Keck Adaptive Optics Note 566

NGAO System Design Phase
Programmatic Risk Evaluation

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ABSTRACT

This note is intended to summarize the significant programmatic risks associated with the NGAO program as identified during the system design phase. The programmatic risks are considered to be distinct from the technical risks addressed in KAON 510.

1. Methodology

The JPL risk evaluation matrix approach used for the Keck Interferometer was selected to track the significant technical risks. This matrix ranks each risk by the consequences and likelihood of the risk occurring. A scale of 1 to 5 is used with higher numbers representing higher risk.

Likelihood of Occurrence:

Level	Definition
5	Very High > 70%, almost certain
4	High >50%, more likely than not
3	Moderate >30%, significant likelihood
2	Low > 1%, unlikely
1	Very Low <1%, very unlikely

Consequence of Occurrence
(replaced JPL's usage of "launch" with "schedule")

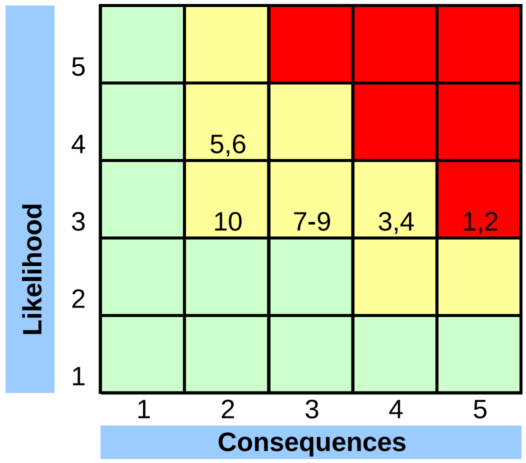
Level	Implementation Risk Definition
5	Overrun budget & contingency. Cannot deliver.
4	Consume all contingency, budget or schedule
3	Significant reduction in contingency or schedule slack
2	Small reduction in budget or schedule slack
1	Minimal reduction in budget or schedule slack

A JPL-format technical risk matrix using these definitions is shown in the next section. In this risk matrix red represents high risks that require implementation of new processes or a change in the baseline plan, yellow represents medium risks that need to be aggressively managed including considering alternative approaches, and green represents relatively low risks that should at least be monitored.

2. Programmatic Risks Identification and Ranking

2.1 Programmatic Risk Matrix

The current programmatic risk matrix is shown in the following Figure.



2.2 Significant Programmatic Risks

The following table lists the significant programmatic risks that have been identified. The risks have been sorted in descending order by highest combined consequences and likelihood scores, followed by highest likelihood and highest consequence. Each risk has a unique number, a trend column which will be used for tracking which way the risks are moving, a consequence ranking, a likelihood ranking, a description, the status of the risk and plans for mitigation.

#	Trend	Conse-quence	Like-lihood	Description	Status	Mitigation
1		5	3	Significant NGAO funding needed.	\$2.7M of combined TSIP/WMKO funding is available for preliminary design. Seeking advancement funding is a high priority for WMKO and is pending the system design review & cost estimate.	1) Good project performance, especially in the system and preliminary design phases, will aid the funding search. 2) Support WMKO Advancement Office fundraising efforts. 3) Produce funding proposals (e.g., TSIP proposal for detailed design).
2		5	3	Required lasers unavailable &/or costs too high	LMCT is developing lasers for Gemini & Keck, but future lasers may not fit with Lockheed's current business model. SOR is working on a 2nd generation laser, but there is currently no means of getting these lasers built for us. Fiber lasers are under development, but do not currently offer a viable option.	1) Track laser progress. 2) Discussions with laser vendors. 3) Actively develop an approach for getting the SOR-type lasers built. 4) Evaluate the impact of procuring less laser power.
3		3	4	Challenge of a rapid project ramp-up	Current plans require a rapid ramp up of personnel between the design phase and the full scale development phase.	1) Produce of a viable plan, during the PD phase, for rapid personnel ramp up. 2) Find additional funds early to allow more people to be involved sooner.

4		4	3	Growth in cost estimate	A system design level cost estimate has been prepared. The costs cost could potentially grow as the design and costs are further developed during the preliminary and detailed design phases.	1) Active effort to identify and exploit cost savings opportunities during PD phase. 2) Employ a design to cost approach during PD and DD.
5		2	4	Lack of full-time personnel	During the SD phase only one to two people were working essentially full time on NGAO, with the rest working part-time. This obviously leads to inefficiencies and the overhead associated with keeping more people involved.	1) Identify further full-time personnel and get them on board as early as possible. 2) Work with existing personnel to transition from other responsibilities in order to focus on NGAO.
6		2	4	Committee management structure (Executive Committee)	The Directors set up an Executive Committee (EC) to manage the SD phase. This approach provided a great deal of expertise & experience to the project and created buy-in from our three institutions. Although the EC worked well together, this approach resulted in distributed part-time leadership, management inefficiency & slower decision making.	1) EC to propose an alternate management structure to the Directors for the PD phase and beyond.
7		3	3	Development schedule for Science Instruments is delayed with respect to NGAO	The science instruments for NGAO will be under separate management from the NGAO system. Because of the longer development timeline and greater potential impact on the NGAO low order relay and LOWFS pickoff design, we plan to start development of the deployable IFS during the NGAO PD phase, and based on this an ATI proposal has been submitted for the system design phase of that instrument. The NIR and visible imagers are viewed as lower risk, and as a result no proposals have been submitted yet for these instruments, although enough detail is available from the NGAO system design phase to begin preparing proposals. It will be critical to have at least the NIR camera available for NGAO lab I&T.	1) Need to agree with the WMKO instrument manager on a viable schedule for the science instruments that meets the NGAO needs. 2) Observatory needs to obtain funding for the science instruments. 3) NGAO and science instrument management should work closely together to ensure the best overall usage of available funds to ensure that a high quality combined NGAO/instrument science product is available in a timely fashion.

8		3	3	Schedule impact of funding uncertainty	Funding uncertainty makes it more difficult to attract new people.	1) Identify more funding. 2) Make commitments to a few key people.
9		3	3	External contract schedule slips	Gemini experienced significant slips in their external contracts for MCAO (laser ~ 40 months instead of 16 months; RTC ~ 43 months instead of 22 months). We currently only have scheduled 18 months between completion of the detailed design and the start of lab I&T.	1) Release long lead external contracts during DD phase. This requires planning to have these items reach the appropriate design level early. 2) Plan in contingency time for late contract delivery. 3) Carefully monitor contract progress and respond to schedule issues.
10		2	3	Schedule slip due to personnel availability	Conflicts were encountered during the SD phase with timely access to part-time personnel due to the press of other competing activities.	1) Switch to full time personnel where possible and get them on board. 2) Clearly identify part-time needs and get commitments from the relevant staff and their supervisors.

4. Programmatic Risk Mitigation Plans

4.1 Preliminary Design Phase

Many of the above programmatic risk items will be addressed during the preliminary design phase. Specific actions planned for the preliminary design phase, on the medium to high risk items, include the following (the numbers below correspond to the first column in the above risk table):

1. NGAO funding.
   - WMKO's Advancement Office has NGAO funding as a very high priority. Advancement will proceed with funding proposals once the project has been approved to proceed.
   - Time for writing proposals has been included in the preliminary design phase plan.
2. Laser availability.
   - While NGAO would benefit from the higher photon return efficiency demonstrated by the SOR single frequency laser, there is no straightforward path to obtaining lasers based on this design. Issues with this procurement are discussed in KAON582. A technology transfer and business model would need to be developed to obtain lasers based on this design. It is also possible that another supplier (including the supplier of the lasers for Gemini South Observatory and the Keck I telescope) might be convinced to build lasers operating in a single frequency mode that would meet our requirements. Determining the best solution to the laser availability problem is a key activity in the PD phase laser WBS.
3. Rapid ramp-up.
4. Cost estimate growth.
5. Lack of full-time personnel.
6. Management structure.
7. Science instrument schedule.
8. Funding uncertainty schedule impact.
9. External contract schedule slips.
10. Personnel availability.

4.2 Laser Procurement

Sean Adkins has written KAON 582 discussing the potential laser systems, vendors and risks, and proposing a laser procurement path that includes a collaborative procurement process with the TMT. His proposal fits well with the need for early retirement of the laser programmatic risks and his plan has been incorporated into our preliminary design phase plan. Sean's plan includes placing a laser contract in June, 2009 in order to have the laser(s) delivered in December, 2013.

This delivery date is a few months late with respect to our current project milestone of starting lab I&T in September, 2013 (although Sean reports that a production prototype laser that would be completed earlier could potentially be used for lab I&T purposes). In addition there is considerable risk that we will have insufficient funds and/or insufficient approval to precede with a laser contract during the preliminary design phase. The earliest significant new funds will likely become available is the start of FY10 which would add an additional few month delay. We will need to work closely with WMKO management on the funding issue.

Sean summarizes the principle risks for the NGAO laser systems as follows:

1. No production laser system available
2. Limited business case for a commercial supplier
3. No clear path to production of the SOR-type single frequency design
4. Development work is required for the power levels needed to use a mode locked design, additional risk that higher power may not achieve the required photon return levels due to saturation
5. Key components such as high power pump diodes remain difficult to obtain and of uncertain lifetime
6. Significant production engineering required to field systems ready for NGAO scale deployment
7. Laser system costs are high.

The feasibility of the proposed TMT collaboration will need to be worked out with TMT management. This collaboration would enhance the limited business case for a commercial supplier and we could also benefit from their thinking about laser performance issues.