

Beyond 2021: A Strategic Vision for the Gemini Observatory

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“The bravest are surely those who have the clearest vision of what is before them, glory and danger alike, and yet notwithstanding, go out to meet it.” – Thucydides

Introduction

This document presents a Strategic Vision for the Gemini Observatory, focusing on its role beyond 2021. At this time the infrared-optimized James Webb Space Telescope (JWST) will have been gathering data for over two years, the Large Synoptic Survey Telescope (LSST) will be near the end of its science commissioning phase and will soon be embarking on its ten-year all-sky survey. Construction of the Giant Magellan Telescope (GMT), the Thirty Meter Telescope (TMT), and the European Extremely Large Telescope (E-ELT) will be well underway, hearkening in a transition from the present ‘8m era’ into one where the dominant ground-based telescopes will be 30m-class facilities. In this document we identify the purpose, direction, and fundamental principles that will guide the Gemini Observatory in this new landscape.

In developing a Strategic Vision for Gemini, the Board of Directors examined Gemini from a high level. Full consideration was given to scenarios that violated the ‘Two Telescopes, One Observatory’ structure that lies at the heart of the present Observatory. Models were also considered in which Gemini South and Gemini North evolved independently in their respective systems, following different science missions, potentially diverging and even merging with other observatories. Another basic principle that was re-examined was the requirement for international partners to maintain identical shares in both telescopes. In short, the Strategic Vision outlined here is the product of examining the future of the Gemini Observatory exhaustively, leaving all possibilities ‘on the table’.

Development of the Vision

The Strategic Vision was developed through a process that combined intense deliberation by a subcommittee of the Gemini Board together with open and transparent consultation from all stakeholders. The subcommittee considered lessons from the historical transition of the '4m-class era' to the '8m-class era' in the 1990s, focusing on common themes amongst 4m-class facilities that prospered during the transition, and noting how many succeeded by adopting areas of specialization that retained very high scientific impact in the 8m-class era. The subcommittee obtained input from stakeholders via the Gemini STAC (who met independently and provided a report at the May 2016 Board meeting), from the Users Committee, and directly from the community through an online community survey.

The community survey was focused on assessing the community's viewpoint regarding the following principles (defined by the Board (1,2) and the Gemini STAC (3-6)) and scenarios (defined by the Gemini Board) for Gemini post-2021:

Board and STAC Principles

1. The two telescopes should be allowed to evolve independently.
2. Individual telescopes should be allowed partial or full specialization.
3. The Observatory should retain around 50% PI-driven science.
4. Up to 50% of the time on Gemini should be reserved for Large Programs.
5. The Observatory should emphasize the provision of new instrumentation and visitor instruments.
6. The Observatory should build on two current strengths: adaptive optics and dynamic time allocation via a queue.

Board Scenarios

1. Rapid follow-up of other facilities
2. LSST follow-up (GS)
3. Sloan Telescope of the 21st century (GS)
4. Merge with other facilities into a single large observatory
5. Merge GN and GS into different structures
6. Dedicate the telescopes to visitor instruments and experiments
7. Dedicate the telescopes to education
8. Specialization for a single long-term study
9. TMT support (GN)
10. GMT support (GS)
11. Space mission support
12. Maintain as is
13. Roboticize for 100% queue

Users were asked to indicate the extent to which they agreed with the principles (on a scale ranging from strong disagreement to strong agreement) and the fraction of time they felt the Observatory should devote to the specified scenarios (in order to allow ‘blends’ of scenarios, dividing time over multiple projects and both hemispheres). The survey was completed in August 2016. The survey results were the focus of additional discussions by the subcommittee over the fall of 2016. The overall Strategic Vision outlined here was proposed and discussed by the full Gemini Board at its November 2016 meeting in La Serena, Chile.

Elements of the Strategic Vision

The community survey provides strong evidence for an overall cohesion in the Gemini community. The committee carefully analyzed the correlations and trends in the survey responses to identify common themes as well as scenarios deemed unattractive or impractical. The following elements of a post-2021 strategic vision reflect a synthesis of the input provided by the various stakeholders:

1. ***Independent evolution of the telescopes.*** The ‘two telescopes, one observatory’ model may remain desirable post-2021, but it should not be an axiomatic or guiding principle of Gemini. There is a strong sense amongst stakeholders that the additional degrees of freedom that would develop from allowing the telescopes to take on independent identities could enhance the overall science impact of the Observatory, and such models should be actively explored.
2. ***Specialization of one or both telescopes.*** It is widely accepted by most stakeholders that as 30m-class telescopes come on-line, 8m-class facilities may be able to enhance their relevance by appropriate specialization.
3. ***Preservation of Principal Investigator science.*** Notwithstanding the previous point, for a large fraction of the community Gemini is likely to remain their main visible/near-IR facility. Specialization must recognize this basic fact and provide balanced access to PI-mode instrumentation for a significant fraction of the available observing time.
4. ***Synergy with other facilities.*** There is broad support in the community for enhancing scientific impact in post-2021 Gemini by operating in a mode that is closely synergistic with other observatories.

The degree of emphasis placed on the elements above differs from Partner to Partner, but the fact that these central elements are held in common by all Partners was of paramount importance in developing the coherent vision for the Observatory that we turn to next.

Synthesis and Recommendations

- *Beyond 2021, Gemini should exploit its geographical location and agile operational model in order to be the premiere facility for the follow-up investigation of targets identified by the Large Synoptic Survey Telescope.*

This recommendation attempts to harness the broad support in the Gemini community (including within those partners not specifically engaged in building or operating the LSST) for Gemini to transform itself into an observatory that is highly optimized for the exploitation of interesting targets identified with the LSST, with a particular focus on providing instruments and operational modes suitable for the rapid characterization of transients.¹ The Strategic Vision subcommittee recommends the Observatory plan on a major fraction of the activity of Gemini South be devoted to LSST follow-up. Synergies with other facilities (e.g. JWST) should also be exploited where they can be identified, and where the particular aspects of Gemini, e.g. its rapid-reaction capability, can be exploited to good effect.

- *Beyond 2021, a significant fraction of the time on the telescopes should remain focused on Principal Investigator-driven science.*
- *Beyond 2021, Gemini should be viewed as the premiere hosting facility for visitor instruments whose scope and ambition may be comparable to that of the ‘facility-class’ instruments.*

These two recommendations are closely coupled.

It is evident that progress in the deployment of 30m-class telescopes is going more slowly than envisioned a few years ago. For the Gemini Partner countries (with the possible exception of Chile), 8m-class telescopes will be the front-line facilities well into the 2nd half of the next decade. Moreover, the opportunity for open access to the 30-m class facilities, once they become operational, remains uncertain for a large fraction of users within the Gemini communities. This has two implications.

Firstly, it provides strong rationale for focusing more effort on developing synergies with LSST (whose schedule is proceeding on-target) rather than on developing synergies with 30m-class

¹ The committee recognizes the very strong scientific rationale for a southern hemisphere wide-field multi-object spectrometer as a component of a strategy for following up on LSST, but the need to preserve a robust principal investigator mode on the telescope (evident from the user survey) suggests that Gemini’s focus should remain on instruments that do not require very radical changes to the telescope’s front end in order to enable a very wide-field capability.

telescopes (at least initially). Secondly, and in spite of the desire to specialize Gemini, it means that there remains a clear need for the telescopes to provide for a broad range of general capability instruments to enable PI-mode science for the foreseeable future. The challenge will be to find the funding for such instruments in a climate that is focused on development of next-generation telescopes. The way forward is to fully embrace the capabilities of institutions within the Partner countries to supply instruments to Gemini, and more importantly their strong *desire* to provide such instruments, using their internal resources, for the benefit of the whole Partnership.

- *Beyond 2021, the future direction of the two Gemini telescopes should be allowed to diverge.*

The continuation of Gemini's totally independent identity is less important than the continuation of its scientific relevance beyond 2021. To enable better science to be undertaken, it may make sense for Gemini to seek partnership with other facilities or entities. Any such changes should be undertaken in a way that respects partner interests and the character of the International Agreement.

Coda

If the Strategic Vision outlined in this document is fully implemented, Gemini in the mid-2020s may be a very different observatory than the Gemini of 2017. But it should be noted that the recommendations in this document, arrived at by starting from a clean slate, and based on wide consultation with the community, are well-aligned with the current overall direction the Observatory. This should be taken as a strong endorsement of the Observatory's leadership, and of the progress along the path we are already walking, and, most of all, of our common vision for the desired destination.

"We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time." — T. S. Eliot

Appendix A. Gemini Strategic Vision Survey

The Strategic Vision Process

The Gemini Observatory starts focusing on the future, specifically on what Gemini will look like beyond the year 2020. The Gemini Board of Directors has set up a Strategic Vision Committee, whose [Charge](#) can be found on Gemini's website. In essence, the Strategic Vision identifies the Observatory's purpose, direction, and fundamental principles. It directly addresses the role the Observatory will play beyond 2021 and considers a variety of funding and partnership scenarios. By the end of this year, the Strategic Vision will be in place. Along the way, we are seeking input, through this survey, from the user community on how they see the way forward and what opportunities we should pursue. If you wish to provide input beyond this survey, please do not hesitate to send white papers to the Gemini Director (mkissler@gemini.edu).

Once the Gemini Board approves the Strategic Vision, the Observatory will develop a Strategic Plan. This detailed roadmap for reaching a preferred future will be aligned with, and derived from, the Strategic Vision; it must encourage new opportunities, consider budget shifts, and examine the changing landscape of astronomical facilities. Once the Board approves the Plan, the Observatory will own it.

The Observatory will have until mid-2018 to prepare this Strategic Plan. The timeline conforms to the Assessment Point (within calendar year 2018) executed by the Gemini Board, in accordance to the International Agreement governing the Gemini Observatory. At the Assessment Point, our international partners will confer about the future of the Observatory and state their intentions to remain in the Partnership.

The present survey is structured in two parts. Part one requests your feedback on the principles put forward by the Gemini Board of Directors, as well as by the Gemini Science and Technology Advisory Committee. Part two is seeking your feedback on potential specialization scenarios.

We are looking forward to hearing from you!

For reference

[Operational Guidelines](#): Observatory strategy during the 2016-2021 International Agreement. For the years beyond 2021, the Observatory is currently developing both a Strategic Vision and a Strategic Plan. The [Charge](#) to the Strategic Vision Committee was approved in Board resolution 2015.B.10.

Gemini Principles

Please tell us how much you agree with the following principles (on a scale of 1 [strongly disagree] to 5 [strongly agree])

Principle 1: Gemini Board of Directors

Gemini South and Gemini North can evolve independently in their respective systems, following different science missions, and potentially diverging.

Principle 2: Gemini Board of Directors,

Gemini North and/or Gemini South can move to a partial or full specialization. The transition era from the 4m-class to 8m-class telescopes suggests us that the facilities that adopted some degrees of specialization had the highest scientific impact (e.g. Crabtree 2008 SPIE Vol 7016, p.10, and subsequent updates).

Principle 3: Gemini Science and Technology Advisory Committee

Given the broad, diverse community that uses the Observatory, maintaining at least 50% of the time for PI-driven science with a range of instrumentation is important.

Principle 4: Gemini Science and Technology Advisory Committee

An increase in time allocation for very large, very high impact projects that use up to 50% of all telescope time is encouraged (currently Large and Long Programs make 20% of the time and run in parallel with regular programs).

Principle 5: Gemini Science and Technology Advisory Committee

Access to the latest technology through new instrumentation, upgrades to current instrumentation, and a visitor instrumentation program is essential.

Principle 6: Gemini Science and Technology Advisory Committee

It is important to build on current strengths, such as the operational agility of queue observations throughout the semester, and the technical investment in Adaptive Optics.

Potential Specialization Scenarios for Gemini

For each scenario, you have the option to choose a percentage representing the amount of telescope time that you would agree to dedicate to this specialization scenario for this telescope in the era 2020-2030. You may add in comments for each scenario. Your percentage total for each site does not need to total 100%

Scenario 1: Specialize the telescope(s) for rapid follow-up of other facilities.

Further optimize the telescope, operations and instrumentation to become/remain the world leader in rapid follow-up of discoveries from any other facility (LSST, ALMA, TMT, GMT, JWST, WFIRST, ...).

Follow-up would happen on two scales: minutes and weeks. For the minute scales: the telescope would be further optimized for rapid acquisition; the (workhorse) instrument suite could be fixed for optimal wavelength coverage and instruments would be optimize for fast

switch from one to the other, and for fast set-up (e.g. IFUs); the operations would include a large fraction of target of opportunity and rapid response.

What fraction of the telescope time should be devoted to this scenario for Gemini North?

What fraction of the telescope time should be devoted to this scenario for Gemini South?

Scenario #2: Specialize Gemini South for LSST follow-up.

Under this scenario, Gemini South would act primarily as a follow-up instrument for LSST.

“Follow-up” is often taken to mean rapid follow-up of transient events, but also could mean (for example) dedicated spectroscopic time for other interesting discoveries. It may be that some of those “interesting discoveries” flow out of the annual catalog releases rather than the nightly images, so one needs to consider a way for the Observatory to respond to catalog releases.

What fraction of the telescope time should be devoted to this scenario for Gemini South?

Scenario #3: Turn Gemini South into the Sloan Telescope of the 21st century.

Replace the M2 unit of Gemini South with a large wide-field MOS capable of measuring thousands of objects with a spectral resolution range spanning 2,000 to 50,000.

This is meant to supply a spectroscopic component of the LSST, so it is a more specialized version of the LSST follow-up scenario (less focus on synoptic follow up, more focus on deep/wide spectroscopy). This turns Gemini South into a fully dedicated, 8m-class, wide-field spectroscopy machine. The science case for this is already extremely well developed in the documents for the Maunakea Spectroscopic Explorer. The Maunakea Spectroscopic Explorer partner countries (mainly in the Pan Pacific) are invited to join Gemini South as partners to help pay for it. (Note: this is a variant of the preceding scenario).

What fraction of the telescope time should be devoted to this scenario for Gemini South?

Scenario #4: Merge into a single larger observatory.

Merge the Gemini telescopes as components of one larger observatory

The Gemini Observatory has been reduced to operations only, with very little resources for innovation. If the goal is to promote creative new developments and have access to specialized resources, the Observatory would profit from merging into a larger structure. In this scenario, Gemini North and South would become part of a single larger organization (e.g. an entity that would be international or at least allow international programs) that could support an ambitious development.

What fraction of the telescope time should be devoted to this scenario for Gemini North?

What fraction of the telescope time should be devoted to this scenario for Gemini South?

Scenario #5: Merge GN/GS into different structures.

Merge the Gemini North and South telescopes as components of different larger observatories.

Similar scenario to that described above (where Gemini North and South become part of a larger organization), but in this variant Gemini South becomes part of one larger organization (e.g. a joint LSST-NOAO-Gemini entity; an entity possibly including GMT) while Gemini North becomes part of another larger organization (e.g. a Maunakea telescope confederation, or larger

international observatory). As a less desirable alternative, one telescope would merge into a larger observatory while the other stays 'stand-alone' and specializes differently with presumably low operating costs (e.g. purely surveys, purely visitor mode, few instruments, ...).

What fraction of the telescope time should be devoted to this scenario for Gemini North?

Scenario #5: Dedicate the telescope to visitor instruments / experiments.

Under this scenario, a significant fraction of the time on Gemini would be dedicated to visitor instruments or experiments.

This is potentially a great way to maintain a fresh, modern suite of instruments. This new flux of instruments could greatly improve Gemini's scientific agility, i.e. its ability to adapt quickly to emerging science areas.

What fraction of the telescope time should be devoted to this scenario for Gemini North?

What fraction of the telescope time should be devoted to this scenario for Gemini South?

Scenario #7: Dedicate the telescope for higher-education purposes.

Increase Gemini's focus on and contribution to STEM education by allocating some fraction of telescope time (on either or both of the Gemini Telescopes) to research projects proposed by semi- and non-professional astronomers, undergraduate students, or even high school children; and/or engage undergraduate/graduate students in the running of the Observatory, thereby making the Observatory the ultimate training platform for the future leaders in ground-based astronomy.

What fraction of the telescope time should be devoted to this scenario for Gemini North?

What fraction of the telescope time should be devoted to this scenario for Gemini South?

Scenario #8: Specialize the telescope for single long-term studies.

This scenario could be used to massively reduce the operations cost, and would be appealing after Gemini's scientific impact will have become greater by conducting single (or two simultaneous?) long-term studies rather than individual short proposals.

The operations would resemble large particle physics experiments at accelerators: the telescope would be fully dedicated to a single experiment, probably conducted with a specialized instrument, and a large fraction of the operations (all nighttime operations, and instrument maintenance) would be conducted by the experiment team.

What fraction of the telescope time should be devoted to this scenario for Gemini North?

What fraction of the telescope time should be devoted to this scenario for Gemini South?

Scenario #9: Specialize Gemini North for TMT support / complementarity.

Adapt the operations (TBD) and instrumentation (TBD) to optimally follow-up or complement TMT science. Consider operating Gemini North together with TMT (and potentially Keck, Subaru and CFHT) as a single optimized observatory. The idea here is to consolidate operation of the telescopes on Maunakea as a single observatory, and to optimize Gemini for operation in areas complementary to TMT.

What fraction of the telescope time should be devoted to this scenario for Gemini North?

Scenario #10: Specialize Gemini South for GMT follow-up.

Similar to the above scenario for the TMT: adapt the operations (TBD) and instrumentation (TBD) to optimally follow-up on GMT science.

What fraction of the telescope time should be devoted to this scenario for Gemini South?

Scenario #11: Specialize for space mission support.

Specialize a telescope for TBD (JWST? WFIRST?) space mission support

This scheme would allow for a large cost reduction in operations, as one (or both) telescopes would be adapted for the follow-up of a dedicated space mission. Operations cost could be covered partly by the Partners, partly by the space agency(ies). The operations (TBD) and instrument(s) (TBD) would be optimized to support a TBD space mission. After a finite period, the Observatory (or one telescope only) could be redefined to support another mission.

What fraction of the telescope time should be devoted to this scenario for Gemini North?

What fraction of the telescope time should be devoted to this scenario for Gemini South?

Scenario #12: Maintain as is.

Maintain significant fraction of one or both telescopes for broad use by wide community, as is currently the case

This mode would continue operations under the current model. This option is motivated by the recognition that user access to facilities has been decreasing as a result of changes in operation modes of several telescopes in the US National Observatories at Kitt Peak and Cerro Tololo over the past decade.

What fraction of the telescope time should be devoted to this scenario for Gemini North?

What fraction of the telescope time should be devoted to this scenario for Gemini South?

Scenario #13: Roboticize for 100% queue.

Roboticize one of/both of the telescopes for 100% queue and/or time domain astronomy

Fully automate the system at either or both telescopes for queue scheduling and rapid (within minutes) response to triggers from LSST and other large surveys, space missions, or from projects on next-generation 30-m class telescopes.

What fraction of the telescope time should be devoted to this scenario for Gemini North?

What fraction of the telescope time should be devoted to this scenario for Gemini South?

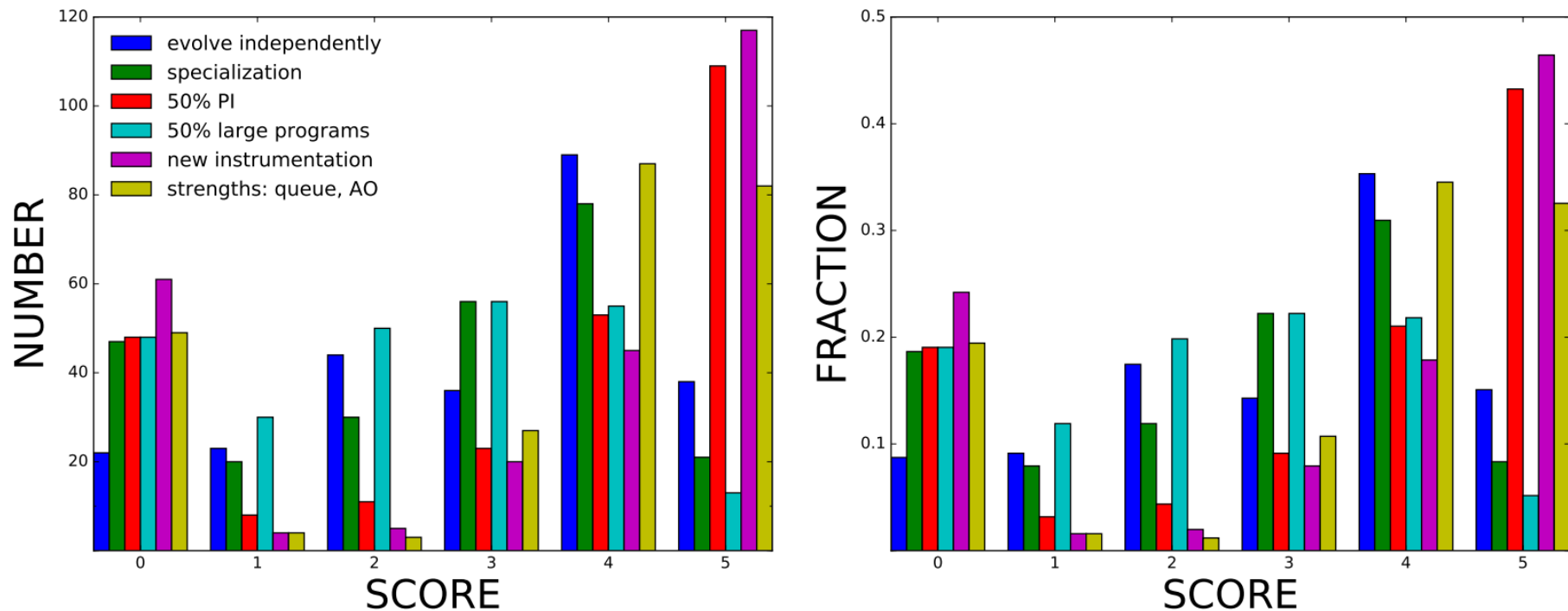
Final: Any other comments you might have, or alternative scenario that you might want to propose?

Survey Process

If you click the 'Finished' button, your survey will be automatically submitted. If you have not clicked the finished button, you may continue the survey process until the 14th of August. The process closes automatically on the 14th, regardless of the state of your survey process. You will no longer have access to the survey after the 14th.

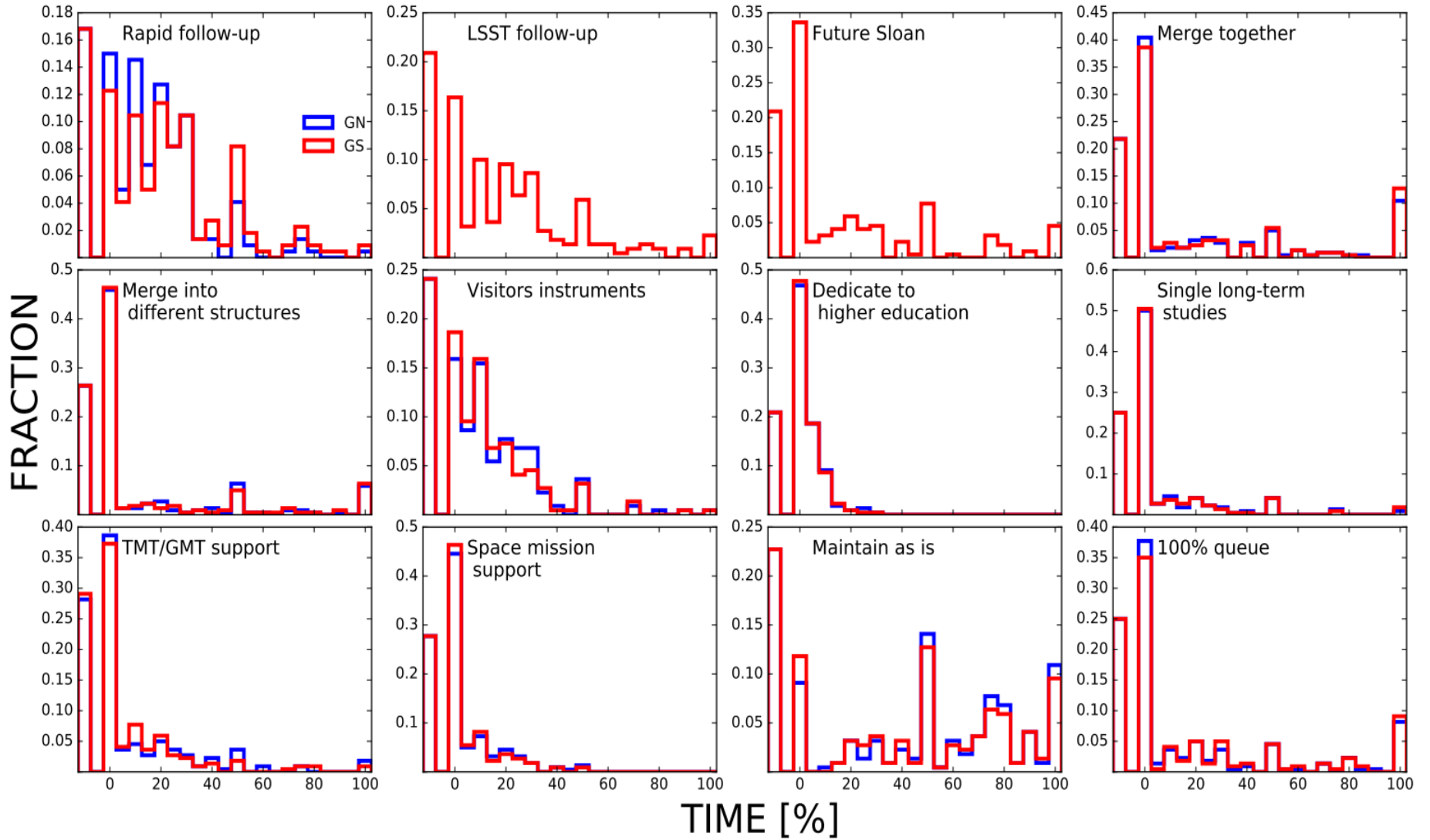
Appendix B. Appendix B. Survey Results and Interpretation

Principles



Note: 0=Strongly Disagree; 5=Strongly Agree:

Scenarios



Note: The questions were formatted in terms of time fractions in order to allow à la carte operational model