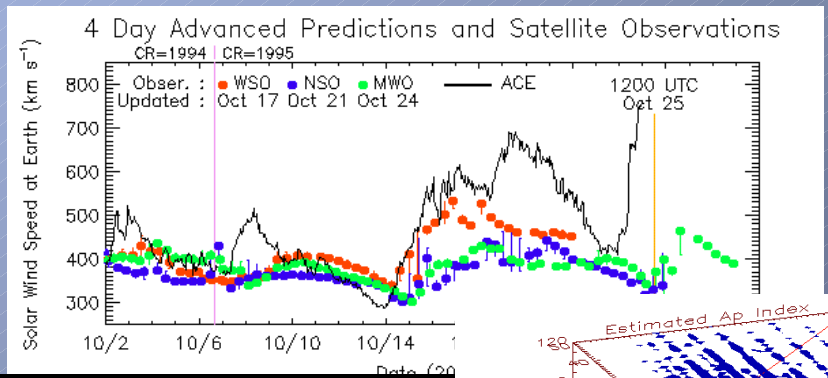
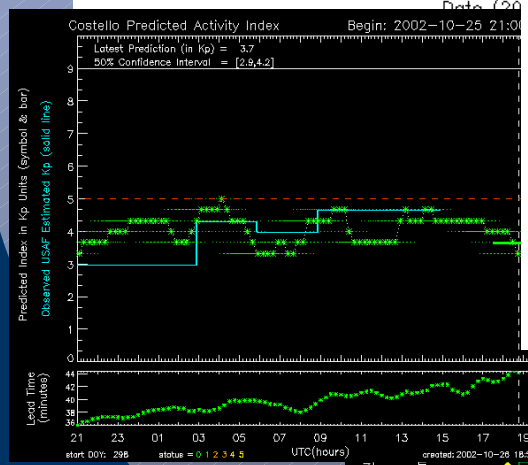
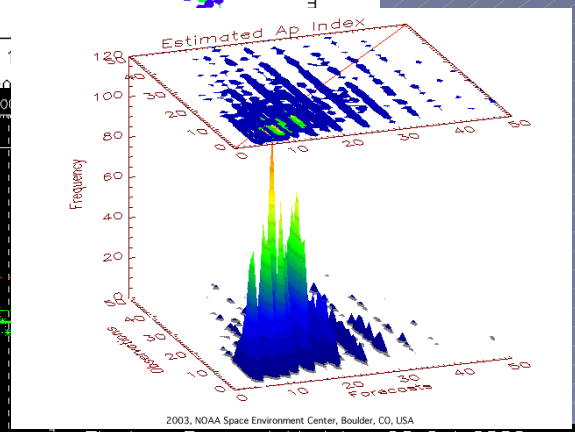
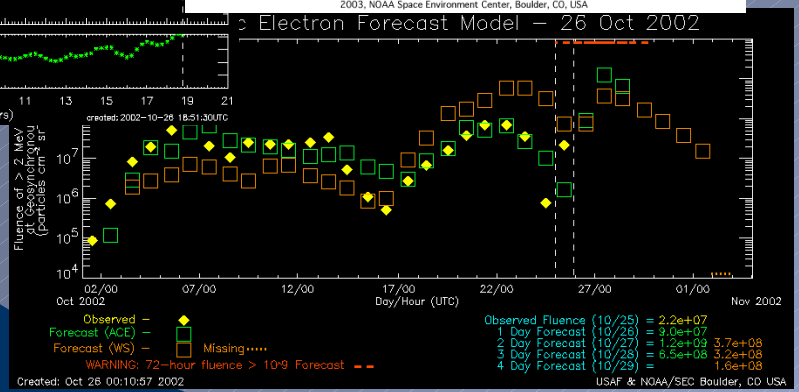
Creating Valuable Space Weather Products: Transition and Verification at SEC Space Weather Operations









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Introduction

Creating valuable products is a multi-step process requiring the involvement of users, service providers, and external partners

- Quality/Value Relationships
  - Definitions, connections, and associated costs
- Elements of Value Creation
  - Planning, transition, process control, continual improvement
- SEC Transition to Operations
  - Selection, iterative development, graduation
- SEC Product Verification Program
  - A comprehensive “end-to-end” approach

Quality and Value Definitions

(Borrowed from the engineering world)

- Quality

  Historical = Within specification

  - In some specified boundary around the ideal target
  - Emphasis on getting within the specified boundary

  Current = On target with minimum variation

  - Emphasis on process control and continual improvement
  - “World Class Quality”

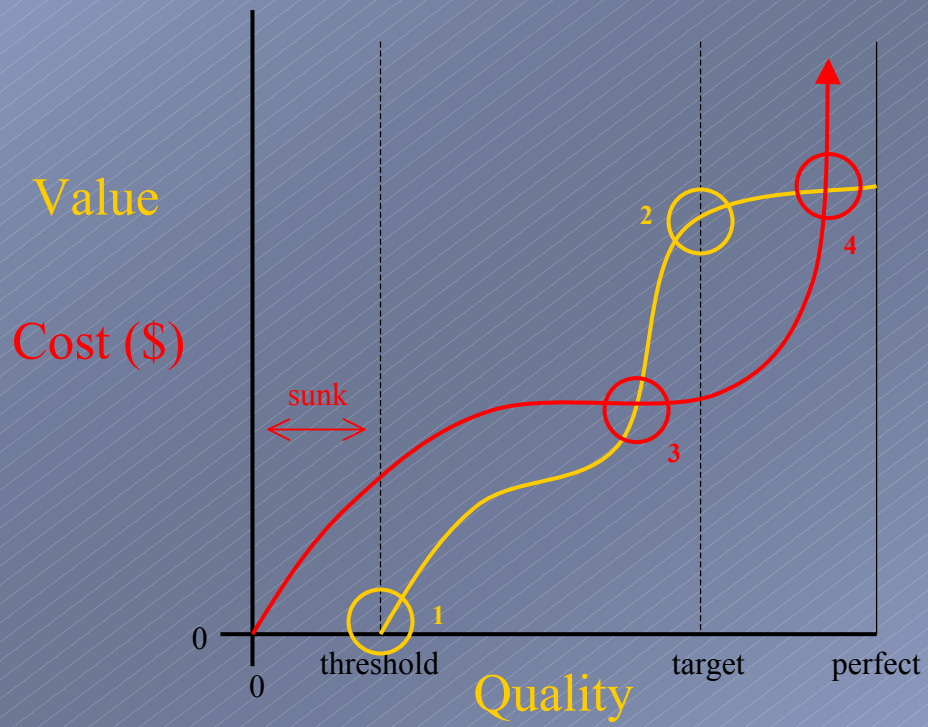
- Value

  Derived benefit (economic surplus) to the user

  - Emphasis on how much the product meets and exceeds user needs and expectations

Quality, Value, and Associated Costs

- Highly user specific
  - Positions of threshold and optimal target
  - Curves may be convex or concave but likely not linear and are unique to each user



Critical Points:

1. Quality threshold where initial value is produced
2. Additional quality produces little more value
3. Break even point—value reaches costs
4. Costs exceed expected new value

Elements of Value Creation

- User Focused Planning
  - Identify users
    - Needs, perceptions, and expectations
    - Usually involves a spectrum of users
  - Identify requirements (product features) needed to satisfy users
    - Establish product quality targets (standards of product performance)
  - Design necessary development and operational processes to achieve desired results

Elements of Value Creation (cont.)

- Product Development and Transition
  - Identify product candidates (e.g., models and data)
  - Evaluate and select most promising candidates
  - Employ iterative development and testing
    - Use operational-like systems and data
    - Involve a mixed team of science, operations, development, support, and user stakeholders when possible
    - Incorporate quality information throughout (data quality, system validation, and product verification: end-to-end quality
    - Use an appropriate level of project management and tracking
  - Generate routine test products
    - Evaluate for performance, robustness, and ability to satisfy users

Elements of Value Creation (cont.)

- Process Monitoring and Control
  - Choose control subjects (product features to monitor)
  - Establish proper metrics
    - Measure the ability to achieve product quality targets
  - Compare actual product performance to targets
    - Product verification
  - Take action on difference if appropriate
    - Distinguish between common and special causes of variation
- Continual Product Improvement
  - Establish the need and viability of improvement
    - Quality/Value relationships, ability, opportunity, etc.
  - Identify candidate improvement projects
    - Evaluate, select , and transition
  - Continue the loop

SEC Transition to Operations

- Candidate Evaluation and Selection
  - Multi-disciplinary evaluation team
    - Science, operations, development, systems support
  - Assemble candidates
    - From various sources, internal and external to SEC
    - Information submitted by model originator: capabilities, intended use, needed data, hardware requirements, validation results, etc.
    - Screen potential candidates for evaluation and scoring
  - Team follows an iterative evaluation and scoring process
    - Share information→Evaluate →Score →Analyze results
    - Repeat process until scores converge to an acceptable range
  - Rank candidates (according to score distributions) and make recommendations to SEC management for transition
  - Evaluation factors: Strategic Importance, Operational Significance, Implementation Readiness

SEC Candidate Evaluation Score Sheet

Transiton Project Scoring Worksheet

Model Name: _____

Scorer: _____

	Transition Candidate Evaluation Factors	Weight	Score: Least 0	1	2	3	4	Most 5
	Strategic Importance							
	[factors 2 and 3 mutually exclusive]							
1	Supports SEC Mission, Vision, Goals	1.00						
2	Congruent with SEC Strategic Plan	1.00						
3	Offers Critical New Strategic Opportunity	1.00						
4	Does Not Restrict SEC Activities	1.00						
5	Provides Sufficient Durability	1.00						
6	Minimizes Duplication of Effort	1.00						
7	Promotes SEC / Community Relations	1.00						
	Factor Subtotal (30 possible)							
	Operational Significance							
	[factors 1 and 2 mutually exclusive]							
1	Contributes to Highest Priority Needs	5.00						
2	Contributes to New Operational Need	3.00						
3	Meets Critical Need of Important User Group	2.00						
	Factor Subtotal (35 possible)							
	Implementation Readiness							
1	Has Reached Critical Maturity Level	2.33						
2	Facilitates Rapid Development and Transition	2.33						
3	Optimizes Use of Available Data	2.33						
	Factor Subtotal (35 possible)							
	Total Score (100 possible)							

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SEC Transition to Operations (cont.)

- Employ Iterative Development and Testing
  - Mixed development team
    - Developers, operators, support staff, users (when possible)
  - Operational-like systems and data
- Track and Sign-Off Critical Transition Steps
  - Documentation (design, operations concept, system requirements, support procedures)
  - Software (reviews, testing, configuration management, maintenance plan)
  - Operational systems monitoring and reporting
  - Product dissemination systems
  - Training (for all stakeholders—operators, users, support staff, etc.)

SEC Transition to Operations (cont.)

- Final Sign-Off and Graduation
  - Key SEC staff
    - Local Responsible Scientist
    - Outside User System Lead (if appropriate)
  - SEC management
    - Space Weather Operations
    - Systems Division
    - Center Director
- Get the Word Out
  - Web announcements, SEC User Notes, meetings, etc.

SEC Verification Program

- Vision
  - An end-to-end verification process meeting the needs of space weather service providers, program managers, model developers, and users
- Objectives
  - Facilitate a comprehensive quality analysis for all SEC products
  - Establish near-real-time quality checks of products
  - Monitor product performance as conditions evolve
  - Provide a foundation for an equitable comparison of competing models

SEC Verification Program (cont.)

- Strategies
  - Use a distributions-oriented approach
    - forecasts and *matching* observations
  - Establish official product quality targets
  - Track key quality metrics
    - accuracy, skill, bias, association
  - Couple current products to recent performance
  - Contrast recent performance to the historical quality record
  - Employ a variety of methods to distribute verification information

SEC Verification Web Pages

- Recent major revision and update
- Performance metrics from 1986–2002 for
  - Short-term geomagnetic K 6 warnings
  - Integer forecasts of daily F10, estimated Ap, and Fredericksburg A index
  - Probability forecasts of M flares, X flares, proton events, and highest geomagnetic activity category
- Glossary of verification terms and bibliography
- In review now, soon to be released to public

www.sec.noaa.gov/forecast_verification