

GEMMA

Gemini in the Era of Multi-Messenger Astronomy

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Annual Report FY2019

Cooperative Support Agreement 1839225
Submitted September 30, 2019

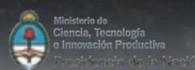
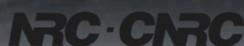


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Summary

The receipt of the award October 1, 2018 prompted the Gemini Directorate to create the “GEMMA” program to improve the ability to deliver the benefits of the individual projects funded by the CSA. The program was identified as the most efficient mechanism to establish processes within a structured framework for reviewing and assessing performance, which include the use of appropriate mechanisms that allow the observatory governance and the National Science Foundation and community stakeholders to measure performance and identify areas for improvement. The program ensures projects are organized and executed in a consistent manner within established standards

Major Goals

The multi-faceted GEMMA program is designed to upgrade Gemini’s instrumentation and operations in order to deliver essential capabilities for forefront astronomical research in the 2020s when both LSST and JWST will be in routine operations. The major hardware deliverable to be provided by GEMMA will be a state-of-the-art multi-conjugate adaptive optics (MCAO) facility, a key technology for the era of extremely large telescopes (ELT) to be deployed at Gemini North; referred to as GNAO. As part of the GNAO project, Gemini will deliver an advanced, flexible Real Time Computer facility for use with the AO systems at both Gemini North and South. The RTC is the brains behind the complex MCAO correction.

The major operations upgrade within the GEMMA program is the development of new software systems to maximize Gemini’s discovery capability in the era of Time Domain Astronomy (TDA). The GEMMA TDA project involves developing all the infrastructure needed to incorporate the Gemini telescopes into an efficient transient follow-up system known as the Astronomical Event Observatory Network (AEON), based on the Las Cumbres Global Telescope Network (LCGTN).

Scientific programs that have been awarded time on the AEON system will automatically trigger observations of the most interesting targets identified by “alert brokers” that monitor public alert streams from LSST and other time-domain surveys, including multi-messenger facilities such as LIGO. Gemini’s telescopes will provide the largest apertures within the network, and thus will be responsible for characterizing the most challenging targets. The TDA project includes the development of robust automated data reduction pipelines for rapid delivery of science-quality data products so the user can assess the outcome in real time.

The PIO-related effort within the GEMMA program will expand on Gemini’s legacy of broader societal impacts with ambitious initiatives inspired by the scientific and technical developments supported by this program. The focus is on multi-messenger and time-domain astronomy and the role of Gemini and other ground-based facilities in this new discovery space. Ultimately, the story told through this work is of a new era in scientific exploration, enabled by cutting-edge technologies and instrumentation supported by focused NSF funding.

As instrumentation enabling multi-messenger astronomy discoveries emerge, a framework for telling a compelling story about these discoveries becomes necessary. To this end, a “summit” of leaders in science education and communications will be convened with the task of converging on a charter to guide the public education and outreach efforts for presenting multi-messenger astronomy to various audiences.

Major Activities Accomplished Under these Goals

GNAO

The largest of the three projects, the Gemini North Adaptive Optics System, held its Conceptual Design Review (CoDR) September 26th and 27th 2019 for the Multi Conjugate Adaptive Optics system at Gemini north. Activities over the past twelve months culminated in design documents describing:

- Driving science cases
- Concept of operations
- Systems engineering technical management
- Trade studies and performance estimates
- AOS optical design
- AOS mechanical design
- RTC system architecture
- GNAO system controller architecture
- Project management plan

The CoDR committee provided a preliminary report on the second day of the review and will provide a comprehensive report within two weeks of the end of the review.

Time Domain Astronomy

The TDA project is working toward a CoDR in October. Activities during FY19 include writing the operational concept document in conjunction with developing the Operations Concept for the Observatory Control System (OCS). Experiments have been executed with different scheduling solvers, including investigation of solutions adopted by Las Cumbres Observatory for the TDA scheduler.

An Application Programming Interface (API) prototype was created to demonstrate how a full GMOS “Nod & Shuffle” observation can be specified, using the OpenAPI specification. The project scientist wrote a Gemini plugin for the TOM Toolkit, a Las Cumbres Observatory led open source software project. This allows teams using the TOM Toolkit to trigger observations on Gemini using the existing, limited API. Work began on the data reduction software, in addition to the setup work, the team produced initial implementation of core algorithms for wavelength calibration and for source extraction.

Public Information and Outreach

During the period of this report staff focused on planning and development of the MMA-TDA Communications Summit with the primary goal of developing a roadmap to advance the cause of effectively communicating the concepts of MMA & TDA to non-scientists.

The initiation of the GEMMA internship program is designed to provide unique opportunities for young career STEM professionals in education and communications. Intern positions were developed, advertised and applicants interviewed. The first of the four intern positions was filled in August. GEMMA interns are developing and evaluating educational content and materials for formal and informal science educational environments.

GEMMA Program Management

The GEMMA program and its constituent projects are governed by an Executive Committee (GEC), chaired by the Deputy Director. The GEC is comprised of senior-level members of the

Gemini Observatory. The list of the GEC members is given in Table. 1. Within the Observatory, the GEC mandate is to monitor and control the resources necessary to ensure the success of the projects and to resolve issues relating to resources, scope, cost, and schedule. The GEC Chair informs the Director of major issues and decisions.

For each project in GEMMA, there is a designated member of the GEC who holds responsibility for interfacing with the project and represents the GEC. For GNAO, this member is Henry Roe, for TDA the member is Andy Adamson and for PIO, the member is John Blakeslee. The Executive Committee invites additional expertise as needed from across Gemini and may include finance, engineering and AURA CAS and HR as needed. Authority flows downward from the Director to the Executive Committee and to the project managers. Need for higher level decisions flows upward along the reverse path.

In all cases, major project decisions that have significant external impacts will be referred to the Executive Committee (such decisions include design choices that impact future development options, impact on operations resources, major procurements, or major changes in project's deliverables). The Executive Committee will seek consensus decisions however, the Chair has final decision-making authority. For clarity, the composition of the GEC is presented below:

Table 1. GEMMA Executive Committee

Name	Title
Henry Roe (Chair, and GNAO Sponsor)	Deputy Director
John Blakeslee	Chief Scientist
Inger Jørgensen	Portfolio Manager
Scot Kleinman	Associate Director Development
Andy Adamson	Associate Director Hawai'i Operations
Rene Rutten	Associate Director Chile Operations
Catherine Blough (GEMMA Program Manager)	Senior Program and Project Coordinator

Monitoring Key Performance Indicators

Cost

The GEMMA program follows the current Gemini financial management practices governing CSA1. Cumulative expenditures at the end of Q2 fell short of the total FY19 budget estimate by more than 10% requiring a revised budget supported by a resourced work breakdown structure to accurately profile the estimated project expenditures for the remainder of FY19 and to move forward unspent funds to later years.

Current overall budget, actual expenditures and open commitments as of August 31, 2019 are shown below in table 2. Payroll for September will increase the total expenditures for FY19. The negative percentage remaining is caused by open commitments for services that span multiple fiscal years. Carry forward of unspent funds will likely be minimal and will be finalized when FY19 is closed by CAS accounting.

Table 1 Summary Budget and Expenditures

TOTAL GEMMA	Approved Budget	Total Expense FYTD	Current Open Commits	-Spend Remaining	-% Remaining
TOTAL WAGE & BENEFITS	1,010,867	883,305	0	127,561	12.62%
TOTAL TRAVEL	91,460	100,942	68,041	(77,523)	-84.76%
TOTAL OTHER DIRECT COSTS	95,963	123,447	437,229	(464,713)	-484.26%
TOTAL INDIRECT COSTS	116,271	103,237	0	13,034	11.21%
TOTAL EXPENSE	1,314,560	1,210,931	505,270	(401,641)	-30.55%
GRAND TOTAL	1,314,560	1,210,931	505,270	(401,641)	-30.55%

Table 2 Budget and Expenditures by WBS

GRAND TOTAL	Approved Budget	Total Expense FYTD	Current Open Commits	-Spend Remaining	-% Remaining
MMA External Fees	116,271	103,237	0	13,034	11.21%
WBS 1.0 Mgmt Account	276,969	275,765	38,594	(37,389)	-13.50%
WBS 2.0 GNAO	727,659	678,359	433,146	(383,846)	-41.84%
WBS 3.0 TDA	129,088	107,544	5,689	15,855	12.28%
WBS 4.0 PIO	64,573	46,027	27,841	(9,295)	-14.39%
GRAND TOTAL	1,314,560	1,210,931	505,270	(401,641)	-30.55%

Table 3 Program Budget and Expenditures

Program	Approved Budget	Total Expense FYTD	Current Open Commits	-Spend Remaining	-% Remaining
TOTAL WAGE & BENEFITS	175,104	161,124	0	13,980	7.98%
TOTAL TRAVEL	53,674	67,237	15,882	(29,445)	-54.86%
TOTAL OTHER DIRECT COSTS	48,191	47,403	22,712	(21,924)	-45.49%
TOTAL EXPENSE	276,969	275,765	38,594	(37,389)	-13.50%
GRAND TOTAL	276,969	275,765	38,594	(37,389)	-13.50%

Program Management “holds” funds for recruitment, relocation and training. The open commitments shown in Table 7 reflect the costs for new hires.

Table 4 External Rates

	Approved Budget	Total Expense FYTD	Current Open Commits	-Spend Remaining	-% Remaining
+TOTAL INDIRECT COSTS	116,271	103,237	0	13,034	11.21%
-TOTAL EXPENSE	116,271	103,237	0	13,034	11.21%
-GRAND TOTAL	116,271	103,237	0	13,034	11.21%

*Financial Reports by Project***Table 5 GNAO Budget and Expenditures**

	Approved Budget	Total Expense FYTD	Current Open Commits	-Spend Remaining	-% Remaining
TOTAL WAGE & BENEFITS	665,355	578,174	0	87,181	13.10%
TOTAL TRAVEL	28,032	24,551	33,271	(29,790)	-106.27%
TOTAL OTHER DIRECT COSTS	34,272	75,634	399,875	(441,237)	-1287.46%
TOTAL EXPENSE	727,659	678,359	433,146	(383,846)	-52.75%
GRAND TOTAL	727,659	678,359	433,146	(383,846)	-52.75%

Open Commitments –

Professional services - Mersenne Optical Consulting Limited - Flat Wave Front Sensors

Contracted services - TEKSYSTEMS - R. Rambold, RTC, POP to 9/30/2023

Table 6 TDA Budget and Expenditures

	Approved Budget	Total Expense FYTD	Current Open Commits	-Spend Remaining	-% Remaining
TOTAL WAGE & BENEFITS	119,334	104,724	0	14,611	12.24%
TOTAL TRAVEL	9,754	2,410	5,689	1,655	16.97%
TOTAL OTHER DIRECT COSTS	0	410	0	(410)	0.00%
TOTAL EXPENSE	129,088	107,544	5,689	15,855	12.28%
GRAND TOTAL	129,088	107,544	5,689	15,855	12.28%

Table 6 PIO Budget and Expenditures

	Approved Budget	Total Expense FYTD	Current Open Commits	-Spend Remaining	-% Remaining
TOTAL WAGE & BENEFITS	51,073	39,283	0	11,790	23.08%
TOTAL TRAVEL	0	6,744	13,199	(19,943)	0.00%
TOTAL OTHER DIRECT COSTS	13,500	0	14,642	(1,142)	-8.46%
TOTAL EXPENSE	64,573	46,027	27,841	(9,295)	-14.39%
GRAND TOTAL	64,573	46,027	27,841	(9,295)	-14.39%

The PIO project financial report shows commitments for travel and contracted services. These were encumbered during FY19 for support of the MTCS summit and will be paid out at the conclusion of the summit in November.

Monitoring Budget and Expenditures

The main drivers of the estimated FY2019 budget underspend were reduced FY2019 labor costs due to a slow start in the hiring of GEMMA staff. In order to monitor the labor effort charged to GEMMA, monthly time card reports are sent to the project managers allowing them to follow up with staff who are under reporting effort compared to the Resource Allocation Sheet, (RAS).

A “GEMMA” RAS was created and each project manager added the required resources for the duration of their respective projects. The GEMMA RAS will be used as the “baseline” to monitor both labor effort requested and effort used and the corresponding labor costs. Additional information on how the GEMMA RAS baseline is used to monitor any additional effort beyond the baseline is described under the Resources section.

Project Managers monitor their respective budgets in Control and CASnet and complete internal Gemini quarterly financial reports that are reviewed by the Portfolio Manager and the Directorate.

Resource Management

Staffing plans based on the work breakdown structure for projects were created in May and submitted with revised PEPS in Q3. Due to continued under spending NSF requested a revised budget and WBS submitted in August. The revised WBS is the current baseline in the GEMMA RAS. Project managers receive monthly reports from the Portfolio Management Office allowing them to compare the resources in the WBS to planned staff effort to actuals.

To ensure that GEMMA has access to the labor resources needed for successful projects a process was developed and implemented by the Portfolio Manager to add stability and predictability to the labor resources available to GEMMA and Operations. Boundary conditions and tolerances for GEMMA labor resource requests that affect Operations staff (staff normally paid by O&M funds) were defined.

- Each GEMMA project’s labor resource plan (WBS FTE list) is the baseline for the project.
- Requests for labor effort beyond the baseline (and outside the defined tolerance) is considered an escalation request for review/change to the GEC.
- The GEC decides if the requested resources can be made available, or if the project will need to adjust or hire dedicated program staff.

- A request from TDA needs to include information from the PM on the consequence for other software projects or Operations. A request from GNAO will be discussed with science operations and engineering operations before action by the GEC.
- PEP labor resource plan (and WBS) are visible to the GEC in order to compare to the RAS.

The tolerances are defined to reflect what the Observatory in general can handle, not what the projects may need. The following describes requests that are considered out of tolerance - all percentages are of nominal load for a full-time staff member:

- Adding any new staff at >15% for one month, or >10% for more than one month (calculated by quarter)
- Increasing any existing staff on a project with >15% for one month or >10% for more than one month
- Decreasing any existing staff on a project with >15% for one month or >10% for more than one month. (A decrease of this size is considered out of tolerance as it frees up sufficient effort for which Operations can take advantage and may also significantly affect O&M labor spending.)
- Implicitly moves from one staff to another of similar sizes are also considered out of tolerance

The tolerances mean that a GEMMA PM can adjust the load for an Operations staff member with ~24h in a month, or ~50h in a quarter without being outside the tolerances and without triggering an escalation. The comparison is always with the project baseline - starting with the August revised WBS baseline. If approved by the GEC a GEMMA project may be re-baselined during the life of GEMMA. Not all requests out of tolerance need to be referred to the GEC if the PM and line manager can reach agreement on the request. However, all requests out of tolerance at the end of a quarterly RAS planning period and not explicitly approved by the line manager will be referred to the GEC.

Milestones and Schedule

Table 8. Milestones

GEMMA Program Milestones*	Completion Date	Revised Completion Date
Program Execution Plan Submission*	1/1/19	Completed
2019A Report to NSF	5/15/19	Completed
TDA and PIO Delta-PEP Submission	5/8/19	Completed
Program and GNAO/RTC Delta-PEP submission	5/24/19	Completed
First Annual Review*	7/10/19	Completed
Revised Budget and Work Breakdown Structure	8/21/19	Completed
2019B Report to NSF*	9/30/19	Completed
GNAO+RTC	Finish Date	
Submit documentation for CoDR	9/5/19	Completed
CoDR* - 1 week delay due to schedule conflicts	9/18/19	9/26/19
CoDR concludes	9/30/19	Completed
PD commences	10/01/2019	On track

Delta CoDR for Project Management	TBD	Work Begun
TDA	Finish Date	
Project Plan submitted to NSF	12/31/18	Completed
Concept of Operations Completed	5/15/19	Completed
Scheduler Work Package Milestones	11/27/20	
Scheduler Work Started	5/16/19	Completed
Gemini TDA APIs Work Package Milestones	3/4/20	
TDA APIs Work Started	7/15/19	Completed
Operational Requirements Baselined	7/29/19	Revised to 10/25/19
Interface Control Documents	10/1/19	
Pipeline Interfaces defined	10/1/19	Completed
Gemini APIs for TDA baselined	7/29/19	Revised 10/25/19
Real Time Pipelines Work Package Milestones	6/10/22	
Real Time Pipelines Work begun	4/1/19	Completed
Reviews	6/10/22	
Conceptual Review	7/10/19	Revised 10/25/19
PIO	Completion Date	
MMA-TDA Communications Summit (MTCS) Milestones	12/30/19	
Development of MTCS key objectives and outcomes	8/30/19	Completed
MMA/TDA Internships	11/30/21	
Initiate hiring process for MMA-TDA internships	5/10/19	On schedule
Intern #1 recruitment process	8/30/19	Completed

Risk Management

The Risk Management Plan was completed. Implementation is currently still via google sheets. In Q1 2020, the manual use of spreadsheets for risk tracking will be discontinued in order to track risk and issues in Jira.

Jira is software currently used by Gemini to manage Telescope Fault Reporting, ITS helpdesk, and Software Issue tracking. For the GEMMA program, Jira will be used to support project management and will organize, track and monitor risks and issues as well as providing document configuration management and change control.

The main advantages to Jira are:

- visibility and traceability of all information associated with an issue (risk/issue/change)
- easy to sort and display information about issues ie. searches/tables/reports
- easy to customize/tailor to suit the project's needs
- Gemini has established experience with the tool

The highest risk to the GEMMA projects continues to be availability of resources. However, implementing the WBS baseline resource requests and the boundary conditions process

described above will provide more consistent resources to the projects. Each project maintains their risk registers. Only two risks have been escalated to the GEC in FY19, involving a shortage of resources for GNAO and PIO. Both mitigated and retired.

Plans, Reviews and Reporting

Per the Cooperative Support Agreement (CSA) Gemini was tasked to produce Project Execution Plans (PEPS) for the projects by January 1, 2019. Semiannual reports are required to coincide with Gemini governance meetings. The GNAO project is required to submit quarterly progress reports and to hold a CoDR by end of FY2019. As a result of underspending in Q1 & Q2 request was made by the NSF for a revised PEP for each project. An NSF review was held in July to assess the progress of the projects. A revised WBS, budget and justification were requested at the NSF review as a result of the FY19 underspending. All reports and plans were submitted timely and the CoDR is on schedule to be held September 26 & 27th, 2018.

List of Acronyms

Acronym	Definition
AEON	Astronomical Event Observatory Network
A&G	Acquisition and Guider unit
AIS	Advanced Image Slicer
ANTARES	Arizona-NOAO Temporal Analysis and Response to Events System
Altair	ALTitude conjugate Adaptive optics for the InfraRed
ALeRCE	Automatic Learning for the Rapid Classification of Events
AO	Adaptive Optics
AOB	Adaptive Optics Bench
AURA	Association of Universities for Research in Astronomy
BTO	Beam Transfer Optics
CAS	Central Administrative Services
CCD	Charge Coupled Device (detector)
CDR	Critical Design Review
CCMP	Configuration and Change Management Plan
CMP	Change Management Plan
CoDR	Conceptual Design Review
CP	Cerro Pachón (the site of the Gemini South telescope)
CPU	Central Processing Unit
CSA	Cooperative Support Agreement
DM	Deformable Mirror
DM0	Deformable Mirror conjugated to the ground-later at 0m.
DR	Data Reduction
DRS	Data Reduction Software
DSP	Digital Signal Processor
ELT	Extremely Large Telescope
EM	Electromagnetic
EMCCD	Electron Multiplying Charge Coupled Device
ESO	European Southern Observatory
FoV	Field of View
FTE	Full-Time Equivalent
FWHM	Full-Width Half Maximum
GEC	GEMMA Executive Committee
GeMS	Gemini Multi-Conjugate Adaptive Optics System
GHOST	Gemini High-resolution Optical SpecTrograph
GIRMOS	Gemini InfraRed Multi-Object Spectrograph
GLAO	Ground Layer Adaptive Optics
GMOS	Gemini Multi-Object Spectrograph (-S located at Gemini South, -N at Gemini North)
GMT	Giant Magellan Telescope

GN	Gemini North
GNAO	Gemini North Adaptive Optics (a generic name for new AO system)
GNAOI	Gemini North Adaptive Optics Imager
GNIRS	Gemini Near InfraRed Spectrograph
GPI	Gemini Planet Imager
GW	Gravitational-wave
GS	Gemini South
GSAOI	Gemini South Adaptive Optics Imager
Hubble	Hubble Space Telescope
IRAF	Image Reduction and Analysis Facility
INTEGRAL	INTErnational Gamma-Ray Astrophysics Laboratory
ICD	Interface Control Document
IDF	Instrument Development Fund
IQ	Image Quality
IR	InfraRed
ISS	Instrument Support Structure
JWST	James Webb Space Telescope
KPP	Key Performance Parameter
KSR	Key Science Requirement
LCO	Las Campanas Observatory or Las Cumbres Observatory
LCGTN	Las Cumbres Global Telescope Network
LGS	Laser Guide Star
LGSF	Laser Guide Star Facility
LGSWFS	Laser Guide Star WaveFront Sensor
LIGO	Laser Interferometer Gravitational-Wave Observatory
LLT	Laser Launch Telescope
LPC	Laser Pointing Camera
LQG	Linear Quadratic Gaussian
LSST	Large Synoptic Survey Telescope
LTAO	Laser Tomographic Adaptive Optics
MCAO	Multi-conjugate Adaptive Optics
MMA	Multi-Messenger Astronomy
MOAO	Multi-Object Adaptive Optics
MTCS	MMA-TDA Communications Summit
MTMW	MMA-TDA Media Workshop
MUX	A readout multiplexer; can be used for testing controllers without the more expensive components of a complete detector
NASA	National Aeronautics and Space Administration
NCOA	National Center for Optical-Infrared Astronomy
NCPA	Non-Common Path Aberration
NFIRAOS	Narrow Field Infrared Adaptive Optics System TMT
NIFS	Near-Infrared Integral Field Spectrometer

NGS	Natural Guide Star
NGS2	Next Generation Sensor for Natural Guide Star
NGSWFS	Natural Guide Star WaveFront Sensor
NOAO	National Optical Astronomy Observatory
NIRCAM	Near Infrared Camera
NIR	Near InfraRed
NSF	National Science Foundation
NUMA	Non-Uniform Memory Access
O&M	Operations and Maintenance
OAP	Off-Axis Parabola
OCS	Observing Control System (Gemini operations software)
ODGW	On-Detector Guide Window
OIWFS	On-Instrument WaveFront Sensor
OIR	Optical and Infrared
PC	Personal Computer
PI	Principal Investigator
PM	Program Manager
PMB	Performance Measurement Baseline
PMKB	Program Management Knowledge Base (Gemini's Project Management Database)
PMO	Portfolio Management Office
PEP	Project Execution Plan
POLC	Pseudo Open Loop Control
PSF	Point Spread Function
PWFS	Peripheral WaveFront Sensor (two located in the A&G system)
QAP	Quality Assurance Pipeline
RfP	Request for Proposals
RTC	Real-Time Computer
rToO	Rapid Target of Opportunity
SEMP	Systems Engineering Management Plan
SFS	Slow Focus Sensor
SH	Shack-Hartmann
SHWFS	Shack-Hartmann WaveFront Sensor
SCAO	Single Conjugate Adaptive Optics
SIMD	Single Instruction Multiple Data
SOAR	Southern Astrophysical Research Telescope
SF	Science Fold
SR	Strehl Ratio
SwRI	Southwest Research Institute
TDA	Time Domain Astronomy
TMT	Thirty Meter Telescope
TOM	Target Observation Manager
ToO	Target of Opportunity

TT	Tip-Tilt
TTM	Tip-Tilt Mirror
TFS	Transient follow-up system
VIS	Visible wavelength region
VLT	Very Large Telescope
WBS	Work Breakdown Structure
WFS	WaveFront Sensor
XAO	eXtreme Adaptive Optics
ZTF	Zwicky Transient Facility

Part I. Risk Identification					Part II. Risk Analysis for Existing Controls			Part III. Risk Response								
Name	Program Risk Category	Risk Description (ignoring controls)	Impact 1-5 (ignoring controls)	Likelihood 1-5 (ignoring controls)	Total Risk Score Low = 1 - 8 Med = 9 - 16 High = 17 - 25	What Controls (if any) are currently in place?	Control Effectiveness 1-5	Residual Risk Score Low = 1 - 8 Med = 9 - 16 High = 17 - 25	Control or Risk Mitigation Strategy	Control effectiveness based on mitigation strategy 1-5	Residual Mitigated Risk Low = 1 - 8 Med = 9 - 16 High = 17 - 25	Contingency Plan	Cost of contingency plan	Owner	Review Due Date	Status
Single source failure	Schedule	If a single resource/person is unable to complete an assignment and there is no identified knowledgeable backstop resource, the program/projects can be negatively impacted causing a schedule delay.	5	4	20	The RAS Process, team meetings will note potential failure points and help to identify backstops with potential escalation to the GEC.	3	10	The use of the boundary conditions will help mitigate some risk, also request PMs send identify the single PoF and have mitigation plans in their own registers to identify safety net.	3	10	Escalate to Directorate	Dependent on staff costs - variable	PM	12/31/2019	
Program/Project Resources	Schedule	If existing resources are not assigned to the project because of competing priorities then program delivery could be negatively impacted	4	3	12	Resource Allocation Process and monthly project reports reporting staff shortage, team meetings and escalations to GEC.	4	9	Watch project portfolio for any at risk projects that could cause the risk and recommend coaching for project teams.	3	6	Escalate to Directorate	Dependent on staff costs - variable	PM	12/31/2019	Open
Program/Project Resources	Scope	If costs of staff from CSA1 exceed available funding in CSA2 projects may need to down scope delivering less than promised	2	2	4	Monitoring costs in control and other costs in casnet	5	4	Increase M&O staff time on Gemma by reducing time on competing projects.	4	3	1) Portfolio Manager to work with PM and Line Managers to reorder team member's tasks to maintain critical path, 2) reduce scope to meet project due date	Dependent on staff costs - variable	PM	7/30/2019	Open
Procurements	Schedule	If procurements cannot be completed in a timely manner because insufficient acquisition planning, business services staff shortages or NSF delayed approvals then the program delivery could be negatively	4	2	8	Monthly contract meeting with CAS, identified procurements for GNAO based on WBS and schedule.	5	8	Work with Cas, NSF on ways to streamline process beneficial to all parties.	2	2	Escalate to GEC, AURA corporate.	Unknown	PM	7/31/2019	Open
Communications	Benefits	If Gemini and AURA, the STAC, the Governance Board, and the user community are not aligned because of miscommunication then the long term goals may not be met.	4	2	8	Governance reports and meetings, User committee, Gemini Focus, GEMMA webpage, regular meetings with NSF.	3	4	Create a communications advisory board	4	6	Hire marketing firm	\$50 per hour	PM	7/31/19	Open
Communications	Benefits	If team communication isn't effective and the team is not aligned, schedule will be impacted.	5	4	20	Escalation to appropriate manager to help resolve communication concerns.	5	20	Clearly defined roles, responsibilities and expectations.	5	20	Escalate to GEC.	Schedule may be impacted	PM	7/31/2019	Open