanel an ad hoc committee including the lead author of the document and other relevant experts. This committee or the TCT itself must *explicitly* approve the change.

Change-controlled documents with other handles, such as LSE- or LPM-, including inter-subsystem interfaces, have project-wide change control processes. Please consult the DM PM, SA, or IS for more information. At least one member of the DM TCT will read each RFC to determine if it might affect a change-controlled document.

If the DMO team can't converge on a resolution to an RFC that has no serious objections but the requestor still feel that something must be done, the request will be escalated. In most non-trivial cases, they will, with the advice of the SA, empanel a group of experts to which they will delegate the right to make the decision, by voting if need be.

Formalities For project management purposes, RFCs are formally proposals made to the DM PM and PS who by default are responsible for everything in DM (they "own" all problems). As owners, they have the final word in accepting or rejecting all proposals. Functionally, they delegate that ownership ? the right and responsibility to make decisions – to others within the team (e.g. the SA, IS, group leads, etc.) who are expected to delegate it even further. Notifying the institutional technical manager about an RFC serves to inform the DM PM.

C Pre-Construction Phase Organization

This section is historical in nature and describes the DM Organization as it has evolved during the Conceptual, Preliminary, and Final Design Phases prior to Construction.

C.1 Conceptual Design Phase

As shown in Figure 4 [5] , during the Conceptual Design Phase, the Project Manager and Project Scientist jointly supervise several Working Group, which are aligned by functional area. The Working Group Leads are strictly technical leaders responsible for specific work areas, and have no budgetary or schedule authority. Their primary work is the development of requirements and architecture in each of these functional areas.

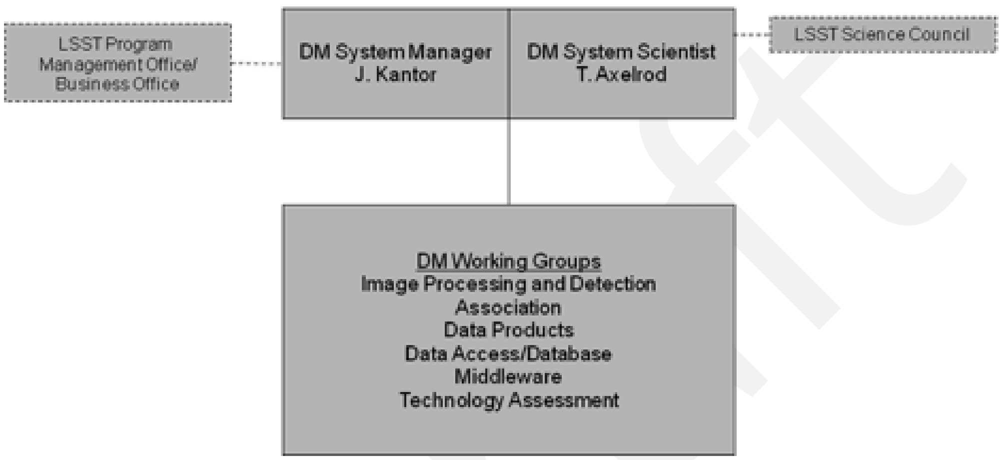

FIGURE 4: Data Management Conceptual Design Phase Organization

C.2 Preliminary Design Phase

The organization transitions to a more complex structure during Preliminary Design, as the role of each DM partner institution is solidified, and D&D prototype development projects called Data Challenges become a primary organizing/tasking vehicle for D&D work. The Working Groups still remain and play a cross-institutional functional role in each area, but there is a more formal structure for work allocation and responsibility, as shown in Figure 5.

In this phase, new positions reporting to the Project Manager and Project Scientist are added. First, there is the DM System QA and Test Lead, who assists the Project Manager in preparation of formal plans, processes, and environments for software development, integration, and test. A Data Management System Architect supports the Project Manager and Project Scientist in matters related to LSST system engineering, including other subsystem interfaces,

[5] LSST Science Council no longer exists. It has been replaced by the LSST Project Science Team and the LSST Science Advisory Committee

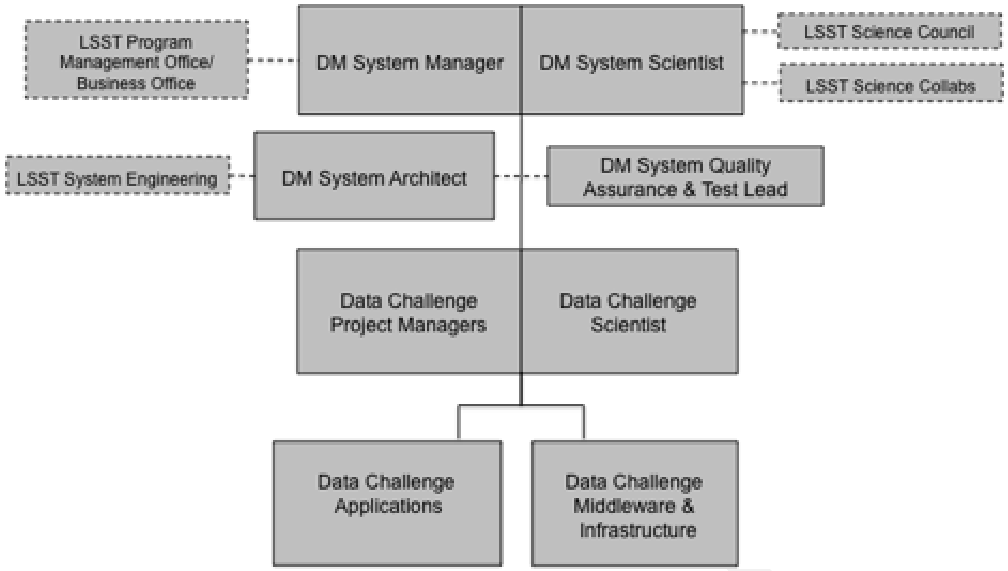

FIGURE 5: Data Management Preliminary Design Phase Organization

overall LSST system control, real-time external system interfaces (e.g. alerting), simulation, and end-to-end system engineering for quality assessment. Finally, temporary Data Challenge Teams consisting of astronomers and engineers are formed for prototyping specific critical design aspects that have high risk (e.g. precursor and simulated data processing and prototype work, research and development of new algorithms for moving object detection or data distribution). Each Data Challenge Team has a designated Project Manager who reports to the Project Manager and Scientist who reports to the Project Scientist for the duration of the Data Challenge.

C.3 Final Design Phase

During Final Design Phase, the organization structure transitions to one that will persist for the remainder of the period in which the DM System is developed and commissioned, up to the start of LSST Observatory operations. As shown in Figure 6, the organization now features lead institutions, each with responsibility for major element of the DM System (Level 2 Work Breakdown Structure elements) and Project Manager. For example, during Final Design, the Processing Services/Tools and Archive Site Manager and Team at NCSA will be conducting prototyping activities in computing, data communications, and data storage to select and verify the ability of System technologies to support the LSST requirements. They will also be involved in creating a supporting infrastructure for the DM Systems. During Construction before the LSST first light time frame, these resources will be focused on implementation of the selected technologies. In order to ensure that team functions as one integrated project, the institutions coordinate support by other lead institution team members directly through this organizational structure, as well as via a number of cross-organizational bodies (described later in this document). Also, due to the span of the organization, the DM Project Manager will be supported by one of the lead institution Project Managers as a Deputy Project Manager in these phases.

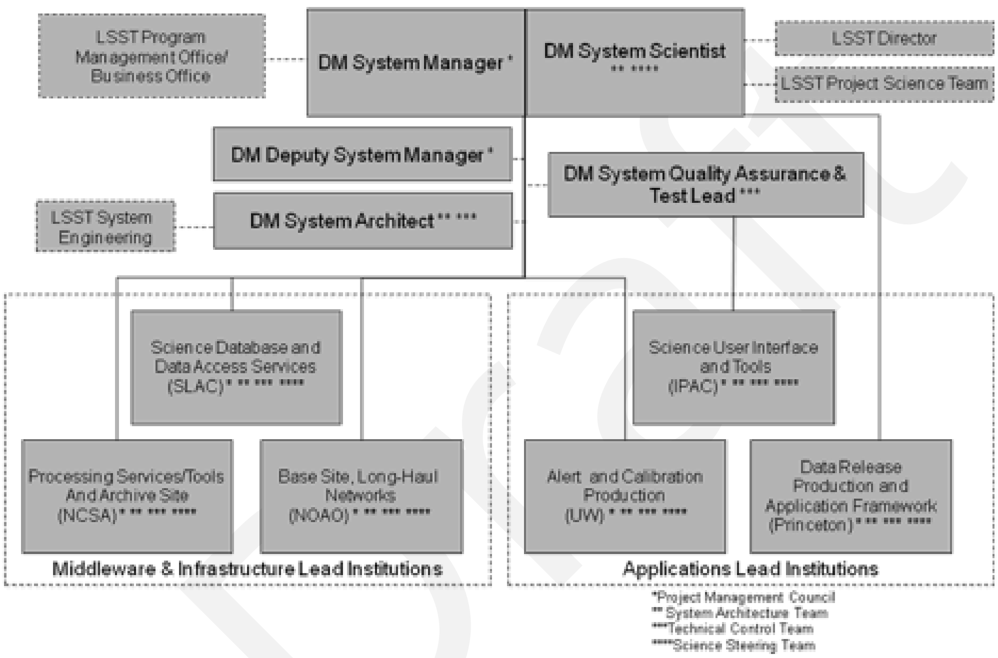

FIGURE 6: Data Management Final Design Phase Organization

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[2] **[LSE-493]**, Docushare, *Waiting for bibtex from Docushare*, LSE-493, URL `https://ls.st/LSE-493`

[3] **[LSE-43]**, Docushare, *Waiting for bibtex from Docushare*, LSE-43, URL https://ls.st/LSE-43

[4] **[LSE-44]**, Docushare, *Waiting for bibtex from Docushare*, LSE-44, URL https://ls.st/LSE-44

[5] **[LDM-512]**, Jenness, T., O'Mullane, W., 2017, *Data Management Risk Assessment Process*, LDM-512, URL https://ls.st/LDM-512

[6] **[LSE-163]**, Juric, M., et al., 2017, *LSST Data Products Definition Document*, LSE-163, URL https://ls.st/LSE-163

[7] **[LPM-20]**, Krabbendam, V., Selvy, B., 2015, *Risk & Opportunity Management Plan*, LPM-20, URL https://ls.st/LPM-20

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[10] **[LDM-503]**, O'Mullane, W., Jurić, M., Economou, F., 2017, *Data Management Test, Verificaiton and Validation Plan*, LDM-503, URL https://ls.st/LDM-503

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E Acronyms

The following table has been generated from the on-line Gaia acronym list:

Acronym	Description
CAM	CAMera
CCB	Configuration Control Board
CR	Change Request

DM	Data Management
DMLT	DM Leadership Team
DMO	Data Management Organisation
DMS	Document Management System (ESA)
DMSR	DM System Requirements
ESA	European Space Agency
ESAC	European Space Astronomy Centre (VilSpa)
ICD	Interface Control Document
JIRA	issue tracking product (not an acronym, but a truncation of Gojira, the Japanese name for Godzilla)
LDM	Light Data Management
LPM	LSST Project Management (Document Handle)
LSE	LSST System Engineering (Document Handle)
LSST	Large-aperture Synoptic Survey Telescope
NCSA	National Center for Supercomputing Applications
NSF	National Science Foundation
PM	Project Manager
PS	Project Scientist
PST	Processing Support Tool
QA	Quality Assurance
RFC	Request for Comments
SA	Science Alert(s)
SAT	Science Archives Team (at ESAC)
SEMP	System Engineering Management Plan
TCAM	Technical Control/Account Manager
TCT	Technical Control Team
WBS	Work Breakdown Structure