Technology Transfer Methodology

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- Introductory Comments
- Life and Death Issues
- Problems in Economics
- Barriers to Finding a Home
- Observations
- More Observations
- A Current Example
- Recommendations
Life and Death Issues

Conception to Maturity (Flight)
  - Typically 8-12 Years
  - Trend Is Wrong

There Are Few Survivors
  - Juvenile Mortality Rates Are High (>90%)
  - Many Deaths Are Warranted
  - Some Deaths Are Untimely
  - Technology Is Cheap, Development Costs Money
  - Orphans Always Die
  - Nurturing Parents Are Critical

Resurrection Is A Fact
  - New Missions (HIPERTHIN)
  - New Supporting Technology (E.P.)

Problems in Economics

Low Production Quantities Discourage Change
  - Amortized Cost of Change Is High
  - Products Have Long Lives
  - Few New Systems
  - No Payback for Incremental Improvements

Market for Propulsion Is Parochial (Fragmented), Short-Sighted
  - No Significant Pooling of Interests, Resources
  - Acquisition Costs Overshadow Life Cycle Costs
Observations

- Implementation Is Need Driven, Not Technology Driven

- Typical Drivers
  - Failure (STS Vernier Engines)
  - New Requirements (SDI - HIPERTHIN Injectors)
  - External Influences (Vendor Disappears, Environmental)

More Observations

Inhibitors to Using Improved Technology in Development

- NIH
- Caution (Perceived Risk)
- Ineffective Marketing (Technical Superiority Loses to Technical Adequacy + Superior Marketing)
- Ignorance (Not Stupidity)
- Lack of Vision (Requirements Growth Unrecognized)
- Funding (Off the Shelf Cheaper)
Technology Transfer – A Current Example

Technology – Ir/Re Chambers For Small Bipropellant Space Engines (0.5-1000 lbf)

Benefits
- Improved Performance
  5 lbf, + 25 sec Is
  100 lbf, + 10-15 sec Is
- Longer Life (10X)
- Wider Margins

Technology Development

1984 – Present
LeRC Primary Funding Source
Also JPL, Aerojet IR&D, SBIR Contracts

Technology Application Opportunities

1987 – Proposed CRAF Mission

MM II Propulsion From FRG (MBB)
MBB 400N Engine Inadequate ($I_s = 308$)
JPL Funds Aerojet 400N Ir/Re Demo Engine
  $I_s = 323$ sec
  Duration = 15,000 sec (Funding Limited)
  $T_{wall} = 3500^\circ F$ (800$^\circ F$ Margin)
Program Terminated
  - "German Engine To Be Used"
  - CRAF Slips, Lower Energy Requirements
Technology Application Status

1990 – MMII Propulsion

- FRG 400N Engine Being Replaced

- Ir/Re A Candidate If Readiness Can Be Demonstrated

- STS Vernier Engines
  - Improved Life and Margin Chambers Being Considered
  - Ir/Re A Strong Candidate

Assessment and Recommendations

- Positive Factors
  - Major Technology Improvement
  - Very Positive Results to Date
  - Concerned Parents (Byers at LeRC, Aerojet)
  - Broad Applicability With Payoff

- Negative Factors
  - Highly Fragmented Market (1's and 2's)
  - Currently Not Need Driven

- Recommendation
  - NASA Recognize and Fill Gap Between Code R Charter and Fragmented User Codes (i.e., Combine Needs)
Recommendations

- Goal - More Effective Use of New Technology

- Approach - Develop Co-Ownership of Technology
  (Minimize NIH, Ignorance, etc.)

- Technique - Co-Sponsorship of Technology
  (Code R vs. E, M, etc.)

Recommendations (Cont)

Co-Sponsorship of Technology

- Code R Budget
  - 1/3 Unrestricted "Blue Sky Technology"
  - 2/3 Restricted to Co-Signing, Co-Sponsorship With Other Codes

- Other Codes
  - Given Budget "Set-Aside" Equal to Code R Restricted 2/3,
    "Set-Aside" Budget Must be Spent in Code R with Co-Signing,
    Matching Code R Funds
Recommendations (Cont)

- Benefits of "Co-Signed" Technology
  - User Code Has Ownership
  - User Code Has Input on Technology Direction
  - Code R Sees Substantial Budget Enhancement
  - Forces Continuing Technologist/User Dialog

- Drawbacks of Suggested Approach
  - Adds Complexity to Administration
  - Nothing Is as Simple as It Appears