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LSST Prompt Data Products

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ABSTRACT

As the Commissioning Execution Plan (LSE-390) says, "The project team shall deliver all reports documenting the as-built hardware and software including: drawings, source code, modifications, compliance exceptions, and recommendations for improvement." As a first step towards the delivery of documents that will describe the system at the end of construction, we are assembling teams for producing of the order 40 papers that eventually will be submitted to relevant professional journals. The immediate goal is to accomplish all the writing that can be done without data analysis before the data taking begins, and the team becomes much more busy and stressed.

This document provides the template for these papers.

1. INTRODUCTION

Eventually, please replace all of the remaining text with your paper text.

The LSST Construction Project team needs to document the as-built hardware and software (see LSE-79 and LSE-390 for details). Although this activity will likely continue well into the operations phase, the majority of anticipated documents will be necessary to enable efficient and robust early science with the LSST facility and thus must be available, at least in a draft form, by the first data release.

As a first step, we are now assembling teams that will be in charge of delivering these documents. An initial paper list collated by subsystem leaders includes about 40 papers that will be submitted to relevant professional journals. Therefore, this deliverable represents a major undertaking and we need to start early. In addition, the commissioning period will be shorter than anticipated due to various delays in construction and thus the time to complete these papers will be shorter, too. Although most of these papers cannot be finished before the end of construction because they will require analysis of LSST commissioning data, we can significantly mitigate the risk that they will never be finished by starting early. The early start will also help mitigate another source of stress for the team during the busy commissioning phase.

2. INITIAL PLAN

The subsystem leaders have assembled an initial list of papers, listed in Appendix. It is likely that this list will evolve with time. Each paper has an editor assigned to it. Each editor is meant to be a team leader who will be initially responsible for the completion of the assigned paper (or perhaps until somone else from the team assumes this leadership role). The editor is not necessarily the team member who will do most of the required work, or who will eventually become the first author. Both issues will be handled by on an individual team basis.

2.1. *The timeline*

We would like to have all the sections that do not depend on commissioning data written and reviewed by February 2021. If we accomplish this goal, we will both have easier time completing these papers, and the team will be less stressed during the commissioning phase.

Our initial timeline is as follows (the further into the future, the less certain it is):

1. Subsystem leads assemble the initial list of papers (DONE)
2. Setup latex templates and email exploders (lsst-constrpapers) (DONE)
3. Schedule the first telecon to discuss task, overall plan and timeline (Oct 2019).
4. Delivery of paper outlines and the second telecon (Jan 2020). Each paper outline should at least contain the list of all sections, their lead authors, and a few sentences about the section scope. Overachievers can add a list of figures etc. for extra credit.
5. First rough draft of sections that can be written without having the LSST commissioning data and the third telecon (June 2020). These drafts should at least include subsection structure, lists of planned tables, figures, rough text, and identification of any impediments to make the Oct. deadline for drafts ready for review (so that we can replan if need be).
6. Sections that can be written without having the data ready for an internal project review and the fourth telecon (Nov 2020).
7. Reviews available and the fifth telecon (Feb 2021)
8. Implementation of the reviewers' comments (from Feb 2021 until first light)
9. Final drafts, including sections that depend on LSST data, available for review and the sixth telecon (Aug 2022)
10. Implementation of the reviewers' comments (from Aug 2021 until the start of operations, planned for Oct 3, 2022). Proceeding with submissions, details TBD...

3. SOME TECHNICALITIES: AUTHOR LIST AND STANDARD LSST REFERENCES

Thank you Tim Jenness and Wil O'Mullane for helping with templates!

3.1. *The LSST LaTeX Classes*

Please see the installation instructions[1] for lsst-texmf. Once you have it installed, you should be able to compile your paper using make.

3.2. *How to handle author list?*

Authors come from the authors.yaml file – find the author ids in the lsst-texmf/etc/authordb.yaml - use db2authors to get the authors and institutes from the db.

XXX Wil, the above is unclear: need more detail about how to use db2authors, what is its output and what to do with it...

3.3. *How to handle LSST standard references?*

The papers should cite standard LSST references[2], where appropriate. For the usage, please see below. These examples all use the ADS handle, unless they are project docs then the use the project handle like LSE-17.

All are on the lsst-texmf which you can get from http://lsst-texmf.lsst.io

3.3.1. *LSST System and Science*

The LSST system (brief overview of telescope, camera and data management subsystems), science drivers and science forecasts are described in:

- LSST Science Requirements Document: Ivezić & The LSST Science Collaboration (2018).
- LSST overview paper: Ivezic et al. (2008).
- LSST Science Book: Abell et al. (2009).

3.3.2. *Simulations*

The LSST simulations are described in a series of papers. Use of the LSST simulations should cite the LSST simulations overview paper Connolly et al. (2014) and the specific simulation tools used:

- LSST Catalogs (CatSim): Connolly et al. (2014)
- Feature-Based Scheduler: Naghib et al. (2018)
- Operations Simulator (OpSim): Scheduler Delgado & Reuter (2016), SOCS Reuter et al. (2016)

[1] https://lsst-texmf.lsst.io/install.html
[2] See https://github.com/lsst-pst/LSSTreferences

- Metrics Analysis Framework (MAF): Jones et al. (2014)
- Image simulations (Phosim): Peterson et al. (2015)
- Sky brightness model: Yoachim et al. (2016)
- LSST Performance for NEO (or moving object) discovery: Jones et al. (2018)

3.3.3. *Data Management*

LSST data management system and the data products are described in:

- The LSST Data Management System: Jurić et al. (2015)
- Data Products Definition Document: Jurić et al. (2017)

3.3.4. *Camera*

- Design and development of the LSST camera: Kahn et al. (2010)

3.3.5. *Telescope and Site*

- Telescope and site overview and status in 2014: Gressler et al. (2014)

3.3.6. *System Engineering*

- LSST systems engineering: Claver et al. (2014)
- System verification and validation: Selvy et al. (2014)

APPENDIX

Initial paper list added here for reference.

"Editor" is a responsible team leader but not necessarily the person who will do most of the required work, or who will eventually become the first author. Both issues will be handled by individual teams.

```
domain: Telescope & Site
editor: Jeff Barr
title: Overview of the LSST Telescope

domain: Telescope & Site
editor: Sandrine Thomas
title: Performance of the LSST Telescope

domain: Telescope & Site
editor: Lynne Jones
title: The LSST Scheduler Overview and Performance

domain: Telescope & Site
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editor: Bo Xin
title: Performance of the LSST Active Optics System

domain: Telescope & Site
editor: Tiago Ribeiro
title: LSST Observing System Software Architecture

domain: Camera
editor: Justin Wolfe
title: LSST Camera Optics

domain: Camera
editor: Chris Stubbs
title: LSST Camera Rafts

domain: Camera
editor: Steve Ritz
title: LSST Camera Cryostat

domain: Camera
editor: Ralph Schindler
title: LSST Camera Refrigeration

domain: Camera
editor: Steve Ritz
title: LSST Camera Body and Mechanisms

domain: Camera
editor: Mark Huffer and Tony Johnson
title: LSST Camera Control System and DAQ

domain: Camera
editor: Tim Bond and Aaron Rodman
title: LSST Camera Integration and Tests

domain: Data Management
editor: Leanne Guy
title: Overview of LSST Data Management

domain: Data Management
editor: Michelle Butler

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title: LSST Data Facility

domain: Data Management
editor: Tim Jenness
title: LSST Data Management Software System

domain: Data Management
editor: Jim Bosch
title: LSST Data Release Processing

domain: Data Management
editor: Eric Bellm
title: LSST Prompt Data Products

domain: Data Management
editor: Gregory Dubois-Felsmann
title: LSST Science Platform

domain: Data Management
editor: Simon Krughoff
title: LSST Data Management Quality Assurance and Reliability Engineering

domain: Data Management
editor: Leanne Guy (with likely delegation to new DM V&V Scientist)
title: LSST Data Management System Verification and Validation

domain: Data Management
editor: Mario Juric
title: LSST Moving Object Processing

domain: Data Management
editor: Robert Lupton
title: LSST Calibration Strategy and Pipelines

domain: Calibration
editor: Patrick Ingraham
title:  Performance of the LSST Calibration Systems

domain: Calibration
editor: Patrick Ingraham
title: Atmospheric Properties with the LSST Auxiliary Telescope
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domain: EPO
editor: Amanda Bauer
title: Overview of LSST Education and Public Outreach

domain: EPO
editor: Ardis Herrold
title: LSST Formal Education Program

domain: EPO
editor: Amanda Bauer
title: LSST EPO: The User Feedback

domain: Commissioning
editor: Chuck Claver
title: LSST Observatory System Operations Readiness Report

domain: Commissioning
editor: Bo Xin
title: Performance of Delivered LSST System

domain: Commissioning
editor: Chuck Claver
title: Active Optics Performance with LSST Commissiong Camera

domain: Commissioning
editor: Chuck Claver
title: LSST Active Optics Performance with the LSST Science Camera

domain: Commissioning
editor: Brian Stalder
title: Integration, Test and Commissioning Results from LSST Commissiong Camera

domain: Commissioning
editor: Kevin Reil
title: LSST Camera Instrumental Signature Characterization, Calibration and Removal

domain: Commissioning
editor: Patrick Hascal
title: Installation and Performance of the LSST Camera Refrigeration System

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domain: Commissioning
editor: Andy Connolly
title: Science Validation of LSST Alert Processing

domain: Commissioning
editor: Keith Bechtol
title: Science Validation of LSST Data Release Processing

domain: Commissioning
editor: Michael Reuter
title: Tracking of LSST System Performance with Continuous Integration Methods

domain: Commissioning
editor: Chuck Claver
title: The LSST Science Platform as a Commissioning Tool

domain: Commissioning
editor: Chuck Claver
title: Commissioning Science Data Quality Analysis Tools, Methods and Procedures

domain: Commissioning
editor: Lynne Jones
title: Performance Verification of the LSST Survey Scheduler
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A. REFERENCES

REFERENCES

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Jurić, M., et al. 2017, LSST Data Products Definition Document

Kahn, S. M., Kurita, N., Gilmore, K., et al. 2010, in Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series, Vol. 7735, Ground-based and Airborne Instrumentation for Astronomy III, ed. I. S. McLean, S. K. Ramsay, & H. Takami, 0

Naghib, E., Yoachim, P., Vanderbei, R. J., Connolly, A. J., & Jones, R. L. 2018, arXiv e-prints, arXiv:1810.04815

Peterson, J. R., Jernigan, J. G., Kahn, S. M., et al. 2015, ApJS, 218, 14

Reuter, M. A., Cook, K. H., Delgado, F., Petry, C. E., & Ridgway, S. T. 2016, in Proc. SPIE, Vol. 9911, Modeling, Systems Engineering, and Project Management for Astronomy VI, 991125

Selvy, B. M., Claver, C., & Angeli, G. 2014, in Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series, Vol. 9150, Modeling, Systems Engineering, and Project Management for Astronomy VI, ed. G. Z. Angeli & P. Dierickx, 0

Yoachim, P., Coughlin, M., Angeli, G. Z., et al. 2016, in Proc. SPIE, Vol. 9910, Observatory Operations: Strategies, Processes, and Systems VI, 99101A

B. ACRONYMS

Acronym	Description
Alert	A packet of information for each source detected with signal-to-noise ratio ¿ 5 in a difference image during Prompt Processing, containing measurement and characterization parameters based on the past 12 months of LSST observations plus small cutouts of the single-visit, template, and difference images, distributed via the internet
Butler	A middleware component for persisting and retrieving image datasets (raw or processed), calibration reference data, and catalogs
Camera	The LSST subsystem responsible for the 3.2-gigapixel LSST camera, which will take more than 800 panoramic images of the sky every night. SLAC leads a consortium of Department of Energy laboratories to design and build the camera sensors, optics, electronics, cryostat, filters and filter exchange mechanism, and camera control system
Commissioning	A two-year phase at the end of the Construction project during which a technical team a) integrates the various technical components of the three subsystems; b) shows their compliance with ICDs and system-level requirements as detailed in the LSST Observatory System Specifications document (OSS, LSE-30); and c) performs science verification to show compliance with the survey performance specifications as detailed in the LSST Science Requirements Document (SRD, LPM-17)
Construction	The period during which LSST observatory facilities, components, hardware, and software are built, tested, integrated, and commissioned. Construction follows design and development and precedes operations. The LSST construction phase is funded through the NSF MREFC account
DAQ	Data Acquisition System
DM	Data Management
Data Management	The LSST Subsystem responsible for the Data Management System (DMS), which will capture, store, catalog, and serve the LSST dataset to the scientific community and public. The DM team is responsible for the DMS architecture, applications, middleware, infrastructure, algorithms, and Observatory Network Design. DM is a distributed team working at LSST and partner institutions, with the DM Subsystem Manager located at LSST headquarters in Tucson
Data Management System	The computing infrastructure, middleware, and applications that process, store, and enable information extraction from the LSST dataset; the DMS will process peta-scale data volume, convert raw images into a faithful representation of the universe, and archive the results in a useful form. The infrastructure layer consists of the computing, storage, networking hardware, and system software. The middleware layer handles distributed processing, data access, user interface, and system operations services. The applications layer includes the data pipelines and the science data archives' products and services
Data Release Processing	Deprecated term; see Data Release Production
Document	Any object (in any application supported by DocuShare or design archives such as PDMWorks or GIT) that supports project management or records milestones and deliverables of the LSST Project
EPO	Education and Public Outreach

Education and Public Outreach	The LSST subsystem responsible for the cyberinfrastructure, user interfaces, and outreach programs necessary to connect educators, planetaria, citizen scientists, amateur astronomers, and the general public to the transformative LSST dataset
LPM	LSST Project Management (Document Handle)
LSE	LSST Systems Engineering (Document Handle)
LSST	Large Synoptic Survey Telescope
LaTeX	(Leslie) Lamport TeX (document markup language and document preparation system)
NEO	Near-Earth Object
Object	In LSST nomenclature this refers to an astronomical object, such as a star, galaxy, or other physical entity. E.g., comets, asteroids are also Objects but typically called a Moving Object or a Solar System Object (SSObject). One of the DRP data products is a table of Objects detected by LSST which can be static, or change brightness or position with time
OpSim	Operations Simulation
Operations	The 10-year period following construction and commissioning during which the LSST Observatory conducts its survey
Quality Assurance	All activities, deliverables, services, documents, procedures or artifacts which are designed to ensure the quality of DM deliverables. This may include QC systems, in so far as they are covered in the charge described in LDM-622. Note that contrasts with the LDM-522 definition of QA as Quality Analysis, a manual process which occurs only during commissioning and operations. See also: Quality Control
Science Platform	A set of integrated web applications and services deployed at the LSST Data Access Centers (DACs) through which the scientific community will access, visualize, and perform next-to-the-data analysis of the LSST data products
Subsystem	Aset of elements comprising a system within the larger LSST system that is responsible for a key technical deliverable of the project
TBD	To Be Defined (Determined)
Telescope and Site	The LSST subsystem responsible for design and construction of the telescope structure, telescope mirrors, optical wavefront measurement and control system, telescope and observatory control systems software, and the summit and base facilities. The Telescope technical team is hosted by NOAO
Validation	A process of confirming that the delivered system will provide its desired functionality; overall, a validation process includes the evaluation, integration, and test activities carried out at the system level to ensure that the final developed system satisfies the intent and performance of that system in operations
Verification	The process of evaluating the design, including hardware and software - to ensure the requirements have been met; verification (of requirements) is performed by test, analysis, inspection, and/or demonstration
camera	An imaging device mounted at a telescope focal plane, composed of optics, a shutter, a set of filters, and one or more sensors arranged in a focal plane array