Lessons Learned in Outsourcing of Board Assemblies

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156 Acres, 133 Buildings, 73 Trailers, 5500 Employees
Principal Product-Solar System Exploration Spacecraft
Harness Fabrication

Cassini Ring Harness

Micro Wave Limb Sounder (MLS) Harness
Outsourcing Thrust

- NASA states that JPL must share the “pie” with industry and reduce internal staff.
- JPL to do what never has been done before. Let industry do what industry can do as well or better than JPL.
- Conventional Electronic Circuit Board assembly and Harness fabrication are to be outsourced.
New Environment

- Faster-Better-Cheaper
- Same budget spread over many more programs. Dilutes the pool of experienced seasoned veterans.
- Time from initiation to flight reduced
- Quality and reliability requirements and desires remain as high as ever
- Procurement regulations stiffened
- "Gray Beards" are retiring and Green Troops taking over.
Harnessing Experience

- JPL experience with the subcontracting of Spacecraft Harnessing has been excellent. Why?
  - Contractors specializing in harnessing of spacecraft are accustomed to first of a kind projects.
  - Minimum documentation required (Usually net list only)
  - Sheet metal mock-up is supplied by JPL
  - JPL sends technician as lead and JPL engineers visit often.
  - Parts are generally well know commodities (Connectors, wire, splices, etc.)
  - Tooling well defined
Results of Harness Outsourcing

- Reduction in JPL workforce.
- Those remaining are highly skilled which can handle emergency rework and modification in final assembly and at launch sites.
- Technicians have been re-trained to be contract manager assistants as well as technical interfaces.
PWBA Outsourcing

- Fast Paced Projects require speedy service (Cassini was 5-6 year program, Mars ‘03 will be less than 30 months)
- Always "first of a kind" work
- Extremely low volume
- Many part numbers but few of each required
- No relaxation of customer expectations
JPL SMT Laboratory
JPL Cultural Impediments

- First of a kind means immature design and, therefore, inadequate drawings.
- Many projects insist on doing it in-house to "have control"
- Everyone gets into the act
- Engineers never quit engineering
- Entrepreneurial spirit allows individuals to do their own thing
Business Impediments

- Companies which are qualified for space work are busy
- Low volume means less interest on part of Industry
- Start-up costs are amortized over very small number of units
  - High Manufacturing engineering and tooling costs
  - Requirements are oppressive (900 pages of documents)
- Meetings and reviews are commensurate with the JPL interests and requirements
  - Kickoff Meeting
  - Ready to fabricate review
  - Ready to ship review
Technical Impediments

- Printed Wiring Board fabrication and test
  ▼ JPL surveys PWB fabricators for in-house builds and monitors quality
  ▼ Same fabricator may not supply same quality to Contractor
  ▼ JPL insists on testing to net list not “golden board”

- Parts
  ▼ JPL provides parts - Problems with lead forming, compatibility with contractor machines (e.g. Pick and Place)
Technical Impediments (cont.)

- Contractor provides parts- Long lead items cause schedule slips, many custom parts in new designs (ASICs, FPGAs)
- JPL part numbering not compatible with Contractor’s inventory control system

- Tooling-
  - JPL will supply solder paste stencil if part made previously. Usually doesn’t fit the Contractor’s screen printer.
  - Lead forming dies needed to form leads to match PWB artwork. JPL will loan out if not in use.
Technical Impediments (cont)

- Bonding, Staking, conformal coating (Polymerics)
  - Materials must not outgas for vacuum environment near optics. If JPL supplies material, Hazard Material handling precautions and paperwork imposed.
  - Special bonding fixtures required
  - Special training required
  - Desirable to test at JPL prior to conformal coating
  - Result is that JPL does all polymeric application which requires additional level of drawing
Results of Outsourcing PWBA's

- Not very successful
- Frustrations for JPL and for prospective Contractors
- We are attempting to improve the process