# Planning for ALMA Science Operations: Lessons from the VLT Experience

David Silva
ESO/Garching
Data Management & Operations Division



## ALMA Science Operations: A Vision…

*Ref: ASAC Report, Oct 2001,App. C*

- **Ops Support Center**
  - San Pedro de Atacama
  - Observation scheduling & execution
  - No Visitors (?)
  - On-line QC

- **Central Office**
  - Santiago?
  - Master archive
  - Off-line QC
  - Data processing & distribution

***Many issues still under discussion…***
***What can be learned from VLT?***

**?**

- **Regional Support Centers (?)**
  - Europe, N. America, Japan
  - Phase 1 & 2 (?)
  - Archive copies
  - Archive research support (?)

# VLT Science Operations

- **Paranal Observatory**
  - Visitor Mode support
  - Service Mode execution
  - Calibration Plan
  - Instrument handbooks, operations specifications

- **ESO Headquarters**
  - Phase 1 & Phase 2 (Service Mode)
  - Long and Medium-Term Scheduling
  - Data Quality Control
  - Data Processing & Distribution (Service Mode)
  - Science Archive Facility



# Operations: Tasks

- **Do not under-estimate required tasks**
  - 24/7 observation execution, monitoring, tracking
    - Real-time scheduling with or without software support
    - Observation execution problem resolution
  - Daily on-site calibration, QC monitoring, tracking
    - Instrument problem troubleshooting
  - Operations process specification
  - User documentation creation & maintenance
  - Phase 1 technical reviews
  - Phase 2 preparation & support
  - Visitor Mode support
  - Breakpoint management (!)
  - **…and what else?**

***VLT(full ops, projected)***
***Annual Users: 800+***
***Observing Runs: 800+***
***ALMA: ???***

## Operations: Staff

- **Hire science ops staff as early as possible**
  - Get involved in early commissioning, ops definition, ops support tool specfication and testing
  - Front-load ramp up
- **Recruitment & retention**
  - Hire best scientists whenever possible
  - Recruitment to Chile from Europe/N. America difficult
    - Competition with Regional Support Centers?
  - Need to built in real research support
    - Time = large enough staff, reasonable workloads
    - Resources (e.g. computers, travel money)



## Operations: Distributed

- **Unified command structure**
  - Well-understood lines of authority and responsibility
  - Process ownership by individuals, not committees
  - Global vision of process development
  - Shared tasks = shared headaches
- **Interfaces & workflow**
  - Keep on-site team focused on on-site activities
    - Do not let users interact with on-site team directly!
  - Regional support in regional culture/language (?)
  - Remote support staff must spend time in on-site environment
- **Need unified system, not just toolkit**

## Operations: Support Software

- **Software for staff, not users**
  - Manage, track & report all high-level operations tasks
  - Workflow driven, relational database oriented, high-level GUIs
  - Systems not just toolbox
    - Needs end-to-end operations concept
- **Issues**
  - High-level operations software always gets lower priority
    - Result: frustrated staff, less efficient ops, fewer observations
  - Who builds? Ops staff answer bad…

***No current observatory started early enough…***



## Early Operations

- **Keep early operations simple and conservative**
  - Under promise, over deliver
  - Assume ops software support tools late and/or require tuning
    - ALMA Simulator, Dynamic Scheduler, Pipelines
  - Plan for high-level software changes
    - Budget for software engineering
    - Keep ops staff involved
    - Rapid prototyping before production versions
  - Minimize user flexibility…

## User/Science Flexibility

- **Breakpoints & Eavesdropping**
  - Benefit: more user flexibility
  - Cost: more ops staff, impossible scheduling
  - VLT Axioms:
    - Do not allow direct contact with on-site operators
    - No user defined breakpoints
- **Restrict execution options (at least in early ops)**
  - Breakpoints, instrument modes, frequencies, array configurations, etc
- **Encourage Director Discretionary Time use**
  - Allows rapid response to unforeseen science result
  - Allows small pilot projects
  - Cost: need DDT committee/process



## Programme Review/Scheduling

- **VLT TAC**
  - Science evaluation only
  - Technical reviews after TAC evaluation
    - Large over-subscription (4:1+) = review load lower after TAC review
    - Operational & technical feasibility
    - Few scientifically meritorious proposals rejected on feasibility grounds
- **VLT Scheduling**
  - Scheduling done post-TAC by ESO staff
  - Scheduling not linear, but probabilistic (weather!)
- **ALMA Concept**
  - TAC does science, technical, and (some) scheduling/queue-building
  - Who does final schedule?
  - What software tools are required?

# Regional Support Centers

- **VLT RSC = Garching**
  - On-line and mission critical
  - Phase 1 for all users
  - Phase 2/Long-Term Schedule – unified!
  - Phase 3: run execution problem troubleshooting & user support
  - Science Archive support

  *…and much more…*

- **ALMA RSC = ?**
  - On-line or off-line?
  - Distributed or Monolithic?
  - What is mission-critical?
    - Phases 1, 2, & 3 (?)
  - What is not mission-critical?
    - Post-observation support
    - Additional data processing software
  - Interfaces to ALMA?

***What can be learned from Gemini?***



# Gemini Observatory

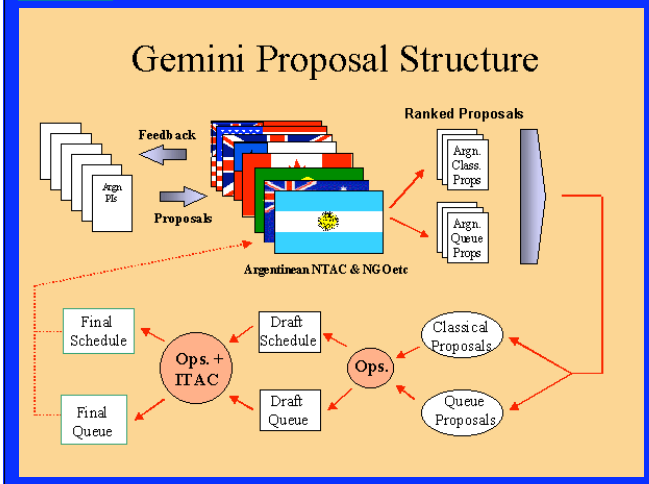


*Figure Source: Gemini Web pages*

- **Phase 1**
  - Managed by partners
  - Merged by Gemini
  - Schedule by Gemini
  - Approved by ITAC
- **Phase 2**
  - Managed by Gemini
- **Phase 3**
  - Managed by Gemini
- **Archive**
  - No Science Archive (?)

***Is this a good model?***

## Calibration Plan

- **Mission critical**
  - Monitor system performance
  - Facilitate Archive usefulness
  - Necessary for science products
- **Observatory responsibility**
  - Cannot be left to individual users
  - Requires monitoring and fine-tuning
  - Driver for pipeline development
    - Need master calibration data, QC parameters



## Quality Control

- **Types of quality control**
  - Information “in” (proposals, observation blocks, etc)
  - Information “out” (science data, calibration data, processed data products)
- **Need systems for both!**
  - Process + software + FTEs
  - No system = more manual work = more “garbage in and garbage out” = more user (and staff) frustration!
  - Keep operations staff in tight collaboration with developers

## Conclusion

*Keep It Simple!*