Production & Maintenance

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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
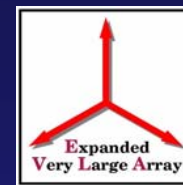 - MIB data collection and processing in each module
  - MIB module control

De-scope Options Identified

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

- **Reduce the DTS band width**
  - **120 Gbits/sec $\rightarrow$ 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**