Manufacturing Goals

• Out-source board assemblies
• Ready the facility for manufacturing
• Build modules in-house as needed
• Maintain the Schedule
Board Design Education

- GTC in-house training (6 hrs)
- PROTEL & PADS training
- OJT during prototype stage
  - Small runs
  - Multiple vendors
- Planned for numerous revisions
Final Circuit Boards

- Designed for automated assembly
- PROTEL, PADS & ORCAD
- Multi-layer boards (6-14)
- BGA, surface mount components
  - Components on both sides
- Ready for Out-Sourcing
NRAO will Provide:

- Basic Ordering Agreement, 1-2 years
  - Long term commitment
- Software designs and BOMs
- Design reviews with vendors
- Dedicated test fixtures
Board Vendor Provides:

- Fully assembled boards
- Partially tested
  - Flying probe tests
  - NRAO test fixtures
- ESD packaged and labeled
- Scheduled deliveries
- Hazardous chemical handling
In-house Module Assembly Preparation

• Trained staff
• Same team that built the prototypes
• Complete assembly drawings
• New soldering stations
• Test equipment & computers in place
ESD Preparation

- 12 ESD stations including floor mats
- ESD totes and parts bins
- ESD shoes and wrist straps
- Humidity controlled facility
- Parts bins by area
Planning for Small Production Runs

- Goal is to produce 28 similar antennas
- Small quantity builds, 5-10 at a time
- AOC warehouse completed modules (not a parts warehouse)
- Small machine shop in AOC
Quality Control

- Producing written QA procedures
- Software support of LabView
  MIB open architecture
  Bench test fixtures
- MainSaver Maintenance Software
Quality Tools

- Shaker Table
- Environmental Chamber
- EVLA Test rack
- Enhanced real-time monitoring
- Red/Green tag procedures
Inventory Control

• New and old warehouse managed by Skip Lagoyda, Business Manager

• JD Edwards software
  Quantity, re-order mechanisms
Attributes of In-house Module Assembly

- Minimize storage problems
- Tight engineering control
- Correct mistakes, perfect design
- Fast turn-around time
Module Attributes

- Meets Scientific Requirements
- RFI quiet
- Cost effective

“It takes Twenty Years to make an overnight Success” - Eddie Cantor
RFI Mitigation

• Goal: Minimize RFI at the source
  – Board level design control
    MIB test results –20 dB lower
  – In-house RFI chamber
    “Test as you build”
RFI Module Design

- No front panel penetrations
- Internal barrier plate
- Double RFI gasket
- RFI air filters
- EVLA motto:
  - “Too Many Screws”
Suppression Success

• Present hardware meets design spec

• DTS module over 60 dB of attenuation

• Cost Saving considerations:
  – May not need double spiral gasket
  – Will not need DTS H-rack
Cost Saving Techniques

• Prototype using coaxial components
• Production using MMICS, surface mount RF components
• Extensive use of COTS equipment
  • 48 Volt power supplies
  • Ethernet switches
  • Optical communications equipment
Cost Saving Continued

• Low Risk, Large Procurements
  – Best price strategy
  – Minimize obsolescence costs
  – Freezes the design
Purchasing Support

- Large procurement forecast
- Competitive bid procedures
  creative selection criteria allows for best vendors – not only lowest price
- BOA, Blanket Orders
- Negotiated warranties
  Balanced with in-house testing
Budget vs. Cost

• Actual costs are now used for budgeting

“To be a Success Be Daring, Be First, Be Different.” Marchant
Appropriate Funding Allocation – DTS Example

• Formatter board parts cost: $9,559.79 (Qty - 10)
  – Includes $152.16 cost for assembly & test
  – Includes $6,600 for 3 transponders
• Bogue Machine parts $2,640 (Qty – 4)
• Spira Honeycomb filters $442 per DTS
  Total $12,641
DTS Example Continued

- Estimated Costs (excluding samplers)
  Power supply board, VICOR bricks $2,700
  MIB and digital board $1,500
  Optical hardware $600

- Total ~ $17,440 ea ($69,764 per antenna)
  Current WBS estimate $72,000

- In-House Assembly/Test Labor $4,000
WBS

Budget Management Tool

- Detailed budgets have been developed and are backed by actual cost data
- Quarterly reviews
- Managed cash flow and work load
If it all goes wrong?
Advantages of a Software Instrument

• Software reconfigurable:
  – FPGAs in most modules
  – MIB data collection and processing in each module
  – MIB module control
De-scope Options Identified

- Fewer wide band receivers
  U-band & S-band

- Reduce the DTS band width
  120 Gbits/sec → 60 Gbits/sec

- Reduces configuration uncertainty
We are Ready for Production

• Tested designs
• Outsourcing commitment
• Cost saving steps in place
• COTS parts & equipment
• Contingency Plans