Discussion Summary: Operating Modes and TACs Panel

Observing modes can play a key role in how telescopes function and what sorts of science they can effectively support. ELTs represent not only very large construction investments, but also extensive long-term operations costs, so careful considerations of science operation modes is warranted to ensure that this investment best serves its scientific community. Historically, there have been two principal modes of science operations at ground-based observatories: classical and queue. Among current 8-m-class facilities, Keck, MMT and Magellan operate mostly in classical mode, while VLT and Gemini support mostly queue-based programs.

Classical Modes

Classical operations have been supported in multiple varieties. In its purest form, observers are awarded a fixed amount of time, usually in units if integer nights though sometimes in smaller fractions of nights, and are expected to carry out their observations on site.

This mode offers close interactions between observatory staff and the community they serve and support. The observations also have a bit more adaptability within the framework of the visitor's science programs. The cost and effort to carry out classical observations for the observer can also serve as strong motivation to obtain the highest quality results once the necessary expertise is acquired. Getting that expertise can be difficult, however, for infrequent or short-term visitors. Classical scheduling is also particularly sensitive to weather and technical problems since the lost time due to these effects cannot be shared by other programs. It can be difficult—and often unpopular with the visiting observer—to incorporate ToO observations into classical programs.

Two common variants of the classical approach include remote and delegated observing. In the former case, the observer carries out their science program in real-time, usually during pre-scheduled observing blocks, but from somewhere other than the observatory. In some cases, the 'remote' sites are not that distant: Keck observations are now frequently carried out at the Waimea headquarters, while CTIO supports Blanco 4m observations from La Serena. In some other cases, remote observing is carried out at great distance, removing the need for the observers to travel at all. Though convenient in terms of travel, the separation from the telescope means that observers lack direct contact with mountain staff and must rely on sometimes indirect information regarding local conditions. Alternatively, some observatories arrange to pool observations in such a way that individual observers carry out programs for a variety of researchers as well as themselves. The MMT, for example, runs its 'Hecto' spectrographs in this manner whenever these instruments are scheduled during long blocks of time. Remote observing is subject to the same sorts of time losses due to weather and mechanical problems that was noted for standard classical observing. 'Pooled' or 'delegated' observing can mitigate this somewhat by ensuring that programs that lost time early in a block are 'repaid' later on. Some observatory support in near-real-time scheduling is needed to effectively realize these sorts of benefits from such 'pooled' observations.

Queue Mode

In most cases in which it is applied, queue observing aims to match observing conditions closely to those required for a given program, something that happens more by luck in classical runs (though of course, it can commonly be achieved at a good site). It is also often noted that a queue system can ensure that the 'best' programs—as defined by the TAC—receive the highest priority. Ideally, these characteristics help ensure datasets of more uniform quality and, in order to provide sufficient information for researchers to carry out their science programs, often automatically provide adequate data to readily archive data. Queue operations are also generally very amenable to ToO programs; if these are expected to be a significant fraction of a facility's science program, this could be an important consideration. Facilities that carry out significant queue programs incur significant costs in staffing to make this mode work well. For users, queue observations also demand considerable preparatory work with no guarantee of any return. This approach also implicitly accepts that TAC grades, even in a relative sense, are useful to prioritize observing schedules. In some observatories, for example Gemini, proposals are binned into three broad categories to help smooth out the stochastic nature of TAC grades. Queue observing also severs the connection between users—who are now no longer really 'observers'—and the facilities from which they receive their data.

Issues

These modes affect more than just who visits observatories, when they visit, or how staffing handles day-to-day scheduling. Instruments that are to be used in queue mode must be designed to be available at all time, and their calibrations must be obtained whenever necessary, as observations demand. This can add another layer of effort for the staff that cannot be directed to, say, maintenance or routine facility operations. On the other hand, to the extent that quick-change capabilities are built into instrumentation suites at individual observatories, classical modes of operation may not adequately exploit these capabilities. Though instrumentation plans for all ELTs are quite advanced, the reality of maintaining such complex machines ready at all times has not been demonstrated, so it is by no means clear which kind of observing mode will be favored by the hardware.

Along with these 'modes' of operation are certain 'styles'. This clearest illustration is the distinction between small and large programs where the former is defined as projects that can be completed in a single observing block of modest duration, while the latter implies a project that may take many years over many seasons to complete. All observatories seem to wrestle with this to some extent; the VLT has its 'Key Projects'; NOAO supports 'Survey' and 'Long-Term' programs that can in principle include Gemini observations. Other facilities, since they tend to be run by comparatively small consortia, can incorporate large programs more transparently by individuals or groups that can rely on a steady stream of observing time year after year. By all accounts, both long and short programs produce good science in the form of published papers (the rates are, to the extent one can measure this, about the same in terms of number of nights per paper). Deciding on the best balance between these and other styles of observing is important, but can probably be readily accommodated by any facility at just about any stage of its construction or operation lifetime.

Perhaps the best way to decide on observing styles is to let the 'market' dictate, and perhaps the best way to determine what the market is saying is to see how telescopes are scheduled today. NOAO operates a complicated TAC process that includes assignments of community access time on large telescopes such as Keck, Gemini, MMT, HET and Magellan. A broad range of people and expertise comprise the NOAO TACs, which are separated into broad disciplines, some overlapping to avoid conflicts of interest. These committees are all told to choose the 'best' science among the proposals they review, but to ignore all other considerations such as amount of time, size of the teams, etc.

There are other models, of course. Some multi-partner observatories (e.g. Keck, Magellan, MMT) have separate TACs at each institution who then fit their programs into a pre-determined fraction of the total observing time. The VLT has similar proportionality constraints, but they operate in a manner similar to NOAO and simply allow the balance between member communities to occur (or not occur) naturally. Remarkably, these all seem to work, implying that it may not be necessary to agonize too much on what's 'optimum'.

However, the NOAO TAC data are interesting in how they reveal demand for modern facilities. Oversubscription for the largest telescopes that the NOAO TAC can assign averages about 3.5-4, a healthy ratio, particularly given that there is no funding associated with ground-based observing time. At NOAO, the oversubscription on the 8-m class telescopes has generally remained significantly higher than for 4m or smaller telescopes. The main exceptions occur when some specific instrumentation upgrades occur on the smaller facilities; for example, over the past two years the KPNO 4-m has been much more oversubscribed than HET and sometimes even more oversubscribed than Gemini. Thus, the case for more, well-instrumented, large-telescope time seems well justified. In terms of large/small programs, the NOAO requests of recent years show a clear evolution to smaller programs for larger telescopes. This must reflect at least the perception of what gets time on these telescopes (TACs at NOAO are very strongly encouraged *not* to alter the length of a request) as well as the kinds of science programs being carried out. Programs of 1-2 day duration are most popular for 6.5-m or larger telescopes at NOAO, while, overall, programs of 3-4 days remain most common for smaller telescopes. The latter partly reflects rules regarding the minimum length of runs on some telescopes, but it is clear that very large programs are not dominant. However, there is a secondary peak of about 15 days for the smaller NOAO telescopes suggesting that some large-scale programs are being requested and approved. One possible factor that affects these statistics is that survey programs are not formally supported (yet) at Gemini, so that biases against longer runs at that facility.

Team size, another 'style' of research, has also evolved. Over time, programs requesting time on larger telescopes have been proposed by ever-larger teams. Since the runs are getting shorter over the same period, this implies less time per researcher on larger telescopes. Is this a sign of the times? Even 15 years ago it might have been difficult to predict the growth of massive groups on proposals and papers, so it is certainly plausible that these trends will continue.

Finally, it is of interest to note that joint NOAO programs with NASA facilities have not grown much over the past few years, nor does the amount of time requested reach the quota for such projects. The role of such joint programs will grow more complicated in the future as rapid-response, large-area surveys such as PanSTARRS and LSST will produce synoptic data on a nightly basis. To what extent will future ELTs coordinate with these and future NASA missions? Current experience at NOAO indicates that there will be interest, though probably at a much higher rate than we see today. The biggest concern, in fact, may be how to limit such joint projects: LSST alone could produce enough transient ToO targets every night to completely swamp future ELTs. Having some understanding of how these relative modes and styles might be accommodated into any future ELTs is critical for the community to gauge their interest in these projects.