***LSST Science Advisory Committee***

***Face-to-Face meeting, Monday, August 12, 2019***

***(as part of LSST2019, the Project and Community Workshop)***

SAC members attending, in person or remotely:

Michael Strauss, Niel Brandt, Lucianne Walkowicz, Charles Liu,

Mansi Kasliwal, David Kirkby, Risa Wechsler, Marcio Catelan, Franz

Bauer, Stephen Smartt, Meg Schwamb, Amy Mainzer, Josh Simon, Rachel

Bean.

A significant number of Project personnel and other LSST2019 attendees

also were present and took part in the discussions.

Our agenda covered three broad topics:

* The makeup, role, and responsibilities of the Science Advisory Committee in Operations.
* The status of the Operations Simulator experiments that the SAC

has recommended.

* The plans for community event brokers, and how they would be selected.

***RECOMMENDATIONS AND ACTIONS***

Here we summarize the high-level recommendations (to the LSST Project) and actions (for the SAC itself) that came out of this meeting. We follow this with full minutes from the meeting, which give a more complete context for these recommendations.

*ACTION:* Strauss will work with Bob Blum and other members of the LSST leadership to develop a new committee, with representation from the Science Collaborations, to assess proposals from international partners for in-kind contributions. They will also develop new guidelines for the Science Collaborations and its relationship with the Project, and a mechanism for naming new members of the SAC.

*RECOMMENDATION:* The Operations Simulator Team has done an excellent job of implementing the recommendations the SAC has given based on community white papers on LSST Survey Strategy. More detailed documentation is needed of the specific algorithms and parameter decisions contained in the simulations carried out. The OpSim team should also continue to engage the white paper authors as they implement the various experiments suggested in those white papers.

*RECOMMENDATION:* The Science Collaboration Coordinator (Federica Bianco) should work with the OpSim team to refine the existing metrics and to generate new ones, to reflect the scientific goals of the survey strategy white papers.

*ACTION:* The SAC will set up the Survey Cadence Optimization Committee (SCOC), in consultation with Blum.

*RECOMMENDATION:* Develop a detailed call for Community Event Broker proposals, with clear requirements and deadlines.

*ACTION:* Establish a subcommittee of the SAC to review proposals for Community Event Brokers.

*RECOMMENDATION:* The Project should confirm that there are adequate personnel to manage the interactions with the community event brokers, especially during commissioning.

*RECOMMENDATION:* The Project should quantify the resources required to host all the proposed event brokers, and (based on the recommendations of the SAC), determine ways to support them all.

*RECOMMENDATION:* The Project should work through event broker use-cases to define requirements on alert packets so that they can be made public, following the (draft) LSST data policy.

*ACTION:* The SAC will set up regular (~monthly) phone conferences to discuss the above issues and more.

***FULL MINUTES***

\*\*\*\*\***The Future of the SAC**

This discussion, led by Steve Kahn (Project Director) and Bob Blum (Operations Director), was raised in the context of understanding the relationship between the Project and the Science Collaborations going forward. The Science Collaborations were formed, roughly in 2006, to be largely autonomous from the Project: the Project gave them broad guidelines and encouraged Project members to join them, but their governance rules, internal structure, and goals were largely self-defined. The Project, and especially the LSST Corporation, have given the Science Collaborations logistical support (and in the case of the Corporation, significant amounts of funding for meetings and other activities), and the Department of Energy has supported the activities of the Dark Energy Science Collaboration. Beyond this, however, the Science Collaborations have no formal role in either the Project or in the eyes of the funding agencies.

One role that the Science Collaborations are likely to be asked to play going forward is to give advice on proposals from international partners describing their in-kind contributions. The new LSST operations model states that data rights for institutions and countries outside the US and Chile will be given in exchange for in-kind contributions to Operations, or the US scientific enterprise. The Science Collaborations are in the best position to judge the usefulness of any proposed contribution to the scientific infrastructure of the LSST community, especially in the context of the roadmaps that many of the Science Collaborations have developed, but also more generally for the US and Chilean community overall.

In this context, we explored the idea that the Science Advisory

Committee define a separate committee, chaired by the Science Collaboration Coordinator (currently Federica Bianco) and made up of representatives of, and named by, the existing Science Collaborations, which would be charged with reviewing proposals for scientifically oriented in-kind contributions. As the NSF and DOE explicitly recognize the SAC as a part of the Project and Operations, this committee named by the SAC of Science Collaboration members would have a formal mandate and recognition from the funding agencies.

In this model, the role of the SAC would be to recommend policy and

guidelines for this committee, but not give recommendations on

specific in-kind contribution proposals beyond those delivered by

the committee.

The question was raised whether the SAC itself should be comprised

of representatives of the Science Collaborations. If that were the

case, the SAC could review the in-kind contributions itself, without

the need to appoint a separate committee. After much discussion, we agreed that much of the SAC's purview requires them to take a perspective broader than, and independent of, a single science collaboration. Most SAC members are in fact members of one or more science collaborations (and they have been chosen to cover most of the science areas that LSST will impact), but their mandate is not explicitly tied to the science collaboration they happen to be a member of. It is valuable, indeed crucial, that the SAC members see themselves as representing more than the needs of a science collaboration. This was invaluable, for example, in our review of the cadence white papers.

Historically, The Science Advisory Committee has reported to the Project Director (Steve Kahn) and Deputy Director (Željko Ivezić); its mandate has broadened to report as well to the Operations Director (Bob Blum)

and the Deputy Operations Director (Phil Marshall). Blum and

Marshall stressed that there will be a significant and on-going role

for the SAC through operations, and will work with the existing SAC

to further define that role. The aim is to finish this definition,

including a well-define process for receiving and vetting proposals

for in-kind contributions, by summer 2020.

The membership of the SAC thus far has been decided largely by

informal conversations between the SAC chair (Michael Strauss) and

the Project Director and Deputy Director (Kahn and Ivezić). We

agreed that we need a more open process, perhaps with community

input. Here are some relevant points and suggestions:

* Blum and Marshall as Operations Directors definitely need to be

part of this process!

* The Science Collaboration Coordinator should be made an ex officio member of the SAC.
* While the current members of the SAC cover many of the major

LSST science themes, there are significant area of expertise that we

are missing, and which we should actively work to fill.

*ACTION:* Strauss, Bianco, Kahn, Ivezic, Blum, and Marshall were charged with putting together a plan for the SAC membership and the makeup of the science collaboration subcommittee. They will also explore broader

questions of the role of and rules governing the science

collaborations themselves, including mechanisms for creating new

science collaborations. (Editor's note: the above individuals met

later in the week, and have started drafting a plan. When it is more

mature, it will be distributed to the SAC and the science

collaboration chairs for comment). Once this plan is in place, we

should write a document describing the relationship of the SAC, the

Science Collaborations, the Project team, the Operations Team, and the

LSST Corporation. There are other entities that have been suggested

during operations, such as a Survey Strategy team and a User's

Committee; we also need to articulate how these are related.

\*\*\*\*\*\*\* **Status of the Operations Simulator runs**

The LSST Project has a plan for Survey Operations, describing how

the sky will be covered as a function of time and filter. However,

it has long been recognized that this plan is not yet scientifically

optimized, and that community input should be sought to refine the

cadence plans. Thus last Fall, the community was asked to submit

white papers with specific suggestions for LSST cadence; 46 were

received. The SAC reviewed them and prepared a detailed set of

recommendations for experiments to be done with the Operations

Simulator, exploring the many excellent ideas included in these

white papers. At the SAC meeting, Lynne Jones and Peter Yoachim

gave us an update of how those experiments are proceeding, and the

lessons learned to date. Their presentation may be found [here](https://project.lsst.org/groups/sac/sites/lsst.org.groups.sac/files/SurveyStrategy_SAC_PCW2019.pdf).

The SAC was very pleased to see the tremendous progress made. The

OpSim code is now far more flexible than it once was, allowing a

broad range of experiments to be tried. The first set of simulation

runs has been released to [community.lsst.org](https://community.lsst.org/t/july-2019-update/3760/5), with more on

the way. The OpSim team is in active discussion with the science

collaborations about further refinements. In addition to the explicit

recommendations from the SAC, there are OpSim experiments exploring

varying the exposure time in response to changing observing

conditions, and the effect of camera rotational dithers. They also

explored a number of variations on rolling cadence, and of ToO

observations for up to 100 LIGO sources per year.

It is a small matter, but the current experiments that extend the

WFD footprint to DEC=+2 include a low-latitude component that

extends quite a bit further North. That extension was a consequence

of the way in which the low-latitude component was defined over a

decade ago, but has no specific scientific driver. The SAC

recommends this extension be dropped in those experiments in which

the footprint of the main survey does not extend further North.

*RECOMMENDATION:* It will be important to document in some detail the specific assumptions and algorithms going into each OpSim run. The cadence white papers and the SAC report on them don't always specify every relevant aspect of the simulations to be carried out, so the OpSim

team made specific decisions for these runs. To interpret the

outputs of these runs will require understanding the decisions

and parameters used in each case.

As a corollary to this: the OpSim team should continue to reach out to the authors of the White Papers and to the science collaborations to clarify questions about the cadence algorithms and rules to be implemented, and to confirm that the specific decisions made are in accord with their wishes.

Some areas that need continued work:

-Implementing specific cadence requests for the Deep Drilling

Fields.

-Implementing, and having metrics for, specific filter choices for

repeat observations on night-to-night observations.

-The tradeoff between intranight repeat observations in the same

filter or different filters. The former is preferred by many

solar system programs, while the latter gives useful color

information for transients. At the moment, experiments have been

done in which all 10 years are done with the same choice of

whether or not to switch filters in a second observation of a

given field. But we should also experiment with a mixture of the

two models.

-Experimenting with different realizations of the weather model,

to quantify the effect, e.g., of poor weather in the first year of

operations. We also discussed correlations between seeing and

weather, which at the moment are assumed to be independent.

-The SAC would like to understand the rolling cadence experiments

better. In particular, the science case for covering the whole

LSST footprint one or more times per year is strong, and further

thought is needed to explore the transition between full-sky and

rolling cadence observing mode.

-The needed depth for the u band in WFD. Because the LSST filter

exchanger can hold only 5 of the 6 filters at any given time, the

u-band is likely to be installed only for the nights around New

Moon. With the u-band depth that the Deep Drilling Fields are

requesting, we're not always reaching the required u-band depth in

WFD. This led to a discussion of whether the u-band depth

requirements in the Science Requirements Documents were correct.

In WFD, they are largely driven by photo-z requirements, and are

indeed thought to be correct.

The OpSim team has been working closely with the Science

Collaborations in developing metrics to capture the various science

drivers; there is a lot of further work needed. For example:

-There is a metric for the number of galaxies available for

large-scale structure measurements. There also needs to be a

metric for galaxies with good weak-lensing shape measurements.

-The metrics don't yet fully quantify the effect of rolling cadence.

The current runs do explore a range of rolling cadence models, but

more work is needed to understand the effect on various science

cases, such as the measurement of supernova light curves.

-The metrics in hand to quantify the ability to characterize fast

transients are somewhat ad-hoc, and need real input from the

science collaborations.

Additional concerns and the planned work are outlined in the last few

slides of the OpSim presentation.

*RECOMMENDATION:* Further work on metrics is very much needed. Jones and

Bianco will discuss this further.

*ACTION:* The SAC has the responsibility of setting up the Survey

Cadence Optimization Committee (SCOC). Strauss and Blum will work to

define this process. Part of this will be understanding the

iterations that will inevitably be needed between the SCOC and the

OpSim team: the SCOC will make preliminary recommendations based on

the OpSim runs in hand, and then likely will recommend further tests

(presumably refinements of existing runs) as they tweak the

recommendations.

Again, the SAC was very impressed with the OpSim team's progress, and

sees a clear path forward to getting the full set of simulations and

metrics we need to make decisions on LSST cadence.

\*\*\*\*\*\*\*\*\*\*\*\*\***Event Brokers**

Leanne Guy and Eric Bellm led the discussion; their slides may be found [here](https://project.lsst.org/groups/sac/sites/lsst.org.groups.sac/files/Bellm_SAC_Brokers_190812.pdf).

The LSST alert stream will be distributed to the community through a

series of community alert brokers, which will do some level of

characterization, filtering, and classification. The policies

describing this process may be found [here](https://ldm-612.lsst.io/).

Letters of Intent were solicited from groups interested in developing

such community brokers; 15 letters were received (as well as 3

"letters of non-intent", which expressed support and input on the

process, but didn't indicate that the authors wished to develop their

own brokers). The Project held a Community Broker Workshop in Seattle

on June 19-21, which included representatives from all but two of the

Letters of Intent, as well as significant science collaboration

involvement. Guy is leading a paper that will summarize the

deliberations.

The Letters of Intent described a range of different science

drivers, with some proposed brokers being more focused than

others. Many of them focus on machine-learning techniques, and

several of them have prototypes already working on precursor surveys

such as the Zwicky Transient Facility. While some want to access

the full alert stream, others are expressly looking to work downstream of full-stream brokers. There is a lot of interest in cross-matching

with external datasets, and in integration with follow-up

facilities.

This workshop led to an understanding of the complementarity between

brokers, and what the requirements on the brokers, and the LSST

service producing the stream, should be. There is strong desire to

make the APIs of the different brokers compatible, to allow people

to compare results (e.g., classifications) across multiple brokers.

A key question raised at the workshop was the timescale on which

astronomers needed the alerts for their science. While some

astronomers (e.g., interested in very fast transients) needed very

quick turnaround, others were happy with hours or day-long lags.

Given the range of different types of science brokers suggested, the

range of science problems addressed, and the fact that the project

is planning to support at least 5 brokers (see below), the SAC

recommended that there be no down-select based on the 15 LOI's; all

teams are welcome to submit full proposals. This leads to the

action items and recommendations:

*RECOMMENDATION:* Develop a detailed call for Community Event Broker

proposals, with clear requirements and deadlines. This call, to be drafted by the LSST Project in coordination with the SAC, will

go out late 2019, with full proposals due roughly the second

quarter of 2020. It is a policy question whether proposals will be

welcomed from teams that did not contribute a letter of intent. It

is also a policy question whether community brokers from international contributors could be considered an in-kind contribution.

*ACTION:* Establish a subcommittee of the SAC to review these

proposals. This selection would be completed in the third quarter

of 2020.

*RECOMMENDATION:* The job of dealing with all these brokers, making sure all the necessary interfaces between the alert stream and the brokers are in place, etc., is likely to be substantial, especially during commissioning. At the moment, much of the burden will fall on Bellm and his colleagues. The Project should determine whether extra personnel will be needed to handle this demand.

The formal operations requirement states that the Project should support at least 5 full-stream alert brokers, limited by available bandwidth. However, based on the LOIs, the science case for more than 5 may be very strong. Some of the 15 LOI’s are for specialized brokers that could work downstream of the full-stream brokers, and thus would not stress the bandwidth limits of the NCSA. Until we see the full proposals, the SAC can't confirm this, but it will be useful to start a discussion on what the financial and logistical impact on the Project would be if the number of brokers were larger. The slides from Guy and Bellm outline some possible ways to handle this, including simply funding more bandwidth from NCSA, or relaxing the latency. Guy and Bellm estimated that servicing all 15 LOI teams could increase the full 10-year operations cost by ~$2M, but this needs to be quantified further based on the proposals we actually receive. Significant saving could be had, e.g., by using cloud hosting of the Prompts Products Database (PPDB), which may lead to a way to distribute the costs of this to the users. All this needs to be explored.

*RECOMMENDATION:* The Project should quantify the resources required to host all the proposed event brokers, and (based on the recommendations of the SAC), determine ways to support them all.

The alerts are designed to be world-public. There is a draft

document being prepared by Bob Blum setting policy for exactly which

data will be public and which are limited to data-rights holders.

In our discussion, we started to outline use-cases for the brokers

that would probe that boundary between public and proprietary data;

an example is whether forced photometry could be included in an

alert packet. A related question is whether the PPDB, which will contain the information on the alerts, would be public.

*RECOMMENDATION:* The Project should work through event broker use-cases to define requirements on alert packets so that they can be made public, following the (draft) LSST data policy.

The Broker selection will be done before LSST scientific first

light. Thus the Brokers will take part in the commissioning

process; we should not expect routine real-time access to LSST

alerts during commissioning.

\*\*\*\***Additional concerns**:

Communication remains a challenge within the LSST world. A specific

example: much of the discussion of the progress on the OpSim runs

they have carried out have happened on community.lsst.org.

However, most SAC members were unaware of this. The LSST Community

Digest should be used more to highlight these discussions,

especially when major announcements such as the release of a large

set of OpSim runs come out.

More generally, it would be useful to have a set of guidelines

(easy to find on the LSST website) about how to get started with

community and slack, and what sort of discussions happen where.

On another communications topic, the SAC would like an update on the

status of the long-promised reorganization of the LSST website.

The SAC has a lot on its plate:

-Preparing the call for proposals for the Event Brokers, and

putting together a committee for that.

-Selecting the SCOC and preparing guidelines for it.

-Defining the subcommittee to review the in-kind contributions.

-Discussing communications issues.

*ACTION:* The SAC will set up monthly telecons to meet more

regularly on the phone, to address the many actions and recommendations above.