



GMT Concept of Operations Document

GMT Document

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1 Scope

1.1 System Overview

The Giant Magellan Telescope is one of a new generation of ground-based “Extremely Large Telescopes” designed to provide unprecedented clarity and sensitivity for the observation of astronomical phenomena. The GMT will leverage cutting-edge optics technology to combine seven primary and seven secondary mirrors into a single optical system that can achieve the diffraction limit of the full diameter of the seven-segment primary mirror surface. The GMT will be located at Las Campanas Observatory (LCO). Located in the high-altitude, desert environment of the Chilean Andes, LCO is owned by the Carnegie Institution for Science and has been operating as a world-class observatory site since 1969. The GMT is intended to execute cutting-edge scientific observations over the full optical and infrared spectrum in all fields of astrophysics with a lifetime of 50 years.

1.2 Document Overview

This document is one of the top-level formal documents, the "Foundation Documents," that define the GMT Observatory. These documents are projections of the Observatory's requirements database that is maintained using the DOORS software and have either been generated by or are identical to the content in DOORS. As these documents are more widely accessible than the database, they constitute the formally controlled Foundation Documents of the GMT Project. The scope of each document is as follows:

- The Concept of Operations Document (ConOps, GMT-DOC-03205) expresses the stakeholders' and owners' intention for the Observatory. Through high-level operational objectives and constraints, it describes what the observatory is expected to do.
- The Science Requirements Document (SRD, GMT-REQ-03213) quantifies the broad observational requirements needed to address the scientific goals of the Partnership, which are described in the GMT Science Book and the science cases for the first-generation instruments. As the product of the Observatory is the data needed to execute these scientific goals, the SRD is organized into Observing Cases – the data equivalent to Science Cases.
- The Observatory Requirements Document (ORD, GMT-REQ-03214) is the response of the GMT Project to the SRD. It contains the top-level engineering requirements for the Observatory that is to be built. It transforms the data specifications for each Observing Case in the SRD into technical specifications for the Observatory Performance Modes.
- The Observatory Architecture Document (OAD, GMT-REQ-03215) captures the top-level system design, consistent with the Observatory Requirements. It defines the subsystems and their interactions as they deliver the various System Configurations that enable the Observatory to implement the Observatory Performance Modes defined in the ORD. The OAD also enumerates performance and resource allocations among the subsystems.

The Observatory Operations Concept Document (OpsCon, GMT-OCDD-01776) describes how the Observatory design described in the OAD will be operated by the Stakeholders during operations to meet ConOps objectives and SRD/ORD specifications. It is the high-level summary of Observatory behaviors and operator interactions.

2 Definitions, Acronyms, and Reference Documents

2.1 Definitions

Table 2-1: Definitions

Term	Definition

2.2 Acronyms

Table 2-2: Acronyms

Acronym	Description
GMT	Giant Magellan Telescope

2.3 Referenced Documents

Table 2-3: Referenced Documents

Document Number	Title	DocuShare Link
GMT-CON-00873	GMTO Founders' Agreement (TARFA)	TBD
GMT-REF-00481	GMT Science Book	https://docushare.gmto.org/docushare/dsweb/Services/Document-13095
GMT-REF-00362	GMT Project Acronyms and Glossary	https://docushare.gmto.org/docushare/dsweb/Services/Document-14403/
GMT-REQ-03213	GMT Science Requirements Document (SRD)	https://docushare.gmto.org/docushare/dsweb/Services/Document-57932
GMT-DOC-03227	GMT Science Case Analysis Document (SCAD)	https://docushare.gmto.org/docushare/dsweb/Services/Document-58041
GMT-OCDD-01776	GMT Observatory Operations Concept (O OCD)	https://docushare.gmto.org/docushare/dsweb/ServicesLib/Document-58029/Document-58029
GMT-DOC-03229	SRD to ORD Analysis Document	TBD

Document Number	Title	DocuShare Link
GMT-RVW-00410	GMT System Level Preliminary Design Report (Vol. 1- 4)	https://docushare.gmto.org/docushare/dsweb/View/Collection-5267

3 Observatory Heritage and Vision

The GMT partnership formed in 2003 when the members of the 6.5m Magellan Telescope consortium and other interested scientists began developing concepts for a next-generation optical/infrared telescope. Their over-arching technical goal for the GMT was to achieve a significant gain in sensitivity using both increased collecting area and better-than seeing limited spatial resolution (i.e. image quality) in standard operation. As a long-lifetime (~50 year) ground-based Observatory, the scientific mission of the GMT is to enable cutting edge observations in all areas of optical (visible and IR) wavelength observational astrophysics – from characterizing conditions in planets orbiting other stars, to exploring the origins of the chemical elements, studying the formation of the first stars and galaxies, and learning the nature of dark matter and dark energy.

The core design of the GMT telescope capitalizes on the technologies and design strategies that have been demonstrated with the exceptional performance of the Magellan Telescopes: a Gregorian optical configuration, large mirror segments produced at the Richard F. Caris Mirror Laboratory at the University of Arizona, and both active and adaptive optical mirror technologies. Further capitalizing on the strengths of the partnership, the GMT will be built at the Las Campanas Observatory (LCO), owned by the Carnegie Institution for Science. The Las Campanas Peak on that property is being made available to the GMTO by a long-term lease.

That partnership has now evolved into the GMTO Corporation. The GMTO is recognized by legal agreement with the Government of Chile as a special international organization with permission and authority to operate within Chile. It is anticipated that the Observatory will be undergo a continuous program of expansion and upgrading based on feedback from its Stakeholders as part of planned operations, including the development of new scientific instruments.

In order to fulfill its science mission, the GMT organization will provide services that include:

- Scientific operations – operating the telescope, scheduling, support for execution of observations, data management;
- Technical support – maintenance, servicing, technical documentation, development and upgrades to facilities;
- Logistical support – transportation, lodging, dining, and observatory infrastructure

The expectations of the GMTO Stakeholders in these areas are described here at a level that is intended to provide guiding principles and strategies. In general, we envision GMTO these services will be efficient and cost-effective. Where appropriate we indicate which Stakeholders have authority to decide how those expectations will be met and where those decisions will be documented.

4 GMT Stakeholders

4.1 Governing Body

The Founding Institutions are those which have joined the partnership agreement of the GMT Corporation, an independent, nonprofit 501(c)(3) Corporation formed in 2008 to manage the development, construction, and operation of the GMT. In the order that they joined, the partnership in 2018 includes the Carnegie Institution for Science, the University of Arizona, Harvard University, the Smithsonian Institution, the University of Texas at Austin, Texas A&M University, the Korea Astronomy and Space Science Institute (KASI), the Australian National University (ANU), Astronomy Australia Limited (AAL), University of Chicago, Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), and Arizona State University. Additional Partners are anticipated to join the GMT before Operations begin.

The Third Amended and Restated Founders' Agreement (TARFA) defines the functioning of the partnership and governance of GMT. As specified in the Founder's Agreement, the Founders designates representatives to the Board of Directors, which is the governing body of the GMT Corp. The Founders' Agreement also anticipates the future involvement of Participants, which are defined as persons or institutions contributing to the operating cost of the Observatory during any given year of the Operations Phase. The role of Participants in governance will be determined by the Board. Founders and Participants during Operations are collectively referred in the rest of this document as "Contributors."

4.2 Partner Scientists

GMT stakeholders also include the astronomy faculty and staff at the Founder institutions, who are represented to the Project and the Board of Directors through the Scientific Advisory Committee (SAC). The SAC members are nominated by their institutions and approved by the Board. The SAC also includes individuals from the broader scientific community. These individuals will be nominated by the GMT President and approved by the Board.

4.3 User Community

GMT will be used by scientists at the Founding institutions, by Contributors (institutions or persons who support Operations during any given year) and by other scientist through discretionary time or other agreements (such as Chilean access). The scientists throughout our partnership play a critical and fundamental role in GMT as the individuals who use the facility to execute its scientific mission – proposing, conducting, and publishing astrophysical observations. As such they are key Stakeholders throughout the lifetime of the Observatory. The broader international community will be involved with the GMT through scientific collaborations and potentially as future Contributors. Their input has been and will continue to be sought on advisory committees.

4.4 Observatory Staff

During the lifetime of the observatory, GMT will be managed, maintained, and operated by the GMT staff, who will play the leading role in enabling the observatory to meet its scientific and performance goals during operations. The productivity of the observatory will require continuous improvement and

expansion of capabilities over its lifetime (see Section 6), an effort in which the Observatory Staff will also play a central role. As such the staff are critical stakeholders with unique insight and impact on the success of GMTO.

The Observatory Staff are anticipated to include, at a minimum, an operations staff located at LCO, an off-site operations group in Chile, and an operations center in North America. The structure and organization of the GMTO Staff will be described in the Operations Plan (OP) and approved by the Board of Directors. The concepts developed to date in support of technical operations are described in the Operations Concept Document [GMT-OCDD-01776].

5 Facilities

5.1 GMTO Site Facilities

The GMT Observatory will be located at Las Campanas Observatory (LCO) in Chile, which is owned and operated as a working observatory by the Carnegie Institution for Science since 1963. LCO is located roughly 160 km north of the coastal town of La Serena. The GMTO site at Cerro Las Campanas has been leased to GMTO.

Individuals at the GMTO site will include visiting scientists and staff engaged in all aspects of the technical and scientific operations of the GMTO telescope, instruments, and subsystems. Activities will range from commissioning of the telescope and instruments, to standard operations, maintenance, servicing, and nighttime observations. The GMTO will provide on-site facilities for all of these activities, include lab space, equipment assembly and servicing areas, maintenance shops, storage space, and office space to support operations on the GMTO site at LCO. Living accommodations (lodging, dining, and recreation areas) will also be provided on the GMTO site to support the extended presence of GMTO staff and visiting scientist at the Observatory.

Visitors not associated with scientific or technical operations (potential donors, students, officials from Founder and Participating institutions) are also expected to visit the GMTO site. Appropriate spaces for interaction and observation of day and nighttime operations will be available for this purpose.

5.2 Off-Site Facilities in Chile

Building on the experience of existing observatories in Chile, we envision off-site support for GMTO at “base” (sea-level) facility located in La Serena. The base facility will provide business, logistical, and administrative support (e.g., purchasing, accounting, personnel transportation, shipping, receiving, and human resources) for GMTO operations in Chile.

5.2.1 North American Facilities

A center for planning and operations throughout the life of the Observatory will be needed in close proximity to one of the partner’s home institutions to provide administrative, technical, scientific, and observing support for GMTO. The most likely location based on current partner activities and involvement is North America. Activities at such an Operations Center will include basic corporate activities (e.g. business and human resources management, accounting, purchasing/receiving, and administrative personnel) as well as scientific operations and planning, and technical and engineering

support. Appropriate network connections and data transfer rates will be needed to enable appropriate connection between the Site and Off-Site facilities.

5.3 Environmental Conditions

5.3.1 Operating Conditions and Survivability

The conditions on the site are documented in the GMT-SE-REF-00144 “Environmental Conditions” document. To enable the 50-year lifetime of the Observatory, the GMTO facilities will be designed and constructed to survive environmental conditions (air temperature, pressure, wind, rain, and snowfall) that have a 50-year recurrence timescale. The Observatory will be designed and constructed to enable safe scientific operation during environmental conditions that exist at the site 99% of the time and will be able to take data that meets the science performance (as described in the SRD for scheduled observations) 95% of the time. Maintenance and operations will be planned to support these performance expectations.

5.3.2 Environmental Monitoring

During safe operating conditions, environment monitoring will be used to facilitate the scheduling and efficient execution of observations that are approximately matched to environmental conditions. This is particularly crucial for the anticipated “queue” or “service” operating modes. Environmental monitoring will be provided to enable real-time response to observing conditions. Monitoring will include, for example, measurements of temperature, pressure, humidity, precipitable water vapor, particulate count, atmospheric turbulence, and seeing. Scheduling and data simulation tools will be used to facilitate planning based on those measurements. In addition, tools and services will be used to forecast environmental conditions and further facilitate planning. Records will be kept of all environmental conditions measured to facilitate planning and analysis of the operations.

5.3.3 Seismic Requirements

The GMT will be designed and constructed anticipating the seismic active at the site, as described in the Site-Specific Seismic Hazard Analysis (SSSHA) report (GMT-DOC-00127_A). To meet the Founders’ expectations regarding the operability and lifetime of the Observatory, the GMT will be able to withstand earthquakes that have a 50% or greater likelihood of yearly occurrence without impacting standard maintenance or servicing schedules. The GMT will also be designed and constructed to survive an earthquake that has more than a 2% likelihood of occurring within 50 years, such that it can be returned to full operation with spares and materials on-site. Allowable time and cost to repair associated with these events will be determined by the Project based on risk and cost assessment.

6 Scientific Performance

The GMT partners have established a clear but appropriately broad set of science objectives that can be summarized as opening new discovery space to address scientific questions across all fields of astronomy – the most important contemporary problems today, from first light to exoplanets as well as those that will arise in the future – and exploiting scientific synergies with facilities operating in complementary

domains.¹ These ambitions drive the technical development of the GMT facility – greater light-collecting and resolving power than existing telescopes – and the scientific instrumentation to enable the measurements needed to turn light sensitivity into scientific measurements. The scientific motivation for the GMT is detailed in the GMT Science Book, which was written in 2012 (GMT-REF-00481) and updated in 2018 (GMT-REF-03257).

In the sections below, we describe the subjective expectations of the partnership that are directly relevant to enabling these science goals.

6.1 Image Quality Efficiency

The objective spatial resolution requirements that enable the most demanding observations anticipated with GMTO are discussed in detail in the Science Cases Analysis Document (GMT-REF-03227). The resulting requirements are summarized in the SRD. In addition to those requirements, the global efficiency and effectiveness of the Observatory will be impacted by the median image quality of the GMT, because the sensitivity of the GMT will be limited by image quality during background-limited observations; the require exposure times required to achieve a given signal to noise are inversely proportional to image quality. The expectations of our partnership for scientific productivity are therefore impacted by median image quality as much as by the best image quality.

To guarantee the efficiency of the Observatory, the Observatory should not significantly degrade the atmospheric seeing in any standard operating mode. Specifically, the following image quality performance will be delivered in median environmental conditions (e.g. temperature, temperature gradient, atmospheric pressure, and wind). The percentiles refer exclusively to atmospheric seeing.

- The GMT Observatory will be able to perform small field visible observations with an image FWHM <1.15 times natural seeing FWHM at 0.5 μ m at least 75% of the time.
- The GMT Observatory will be able to perform small field IR observations with an image FWHM <1.20 times natural seeing FWHM at 1.65 μ m at least 75% of the time.
- The GMT Observatory will be able to perform medium field visible observations with an image FWHM <1.15 times natural seeing FWHM at 0.5 μ m at least 75% of the time.
- The GMT Observatory will be able to perform medium field IR observations with an image FWHM <1.20 times natural seeing FWHM at 1.65 μ m at least 75% of the time.
- The GMT Observatory will be able to perform wide field visible observations with an image FWHM <1.20 times natural seeing FWHM at 0.5 μ m at least 75% of the time.

This image quality is expected at zenith angles less than 15 degrees and is expected to do decline with airmass and with decreasing wavelength according to standard scaling laws.

¹ The contemporary science cases identified by our Partnership echo the “Decadal Review” reports published by the National Academies of Sciences and the National Research Council that reviewed the state of the field in 2001 and 2010. (“Astronomy and Astrophysics in the New Millennium,” National Academies Press; “New Worlds, New Horizons in Astronomy and Astrophysics,” National Academies Press)

6.2 Observing Efficiency

A wide range of functional performance factors will also have significant impact on the efficiency of the Observatory in executing observations. In general, the GMT will be designed to facilitate on-sky, observing efficiency, subject to limitations imposed by safety and maintenance requirements, and the Observatory will monitor performance, end-to-end, to facilitate continuous improvement in performance. The Founders' expectations for observing efficiency include the following:

- The Observatory will be able to move and acquire a new target anywhere on the sky in less than 600 seconds using any observing mode or instrument, and in less than 180 seconds when using the same observing mode and instrument used on the previous target.
- The Observatory will be able to make small moves of 1 degree or 0.1 degrees and acquire a new target at that location in 5 seconds and 2 seconds respectively when using the same observing mode and instrument.
- To facilitate optimal scheduling of observations in dynamic environmental conditions, science instruments should be available for use when mounted on the telescope within the timescales described below. (See Instrument Support, Section 10.5).
- To the extent that it is scientifically useful and technically feasible, the simultaneous use of multiple instruments will be enabled. (See Instrument Support, Section 10.5).

Criteria relevant to evaluating operational efficiency are discussed further in Section 11.

7 Instrumentation

As described in the 2014 System Level Design Review Report [GMT-RVW-00410], the GMTO selected a suite of first-generation instruments that enables a majority, but not all, of observations needed execute the scientific goals of the Partners. The scientific impact of the Observatory over its lifetime will depend on the continuous expansion of observing capabilities through new instruments and potentially new observing modes. For that reason, the observatory will maintain a vigorous program of instrumentation development. Because support of new instruments demands GMTO resources, this effort will be guided by the SAC during the project development and operations phases through review and endorsement of solicited and unsolicited instrument proposals.

We anticipate a program of rapid instrument development and deployment of instruments with focused capabilities, capitalizing on the technical advantage afforded by the GMT's small plate scale to keep instruments compact. The experience of Partners suggests that the most effective and productive instruments will come from concepts developed and motivated by active scientists and instrumentation teams at the Partner institutions. To facilitate new instrumentation, the GMTO will support and encourage partner awareness of Observatory operations and capabilities.

The GMTO Staff will coordinate development to the degree necessary to guarantee effective integration, operation, and maintenance at the telescope. The process for review and coordination will be approved by the SAC and Board before Operations phase begins. At a minimum, all instruments will pass a pre-ship review before being delivered to the Observatory. Installation and commissioning of new instruments will be conducted in coordination by the instrument's development team and GMTO observatory technical staff.

7.1 Facility Instruments

Facility Instrument are developed for standard operation and will be available to be scheduled for observing programs from any GMTO user. We anticipate supporting the addition of new facility instruments and significant upgrades to existing instruments at a rate of one every three to five years during Operations. New observing modes may be developed as needed and appropriate to support new instruments. New facility instruments and upgrades will be developed with prior endorsement by the SAC and approval by the Board. The strategy for funding Facility Instruments will be developed during the Construction phase and documented in the Operations Plan (OP). Funding support may be allocated in the annual Operations budget, the instrument teams will cultivate however experience suggests that a variety of funding sources. Each Partner will have a responsibility to contribute, technically and financially, to the development of new instruments. Strategies to balance these contributions in will be approved by the Board prior to Operations Phase. The SAC has endorsed the incentive of guaranteed observing time for the instrument teams.

The acceptance criteria for any facility instruments will be determined by the GMTO Project during the Construction Phase and by the GMTO during Operations. In addition to the obvious functional and performance requirements, which will be determined in coordination with the instrument teams, all facility instruments will provide documentation for the instrument. The documentation will be sufficient to enable experienced observers to plan and execute observations in all supported modes of operation on the GMT. It should include, for instance, a description of the basic design of the instrument and of the supported observing modes, performance characteristics, calibration requirements, set-up procedures, recommended observing strategies, and data tools and pipelines (described below).

The OP will define the process by which GMTO Staff work with the instrument teams to commission instruments. Commissioning activities will begin only after the instrument teams have demonstrated that all instrument modes meet technical requirements and all software tools, interfaces, data pipelines, and documentation are completed. Because of the complexity of the GMTO instrument interfaces, the GMTO Staff will take primary responsibility for guaranteeing the safety of personnel and equipment during commissioning. The GMT Observatory will have responsibility for instrument maintenance, minor improvements, and performance monitoring only after the instrument has completed commissioning and is accepted for general use. The OP will describe a process by which GMTO staff are trained in the operations and maintenance of a new facility instrument (hand-over). GMTO Staff will also plan with the instrument developers to provide on-going technical support beyond standard maintenance. Appropriate laboratory and storage space will be available at the GMTO site to support the assembly, commissioning, maintenance, and servicing of facility instruments.

7.2 Visitor Instruments

To broaden the scientific capabilities of the observatory, the GMTO will support “Visitor Instrument” program. Visitor Instruments are those for which the GMTO Staff does not assume the responsibilities of support and maintenance, and which are not available to the general GMTO user community without involvement or approval of the instrument’s PI. Visitor instruments will comply with safety requirements and interface specifications designated by the GMTO Staff and described in the OP to ensure the safety of GMTO hardware and personnel and to assure that normal operations are not compromised by, for example, vibrations or electromagnetic disturbances.

Visitor Instruments will not be scheduled for GMTO observations without the presence of an instrument team designated by the Principal Investigator. The data from Visitor Instruments will be archived, however availability of that data to the GMTO partnership or broader community will be negotiated with the instrument's PI before it is brought to GMTO and approved by the Board. The GMTO Staff will not assume responsibility for instrument support or maintenance but will have shared responsibility during all instrument handling and observations to guarantee the safety of GMTO hardware and personnel. Visitor Instruments must pass a pre-ship review with criteria established in the OP and by the GMTO Staff before arrival at the Observatory.

8 Science Operations

Science operations include activities from proposal submission through execution of observing programs, data reduction, and finally data analysis and publication of scientific results. GMTO will support all aspects of science operations, including the development of tools for proposal preparation and evaluation, simulation of observations, scheduling of observing programs, support for the observers, data archiving and development of tools for efficient use of the data archive, development of data reduction software, and support to scientists through the data reduction and calibration steps.

In general, the GMTO Stakeholders envision a highly efficient and cost-effective operations models, in the style characteristic of the privately-funded US observatories (e.g., Keck, Magellan, MMT, LBT). This vision is described below. The SAC has produced a White Paper (*GMTO Operations: Selecting, Scheduling, and Executing Science Programs*, GMT-DOC-01583, Rev. A) which discusses the priorities and goals of the scientists at our Founder institutions, and makes several recommendations regarding the processes used for proposal review, time allocation, scheduling, and operating modes. The recommendations are provided here where appropriate and will implemented subject to the judgement of the GMTO and approval of the Board.

8.1 Time Allocation

The Founders' Agreement provides guidelines for the distribution of observing time, which refers to the total time available for science operations during a year in standard operation. The details of the time allocation strategy will be described in a report on the "Time Allocation Procedure" that will be provided by the GMTO President three years before the commencement of the Operations phase. This procedure will be reviewed and approved by the Board and may be modified periodically during Operations based on the experience of the GMTO Staff and the Contributors. The scientists at the Founders' institutions have provided a more detailed vision for the allocation of observing time and the modes in which observations will be conducted (see SAC White Paper GMT-DOC-01583). The specifications below are consistent with the guidelines provided by the Founders' Agreement and the recommendations provided by the SAC. The distribution of time for Engineering is discussed below (see Section 10.3).

8.1.1 Contributors (Founders and Participants)

Most of the observing time will be allocated to Contributors, those individuals or institutions that have supported the capital cost of the facility and the annual operations cost. Founders' time will be allocated in proportion to their Founders' shares, derived from their time-weighted contributions to construction. Participants' time will be allocated in proportion to contributions to the annual operations budget. The

relative weighting between Founders' and Participants' time will include time- and risk-weighted considerations over the life-cycle of the facility. The allocations will be reviewed and approved by the Board annually.

8.1.2 “Other Observers’ Time”

The Founders' Agreement allows for observing time to be allocated to groups that are neither Founders nor Participants (collectively, “Contributors”). This may include Chilean Observers and other entities at the discretion of the GMTO Board.

8.1.3 President’s Discretionary Time

President’s Discretionary Observing is observing time assigned by the GMTO President (or equivalently the Director of GMTO during Operations) for projects, individuals, or to institutions. The GMT Founders' Agreement specifies that the total observing time allocated in this way will not exceed 5% after Engineering Time is deducted. The President (or Director) will determine how time is allocated and how it is to be used.

8.1.4 Time Allocation Process

The Operations Plan will describe the process by which Contributors and Other Observers are allocated observing time. The process will depend on a number of factors, including the types of observing modes that will be supported, the fraction of time going to individual investigators (or teams), and the fraction (if any) of time going to multi-year projects (such as “key projects” or other longer-term programs).

While the details are not determined, the SAC has recommended that process be used in which observing proposals from eligible observers (collectively Contributors and Board-approved “other observers”) are reviewed and ranked by multiple Time Allocation Committees (TACs) – a GMTO-led TAC and Partner-led TACs – and then combined by a Merging TAC. (see SAC White Paper GMT-DOC-01583). A schedule will be developed by GMTO based on the final results. The details of the merging process, the fraction of time to be allocated by the GMTO vs Partner TACs, and the strategies of the scheduling algorithms will be developed in the Operations Plan and Time Allocation Procedure report. While these details will no doubt be revised over the lifetime of the Observatory, the central goals of the allocation process will be to encourage collaboration between the scientists at Contributing institutions, to enable Contributing Institutions to meet their individual scientific and programmatic goals, and to balance time allocation between the Contributors per the Founders' Agreement. Again, the Time Allocation Procedure will be approved by the Board.

8.1.4.1 Proposal Process

The SAC has recommended that the proposal process include multiple phases to facilitate review and scheduling of proposals. A single, uniform proposal template will be used for proposals reviewed by all Time Allocation Committees for both the proposal phase (sometimes called “Phase I”) and the scheduling/execution phase (sometimes called “Phase 2”). The GMTO will develop the formats and templates for these proposals prior to Operations.

8.1.4.2 Partner Share Balancing

Balancing time allocations of the individual Contributors, efficient scheduling of observations, and completion of observing programs within a single observing season are all in the interests of the Contributors and their scientists, as well as the GMTO. To optimize all of these interests, the balancing of partner shares may not be achieved in each observing season. The SAC has also recommended that the balancing of partner shares, including by season and moon phase, should be maintained over a three-year (or less) timescale, as possible, to maximize the scientific return and operational efficiency of the Observatory with the fair distribution of observing time to the Contributors.

8.2 Operating Modes

Operating Modes describe the way scientist will be involved in collecting data during operations. (These are not to be confused with “Observatory Performance Modes,” or OPMs, which describe the telescope wavefront control strategies, such as GLAO). While some observing programs can be clearly prescribed and executed according to a pre-determined schedule, others will benefit from dynamic planning that demands the involvement of the proposing scientists. A range of operating modes, described below, will therefore be supported by GMTO during steady-state operations with the goal of maximizing the scientific productivity of the Observatory for both well prescribed and more exploratory observing programs.

8.2.1 Automated Observations

In all operating modes, “scripted” blocks of telescope and instrument commands will be used to execute the observations to assure that observing time is used efficiently during nighttime operations. However, during all operating modes, accommodations should also be made for real-time adjustment of the observing programs based on the observer’s judgement to improve scientific results.

8.2.2 Queue Operating Mode

The baseline operating mode for GMT will be Queue (or “service”) Operating Mode. In this mode, GMTO Staff Observers will carry out observations drawn from a suite of programs that target sources at a range of locations on the sky and require a range of different environmental conditions. Observations will be selected to match data requirements to the environmental conditions to optimize the performance needs of the observational program with the data quality available at the GMTO on any given night. The proposing investigators (PIs) will be alerted when their observations are scheduled within a given time period (1-5 nights). A targeted queue may be used to execute a subset of programs that need unusual conditions or specific times (such as synoptic observations).

While the Investigator’s involvement during the observations is not required, Investigators will be welcome to participate as advisors or “watchers” of the observations, either on-site or remotely. Such involvement will be encouraged, particularly during the early stages of operations, to facilitate the involvement of the community, future instrument development, and increase coordination between the GMTO its Stakeholders.

This mode has been endorsed by the SAC for baseline operations. The level of support for needed in this operating mode will include telescope operators and specialists who help with the set-up and calibration of the instruments and observing interfaces.

8.2.3 Investigator-Directed (“Classical”) Operating Mode

GMTO will support an Investigator-Directed Operating Mode in which specific hours or nights are allocated to an individual or team to execute a specific observing program. Investigators who are unfamiliar with the Observatory will be encouraged to travel to the site to direct all (day- and night-time) operations associated with data collection during their allocated time. Observations will be executed under the direction of the investigator, subject to safe operating limits of the facility. This mode is required for commissioning of new instruments, but it is also important for long-term programs in which investigators develop techniques or experience that improves, for instance, data quality, data consistency, or observing efficiency.

As observers will be needed on the GMTO Staff for this operating mode they will be available to provide support for scientists using the GMTO in Investigator Directed mode (see below). The default level of support for this operating mode will be similar to that needed in queue operations. In addition to telescope operators and instrument/AO specialists, GMTO Staff Observers will be available to assist Investigators with quick-look data reduction and otherwise facilitate efficient use of observing time. Experienced GMTO observers may lead this mode from remote sites or on-site, and collaborators may participate on-site or from remote sites.

This mode is endorsed by the SAC for use a minority of the time and to the extent that it does not prevent efficient execution of queue-scheduled operations. This limitation will apply to individual Contributor as well as in the aggregate, although each Contributor will have the opportunity to request larger fractions of time in this mode.

Some institutions may choose to provide their own “service observing” program within a block of time scheduled to a single Institution. This is operationally equivalent to an Investigator-Directed mode from the operations perspective and for the purpose of time allocation.

8.2.4 Remote Operations

Remote access for investigators will be supported in all Operating Modes during steady-state operations. Locations from which remote access is available will include at least one site at the North American Facilities and may include sites at the Founders’ institutions. Access from a broader range of locations will be enabled at the discretion of the GMTO Staff. Investigators may choose to participate via a passive “eavesdropping” mode or in may lead data collection activities in an active mode, Investigator Directed Operating Mode. In standard operations, GMTO will provide the same level of support for remote and on-site participants in Investigator Directed operations. Remote Operations sites will be developed collaboratively with GMTO staff and will comply with technical standards set by GMTO to ensure efficient operations.

8.2.5 Non-Standard Observing Programs

The GMTO Contributors may allocate time for non-standard programs, including large or long-duration programs for which scientific result require a complete data set, and programs for which an “interrupt mode” is required to observe rare, transient sources. Time for such projects may include the time allocations of any number of Contributors. Strategies for supporting such observing programs will be developed by the GMTO in the Operations Plan. GMTO will be designed and constructed to support

rapid acquisition of such targets and switching between instruments to enable these science goals and facilitate efficient scheduling of such non-standard observations.

8.2.6 Early Science Operations

Early science operations are assumed to take place between the time when “science first light” occurs and when the project has reached steady-state operations. This period is expected to begin within 12 months installation of four primary mirror segments and 4 secondary mirror segments on the telescope structure. Steady-state (science) operations will begin within 36 (TBC) months of the installation of seven primary mirror segments and 7 secondary mirror segments on the telescope structure. The beginning of steady state operations will be at the discretion of the GMTO Project and will be approved by the Board. The definition of early science and standard operations may be revised in the Project Execution Plan or Operations Plan during the Construction Phase.

9 Data Management

9.1 Data Formats and Compatibility

Science data collected with the GMT (and relevant metadata, see below) will be delivered in common data formats that are compliant with world-wide Virtual Observatory standards as defined at the time of the instrument Preliminary Design Reviews. The baseline format will be the “Flexible Image Transport System” – FITS. The particular version(s) of FITS supported (e.g., multiple image extensions) will be specified by the GMTO Project as part of the instrument data system development.

9.2 Data Processing Tools

Data reduction tools that do not require interaction will be available to ensure that an experienced observer can assess the quality of science observations. To enable efficient use of observing time, data products sufficient to assess even the most complicated observations (such as from integral field unit spectrographs) should be available in one minute or less after exposures are completed. These “quick-look” tools will be available for all supported observing modes for any facility instrument and will be provided by the instrument teams. Visiting instruments must demonstrate that data quality can be rapidly assessed during standard use on the telescope to ensure successful and efficient operations at the discretion of the GMTO Staff. Quick-look tools will also be provided by the instrument teams to enable assessment and monitoring of instrument health and calibration by GMTO staff. For all standard observing modes, GMT Observatory shall provide processed data appropriate for scientific analysis that has passed quality control within 24-hour of observations [goal: 1 hour].

9.3 Data Reduction and Calibration Pipelines

To facilitate publication of data and maximize the scientific impact of the GMTO, data reduction tools will be available to execute basic data reduction processing for any data taken with facility instruments in any supported observing modes. These data “pipelines” will, at a minimum, remove instrumental signatures and perform basic data reduction steps such that the data are ready for scientific analysis and

publication (science-ready data products)². These pipelines will be developed and provided by instrument teams and maintained by the GMTO Staff throughout the lifetime of the Observatory. Completion criteria for data pipelines will be determined on an instrument by instrument basis by the GMTO Project during Construction or by the GMTO Staff during Operations. Pipelines will be made available to use off-site through the data archive. (See below).

9.4 Data Archiving

GMTO will maintain a data archive for the life of the facility. The essential functions of the data archive are (1) to capture and curate raw data to assure that it is not lost, (2) to associate that data with appropriate metadata and data reduction tools, and (3) to support multiple scientific uses of any data. The goal of the archive is to increase the scientific productivity of the GMTO by facilitating the efficient distribution and reduction of data for scientific analysis and publication. In addition to archiving scientific data and metadata, the archive will store the data reduction tools provided by the instrument teams so that they can be used and improved by the community. The archive interface will support access, queries, and quick-look tools that facilitate the use of the archive for purposes including the execution of the originally proposed observing program, future scientific programs, assessment of Observatory operations, and engineering diagnostics.

In addition to the primary archive, a “local” archive will be provided at the GMTO site to ensure data security for a period of at least one month without requiring a network connection to either the sea-level facility or to the site of the primary data archive.

The SAC has produced a White Paper (*GMTO Science Archive*, GMTO-DOC-01582, Rev. A) in which they discuss the capabilities that would be of use to the scientific community at our Founders and Participants, and the broader scientific community. Potential strategies for achieving those capabilities are also discussed to clarify the goals of the scientists. The Archive will be designed, developed, and supported during operations to meet the specifications given in this document and subject to the judgement of the GMTO to balance cost and performance.

9.4.1 Science Data

All science data obtained at the GMT using any instrument will be stored by GMTO. The archive will be developed and maintained by GMTO Staff and will include all data taken as part of any scheduled observing programs and calibration data taken to support instruments in use at the Observatory. In addition to the science data itself, the archive will include “metadata” relevant to the science data with the goal of maximizing the future utility of the archive for a range of purposes. The metadata may include such information regarding the observing target, exposure details, enclosure configuration, telescope configuration, instrument configuration, environmental conditions, astronomical conditions (e.g. moon coordinates), and proposal information. Science data will be archived, at a minimum, in its raw format.

² We refer to data reduction as standard processing of data that is independent of the data program and does not necessarily require the judgement of the investigator to execute (e.g. bias subtraction, flat fielding, flux calibration, wavelength calibration, and data cube assembly). We refer to data analysis as steps which are program specific or require the input of the investigator.

To facilitate rapid data reduction and publication of scientific results, the data pipelines provided by all instrument teams will be made available via the archive. To facilitate the community development of data tools, the data pipelines will be provided “open source” to investigators and the Observatory will provide strategies to facilitate the exchange of updated data processing tools. The archive will also include quick-look tools to allow the data to be re-processed rapidly. The Operations Plan will specify the extent to which the GMTO will support additional data products, such as publication- and analysis-ready data (individual science-ready exposures and final data products such as co-added or mosaicked images).

9.4.2 Engineering Data

GMTO will collect and archive selected engineering data from the telescope, instruments, and AO systems that may be useful to assess the status of hardware, diagnose failures, refine observing processes, or assess operations. These will be accessed through an engineering data management system that will be developed during the Construction phase. To the extent practical, engineering data will be archived for the life of the observatory.

9.4.3 Data Access

GMTO will collect and archive selected Data will be made available to Investigators at the GMTO site through local hardware and to remote investigators at any location at which remote operations are supported. The GMTO will provide access to raw data and “quick-look” products via the data archive to any approved investigators within 1 hour of observations [goal: 5 minutes] from any location in standard operation. For data taken in all standard observing modes with facility instruments, GMTO will provide access to processed data products appropriate for scientific analysis within 24 hours of observations [goal: 1 hour]. GMTO will provide the support necessary to assure the quality of these data products.

The SAC has endorsed the implementation of proprietary data periods to protect the interests and investment of the proposing investigators and the Founders’ institutions and, in particular, to protect students and postdocs conducting research critical to their career development. To maximize the scientific productivity of the GMTO, the SAC also endorses a policy of open data access that would include the Contributors and potentially the broader community after the proprietary period has passed. The data access policy is subject to approval by the GMTO Board.

10 Observatory Technical Operations

10.1 Lifetime

The Founders intend the GMT to be a long-lived, ground-based observatory with an operational lifetime of at least 50 years. It will be designed, constructed, and operated to enable high scientific impact throughout that lifetime. The GMT will require routine maintenance and servicing of the entire facility (enclosure, telescope structure, telescope optics, instruments, and observatory infrastructure), as well as a regular influx of new instrumentation, and periodic upgrades to the facility to remain competitive and execute cutting-edge science throughout that lifetime. This will require continuous investment during the Operations phase, which will be part of the Operations budget.

10.2 Nighttime Operation

The GMT is being planned and designed for nighttime observing only. Nighttime here is defined as the time between the end of evening nautical twilight and the beginning of morning nautical twilight. At these points, the center of the sun is 12 degrees below the horizon. For Las Campanas, this time interval corresponds to roughly 10 hours per 24-hour period in the mean. The GMT will be operable outside those hours for calibrations, following the specifications in the Operations Concept Document. The GMT Science Advisory Committee has not identified any compelling science that requires daylight observations, and none are included in the GMT Science Book.

10.3 Engineering Time

Observatory subsystems will require regular maintenance and periodic servicing, some of which will inevitably impact the availability of the telescope at night for science operations. Engineering nights will be scheduled regularly to perform such activities. The amount of Observing Time allocated per year Engineering Time will be determined by the GMTO President, in consultation with the Board, to meet the operational needs and budgetary restrictions of the GMT.

Maintenance Time and Commissioning Time are included as Engineering Time in the GMTO Founders' Agreement. Based on the experience of current ground-based facilities, the Observatory will be designed and constructed to enable the Observatory to operate with less than 10% of total available nighttime hours allocated to engineering in standard operations.

10.4 Down Time

The observatory will incur more downtime during and after significant upgrades and commissioning efforts, and less downtime during steady state operations. The most efficient 8 m class observatories achieve downtimes in the 1-2% range in steady state operations. Based on the experience of those facilities, when operations are disrupted for downtime at rates higher than 3%, the burden on facility Staff will be difficult to sustain and Staff time will be dominated by reactive rather than proactive engineering technical efforts. To maximize the productivity of the Observatory and to enable efficient and sustainable operations with a cost-effective Staff, the GMTO will be designed, constructed, and operated to have less than 4% [goal of 2%] of the total time available for science operations lost to technical downtime. Time allocated to scheduled maintenance, environmental conditions or other programmed interruptions will not be counted in this percentage.

10.4.1 Maintenance Time

GMTO will schedule time on the telescope to carry out engineering and development activities, as well as preventive maintenance that is not time-critical. Necessary engineering time will be determined by the GMTO Staff in operations and allocated such that downtime (due to technical failures or repairs) is kept within the prescribed limits, scheduled servicing and upgrading of the facilities can be supported, and new subsystems (including instruments) can be commissioned.

Maintenance Time is defined as nights or partial nights scheduled for routine maintenance operations that preclude science operation (e.g. mirror recoating, mounting and check out of a science instrument after initial commissioning, night time testing and recalibration of telescope systems, etc.).

10.4.2 Commissioning Time

As a portion of the total engineering time allocation, time will be planned for commissioning new facility science instruments, AO system components, and other capabilities. In steady-state operations, the GMT Observatory will schedule no more than 15 nights (4% of the available nights) per year for instrument commissioning. This assumes no more than one new major instrument per year. Commissioning time for all facility instruments will be approved by the GMTO Board based on recommendation of the GMTO President as part of the authorization process for new instruments and capabilities.

10.5 Instrument Support

As described above, the development, maintenance, and operation of facility instruments and the use of visitor instruments will be supported by the GMTO throughout the lifetime of the Observatory. The details of this support will be described in the Operations plan consistent with the expectations provided in below and in Section 7.

10.5.1 Instrument Lifetimes

Previous generations of ground-based observatories have shown that successful instruments with broad scientific capabilities are likely to be in high demand for more than 30 years and potentially throughout the lifetime of the observatory, particularly with upgrades to components such as detectors and optical elements. While not all instrument are intended to have “work-horse” capabilities, long instrument lifetimes allow the capabilities of the Observatory to build over time in a way that is both scientifically advantageous and cost-effective for the partnership. For these reasons, Facility Instruments will be designed, constructed, and maintained to have a scientific lifetime of not less than 10 years.

10.5.2 Instrument Stations

The GMT will provide multiple instrument mounting locations that can support a range of different observational capabilities as described in the SRD. Mounting locations will be such that instruments can be maintained in an observation-ready state to enable rapid switching between instruments during the night and to minimize the frequency of daytime changes. Rapid switching between instruments will support time-critical observations and enabling the execution of observing programs matched to the environmental conditions. Time critical events include both predicted astronomical events and unpredicted transient events, also called “target of opportunity” observations.

10.5.3 Instrument Calibration

Facilities will be provided by the GMTO to enable the daytime calibration of instruments and the telescope as required to facilitate efficient nighttime operations. This will include, at a minimum, strategies to enable wavelength calibration and flat fielding of instruments designed for the widest telescope field of view, and the calibration and alignment of the telescope itself. The strategies (hardware, software, and operational procedures) will be such that observations of scientific targets may begin promptly at the start of astronomical twilight and “quick-look” data tools have the calibration information necessary to provide the data products described above.

10.6 Support for Scientists

User support” refers to the services and documentation provided to current and prospective users of the facility and archival data. These users may be astronomers observing on-site or remotely, or those astronomers whose programs are being executed through a queue or service mode. GMTO should provide these scientists with assistance in the following areas:

- Documentation related to the facility, instrumentation, infrastructure and logistics (travel, lodging, food, computing).
- Proposal preparation and program execution (phase 1 and 2 tools as needed, web forms, software).
- Advice and/or assistance with preparing for an observing run.
- Advice and/or assistance with planning to use a facility instrument.
- On-site (or remote) assistance in observing with a facility instrument.
- Instructions for retrieving data from the science archive.
- Guidance in reducing and calibrating data from a facility instrument.

10.7 Safety

The GMTO Stakeholders are committed to providing a safe working environment for GMTO staff, users, visitors, and those all who work at GMTO. The philosophy of the GMTO regarding the health and safety of the Observatory, its personnel, and the environment are described in the *Health, Safety, and Environmental Policy Document* (GMT-PM-DOC-00243, Rev. A). The strategies and processes that will be implemented by GMTO to ensure a safe and environmentally sensitive Observatory are described in the *GMT Health, Safety, Security, and Environmental Strategy Document* (GMT-DOC-01061, Rev. A).

The overarching goal of the GMTO safety policies is to achieve the highest performance in safety, health, and environmental management practices and to create and maintaining a safe and healthy working environment for all those involved with GMTO. As described in the documents above, the GMT facility will be designed and constructed with minimizing the safety risks to personnel and equipment. During the Construction Phase, all critical operations (e.g. primary mirror handling procedures, instrument handling procedures) will be reviewed for safety. GMTO designs will be developed that ensure appropriately low risk to personnel and equipment over the life of the Observatory. During the Operations Phase, strict safety practices and procedures will be defined for all operations and safety reviews will be conducted on a regular basis.

The GMTO will document environmental health and safety regulations related to construction and operations, such as emergency response plans, hazard analysis plans, and design regulations relevant to construction, shipping, work environment, and operations. GMTO will have safety personnel on site during Construction to oversee and enforce all aspects of personnel and hardware safety and will conduct periodic reviews of the Safety Plan and compliance with it. Safety personnel will train all employees regarding personnel and hardware safety as appropriate to their involvement with GMTO. The Observatory shall maintain a policy of “open reporting” with regard to all issues related to health and safety of the observatory and personnel.

Environmental conditions at the site will be monitored to ensure that the Observatory is operated only during safe conditions and is secured when conditions deteriorate outside of operational ranges. The GMT Safety Plan will include evacuation planning to ensure the safety of personnel when necessary.

During the Construction and Operations Phases, the health and safety of GMTO personnel and equipment is the responsible to the Board and President of GMT. To the extent that they are involved with development of GMTO subsystems, Founders' will govern the activities at their institutions, however subsystems must be designed and fabricated to safety standards established by GMTO.

11 Performance Assessment and Improvement

The GMTO is committed to meeting the scientific goals of the Founders through a process of continuous improvement that incorporates feedback from the Founders, scientists, and staff. The SAC has produced a White Paper (*GMT Metrics*, GMT-DOC-01584, Rev. A) that provides a detailed discussion of the performance criteria that are of interest to the scientific stakeholders, including potential metrics by which those criteria could be monitored. The GMTO's operations planning, evaluation, and continuous improvement strategies will incorporate these and other criteria for assessing the scientific and technical performance of the GMT, following the specifications below.

11.1 Assessment of Technical Performance

The GMTO will develop a strategy for consistent monitoring and tracking of Observatory performance to support maintenance, troubleshooting, and performance improvement. Tools and strategies will be developed to enable the status of all critical subsystem to be monitored from a single control "station" (physical or electronic) to facilitate the prompt identification of long-term performance problems that may impact nighttime operations.

11.1.1 Daytime Operations

The GMTO Project will develop processes for assessing the health of the Observatory and all subsystems, including facility instrument, during routine daytime operations. These will incorporate the operational strategies and recommendations of the subsystem development teams as well as feedback from Observatory Staff during commissioning.

Metrics will be developed to monitor the efficiency and effectiveness of daytime operations. These will include:

- Maintenance efficiency – time spent engaged in reactive engineering efforts (in response to failures or errors) as opposed to time spent proactively improving performance or developing new capabilities.
- Telescope and instrument release times – the time of day at which telescope, and instruments are made available each day for scientific operations.
- Time spent on instrument calibration during daytime versus nighttime operations – the effective use of daytime for preparation of the instruments.

11.1.2 Nighttime Operations

The efficiency and effectiveness of nighttime operations contributes directly to the scientific impact of the Observatory. Statistics related to all functional and scientific performance requirements for the Observatory are of interest. A subset of metrics that will be developed to monitor the efficiency and effectiveness of nighttime operations include the following:

- Efficiency of nighttime initialization procedures for all subsystems.
- Instrument switching times
- Instrument configuration accuracy, efficiency, and completeness
- All steps associated with target acquisition, including dome slewing, telescope slewing, and establishment of guiding and image quality.
- Calibration overheads.
- Total open-shutter time on the scientific targets.

11.2 Assessment of Scientific Performance

11.2.1 Data Quality Metrics

The GMTO will monitor all characteristics for which science requirements have been defined. Those that can be measured using “quick-look” data tools will be monitored as part of nighttime operations. The most important of these are throughput and image quality. Throughput of the instruments and telescope will be monitored separately to support maintenance of each. Image quality characteristics that will be monitored during observations will include, for instance, encircled energy (or PSSN), Strehl ratio, and PSF characteristics (stability, uniformity, etc.) at the focal plane of the telescope and instruments. The GMTO Staff will include personnel that are responsible for identifying performance trends. Additional metrics will be developed utilizing processed data products that can be used to monitor the performance of instruments (e.g. fiber throughput or instrument flexure) and support their maintenance.

11.2.2 Time Allocation and Scheduling

The GMTO will develop a Time Allocation Plan that includes strategies for accounting of observing time to each Contributor, including moon phase, season, and total time allocations. The Observatory will maintain statistics regarding the total distribution of observing time per instrument, per Observing Performance Mode (e.g. diffraction limited vs seeing limited small field IR spectroscopy), and per Operating Mode (e.g. queue vs classical). Additional statistics relevant to the effective use and planning of observations will be tracked. These will include the fraction of time spent on time-critical observations (“target of opportunity observations” for which other scheduled observations are interrupted), the percentage of completed of scientific programs, the total observing time invested per program, and the effectiveness of the queue scheduled observations. The latter may include, for example, the degree to which observations are well matched to the conditions, the manner in which programs are completed (with observations occurring on a single or multiple nights) and the fraction of programs that are completed.

11.2.3 Archive Use

The Observatory will track the use of the archive, similar to other “operating modes” to assess the effectiveness of the archive for science. Potential metrics include the total number of papers produced, the number of citations to the archive, the total number of observations extracted, searches executed, total uptime, and the number of unique users.

11.2.4 Scientific Productivity

The fundamental product of the Observatory is data. Scientific publications that result from those data can only be produced by scientists, and that rate of those publications will be influenced by the policies adopted by each Contributor to encourage rapid publication. In addition, the scientific metrics that are of most interest to each Contributor will vary. With those caveats, the scientific productivity is of unanimous interest to the GMTO and its Founders, and the GMTO will monitor a wide range of metrics with the goal of developing strategies that will increase that impact. Such metrics will include:

- The number and impact publications, potentially with adjustments for long-term science programs.
- The number and value of external grants attached to GMT science programs.
- The number of PhD theses based “significantly on GMT data.”
- The number of undergraduates at GMT institutions involved in GMT science programs.
- The number of Contributor institutions collaborating per proposal.
- The number of non-Contributor institutions collaborating per proposal.

The SAC has also advocated that GMTO invest in higher risk scientific programs that may have lower impact on short timescales. Such proposals could be explicitly identified, and time allocation committees may choose to allocate some fraction of observing time to programs which have high scientific merit regardless of their estimated risk of success, be it scientifically, technically, or operationally.

11.3 Assessment of Contributor Satisfaction

Feedback will be collected regarding all Observatory services in support of scientific stakeholders, including the application process, the scheduling process (sometimes called “phase II”), execution of observations, data quality, data completeness, the data archive, and data reduction. The GMTO may choose to develop a “user committee” to provide users with a channel for communicating with the GMTO Staff and Board if the SAC does not serve this purpose during Operations. The GMTO will also solicit Staff feedback during Operations.

11.4 Assessment of Public Relations

It is in the best interests of the GMTO and the Contributors’ institutions to develop and maintain visibility with the public and the scientific community. This effort should be assessed by professional development and outreach staff, and may include the following metrics:

- The number of Press Releases issued per month that refer to GMTO.
- The number of K-12 students, undergraduates, and graduate students participating in GMTO-related outreach and/or education programs.