The Applied Meteorology Unit: Nineteen Years Successfully Transitioning Research into Operations for America's Space Program

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Purpose of the AMU

- Goal: Improve weather support to Space Shuttle and America's space program
- Method: Bridge the gap between research and operations
- Technology Functions:
  - Develop
  - Evaluate
  - Tailor
  - Transition

History of the AMU

- Creation
  - Mid-1980s Space Shuttle Goal: Reduce number of costly weather-related delays
  - NASA convened “blue ribbon” panel of experts on weather support to spaceflight
    - Recommended creating a techniques transition unit
  - NASA requested National Research Council (NRC) opinion
    - NRC concurred and recommended creation of an ‘Applied Research and Forecast Facility’

History of the AMU

- Established Oct 1991 by NASA, USAF, NWS MOU
  - Collocated with Range Weather Operations
  - Operated by ENSCO, Inc. under NASA contract
  - Primary Customers: USAF/45WS, NWS/SMG, NASA/Shuttle, NWS/MLB
- Nationally recognized process for tasking by customers
- Outstanding performance
  - Technical quality reflected in over 25 journal articles
  - Administrative quality reflected in multiple AMU awards from national organizations
  - Customer satisfaction reflected in numerous group and personal awards & direct feed-back

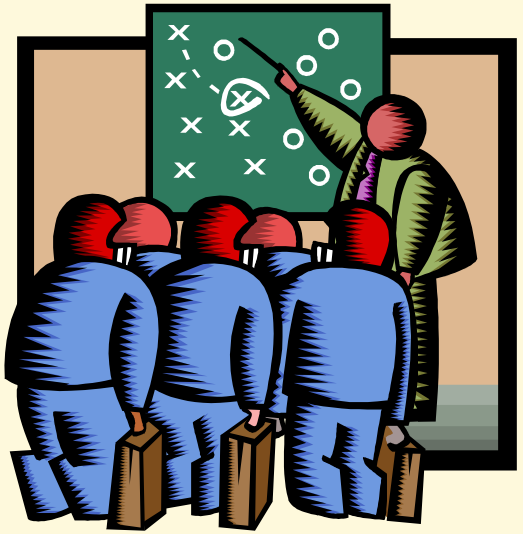
Elements of Technology Transition

- Operational employment of a significant technology development supporting spaceflight requires six critical elements
  - Evaluation
  - Development of a concept of operations (CONOPS)
  - Tailoring
  - Installation
  - Acceptance testing
  - Training

- Advantages of a dedicated technology transition organization: 1. Works in close cooperation with customers; and 2. Simplified coordination.
  - Result: much more effective transition process

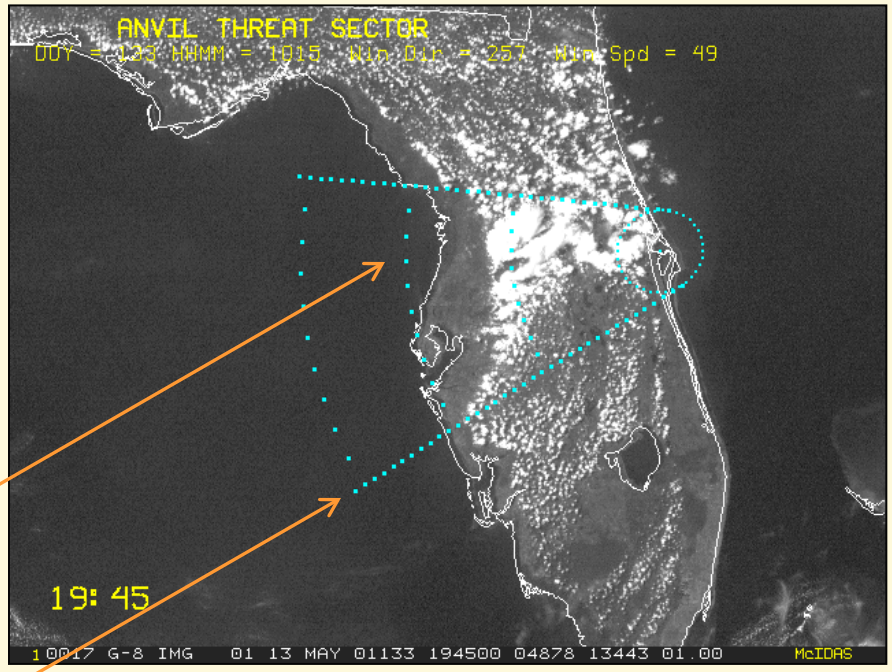
Practices and Procedures

- Managing Technology Transition
  - Address real customer requirements
  - Meet those requirements
  - Have resources with required skills
  - Secure customer buy-in
- AMU Management “Best Practices”
  - Customer-driven tasking
  - Collocation with operational facility
  - Frequent visits with non-collocated customers
  - Managed and funded separately from the operational units
  - Customer involvement throughout the process
  - Flexibility throughout the task
  - High skill level and flexible skills mix
  - Attention to customer relations



Best Practices Example - Anvil Tool Description

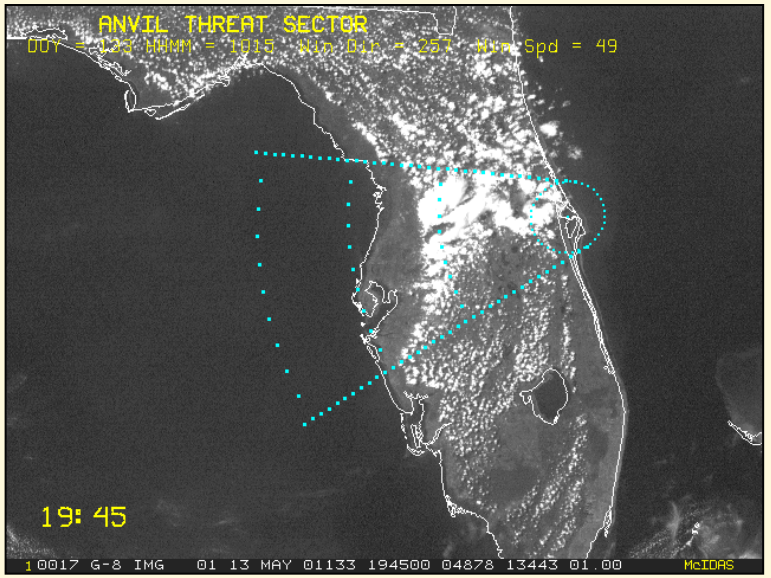
- Used to forecast violation of anvil-related launch or landing constraints
- Anvil “Threat Corridor” overlaid on visible satellite image
- Based on mean layer wind vector at anvil altitude
- Range rings show time until anvil arrives at site
- Width of corridor based on statistics of wind directional deviations



Best Practices Example – Anvil Tool Context

- First Anvil Tool task (Phase I) developed a product for launch support use by 45WS in their MIDDS system.
- 45WS requested additional capability in a Phase II project.
- SMG requested transition of tool to AWIPS for Shuttle landing forecasts. This also done in two phases.

Final reports on the four Anvil Tool tasks described above may be found at the AMU website below under the links to Final Reports, Short Term Forecast Improvement, FY00, 02, 07 and 08.



Best Practices Example –Anvil Tool Phase II Process

- Request submitted by 45WS to the AMU FY01 Tasking Meeting and approved by consensus at that meeting.
- Goals
  - Increase sample size and statistical reliability of Phase I tool
  - Develop objective graphical tools for lead times up to 36 hours
- NASA Task Order to AMU which generated Task Plan
- Work reported in AMU Monthly and Quarterly Reports
- Product beta tested by 45WS and revised as requested
- Final Report reviewed by customers before release
- Final Report revised, published and posted to website

Note: Additional capability and training requested and provided in Phase III (unpublished)

Best Practices: Example – Anvil Tool Phase II Best Practice Allocation

- Customer-driven tasking (including addressing real customer requirements and securing customer buy-in)
  - Tasking requested by 45WS at annual Tasking Meeting
  - Tasking approved by consensus of all customers
- Collocation with operational facility
  - Interactive beta testing of product by 45WS
- Frequent visits with non-collocated customers
  - Facilitated later development of AWIPS version for SMG
- Managed and funded separately from operational units (including having adequate resources)
  - NASA issues Task Order as AMU funding source and Government manager for the AMU contract

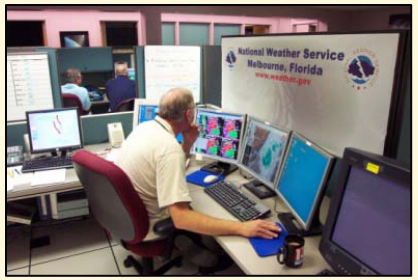
Best Practices: Example – Anvil Tool Phase II Best Practice Allocation

- Customer involvement throughout the process
  - Tasking proposed by customer
  - Customers receive monthly progress reports
  - Customers receive detailed quarterly technical reports
  - Customers beta test the product and suggest improvements
  - Customers review the final report and suggest improvements
  - Customers suggest follow-on projects
- Flexibility throughout the task
  - Customers suggestions welcomed and implemented
- High skill level and flexible skills mix
  - Task plan includes project team tailored to the skills requirements of the specific project

Best Practices: Example – Anvil Tool Phase II Best Practice Allocation

- Attention to customer relations (including meeting the customer requirements)
  - Customers fully informed of progress, and also of problems if there are any, throughout the process.
  - Customers encouraged to critique the work and suggest improvements
  - Customers' suggestions are discussed with the customers and acted upon
  - Beta testing and review of the final report by customers gives them assurance that the deliverables meet the requirements



Conclusion

- The AMU is a model for a successful strategy to transition technology to America's space program
- AMU Management "Best Practices"
  - Customer-driven tasking
  - Collocation with operational facility
  - Frequent visits with non-collocated customers
  - Managed and funded separately from ops units
  - Customer involvement throughout the process
  - Flexibility throughout the task
  - High skill level and flexible skills mix
  - Attention to customer relations
- End-to-end customer involvement